Newsletter of

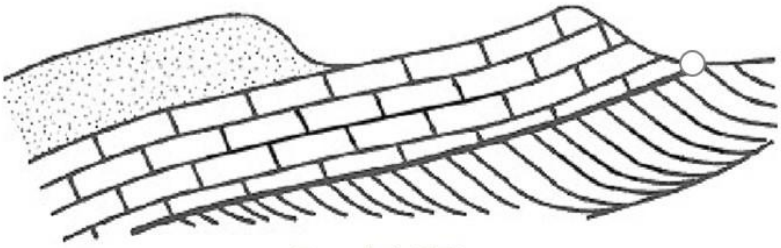
The Farnham Geological Society

Volume 26, Number 3, August 2023

Remarkable Rocks, a cluster of what appear to be precariously balanced granite boulders in Flinders Chase National Park, Kangaroo Island, South Australia.

Farnham Geological Society

Farnhamia farnhamensis



Founded 1970

A local group within the GA

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Editorial

Welcome to the third edition of the FGS Newsletter for 2023. I hope you are all fit and well.

This month's Newsletter brings you some interesting articles, including reports from our monthly lectures for all those who did not get a chance to view them "live". And do not forget to come along to **The Maltings** or **Zoom-in** on **Friday, 15 September** for **Dr. Jeremy Young's "Coccoliths, not only make the chalk but also microfossils of extraordinary ability, complexity and beauty"** which promises to be an excellent presentation.

The success of our Newsletter depends upon you, the Members, providing material. So, if you have been on a Field Trip, visited a site of geological interest, listened to an interesting Zoom talk, webinar or TV programme, or have any other news or views you would like to share or questions you would like to ask, then please feel free to get in touch with the Newsletter Editor, Mick Caulfield (caulfm@hotmail.com).

We are still looking for members to both join the FGS Committee, as well as help with organising the Societies various activities. Please contact any member of the Committee if you would like to help.

Front Cover

This month's Front Cover photograph was taken by **Mick Caulfield** in July 2005, while on holiday with his family in Australia. **Remarkable Rocks** can be found on the southern coast of Kangaroo Island perched 200 feet above the sea, nestled on the clifftop of the stunning Flinders Chase National Park. The island is located just off the coast of Adelaide in South Australia.

Kangaroo Island is home to a haven of natural wonders, including Remarkable Rocks. They comprise a series of massive rocks that range in both size and shape. From sharp points to smooth edges, the rocks are completely unique, created through erosion. Intricately carved by both the continuous wind, rain, and nearby sea salt, these rocks have undergone 500 Ma of slow erosion. The rock is an Ordovician granite, with the material coming from the splitting of the supercontinent Gondwanaland. Once the split began, Australia and Kangaroo Island began moving northward, with the Ordovician granite sitting along the edge of the spilt.

The base dome platform rock is the remnants of lava with the eroded granite boulders sitting on top, formed over millions of years. The darker patches of Remarkable Rocks are thought to be the remnants of Cambrian rocks, made of black mica, bluish quartz, and pinkish feldspar, into which the granite was intruded.

Contents

The Unexpected Chairman

Following Graham Williams sudden and unexpected disappearance as Chairman in September 2019 and with no one else wanting to be Chairman, I duly took it on at the AGM in January 2020. A memorable year for three things – 1) July 2020 was the 50th Anniversary of the FGS, 2) on 29 January life changed completely when we were all hit by COVID-19 and later 3) we extended/reciprocated Zoom and field trip activities with other local geological societies.

The **50th Anniversary** was really important to me because I had started work at BP Research Centre and had coffee with Edward 'Ted' Finch, a BP palaeontologist, who seemed to prefer to socialise with the Petroleum Geologists rather than the micropalaeontologists.

Ted would come in and tell us about this group of people in Farnham who were studying geology as part of the **Workers Education Association** (with Ted & Peter Olver) and undertaking field trips - mainly to Squerryes Court Pit near Westerham. As Peter Luckham and others will tell you – they had great fun and had their children with them on many trips. I remember Ted walking in one day at BP and laughing when he declared that this group had now formed themselves into **"Farnham Geological Society."**

Sadly, Ted died in 2020 before we could celebrate the 50th Anniversary in July but it was important to me that we honoured the achievement of both him and Paul, those early members – and all the

following members – together they had kept the Society in existence for 50 years. So, I put together a little booklet about the Society.

The plan had been to have a celebration meeting in the Maltings with FGS and other specimens, refreshments, and a lecture; however, Covid restrictions meant that we had to begin holding meetings using Zoom, but we still attempted to have a special celebration on 10 July 2020.

Zoom has proved to be a double-sided experience for FGS (like most other societies) – namely allowing distant and other members to participate easily (especially on cold, wet, icy, foggy winter evenings) but the downside is that there was no social interaction or field trips which was a great shame and missed, in some way, by all.

I have been very fortunate to have the experience of **Peter Luckham** as our Treasurer and **Judith** as Secretary, **Janet** as Programme, **John Williams** as Field Trip and **Sally** as Membership Secretaries, also **Mick C.** as Newsletter Editor and **Mike M.** as all things technical plus **Michael H.** for keeping the website up to date, **Alan Whitehead** as a long-standing committee member and **Peter C.** for updating our advertising actions. Mick has introduced a wonderful new type of newsletter which I am thrilled about, and I am pleased to say that Mike M is in the process of updating much of the technical aspects. Thank you all very much - I am very grateful for helping me run the Society.

Liz standing next to the femur of *Titanosaur Patagotitan mayorum*

I feel guilty because I nagged Michael H. to update the website – but full-time work meant he just didn't have the time. This is where I was very fortunate asking for help and finding Walter Bonnici who volunteered to update the website (whilst on holiday) and also to find Bob Rusbridge who is happy to keep it updated. Thank you very much to all three for working together to give us a nice new website and to Michael H. for the many long years of activity before that.

There are lots of other things that the Committee pitch into – providing and attending displays of local geology, FGS and other mineral specimens, of FGS field trips, with rock samples, etc. These events have varied from the Open University Geological Society Annual Conferences, the Geologists Association Annual Conferences, Churt Fetes and the Farnham Scouts Event – all time consuming, exhausting but enjoyable and a way of promoting geology and in particular the Society to the outside world. Thank you to Janet, Sally, Judith, Mike, both Peters, Mick C., *et. al.* for their contributions to these events.

We all need to thank Janet Burton who provides us with refreshments at every meeting – thank you Janet from us all.

I have also been very lucky to have the support of Mike M., Mick C., and Peter C. to help with the **Introduction to Geology Course**. I started this in 2015 but it was interrupted when my husband, Harry, died then restarted in December 2020 and proved popular with about thirty-five members. It finally finished in March this year. Thank you very much 'boys' for your support and help and to all the 'students' for your unmitigated enthusiasm.

I am pleased to say that I am leaving an excellent committee as I retire with Mike M. ready to take over from Peter L. when he decides to retire. Peter was the first real FGS Treasurer from the earliest

days, and he wants to complete an unbelievable **"50-year stint"** as Treasurer – more loyalty than any committee deserves and more than any other committee member, that I am aware of, has given. A very big thank you Peter – there is no hurry to go but we can all relax knowing that your work will continue appropriately in Mike's hands when you are ready to retire!!

I also feel lucky to leave you with the continued experience of Judith, Janet and Sally with Mick, Mike, Peter C., and Bob (with Walter's help) but to also have Tessa Seward who has joined the committee to replace John W. as Field Trip Secretary – a job which John had done for many years and had to take over completely once Graham W. departed.

It is difficult to thank all those people adequately and I hope you as members will all support the new committee as you have supported me – also I hope that a few of you YOUNGER members (especially those with some form of geological background) step up to help the Society and Committee going forward, for the next decade or so.

Last I have to thank all of you – the members – you have all helped and supported me and the rest of the committee. I have received a great deal of help at times – both physical and moral. Good luck to you all. I shall attempt to make most meetings and all other events and to chat with you on Zoom or in the flesh.

Liz Aston
B.Sc., ULSS, CGeol, FGS

Farnham Geological Society

Committee 2023

Chair … Interim	*Mick Caulfield*
Treasurer	**Peter Luckham**
Secretary	**Judith Wilson**
Programme Secretary	**Janet Catchpole**
Membership Secretary	**Sally Pritchard**
Field Trip Secretary	**Tessa Seward**
Newsletter Editor	**Mick Caulfield**
Web Manager	**Bob Rusbridge**
Advertising	**Peter Crow**
IT/Sound	**Mike Millar**

Field Trip Programme 2023

Our programme for this year has yet to be finalised.

Meeting Programme 2023

Please note The Maltings and Zoom meeting times:
7.30 pm for 8.00 pm start.

Coccoliths, not only make the chalk but also microfossils of extraordinary ability, complexity, and beauty
Dr. Jeremy Young Fri, 15 September
UCL

Minerals of the Mourne Mountains
Dr. Norman Moles Fri, 20 October
Brighton University

The Rotating Earth and Plate Tectonics
Dr. Bob Maurer Fri, 10 November
HHGS

Madagascar, Mindat Conference and local mineral
Peter Nancarrow Fri, 8 December
RHUL

Geologists' Association
Lecture Programme 2023

https://geologistsassociation.org.uk/lectures/

Gold Mining and the Welsh Connection
Mark Austin Fri, 6 October

The Festival Of Geology
UC London Sat & Sun, 4 & 5 November

The extinction of a giant apex predator: implications on a food web structure
Amy Shipley Fri, 1 December

Reading Geological Society
Lecture Programme 2023

https://readinggeology.org.uk/lectures.php

A rolling stone gathers some gloss
Prof. Rob Hosfield Mon, 4 September
University of Reading

Coastal Geology, Erosion and Flood Risk in an Era of Man-made Climate Change
Dr. Ken Pye Mon, 2 October
Kenneth Pye Associates Ltd

Mining Magmas for Metals and Energy – a novel strategy for achieving Net Zero
Prof. Jon Blundy FRS Mon, 6 November
University of Oxford

Mole Valley Geological Society
Lecture Programme 2023

http://mvgs.org.uk

Portland Island's balmy Jurassic coast
Andy Los & Thu, 7 September
Dr. Trevor Burchette

The Wealden Iron Industry
Jeremy Hodgkinson FSA Thu, 9 November
Wealden iron researcher

Horsham Geological Field Club
Lecture Programme 2023

http://www.hgfc.org.uk/

Bumps in the bay: Jurassic thrombolites
Prof. Dan Bosence Wed, 13 September
RHUL

Global warming
Prof. John Marshall Wed, 11 October
University of Southampton

The Toarcian to Bathonian biostratigraphy of Saint-Maixent, Southern Brittany, France
Dr. Bob Chandler Wed, 8 November
HGFC President

Next Lecture

Friday, 15 September 2023

7.30 pm for 8.00 pm

Coccoliths, not only make the chalk but also microfossils of extraordinary ability, complexity, and beauty

Dr. Jeremy Young, UCL

Dr. Young has over 28 years of experience working on nannofossils and extant coccolithophores.

Lecture Summary

Friday, 12 May 2023

On Friday, 12 May 2023 *some 37+ FGS attendees in The Maltings & via Zoom, together with other society members, welcomed Dr. Andrew Scott in presenting our external lecture.*

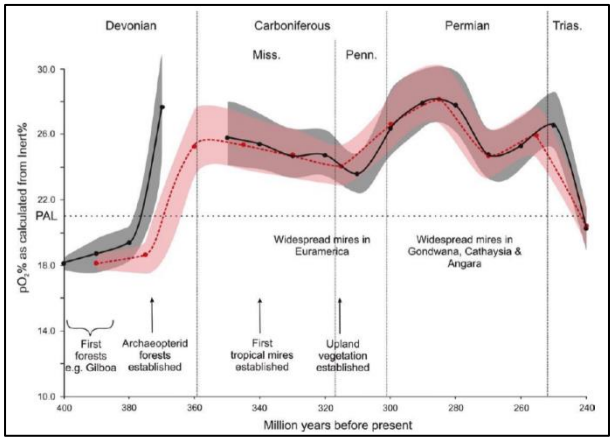
Carboniferous wildfires revisited

Dr. Andrew Scott, RHUL

Fusain occurs widely in Carboniferous coals and sediments. It is now recognised to represent charcoal and be the product of wildfire. The occurrence of fire is partly constrained by atmospheric oxygen levels, availability, and nature of fuel and by aspects of climate (rainfall and seasonability in particular). The majority of fires in the Carboniferous were probably started by lightning strikes or by volcanic activity. It is thought that fire plays a major role in many Carboniferous ecosystems.

Report by Anne Kingston, FGS Member

Professor Scott began studying this topic in 1973 when he was working on Carboniferous plants. He found tiny pieces of charcoal in some layers. The nature and occurrence of fossil charcoal in sediments and coals is the main avenue for the study of the history of Carboniferous fires. Fires have been shown to be common in many Carboniferous ecosystems worldwide, yet we still have little understanding of the details of what, where and how such fires occur or of their effects both on the local ecosystem as well as the Earth System as a whole.



The evolution of Late Palaeozoic fire systems (based partly on data from Scott and Glasspool (2006)). The oxygen curves have been calculated from the inertinite in coal data and are based on 10 Ma (solid black line) and 15 Ma (dashed red line) binning of the data.
(Ref: Glasspool, Scott et al. 2015, Frontiers in Plant Science, 6 :756)

In the present day, Britain is number 4 in Europe for fires and Surrey is the most wooded county in England and subject to many fires each year. Today we have the ability to monitor fire by satellites and Professor Scott asked the question: what was fire like on Earth in geological history?

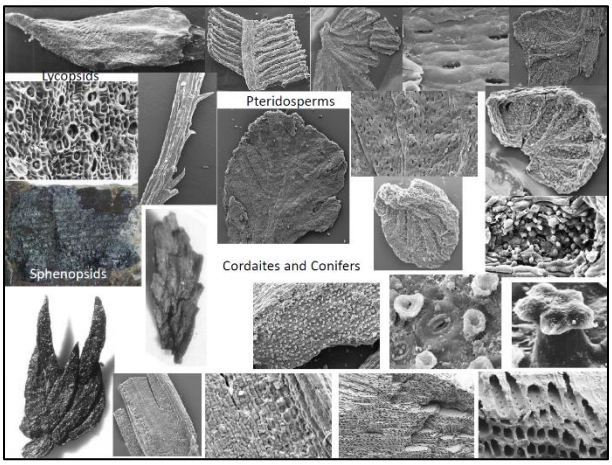
What makes a fire?

1. Fuel
2. Ignition source
   i) Lightning
   ii) Volcano
   iii) Humans
3. Oxygen

The Earth's present-day atmosphere contains 21% oxygen. We need to think about concentrations in geological history. In the Silurian and Devonian Periods, the oxygen concentrations were low compared to today, whilst in the Carboniferous the concentration of oxygen was higher than today. There were major changes in vegetation in the Carboniferous Period when the first forests and major tree groups evolved.

Studies of charcoal residues can provide data on the plants that have been burned by wildfires and may provide information on the charring temperature and of the fire itself. Information on the amount of charcoal in coal appears to relate to the atmospheric oxygen concentration so that charcoal can be used as a measure of the concentration of oxygen in the atmosphere at the time of its formation.

One feature of charcoal is that it preserves the structure of the plant which can be seen under a hand lens; even flowers have been preserved.



In the 1980's the study of the Pettycur Limestone in Fife, Scotland showed that there were a lot of fires in this system as it had been caught up in lava flows. A section through the Pettycur limestone showed that some material is black and that it is charcoal. Stomata are preserved in a leaf. The atmospheric oxygen concentration at this time was 23+%. Carbon dioxide concentrations can also be calculated.

The late Carboniferous Period i.e., Pennsylvanian has been studied to try to answer the following questions.

1. What was being burnt?
2. What kind of fires were there?
3. Were any types of vegetation more prone to fires?
4. Can we identify different fire regimes?
5. Can we assess fire size and frequency?

Are we able to identify surface fires (e.g., a bit like heathland fires of today)?

How does fire become a crown fire (i.e., in the tops of trees) and how does it spread?

Are some types of vegetation more fire prone? For example, in the Amazon lightning may strike a tree which catches fire, but the fire does not spread because the area is so wet.

In Arizona in the past cacti may have caught fire but the fire did not spread because there was not much other vegetation. Nowadays there is grass grown for cattle and this allows the spread of the fire from one cactus which is on fire to the next cactus. This is a modern problem.

Professor Scott mentioned that one of the main sources of ignition these days is portable barbeques.

Professor Scott has written several publications and books (see pages 50 & 51) .

A fascinating and excellent talk from Professor Scott.

Lecture Summary

Friday, 2 June 2023

On Friday, 2 June 2023, some 30 or so FGS attendees in The Maltings & via Zoom, together with other society members, welcomed Dr. Colin Summerhayes in presenting our external lecture.

The Anthropocene: A New Geological Epoch?

Dr. Colin Summerhayes (Scott Polar Research Institute, Cambridge University)

The subtext to this lecture was "Can we engineer our planetary future?"

The question as to whether or not we should mark an end to the Holocene Epoch with the introduction of a new epoch, **the Anthropocene**, is under active consideration by the **Anthropocene Working Group**, of which I am a representative. The AWG is a sub-unit of the Sub-commission on Quaternary Stratigraphy, a body of the **International Commission on Stratigraphy**, which will examine the evidence in favour (or not) of forming a new epoch and pass its recommendation to the **International Union of Geological Sciences (IUGS)**. Currently, teams associated with the AWG are undertaking research on a selection of sites around the world in the search for a possible Global Stratigraphic Section and Point (GSSP), which will define the boundary and be marked by a so-called ***'golden spike.'***

Human activities have ramped up enormously with the growth in population from 2.5 billion in 1950 to 8 billion now, with a possible peak of 10 billion expected by 2050. These activities increased dramatically with the end of the Second World War, when a great many of the numerous factories dedicated to the efficient production of guns, fighter planes, bombs, shells, tanks and so on were no longer required and turned instead (with the growth of Madison Avenue type advertising) to the production of goods to satisfy supposed consumer wants. The acceleration in human impacts on the environment came to be known as **'The Great Acceleration'**, and it led to Nobel Chemist

Paul Crutzen interrupting a meeting on the Holocene, in 2000, to say (roughly) – "wait, we're no longer in the Holocene; things have changed so much we must be in a new geological era – the Anthropocene". He was recognizing that we humans have become equivalent to a geological force on the face of the planet.

Let's consider some of these changes. Early humans were hunter-gatherers, with no fixed abode. To get their meat they followed herds on their migrations in response, both to seasonal change in the short term and to climate change in the long term. We are different – we now have fixed abodes, most of us living in cities, which can't easily be moved if the climate changes.

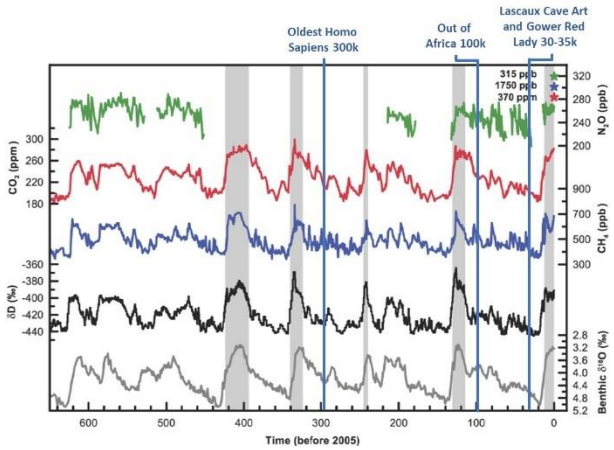


Figure 1: Humans and Climate

Large scale farming began around 10,000 years ago in restricted areas, then gradually expanded, displacing hunter-gatherers to the fringes, and creating fixed settlements. Herding and agriculture gradually expanded around the world, along with population, which reached about 1 billion by 1800. More than 75% of the planet's land is now directly affected by our activities, which, over time, have severely degraded natural soils to the point where they are virtually useless for agriculture without significant applications of fertilizer.

Applications of nitrate and phosphate fertilizer have grown with time. While phosphate is still largely mined, most nitrate fertilizer now comes from an industrial process and can be identified by its unique isotopic signature. We have modified Nature's nitrate and phosphate cycles in the cause of our consumption of food. The run-off of fertilizer from farm fields in the rainy season takes these nutrients to the coast where algal consume them, which leads to the depletion of oxygen in coastal waters, creating so-called 'dead zones' where no fish can live – e.g., off the Mississippi Delta, in the Baltic Sea, and in the Black Sea.

We have also modified Nature's carbon cycle, by our growing consumption of fossil fuels. This has put excess CO_2 (a greenhouse gas) into the environment; 50% of it stays in the air, about 25% is absorbed by plants and 25% is dissolved in the ocean. This ocean absorption changes ocean chemistry making the water slightly less alkaline (i.e., slightly more acidic), which is having deleterious effects on carbonate-shelled plankton at the base of the food chain.

Being a greenhouse gas, the CO_2 in the air causes it to warm. CO_2 is not the only human addition of a greenhouse gas to the atmosphere – it is joined by methane (CH_4), much of it from animal husbandry, because it is a by-product of the processing of grass in the 4 stomachs of cattle (beef and dairy) and sheep. Today, globally, we farm 5 billion hectares of land, 4 billion of which is for meat and dairy (much of it as crops like soy for animal feed); 60% of global farmland supports beef, which supplies only 2% of humanity's protein needs. Meanwhile the farming of cattle produces annually 1.9 billion tonnes of greenhouse gases (CO_2 + CH_4 + nitrous oxide – N_2O). In contrast, sheep and goats, pigs and chickens produce very few such emission.

In Palaeolithic times the wild mammal biomass was equivalent to about 20 million tonnes of carbon, by 1900 this had fallen to c.10 million, and by 2015 to 3 million. By 1900, following the development of agriculture and livestock herding, our livestock grew to 35 million tonnes of C and our human population to 13 million tonnes. These amounts grew to 100 million tons of C in livestock and 60 million tonnes C in humans by 2015. So now the wild land mammal population is a mere 2% of mammal biomass, the livestock represents 63% and the human contribution represents 35%. These are radical changes by any means of calculation.

We have also radically changed the hydrological cycle, by damming almost every river and stream on the planet. As a consequence, very little of the silt that formerly reached the sea now does so. One immediate result is that deltas, which were formerly fed by river-borne silt, have begun to sink, several having sunk by at least 1m since the 1930s. They are also subject to further sea level rise and coastal retreat by the additional effect of global warming, which we will come to later. Deltas like the Mekong are breadbaskets for the interior, so their loss will have a serious impact on food supplies.

Our human activities have produced vast volumes of new materials, which can be seen as techno-fossils for future geologists. Since 1950 the production of aluminium has increased from close to zero to 35 million tonnes/year, while that of concrete has increased from close to zero to 27 Gigatonnes/year (that is equivalent to the total annual flux of all sediments from rivers, winds, glaciers and coastal erosion). Half of the concrete ever produced has been produced in the past 20 years. The production of plastic has increased from c.1.7 million tonnes in 1950 to some 300 million tonnes per year now, and both macro and microplastics are now found in sediments across the world. We now use vastly more metals of different kinds than were used as recently as 1700. Humans have also produced around 180,000 synthetic mineral-like substances (think computer chips, solar panels, catalytic convertors, for example) compared with the 5,000 produced by Nature. This excludes the 85,000 or so industrially produced chemicals. All of these products end up in the environment, along with other obvious techno-fossils like Bic pens and toothbrushes).

Last but not least of these new materials comes from our pollution of the planet with fallout from atomic weapons tests; the global signal of long-lived plutonium will last for thousands of years following its initial build-up in the very early 1950s. A great many of the rising signals of human activity like this coincide with the Great Acceleration, which is roughly taken to begin in 1950, a useful starting date for the end of the Holocene.

Humans have also affected biodiversity. We love our local plants and birds, so when we move across the world we often take them with us. For instance, Māori's and Europeans introduced some 1,570 invasive plant species to New Zealand to compete with its 1,790 natural plants. Meanwhile many of our own gardens are replete with foreign plants. We are globally changing biodiversity, something that will be obvious to future geologists.

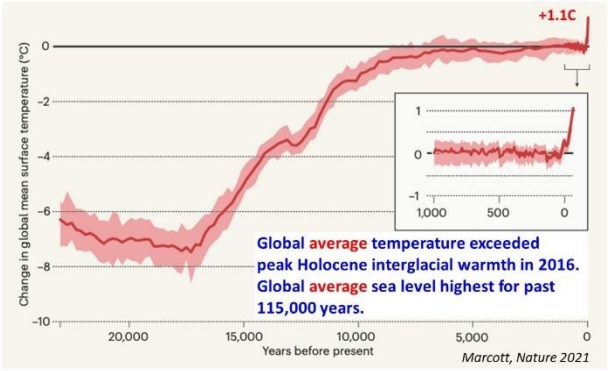


Figure 2: Change in global mean surface temperature. Net Result is flat average Holocene temperature, plus modern warming (fastest in 24,000 years).

Now to global warming. Is the climate always changing as the sceptics like to tell us? Yes, but it is a trite observation, not a scientific one. What any scientist (professional or amateur) needs to know is **WHY is the climate changing at any one time**; **WHAT is causing it to change**? It has been known ever since the practical laboratory experiments of John Tyndall, FRS, in the 1860s, that CO_2 and methane and water vapour are greenhouse gases. They absorb heat coming from the Earth's surface and re-radiate it in all directions, keeping the atmosphere warm. As the decades have passed since his momentous discoveries, data upon data has accumulated to show how correct he was. Our atmosphere now contains around 420 ppm of CO_2, whereas during past interglacials its concentration only reached about 280 ppm. The combined greenhouse gases (excluding water vapour) now amount to 500 ppm. The last time the Earth's climate saw values like that was in the Eocene before the formation of the first Antarctic Ice Sheet 34 million years ago. If we confine ourselves to just CO_2, the

last time its abundance was around 400 ppm was in the Mid Pliocene some 3.2 million years ago, when the Arctic was so warm that temperate forests covered Ellesmere Island and Greenland.

Let's not forget water vapour. When the air warms by 1degC, evaporation increases and the air contains 7% more water vapour, accentuating the effects of the other greenhouse gases. This does not work in the stratosphere, where it is so cold that water vapour is frozen out, leaving only the other greenhouse gases along with oxygen and nitrogen.

For the broader context we need to look at **Milankovitch Cycles** and **solar cycles**. The Milankovitch Cycles are extremely slow, with repetitions centred on 100,000, 40,000, and 20,000 years. We are currently in a Milankovitch phase that warmed Earth out of the Last Glacial Maximum (20,000 years ago), to a peak in insolation around 12,000 years ago, after which insolation slowly declined, taking Earth into the so-called 'neoglacial' of the past 4,000 years. This was not a strong enough change to create a full glacial, something that astronomers predict should not occur for at least another 30,000 years. Over the next 5,000 years they expect insolation from Milankovitch effects to be minimal. So, they are not the cause of recent warming.

During the middle period of the last glacial intervals the climate became unstable and flickered between cold and warm states. These flickers were caused by changes in ocean circulation. Heat built up in the Southern Hemisphere ocean, then slowly discharged into the Northern Hemisphere, where its arrival triggered sudden warmings in places like Greenland. The warming phases in the north lasted a few hundred years before the cooling returned as the southern oceans warmed. These flip-flops reflect the behaviour of what is known as the 'bipolar seesaw'. The northern warmings were fast – as much as 15degC in the space of 10-50 years, which is faster than what we are now seeing. However, that flickering disappeared both in peak glacial and peak interglacial times and does not apply now.

We can use isotopic signatures to identify the solar cycle. When sunspots are abundant the solar wind is strong, and it protects the Earth's atmosphere from cosmic rays originating in outer space. When the solar wind is weak, more cosmic rays can enter the atmosphere, where they interact with atmospheric particles to produce the isotopes 14C and 10Be, which we can identify in geological materials (like stalactites and ice cores). At these times the climate is cool and ice floes drift further south through the North Atlantic, where we can identify their paths from ice-rafted debris in sediment cores. Throughout the Holocene we can see irregular fluctuations in warming and cooling attributable to these solar changes. However, they were rather small, and much less strong than the Milankovitch glacial-interglacial cycles. In western Europe the isotopically identified cold periods coincided with both ice rafting offshore and high rainfall (giving rise to high lake levels) onshore. One such cold period was the Little Ice Age, centred on about 1650.

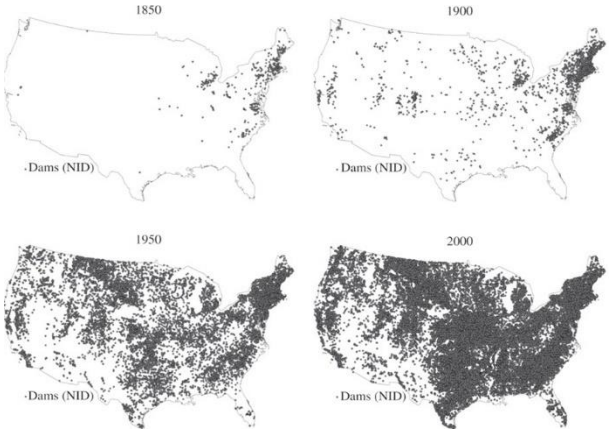


Figure 3: Perturbing the Hydrological Cycle: Global Growth of Dams (e.g., USA).

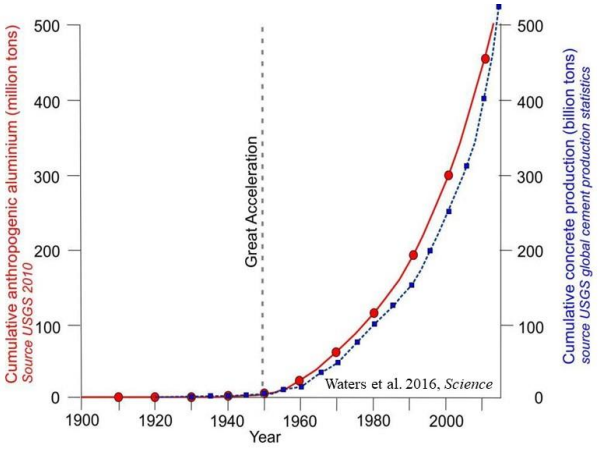
In the 19th and 20th century we can use meteorological measurements to identify these solar cycles. There was a solar peak in the 1780s, and another in the 1860s, and a further one in about 1980. If the Sun was driving our climate change during this period, the temperatures at these three times should have been about the same. It was the same in the 1780s and 1860s, but it was very much warmer in 1980. Furthermore, since 1980 sunspots

have declined, while the temperature has gone on rising. The logical conclusion is that the rise in greenhouse gas emissions since 1900 accounts for the high temperatures in 1980 and beyond. It's not the slow Milankovitch cycles, nor the solar cycles. It's just another one of those Anthropocene phenomena driven by human activities.

Where do we go from here?

Average global warming is now at about 1.2degC above 1900 levels. Assuming business as usual, with increasing greenhouse gas emissions, we are likely to see the global average reach 1.5degC by 2030 and maybe 2degC between 2050 and 2100. Governments meeting annually under the **UN Framework Convention on Climate Change (UNFCCC)** have agreed to aim for **Net Zero**, which means taking out of the atmosphere as much CO_2 as our processes pump into it. While this seems a worthy goal, it fails to address the simple fact that this will maintain CO_2 levels about where they are now, which, inevitably means that the world will continue to warm. What few people realise is that while the average global warming temperature may be about 1.2degC, it is 2 or 3 times that in the polar regions, especially the Arctic, which is where there is a great deal of melting ice. Hence we can confidently predict that maintaining CO_2 levels will melt more ice and raise sea level further. The only way to stop that would be to bring CO_2 levels down below 1.5degC - a big (and expensive) ask.

In terms of the Great Acceleration beginning in 1950, the CO_2 and temperature picture is slightly clouded. Although it is now known that more than 90% of our burning of fossil fuels has taken place since 1950, the acceleration of airborne CO_2 emissions appears to date from roughly 1965, while the associated acceleration in air temperatures dates from 1970. The CO_2-temperature association between about 1940 and 1970 was obscured by the dirtiness of industrial processes and home fires, most of which were coal-based, producing aerosols that reflected solar energy. These aerosols gradually disappeared by 1970 with the advent of a succession of Clean Air Acts, which stopped aerosol emissions from power stations and home fires. As the use of coal as a primary fuel decreases, further warming is expected to appear.



Annual concrete production = 27.3 billion tons/yr:
= total flux of all sediments from rivers, aeolian dust, ice sheets, glaciers and coastal erosion.

Figure 4: Novel Lithostratigraphic Indicators. Production of Aluminium (35 Mt/yr.) & Concrete (27 Gt/yr.).

What does geology tell us is likely to happen if warming is sustained?

During the last interglacial (the Eemian) around 125,000 years ago, sea level rose by about 15m above present levels over a period of about 3000 years, before slowly declining. Temperatures at the time were about the same as they are now. Much the same sort of rise was seen in the Mid-Pliocene. Sea level is currently rising slowly, but geology tells us that there is normally a considerable lag between temperature rise and full ice melt. Bearing that in mind, we might expect to see sea level rise reach as much as 2m (above 1900 levels) by 2100, and between 5-15m (above 1900 levels) over the following 200-300 years.

How long might the Anthropocene last?

Calculations by climate modellers suggest it could be as much as 500,000 years, depending on the amount of greenhouse gas we put into the atmosphere in the next 50 years. Evidently, CO_2 has a very long tail (*see Archer, 2011*).

The obvious way out of this dilemma is to reduce CO_2 and CH_4 emissions drastically, which would require a massive, rapid and

costly change to our global energy infrastructure. It is doable. But are global citizens prepared to pay the cost? If not, we will in any case have to bear the cost of extreme warming and sea level rise. We are caught between a rock and a hard place.

An excellent, thought-provoking talk from Dr. Colin Summerhayes.

Further Reading:

- Zalasiewicz, J., Waters, C., Williams, M., and Summerhayes, C.P. (eds.), 2019, The Anthropocene as a geological time unit. **CUP**. 361pp
- Archer, D., 2011, Global Warming: Understanding the Forecast (2nd Ed). **Wiley**.

Podcast

The Infinite Monkey Cage: Supervolcanoes

Brian Cox and **Robin Ince** find out if supervolcanoes are worth worrying about. They are joined by volcanologist **Tamsin Mather**, geologist **Chris Jackson** and comedian **Rachel Parris**. They learn about the worst eruptions of all time, including the eruption that may have sparked the French revolution. They find out what volcanologists like Tamsin are doing to monitor supervolcanoes and if volcanologists do predict an impending eruption, is there anything we can do about it?

Reference:

https://www.bbc.co.uk/programmes/m001ng4w

Lecture Summary

Friday, 14 April 2023

On Friday, 14 April 2023, FGS attendees at The Maltings and via Zoom, together with other local society members, welcomed Dr. Dan Bosence in presenting our external lecture.

Bumps in the Bay: Enigmatic circular sea-floor structures off the Jurassic Coast

By Professor Dan Bosence, Emeritus Professor of Carbonate Sedimentology, Department of Earth Sciences, Royal Holloway College, University of London

Report by Anne Kingston, FGS Member

Professor Dan Bosence has been working on this project in Weymouth Bay for about four years. There is no sediment in Weymouth Bay because the currents and tides are so strong. They used echo-sounding techniques on the sea floor where the water is about 30-40 metres deep, with strong currents and poor visibility. There is nothing similar in the coastal and quarry outcrops nearby, **so it is a problem working out what the structures are**.

Many geological processes cause circular structures, but Dr. Bosence was able to discount **sink holes**, **gas escape structures** and **impact craters** as these cause depressions not raised areas.

Professor Bosence then posed the question: How do you solve the origin of these structures?

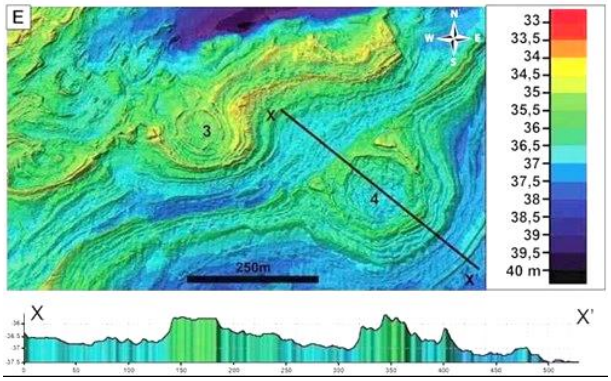
Several options could be considered:

i. Morphology of the bumps.
ii. Where do they occur.
iii. When were they formed.
iv. Diver sampling of the bumps.
v. Results and implications.

Use of Multi-Beam Echo-Sounding (MBES)

MBES is a wide beam emitted from a survey ship to obtain a three-dimensional image of the sea floor. The Bumps **occur offshore in a band between Kimmeridge Bay to Durlston Head near Swanage**. The Purbeck Fault

originated in the Jurassic era going into the Cretaceous era.



MBES image of bumps that are truncated domes in upper Purbeck limestones and shales. Depth scale in metres and X –X" is a seafloor bathymetric profile (Credit: Bosence et al. 2018).

During the Cretaceous the North Atlantic was forming. They looked at the distribution of the Bumps in a band southwest from **Durlston** using mapping from the MBES images. They found that the bumps have a restricted distribution and are only found in the Upper Purbeck Limestone on the southern limb of the Purbeck Anticline southwest from Durleston Head.

They collaborate with the Isle of Purbeck Sub-Aqua Club (IPSAC). The divers trained in the Portland quarries, so they knew what they were looking at. The divers did their sampling at 30-40 metres depth, 5km (just over 3 miles) south of St. Aldhelm's Head. Between 2019 and 2022 there were 12 successful dives collecting samples.

Due to the strong currents and water depth the sampling dives were restricted to either side of low water and for only a short time interval.

The currently favoured hypothesis as to the identity of the bumps/mounds is that they are looking at large, depth-restricted tufa mounds in the Purbeck Lake.

Professor Bosence said that similar circular structures have been imaged on Mars and that his work near Purbeck may help with the difficulties in interpreting Planetary geology and he concluded by saying that the Purbeck geology has been studied for more than 150 years but there are still more discoveries to be made.

Professor Bosence gave a very comprehensive and most interesting talk, a lot of which has been published.

Reference:

BOSENCE, D.W.J., COLLIER J.S., FLECKNER S., GALLOIS A. and WATKINSON I.M. (2018) Discriminating between the origins of remotely sensed circular structures; carbonate mounds, diapirs or periclinal folds? Purbeck Limestone Group, Weymouth Bay, UK. ***Journal of Geological Society of London***, 175, 742-756.

Interesting Videos and Photographs 1

Video: Uyuni salt lake

This film was made at the Uyuni salt lake in Bolivia (the largest in the world and at 3,700m above sea level). They say this is ***where heaven meets earth***.

Most of the year the salt lake remains completely dry, but in the rainy season, in the summer, it can accumulate brine 20 to 30cm depth on its surface. When this occurs, it becomes a mirror that reflects the entire landscape - and heaven meets earth.

Reference:

https://www.youtube.com/watch?v=WrFa3Kg2xL8

Venus & Mt Fuji

Venus as seen above Mt. Fuji in Japan. (Image credit: Yuga Kurita/Getty Images)

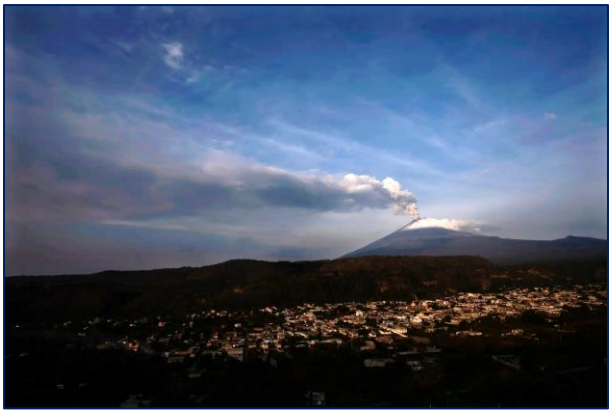
Reference:

https://www.space.com/venus-late-night-sky-morning-star-may-2023?utm_term=8DEBC9E5-6C7F-4337-AFFF-D9A51CC6C2C0&utm_campaign=58E4DE65-C57F-4CD3-9A5A-609994E2C5A9&utm_medium=email&utm_content=42BA3207-74A2-434A-834E-1D099B7A761D&utm_source=SmartBrief

Ga	**(giga-annum)**	**billion years**
Ma	**(mega-annum)**	**million years**
ka	**(kilo-annum)**	**thousand years**

Mexico's Popocatépetl volcano

Popocatépetl volcano, as seen from Paso de Cortés in Amecameca, Mexico. (Photograph: Cristopher Rogel Blanquet/Getty Images)



Popocatépetl, as seen from Santiago Xalitzintla, is Mexico's second tallest volcano at 5,550 metres (18,209ft) above sea level, and on clear days is a fixture of the Mexican capital's distant southern skyline. (Photograph: Marco Ugarte/AP)

Reference:

https://www.theguardian.com/world/gallery/2023/may/25/mexico-popocatepetl-volcano-spews-ash-and-smoke-in-pictures

Solar Eclipse

Japan's iSpace HAKUTO-R lander captured this photo in orbit around the Moon while a solar eclipse was occurring on Earth on April 20, 2023. You can see the Moon's dark shadow passing above Australia as a dark smudge.

References:

1. https://www.space.com/moon-earth-shadow-solar-eclipse-landing-ispace
2. https://www.planetary.org/space-images/hakuto-r-sees-solar-eclipse-from-moon
3. https://www.discoverbucksmuseum.org/who-was-mary-anning/?fbclid=IwAR1pcQyOiMcPsuwG_U0dMTwwIK9u2DtRUguC9quAbAJmxaaP8bpuBUkgA30

News

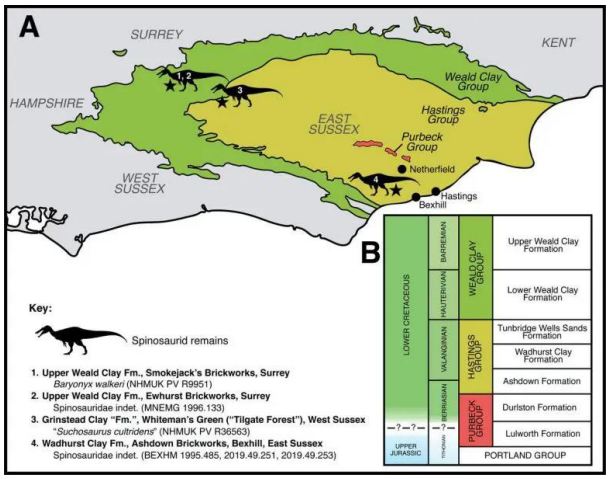
Shattering preconceptions: Diverse spinosaur species roamed Cretaceous Britain

By PEERJ
26 June 2023

A recent study by the University of Southampton indicates that distinct spinosaur groups lived in Cretaceous Britain, challenging previous beliefs. Using a spinosaur tooth from the **Hastings Museum**, researchers found it belonged to a different species, not the commonly identified *Baryonyx*. This finding underlines the rich diversity of spinosaurs in southern England and the potential for discovering new dinosaur species in well-explored regions.

Analysis of a British spinosaur tooth by paleontologists at the **EvoPalaeoLab of the University of Southampton** shows that several distinct spinosaur groups inhabited Cretaceous Britain.

Illustration of White Rock spinosaurid by Anthony Hutchings. A new study by paleontologists at the University of Southampton's EvoPalaeoLab shows that several distinct groups of spinosaurs inhabited Cretaceous Britain. (Credit: UoS/A Hutchings)



Geological context of the Lower Cretaceous deposits of southeast England, focussing on the Purbeck Group and Wealden Supergroup. ***(A)*** *Schematic geology of the Lower Cretaceous deposits of the Weald Sub-basin (southeast England), highlighting published spinosaurid finds (Charig & Milner, 1997; Salisbury & Naish, 2011; Turmine-Juhel et al., 2019). Based on Austen & Batten (2018: Fig. 2). Note that various additional spinosaurid teeth are known from the region but remain undescribed in detail (Fowler, 2007).* ***(B)*** *Simplified stratigraphic column of the Weald Group in southeast England, based on Batten & Austen (2011: Fig. 3.2). Note that the Grinstead Clay Formation, which subdivides the Tunbridge Wells Sands Formation in Batten & Austen (2011) and from which the "Suchosaurus cultridens" type specimen was*

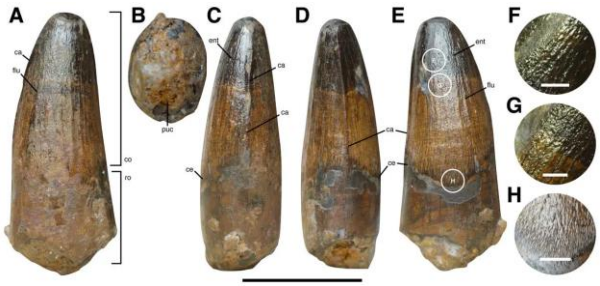
discovered (Salisbury & Naish, 2011), is downgraded to a member of the latter formation in other works (Hopson, Wilkinson & Woods, 2008) and has not been included in this column. (Credit: Spinosaurid silhouette courtesy of Dan Folkes)

Stored within the collections of the **Hastings Museum and Art Gallery** in **East Sussex**, the fossil that forms the basis of the new study was gifted to the museum in 1889. It was collected from the local Lower Cretaceous rocks of the Wealden Supergroup, a thick, complicated rock sequence deposited across south-eastern England between 140 and 125 Ma ago.

The Wealden is famous for its spinosaur fossils. *Baryonyx* – discovered in the Wealden of Surrey in 1983 – is one of the world's most significant spinosaur specimens, since it was the first to reveal the true appearance of this crocodile-headed, fish-eating group. Less impressive spinosaur remains – isolated teeth – are common throughout the Wealden, and have often been identified as belonging to *Baryonyx*. However, some experts have long suspected that this is incorrect, and such is confirmed by the new study published in ***PeerJ Life & Environment.***

"We used a variety of techniques to identify this specimen, in order to test whether isolated spinosaur teeth could be referred to *Baryonyx*," said lead author Chris Barker, whose PhD focuses on the spinosaurs of southern Britain. "The tooth did not group with *Baryonyx* in any of our data runs. It must belong to a different type of spinosaur."

The results show that distinct and distantly related spinosaur types lived in the region during Early Cretaceous times. This backs up research by the EvoPalaeoLab team, who argued in previous studies that the spinosaurs of southern England are more diverse than previously thought. In 2021, they named the 'hell heron' *Ceratosuchops* from the Isle of Wight, and in 2022 announced the discovery of what might be Europe's largest ever land predator, a giant known only as the White Rock spinosaur. These several spinosaurs did not all live at the same time, but inhabited the region over the course of more than 15 Ma.



Different Views Spinosaur Tooth. (A) Lingual, (B) basal, (C) mesial, (D) distal and (E) labial view. (F–G) Close up of the enamel texture on the labial tooth surface. Abbreviations: ca, carina; ce, cervix; co, crown; ent, enamel texture; flu, flute; puc, pulp cavity (infilled); ro, root. Scale bars (A–E): 10 mm, (F–G): 1 mm. (Credit: PeerJ)

"Museums themselves are places to make exciting discoveries as our understanding of specimens changes from the time they were deposited. What this work highlights is the importance of keeping collections alive, and developing our understanding of them. Curators are essential to help us navigate the cupboards and displays, helping us to unpick the often - incomplete records - either never fully written, or lost to time. The diversity of palaeoenvironments is not always hidden in rocks, it is often waiting in a museum, its importance waiting to be rediscovered!" said Dr. Neil Gostling

"Dinosaur teeth preserve numerous anatomical details, and we can use various analytical techniques to see how similar, or different, they are to other teeth. Our new study shows that previously unrecognized spinosaur species exist in poorly known sections of the Wealden's history, and we hope that better remains will be discovered that improves our knowledge. Here's another reminder that even well-studied places like southern England have the potential to yield new dinosaur species," said Dr. Darren Naish.

References:

1. https://scitechdaily.com/shattering-preconceptions-diverse-spinosaur-species-roamed-cretaceous-britain/?expand_article=1
2. For more on this research, see **140 Million-Year-Old Tooth Unveils Diversity of**

Spinosaurs in Ancient Britain. https://scitechdaily.com/140-million-year-old-tooth-reveals-diversity-of-spinosaurs-in-ancient-britain/

3. “Isolated tooth reveals hidden spinosaurid dinosaur diversity in the British Wealden Supergroup (Lower Cretaceous)” by Chris T. Barker, Darren Naish and Neil J. Gostling, 31 May 2023, PeerJ. https://peerj.com/articles/15453/

Staffordshire earthquake causes rumbling and homes to shake

By Susie Rack & Lee Blakeman, BBC News, West Midlands
29 June 2023

Residents reported "rumbling" and rattling windows and doors after a **3.3 magnitude earthquake** hit Staffordshire on Wednesday evening (28 June).

The British Geological Survey (BGS) said the tremor's epicentre was **7.3km below Tean**. It is the largest of **21 earthquakes** to strike the UK in the **past two months**.

The BGS said people had reported "an initial rumbling, then a bang" with what "felt more like a shunt, like something had hit something".

People as far as 20km from the epicentre took to social media to describe the effects.

Kelvin Evans, in Upper Tean, said he heard a "very loud, weird, spooky noise, that seemed to vibrate the front of the house." Another Tean resident, Jenni Brown, said she thought a vehicle had veered off the road and bumped the side of her house.

'A very large shake'

Carol Heather, from Hilderstone, said she felt an impact and noise so loud she thought it was a bomb. "My hair stood on end, I was jolted out of my seat. I was just watching a film and it was really frightening, terrifying. It was such a bang."

Mark Begg, 30, said he was at home in Uttoxeter when he felt "a very large shake". After checking the house and finding no signs of damage he concluded "it was most likely a mini-earthquake".

Tom, 38, in Cheadle said: "I was sitting watching an episode of Only Connect with my wife on YouTube and as we opened another bottle of wine the whole house shook. I thought either one of the children had fallen out of bed or something else had happened."

Several people in Derbyshire also reported feeling the quake which included Gurj Sanghera who tweeted to ask if anyone else felt it in Derby while Andy Savage posted "there was deffo something it was brief".

Dr. Ian Stimpson, a senior lecturer in geophysics at Keele University, said the area had not historically been hit by earth tremors.

"With this location and depth it is likely to be a natural earthquake rather than anything to do with former mines," he added.

The BGS records and locates between 200 and 300 earthquakes in the UK each year with the majority only detected by sensitive instruments.

The **largest earthquake** ever recorded in the UK was in the North Sea on **7 June 1931**, with a **magnitude of 6.1**. The epicentre was in the Dogger Bank area, 120km north-east of Great Yarmouth, Norfolk.

Reference:

https://www.bbc.co.uk/news/uk-england-stoke-staffordshire-66050598

Labour’s energy day: We need policies that build on our strengths, not undermine them, says Offshore Energies UK

OEUK PRESS RELEASE
19 June 2023

Labour’s proposed ban on new oil and gas exploration licences in UK waters will undermine the UK’s energy security, jobs and attempts to reach net zero, Offshore Energies UK’s chief executive has warned.

David Whitehouse's comments followed a speech by Labour leader Sir Keir Starmer in Edinburgh today, setting out his party's vision to make the UK a clean energy superpower by 2030.

Mr. Whitehouse said he welcomed many of Sir Keir's comments, especially his recognition of the key long-term role that oil and gas would play in the UK economy to net zero and beyond. He said the industry also strongly supported the UK government's and Labour's commitment to making the UK carbon neutral by 2050.

Offshore Energies UK represents over 400 companies involved in producing energy from oil, gas and wind in UK waters. Through the North Sea Transition Deal agreed with the UK Government, the sector has agreed to invest up to £16 billion in low carbon energy, including developing new technologies such as carbon capture and storage, and mass hydrogen production. The sector supports over 200,000 UK jobs, 90,000 of them in Scotland.

The UK consumed about 77 billion cubic metres of gas last year with about 40% coming from UK waters. It also consumed 61 million tonnes of oil with UK production equating to 67% of that total. About 24 million homes rely on gas boiler for heat and, overall, the UK gets about 76% of its total energy from oil and gas.

The Climate Change Committee has said that oil and gas will still meet 50% of the UK's energy needs in the mid-2030s and that even by 2050, oil and gas will still provide 22% of the UK's energy needs.

OEUK said new licenses remain an important tool for the UK to protect affordability, support jobs, cut emissions and accelerate the transition.

OEUK Chief Executive David Whitehouse said: "We do welcome Sir Keir Starmer's recognition of the critical role of oil and gas, and of the offshore industry, and its 200,000 workers in delivering energy security and net zero. Everyone is clear that the energy system must change.

"But Labour's proposed ban on new exploration licences is too much too soon. It would be damaging for the industry, for consumers and for the UK's net zero ambitions.

"The figures are clear. The UK has 283 active oil and gas fields but 180 will shut down by 2030. If we don't replace them with new ones, then production will decline much faster than we can build low carbon replacements. It means the UK will become increasingly reliant on imports.

"UK energy operators produce 40 per cent of our gas and 60 per cent of our oil. We have 24 million homes reliant on gas boilers and 76 per cent of our total energy comes from oil and gas. So North Sea supplies are essential to energy security – and we need new licences just to slow the natural decline in current levels of production while we build the low carbon systems of the future. "As we build that future there is no simple choice between oil and gas on the one hand and renewables on the other. The reality is that to keep the lights on and grow our economy, we need both. By the mid 2030s, oil and gas will still provide for 50% of our energy needs. Consumers and businesses won't forgive anyone who shuts down Britain's oil and gas industry only to replace it with imports of foreign oil and gas. We have jobs in nearly every UK Parliamentary constituency and skilled energy communities up and down the country. We need policies that build on our strengths, not undermine them".

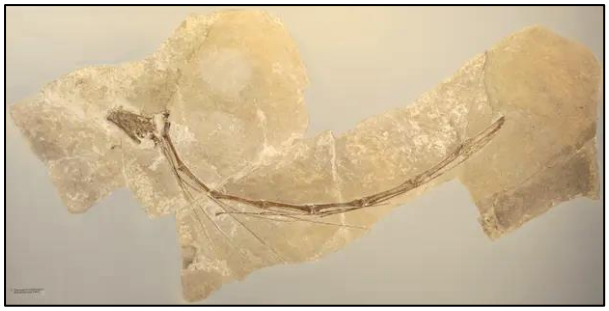
Reference:

https://oeuk.org.uk/labours-energy-day-we-need-policies-that-build-on-our-strengths-not-undermine-them-says-offshore-energies-uk/

Fossils show long necks of prehistoric reptiles were targeted by predators

Evidence suggests slender necks of some ancient marine creatures were a deadly weakness

Ian Sample, The Guardian Science Editor
19 June 2023



The fossil of the larger tanystropheus fossil found reached up to 6 metres long. (Photograph: Stephan Spiekman)

For nearly two centuries, fossil hunters have mused that the improbably long necks of some ancient marine reptiles made them tempting targets for hungry predators.

Now, researchers have uncovered grisly evidence that sticking one's neck out really was a deadly weakness: the remains of two creatures whose heads were snapped off in acts of Triassic violence.

"We think they were grabbed by the neck and killed that way, and because the neck doesn't have much muscle, the predator left them and focused on the much more meaty body," said Dr. Stephan Spiekman, a palaeontologist at the **State Museum of Natural History in Stuttgart, Germany**.

Spiekman and his colleague Dr. Eudald Mujal, an expert in prehistoric bite marks, made the gruesome discovery while examining a pair of 240 Ma old fossils of *tanystropheus*, a marine reptile recovered from Monte San Giorgio on the Swiss-Italian border.

At the time, before the emergence of the dinosaurs, the mountain was home to a tropical lagoon. Fossils from the rocks preserve such a spectacular diversity of prehistoric fish, reptiles, crustaceans and other species that it was designated a Unesco world heritage site.

The fossils studied belong to two different species of *tanystropheus*, one smaller animal about 1.5m long, and another much larger creature about 6m long. In both cases, only the small head and part of the long, slender neck remain. The bodies, ominously, are missing.

Close inspection of the larger fossil revealed two tooth-shaped holes in the vertebrae at the precise point where the neck was cleanly broken. "The whole neck is broken in exactly one plane," said Spiekman. "The neck was broken in one go, and having the tooth marks there is pretty conclusive evidence that some animal bit its neck off."

The smaller reptile seems to have suffered the same fate. Again, the neck and slender supporting neck ribs which run parallel along the vertebrae to provide stiffness, were broken at a single point. This time, a small tooth-shaped hole was found further up the neck, away from the fracture point. Scavenging looks highly unlikely, the scientists say,because bite marks look different in dead animals, and scavengers tend to cause far more damage when they tuck in to a carcass.

The evidence suggests that while many marine reptiles reaped clear benefits from exceptionally long necks – the larger *tanystropheus* had a neck comfortably over 2m – the advantages came with a cost. As depicted in Henry De la Bèche's 1830 watercolour, **Duria Antiquior**, a long neck was a great way to lose one's head.

Based on the size of the teeth marks, Spiekman and Mujal suspect the beheadings were performed by other marine reptiles, perhaps a distant ancestor of the plesiosaur called a *nothosaur*, an early ichthyosaur, or the stocky *helveticosaurus*. Details are published in **Current Biology**.

"These are some of the most macabre fossils I've ever seen," said Steve Brusatte, a professor of vertebrate palaeontology at Edinburgh University, who was not involved in the study. "You can sense the violence of the reptile-eat-reptile world of the Mesozoic when you look at these fossils."

"It seems like these long necks were a type of superpower, which allowed these reptiles to ambush their prey by darting their heads like a spearfisherman," he added. "But all superheroes have a weakness, and these long necks would have been kryptonite to these animals, as they left them vulnerable to attack from other reptiles.

"Still, long necks persisted in so many reptile groups, for so long, right up to the asteroid that knocked many of them out, alongside their dinosaur cousins. The value of a long neck must have generally outweighed the costs."

Reference:

https://www.theguardian.com/science/2023/jun/19/fossils-long-necks-prehistoric-reptiles-targeted-predators

Isle of Wight fossilised remains identified as new dinosaur species

Creature has been named Vectipelta barretti after Prof. Paul Barrett of London's Natural History Museum

Matthew Weaver, The Guardian
16 June 2023

Fossilised remains from the Isle of Wight have been identified as a new dinosaur species that has been named after a palaeontologist at the London's Natural History Museum.

It belongs to a group of plant-eating dinosaurs known as *ankylosaurs* that was found in the 1980s on the island's Wessex formation – a geological feature dating to between 145 Ma and 66 Ma years ago.

After analysis revealed it was a new species it was named *Vectipelta barretti* – after Prof. Paul Barrett, the head of fossil vertebrates at the Natural History Museum (NHM).

Vectipelta barretti is the second armoured dinosaur to be found on the island. (Credit: Stuart Pond/NHM/PA)

It is the second armoured dinosaur to be found on the island, the first one being *Polacanthus foxii*, which was unearthed in 1865. *V barretti* differs from its predecessor *P foxii* in its neck and back bones.

Analysis also shows both species have different pelvic structures and *V barretti* has a more blade-like, spiked armour.

Barrett said: "I'm flattered and absolutely delighted to have been recognised in this way, not least as the first paper I ever wrote was also on an armoured dinosaur in the NHM collections. I'm sure that any physical resemblance is purely accidental."

The findings are described in the **Journal of Systematic Palaeontology.**

The co-author, Dr. Susannah Maidment, a senior researcher at the NHM, said: "Paul has been a really important and significant mentor, supervisor, colleague and friend to myself and several of the other authors on the paper, and we wanted to thank him and recognise his huge contributions to dinosaur palaeontology."

Speaking to **BBC Radio 4's Today** programme, Maidment said when the remains were discovered in the 1980s they were thought to be from the same species as the 19th-century find on the island. But, she added, "we've now discovered it's rather different from the Polacanthus and it's a new species. It's got differences in its vertebrae, its pelvis and some of its armour is different as well. So we are quite confident it's a completely different animal."

Although both ankylosaurs originated from the same island, the researchers found they were not closely related.

In fact, they said, *V barretti* is most closely related to some Chinese ankylosaurs, suggesting these dinosaurs moved freely from Asia to Europe in the Early Cretaceous period, up to 145 Ma years ago).

Stuart Pond, a researcher at the NHM department of Earth sciences, said: "This is an important specimen because it sheds light on ankylosaur diversity within the Wessex formation and early cretaceous England."

The researchers said rocks from the Wessex formation and the Isle of Wight were "hugely important" to understanding more about how dinosaurs became extinct.

Reference:

https://www.theguardian.com/science/2023/jun/16/isle-of-wight-fossilised-remains-identified-as-new-dinosaur-species

UK's tax changes: First step to 'restore confidence' in oil & gas sector and safeguard energy security

Melisa Cavcic, Offshore Energy
9 June 2023

After the UK government raised a windfall tax on oil and gas producers' profits, the hike stoked fears of a collapse in investments in the sector, as many players started contemplating downgrading their UK portfolio or even exiting the North Sea to pursue oil and gas developments in a lower-tax environment. In light of this, the UK has now made adjustments to the oil and gas tax terms in a bid to protect the country's energy security and the jobs of people in the sector.

The Energy Profits Levy, which was introduced as a part of a raft of budgetary measures aimed at shoring up the UK's finances and tackling the cost-of-living crisis, put a marginal tax rate of **75 per cent** on North Sea oil and gas production. At the time of the original announcement, *Offshore Energies UK (OEUK)* warned that the windfall 'supertax' proposal would risk driving out oil and gas investments from the UK waters, which could hinder the UK's energy security along with its transition plans for a low-carbon future.

Following the windfall tax hike, OEUK underscored that these tax changes on oil and gas production were threatening to drive out investors and drive-up imports, leaving consumers increasingly exposed to global shortages. In light of this, Moody's outlook confirmed that the higher tax rate would result in lower projected positive free cash flow (FCF) generation with the related impact on cash flow lasting longer because of the levy's extension beyond the end of 2025.

Westwood Global Energy also recently highlighted that these tax changes had the potential to not only put oil and gas investments at risk but also amplify the mass departure of rigs from the North Sea, which could lead to the point of no return for North Sea rigs. Bearing this in mind, OEUK has been calling for a trigger price for the windfall tax, so that, it would only apply when oil or gas prices are high, and a windfall profit was being earned.

Based on the new tax changes, it seems the UK government has heard these calls and decided to do something about it to give the oil and gas sector certainty to raise capital and invest in new and existing projects, securing "affordable and reliable" domestic energy supply and protecting some of the 215,000 British jobs the sector supports. While the increased windfall tax will still remain in place for the next five years when oil and gas prices remain higher than historic norms, it will fall back to **40 per cent** – the previous level prior to the hike – when prices consistently return to normal levels for a sustained period.

Therefore, the government will introduce a new **Energy Security Investment Mechanism** to protect the domestic energy supply, however, the Office for Budget Responsibility believes this will not be triggered until before the tax's planned end date in March 2028. The windfall tax is expected to raise almost **£26 billion** by this date, which will fund the measures aimed at helping with the cost of living.

According to the UK government, this is part of its strategy to support households with energy bills whilst providing certainty to investors to secure the long-term future of domestic energy production, as the Energy Profits Levy has raised around £2.8 billion to date, helping the government pay just under half the typical household energy bill last winter.

Gareth Davies MP, Exchequer Secretary to the Treasury, commented: "It is right that we recover excess profits resulting from Putin's war and use the money to help people with their energy bills. Thanks to the revenue raised

from windfall taxes on energy profits, we will have helped save the typical household £1,500 on their energy bill by July.

"While we stepped in to help, never again can our energy supplies be at the whim of petrostate despots like Putin. That's why it's so important that we secure investment in our own domestic supply, protecting the tens of thousands of British jobs that come with it. It would be beyond irresponsible to turn off the North Sea taps overnight. Without oil and gas from British waters, we would be forced to import even more from overseas, putting our security of supply at risk."

Furthermore, the tax rate for oil and gas companies will return to 40 per cent if both average oil and gas prices fall to, or below, $71.40 per barrel for oil and £0.54 per therm for gas, for two consecutive quarters. The UK government claims that this level is based on 20-year historical averages. This was introduced as a result of the official forecasts by the UK government and the North Sea Transition Authority suggesting that a block on North Sea oil and gas investment would mean the UK's dependence on imports would rise from the current 50 per cent to 80 per cent by 2033.

David Whitehouse, OEUK Chief Executive, remarked: "We've always been clear that when the windfall conditions go, the windfall tax should go. This is a step in the right direction, but many more will need to be taken to restore confidence to our sector. We will now work closely with the government and lenders to understand the detail of the measure and its effectiveness at unlocking investment. Enabling continued UK energy production now and in future depends on a predictable and fair fiscal environment.

"The UK must be competitive if we are to be successful in the global race for energy investment. We are proud to make a huge contribution. In 2022/23 alone we will add over £20 bn to the UK economy overall. We provide over 200,000 good, skilled jobs across the length and breadth of the UK. As we build the future there is no simple choice between oil and gas or renewables. The reality is we need both. In the mid-2030s, oil and gas will still provide 50 per cent of our energy needs."

Offshore Energies UK underscores that the industry is still facing considerable challenges to safeguard the jobs of its 200,000-strong skilled workforce, ensure the UK's homegrown energy security, and power the transition to net-zero and beyond with homegrown oil and gas rather than imports, thus, more needs to be done to get to grips with these challenges.

Unity platform. (Source: INEOS)

Reference:

https://www.offshore-energy.biz/uks-tax-changes-first-step-to-restore-confidence-in-oil-gas-sector-and-safeguard-energy-security/?utm_source=offshoreenergytoday&utm_medium=email&utm_campaign=newsletter_2023-06-12

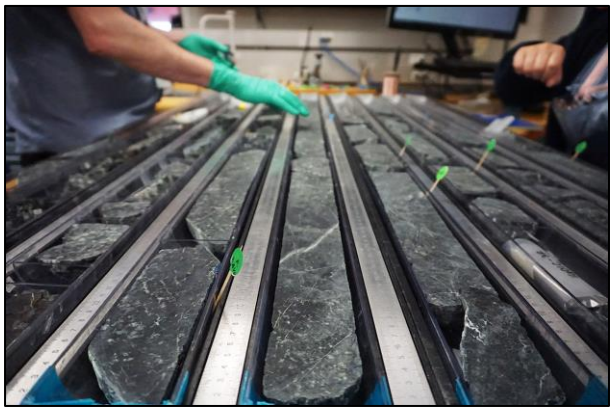
At long last, ocean drillers exhume a bounty of rocks from Earth's mantle

Rocks fulfil 60-year-old quest and could yield science bonanza

By Paul Voosen, Science
25 May 2023

In 1961, geologists off the Pacific coast of Mexico embarked on a daring journey to a foreign land—the planet's interior. From a ship, they aimed to drill through the thin veneer of Earth's crust and grab a sample of the mantle, the 2900-kilometer-thick layer of dense rock that fuels volcanic eruptions and makes up most of the planet's mass. The drill only got a couple hundred meters below the seabed before the project foundered under spiralling

costs. But the quest - one of geology's holy grails - remained.



Researchers have collected an unprecedented amount of mantle rocks from below the sea floor.
(Credit: JOHAN LISSENBERG/CARDIFF UNIVERSITY & IODP)

This month, researchers onboard the **JOIDES Resolution**, the flagship of the **International Ocean Discovery Program (IODP)**, say they have finally succeeded. Drilling below the seabed in the mid–Atlantic Ocean, they have collected a core of rock more than 1 kilometre long, consisting largely of peridotite, a kind of upper mantle rock. Although it's not clear how pristine and unaltered the samples are, it is certain the cylinders of grey-green rock present an unparalleled new record, says Susan Lang, a biogeochemist at the Woods Hole Oceanographic Institution and a co-lead of the cruise. "These are the types of rock we've been hoping to recover for a long time."

Researchers on land are eagerly following the ship's daily scientific logs as it continues to drill, says Jessica Warren, a mantle geochemist at the University of Delaware. "Getting down to this really fresh stuff has been a dream for decades and decades," she says. "We're finally going to see the Wizard of Oz."

The samples can help answer a host of questions, says Johan Lissenberg, an igneous petrologist from Cardiff University onboard the ship. They can provide direct evidence for how ocean crust differs in composition from the upper mantle and better estimates of elemental abundances in the planet's primary reservoir of rock. The samples of mantle will also help researchers understand how magma melts out of the mantle and rises through the crust to drive volcanism, Lissenberg says. "This could be a whole step forward for understanding magmatism—and the global composition of the bulk Earth."

Drilling was conducted aboard the JOIDES Resolution, a U.S. ship slated to retire next year. (Credit: GABRIEL TAGLIARO AND IODP)

The 1961 project, called **Project Mohole**, was the first of a handful of unsuccessful attempts to reach the mantle. It was named after the **Mohorovičić discontinuity, or "Moho",** a geophysical boundary defined by a sudden spike in the speed of seismic waves where the crust, a mélange of rocks crystallized out of mantle melt and altered by water, gives way to the more homogeneous mantle. The Moho lies some 35 kilometres below thick continental crust. But it is only about 7 kilometres below ocean crust. And it is shallower still at drilling site of the JOIDES Resolution at the Mid-Atlantic Ridge, where the North American and Eurasian tectonic plates are being stretched apart, forcing the mantle upward.

Recovering a long mantle core was not the primary goal of the cruise, which is probing the Atlantis Massif, an underwater mountain, for clues to the origin of life. The massif rocks contain lots of olivine, a mineral that reacts with water in a process called serpentinization. The reactions generate hydrogen, which serves as an energy source for microbial life at the ***"Lost City"***, a nearby complex of ocean-bottom mineral chimneys deposited by gushers of superheated water.

It's long been theorized that life could have originated in such settings, which are rich in

organic molecules. The cruise aimed to deepen a previously drilled 1.4-kilometer-deep hole, pushing to a depth too hot for life, where organic compounds that might have provided the raw material for the earliest life might lurk. But progress was slow.

So, the ship returned to another site near Lost City, where shallow cores drilled in 2015 had found what appeared to be mantle rocks highly altered by seawater. After punching through a horizontal fault near the seabed, "the drilling just went so magically well," says Andrew McCaig, a geologist at the University of Leeds and the cruise's other chief scientist. The only hiccup came when the recovered peridotite rocks contained veins of asbestos, prompting increased safety protocols.

There's still some room for debate about whether the rocks are a true sample of the mantle, says Donna Blackman, a geophysicist at the University of California, Santa Cruz. The seismic speed-up at the Moho is thought to reflect the lack of water or calcium and aluminium minerals in mantle rocks. Because the samples still show some influence of seawater, Blackman says she might classify them as deep crust. "But the petrology is interesting and special regardless," she says. And as the team continues drilling into deeper rocks, Lissenberg says, "They're getting fresher."

Indeed, it appears the team is already sampling mantle rock that has never melted into magma, which then cools and crystallizes into different kinds of crustal rocks, says Vincent Salters, a geochemist at Florida State University. By capturing the rock at this point, he says, researchers should be able to learn how magma melts, flows, and separates - clues to the workings of volcanoes worldwide.

The rocks could also answer other basic questions, such as how much the lavas collected at midocean ridges - which are often taken as a stand-in for the mantle - differ from the mantle itself, says James Day, a geochemist at the Scripps Institution of Oceanography. The abundance of radioactive elements in the rocks could improve estimates of how much heat the mantle produces as a whole, driving the deep convective motions that are the engine of plate tectonics. And their physical strength can inform studies of how earthquakes fracture and propagate in the upper mantle. The cores could also help clarify how well the mantle is mixed, reincorporating ingredients from the continental crust that is drawn back into Earth's interior at deep ocean trenches. "There's so much more to this than understanding a little piece of ocean floor," Day says.

Research on the rocks has already begun in labs onboard the JOIDES Resolution, and eventually the cores will be available at IODP repositories for all. But all the excitement over the rock samples also comes with some bittersweetness: the expedition may be one of the last for the ship. In March, the National Science Foundation (NSF) announced that, because of cost increases and a lack of a deal with its international collaborators, it will end its operating contract for the ship in September 2024.

The ship is in great condition and could continue until 2028, says Anthony Koppers, an associate vice president at Oregon State University and a leader in the IODP community. There's still a slim possibility that the U.S. Congress will fund an extension, he says. But NSF has no plan yet to develop a successor ship. And the other two big contributors to IODP, Europe and Japan, are moving on. This month, they announced the creation of IODP^3, a new global drilling program that will make heavy use of Japan's drill ship, the D/V Chikyū, which in the past has operated mostly in waters near Japan.

This was Lang's first cruise on the JOIDES Resolution, and she was astonished at how well outfitted its labs were and how knowledgeable its technical staff is. The success they're having testifies to their decades of experience probing beneath the ocean floor, she says. "It's so unfortunate that something like this is going to be lost."

Reference:

https://www.science.org/content/article/long-last-ocean-drillers-exhume-bounty-rocks-earth-s-

mantle?fbclid=IwAR3FUApDItSUeQbTVBHBSh2sbTlEozEIRaxqj3rhK3UQOSn6oejEyylgKNY

New carbon storage licences mean UK could bury 30 million tonnes of CO2 a year by 2030 – and become a world leader in decarbonisation technology, says Offshore Energies UK

Press Release
18 May 2023

The UK can become a world leader in carbon storage following today's announcement of **20 licences** for storing millions of tonnes of CO2 in rocks deep below its surrounding seas, said Offshore Energies UK's chief executive.

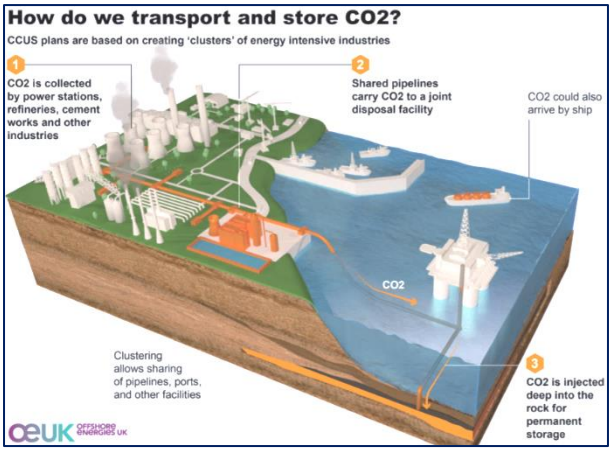
David Whitehouse said the decision to offer 13 areas off the UK's coast as sites for permanently storing millions of tonnes of CO2 meant the UK could pioneer a technology that would be essential in the fight against climate change.

It follows today's announcement by the **North Sea Transition Authority** that it is **awarding 20 carbon storage licences to 12 companies**. The licences cover 12,000 square kilometres at offshore sites near Aberdeen, Teesside, Liverpool, and Lincolnshire.

Some of the sites are expected to be in operation in as little as six years. They are expected to make a vital contribution to the UK target of **storing up to 30 million tonnes of CO2** a year by 2030. This would reduce the UK's total greenhouse gas emissions by up to 10%.

Carbon capture and storage involves the capture of CO2 emissions from industrial processes, such as electricity generation or steel production, which typically use fuels like gas, oil or coal.

The CO2 created by burning such fuels is captured, compressed into a liquid and then injected into deep underground rocks – generally more than 800 metres deep.



The seabed around the UK contain rock formations with the potential to hold up to 78 billion tonnes of carbon dioxide. That is the equivalent of two centuries' worth of the UK's emissions today – and one of the biggest storage capacities in Europe. The carbon capture and storage opportunity could be worth £100bn to the UK's energy supply chain by 2050.

This first carbon storage licensing round is likely to be the first of many, as it is estimated up to 100 CO2 stores could be needed for the UK to meet net zero by 2050.

OEUK's Chief Executive Officer, David Whitehouse, said: "Carbon capture will be a key tool in the global fight against climate change. These pioneering projects can create a wave of new jobs across the country, provide new opportunities for UK businesses at home and abroad, and maintain our world-leading action to reach net zero.

"The UK's offshore oil and gas industry has the expertise needed to make carbon storage a success – and these licence awards can showcase our heritage of energy production skills to the world.

"If we get this right, it will not only help the decarbonisation of heavy industry, power generation and manufacturing globally but also create growth and export opportunity for industrial communities across the UK.

"But we will need 100 such sites or more, and the Track 1 and 2 clusters to be accelerated, if we are to reach net zero – so we mustn't stop here. We look forward to the Government's continued support for CCUS to make sure the

UK secures a leadership position in this exciting new sector."

Reference:

https://oeuk.org.uk/new-carbon-storage-licences-mean-uk-could-bury-30-million-tonnes-of-co2-a-year-by-2030-and-become-a-world-leader-in-decarbonisation-technology-says-offshore-energies-uk/

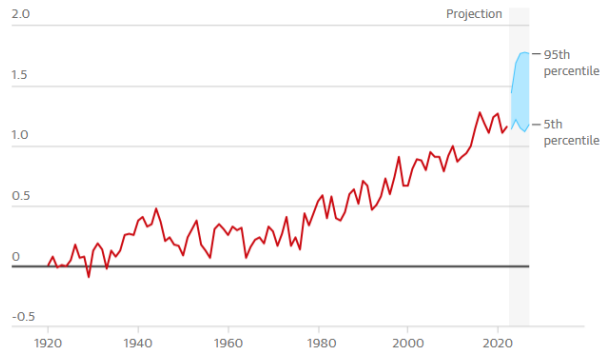
World likely to breach 1.5C climate threshold by 2027, scientists warn

UN agency says El Niño and human-induced climate breakdown could combine to push temperatures into 'uncharted territory'

Fiona Harvey,
The Guardian Environment editor
17 May 2023

The world is almost certain to experience new record temperatures in the next five years, and temperatures are likely to rise by more than 1.5C above pre-industrial levels, scientists have warned.

Global temperatures are likely to exceed 1.5C above pre-industrial levels for at least one of the next 5 years
Global mean near-surface temperature anomalies from 1850-1900 average, °C



Guardian graphic. (Source: WMO analysis of HadCRUT5, NOAA, GISTEMP, ERA5, JRA-55, Berkeley Earth temperature data)

The breaching of the crucial 1.5C threshold, which scientists have warned could have dire consequences, **should be only temporary**, according to research from the World Meteorological Organisation (WMO).

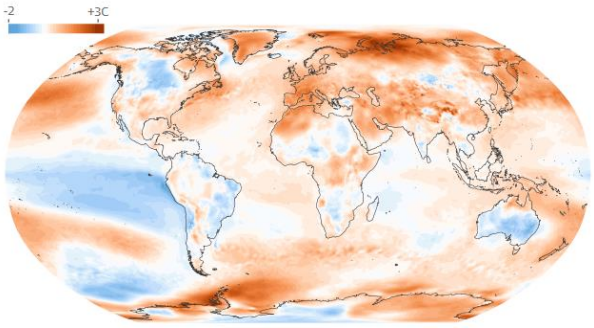
However, it would represent a marked acceleration of human impacts on the global climate system, and send the world into "uncharted territory", the UN agency warned.

Countries have pledged, under the 2015 Paris climate agreement, to try to hold global temperatures to no higher than 1.5C above pre-industrial levels, after scientific advice that heating beyond that level would unleash a cascade of increasingly catastrophic and potentially irreversible impacts.

Prof. Petteri Taalas, the secretary general of the WMO, said: "This report does not mean that we will permanently exceed the 1.5C specified in the Paris agreement, which refers to long-term warming over many years. However, WMO is sounding the alarm that we will breach the 1.5C level on a temporary basis with increasing frequency."

Global average surface temperatures have never before breached the 1.5C threshold. The highest average in previous years was 1.28C above pre-industrial levels.

Temperature anomalies in 2022
Near-surface temperature anomalies, 12-month average in comparison with 1991-2020



Guardian graphic. (Source: Copernicus/ERA5)

The report, published on Wednesday, found there was a **66% likelihood** of exceeding the 1.5C threshold in at least one year between 2023 and 2027.

New record temperatures have been set in many areas around the world in the heatwaves of the past year, but those highs may only be the beginning, according to the report, as climate breakdown and the impact of a

developing El Niño weather system combine to create heatwaves across the globe.

El Niño is part of an oscillating weather system that develops in the Pacific. For the past three years, the world has been in the opposing phase, known as La Niña, which has had a dampening effect on temperature increases around the world.

As La Niña ends and a new El Niño develops, there is a 98% likelihood that at least one of the next five years will be the hottest on record, the scientists found.

Taalas warned of the effects. “A warming El Niño is expected to develop in the coming months, and this will combine with human-induced climate change to push global temperatures into uncharted territory. This will have far-reaching repercussions for health, food security, water management and the environment,” he said. “We need to be prepared.”

The Arctic is heating much faster than the rest of the world, and this appears to be having an impact on global weather systems, including the jet stream, which has disrupted weather across the northern hemisphere in recent years.

There is likely to be less rainfall this year in the Amazon, Central America, Australia and Indonesia, the report found. This is particularly bad news for the Amazon, where scientists have grown increasingly concerned that a vicious cycle of heating and deforestation could tip the region from rainforest into savannah-like conditions.

Severe droughts can occur in Australia, Indonesia and parts of southern Asia during an El Niño pattern.

That could have calamitous consequences for the planet, which relies on rainforests as massive carbon sinks.

Over the next five years, there is **likely to be above-average rainfall** in northern Europe, Alaska and northern Siberia, and the Sahel, according to the report.

For each year from 2023 to 2027, the global near-surface temperature is predicted to be between 1.1C and 1.8C above the pre-industrial average, taken from the years 1850 to 1900.

The world has warmed considerably in recent years. In 2015, when the Paris agreement was signed, requiring countries to hold global temperature increases to no more than 2C above pre-industrial levels while “pursuing efforts” to hold them to 1.5C, it was forecast that the chance of temporarily exceeding the 1.5C threshold within the following five years was zero.

This November, governments will meet for the Cop28 UN climate summit, where they will assess progress towards meeting the goals of the Paris agreement. Known as the “global stocktake”, this assessment is likely to show that the world is far off track to reduce greenhouse gas emissions by the 43% this decade that is required to have a good chance of limiting temperature rises to 1.5C.

References:

1. https://www.theguardian.com/environment/2023/may/17/global-heating-climate-crisis-record-temperatures-wmo-research

BGS releases 10K maps through updated maps portal

BGS releases an updated maps portal, which allows users to view all publicly available, maps and includes 10,000 and 1:10,560 scale maps for the first time.

16 May 2023

As part of our continuous effort to provide more open access to our data, BGS has launched the updated **BGS Maps Portal**. The renewed portal provides access to over 45,000 BGS maps and sections with the following themes:

- Geological
- Geophysical
- Geochemical
- Hydrogeological

The large-scale 10,000 and 1:10,560 BGS onshore geological maps collection is included in this portal for public viewing for the first time,

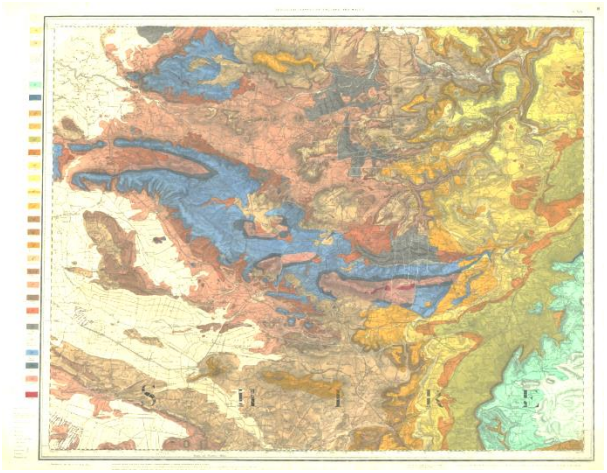
along with the key 1:50,000 and 1:63,360 maps of England, Wales and Scotland.

Image of National grid graphical interface on portal BGS © UKRI

Map portal features

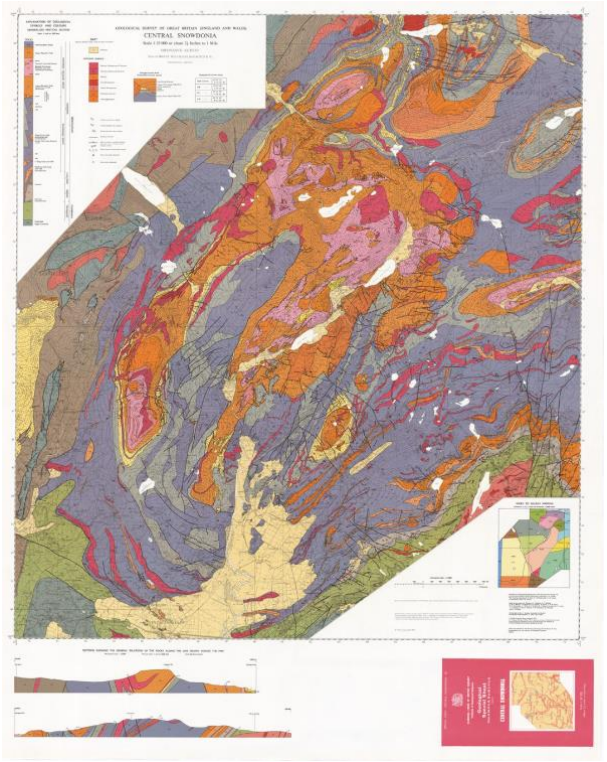
The new portal will allow users to view all publicly available maps, held by BGS, with quick-view thumbnail browsing and an increased number of scanned images. Users can view the collections for free; those wishing to purchase their own copy of a map can buy high-resolution PDFs through the BGS shop.

A small number of maps do not have scans; for completeness, we have provided the full catalogue with all the maps' details, omitting image links where scans do not exist.



County series sheet 19, solid, 1:63 360, 1873. BGS © UKRI

We hope that, by providing this enhanced service, the maps portal will better meet our users' diverse needs. However, it is important to note that users should visit BGS's digital dataset **BGS Geology**, the **GeoReports** service or the **onshore GeoIndex** to access the latest digital vector mapping. The digital vector data in these services can differ significantly from the mostly historical maps presented in the maps portal so the most up-to-date vector data should be consulted for more professional user needs.



Central Snowdonia sheet 11, solid, 1:25 000, 1972. BGS © UKRI

History of geological mapping at BGS

Since BGS's inception in 1835, our maps have evolved in differing iterations of scale. Initially surveyed and produced at the 1:63,360 (one inch to one mile) scale, the decision was made in the 1850s to carry out geological surveys at the 1:10,560 scale (six inches to one mile). This standard large-scale map scale for recording field-survey information and producing maps continued for much of BGS's existence and was based primarily on the Ordnance Survey County Sheet lines.

The next major change came in the 1940s, when these 'County Series' maps began to be replaced by National Grid sheet line maps. Finally, in the late 1970s, the metric 1:10,000 scale was introduced and became the standard large-scale format for field mapping. A small number of remote areas were mapped and provided at the 1:25,000 scale.

The new 2023 to 2028 BGS Strategy 'Understanding our Earth' includes a renewed focus on national mapping, an aim which is supported by the renewal of the BGS Maps Portal.

Reference:

https://www.bgs.ac.uk/news/bgs-releases-10k-maps-through-updated-maps-portal/

Dorset's dinosaur hunters

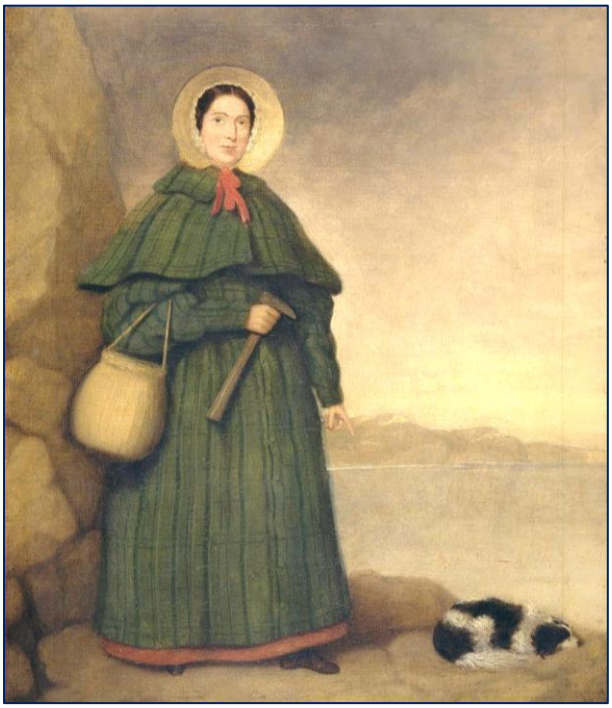
Richard Askwith meets a retired plumber with a £5 million fossil museum dedicated to his work and seven species named after him

Richard Askwith, The Times
11 May 2023

Like palaeontology itself, the commercial fossil trade has deep roots in Dorset. It was here, on the rock-strewn beaches between Lyme Regis and Charmouth, that Mary Anning, the barely educated daughter of an impoverished cabinet maker, not only made some of the 19th century's most significant fossil finds but earned a living from selling them.

Fossil hunter Steve Etches. (Credit: ETCHES COLLECTION)

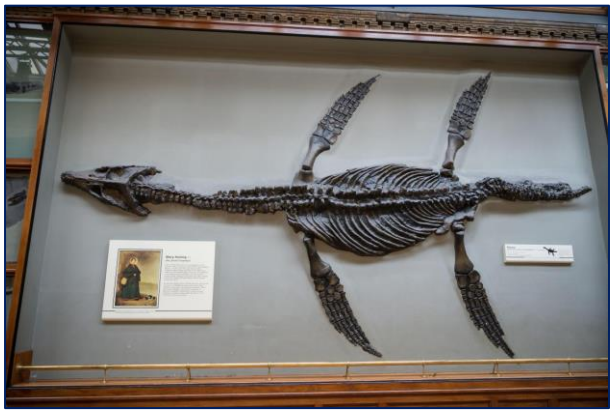
Today, beneath those same crumbling cliffs, you can sense Anning's spirit and, walking alongside, the spirit of private enterprise. Each time the tide recedes, self-starting fossil hunters pick through the rocks, oblivious to wind or rain, scanning the rough shingle for hidden treasures. It's not uncommon to see 40 or 50 at once on Charmouth beach. Numbers are said to have doubled in the past decade.



A painting of Mary Anning fossil hunting with her dog, c.1842.

This is a coast of ichthyosaurs and pterosaurs — creatures of the sea and air. They may lack the crude, bloodthirsty kudos of the American west's earth-shaking dinosaurs but still, some of the specimens in the **Old Forge Fossil Shop**, Chris Moore's little store on the edge of Charmouth, are on sale for several thousand

pounds. About 40 miles further east, by the tar-black cliffs of Kimmeridge Bay, lives Steve Etches. The 73-year-old retired plumber left secondary modern without a fossil-relevant qualification but now has an MBE, a string of academic honours, a £5 million museum dedicated to his palaeontological work and, at the last count, seven species that have been named after him (notably the ichthyosaur *Thalassodraco etchesi* and the pterosaur *Rhamphorhynchus etchesi*).



A plesiosaur fossil found by Anning at the Natural History Museum in London. (Credit: ALAMY)

Ammonite block detail at the Lyme Regis Museum. (Credit: ETCHES COLLECTION)

His expertise comes from four decades of tireless spare-time fossil hunting, focused (unusually) on the dark, forbidding rubble of the late-Jurassic rock formation known as the **Kimmeridge Clay**. His specialist knowledge of the local fossil record is unrivalled. “I’ve studied every inch of these rocks.”

All those years of rock-hopping and specimen-heaving have left Etches fit and agile, and he still goes searching for fossils after a spring tide. But he has already accumulated a priceless collection of more than 2,800 specimens — which he has bequeathed to the nation. He has no idea what it is worth. “I’ve never sold a fossil in my life.” He just likes to see the public engaging with his work, a short walk from his Kimmeridge home, at the Etches Collection Museum of Jurassic Marine Life.

For fossil hunters this may be the real lure of the Jurassic Coast: not the hope of a life-changing auction at Sotheby’s but the richer prize of making a permanent mark on science. Moore still beams when he talks about *Leptonectes moori* — a previously unknown ichthyosaur he found in 1995, now on display at the Natural History Museum in London. And each time a visitor marvels at the “Charmouth crocodile” in the Lyme Regis Museum and reads its scientific name, *Turnersuchus hingleyae*, tribute is paid to the two local enthusiasts, Paul Turner and Lizzie Hingley, who discovered it in 2017.

Steve Etches as a budding fossil hunter in the 1950s. (Credit: ETCHESCOLLECTION / BOURNEMOUTH NEWS / SHUTTERSTOCK)

Dorset isn’t the only popular fossil-hunting ground in the UK, but it is the only one that’s a Unesco world heritage site. It’s also the only place where you can see 185 million years of geological history sequentially exposed, from the Triassic (in the west) to the Cretaceous. Fossil hunting thrives here, not because of money or museums but because of public passion. We are hungry for glimpses into the deep, deep past — and growing numbers of

people simply can't resist the primitive thrill of thinking that, as Moore puts it, "Today you might find something amazing."

Thalassodraco (meaning "sea dragon") etchesi was named in honour of Etches. (Credit: ETCHES COLLECTION)

FGS Newsletter Editor Mick Caulfield next to the statue of Mary Anning in Lyme Regis, Dorset. (Credit: A Caulfield)

Reference:

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UK: North Sea 'treasure map' to grow the economy and unleash the UK's carbon capture and storage industry

energy-pedia
11 May 2023 ***Source: GOV.UK***

Companies licensed to drill in North Sea to report findings to regulator in new powers brought forward in Energy Bill amendment.

- New powers for regulator will help develop most comprehensive picture yet of UK's carbon capture and storage potential.
- This will deliver on the Prime Minister's priorities by helping to attract investment, support as many as 50,000 new jobs by 2030 and grow the economy.
- Energy Bill will also support the scale up of UK's hydrogen and nuclear power industries.

A **'treasure map'** of what lies beneath the North Sea will be created to help the UK become a world leader in carbon capture and storage.

Companies already at the forefront of this technology and licensed to drill in the North Sea will have to report what they find to the regulator, which will develop the most comprehensive picture yet of the geological area's make-up.

This information can then be used to unlock the UK's huge potential by quantifying for investors how much carbon capture and storage could be possible. This could attract more companies to the UK, supporting as many as 50,000 green jobs by 2030, helping to grow the economy and delivering on the Prime Minister's priorities.

The government intends to bring forward these new powers for the **North Sea Transition Authority** in an amendment to the **Energy Bill**, which had its Second Reading in the House of Commons on May 9.

The Energy Bill was introduced to Parliament on 6 July 2022. It will deliver a cleaner, more affordable, and more secure energy system

over the long-term for the UK, while liberating private investment in clean technologies.

Secretary of State for Energy Security and Net Zero Grant Shapps said:

'The UK is in prime position to become a world leader in carbon capture and storage – a whole new industry that could boost our energy security, help cut our own emissions and those of our European neighbours and create thousands of jobs for the future. By working with the brightest and best who are already out in the North Sea, we can grow our economy by building the treasure map needed to unlock the full potential of this geological goldmine.'

Minister for the Energy Bill, Nuclear and Networks, Andrew Bowie said:

'Russia's illegal war in Ukraine has laid bare the need to transform our energy system, and our landmark Energy Security Bill will mean homes and businesses across the UK benefit from a cleaner, more affordable and more secure energy system. With security at its heart, the Bill is the most significant piece of energy legislation in a decade and puts the UK on the path to cleaner electricity by ramping up carbon storage and our technologies of the future.'

Stuart Payne, North Sea Transition Authority Chief Executive, said:

'Carbon storage is essential to reaching net zero, and the industry requires a wealth of reliable information to select sites to store millions of tonnes of greenhouse gases. The NSTA welcomes these new powers to collect this vital data and share it with the industry as it leads the orderly transition and provides thousands of skilled jobs.'

Carbon Capture and Storage involves separating carbon dioxide from industry and storing it safely under the seabed in spaces left by oil and gas extraction. Thanks to the geological make-up of the UK, this country is almost uniquely placed to benefit from this and create a whole new industry.

Estimates suggest that there may be enough space underneath the UK's oceans – including its old oil and gas fields – to store up to 78 billion tonnes of carbon dioxide – the equivalent to the weight of around 15 billion elephants. To kickstart this industry, the UK aims to store 20 to 30 million tonnes of carbon dioxide per year by 2030 – equal to removing up to 6 million cars off UK roads each year.

As well as helping cut the UK's own emissions, this potential is believed to be so considerable that this country could also help other nations using carbon capture and storage – including other European countries – by storing their carbon emissions too.

Under plans announced in Parliament today (May 9), the government plans to grant the **North Sea Transition Authority**, as a carbon storage regulator, powers to obtain information and samples from those who have a licence already to store carbon.

These will give the information needed about the geological features of hidden underground spaces underneath the North Sea that have already been mapped. This will help develop an encyclopaedic knowledge about what lies beneath the waves and confirm the likely scale of the industry this could create, helping to encourage private investment.

UK government Minister for Scotland John Lamont said:

'Expanding carbon capture and storage forms a vital part of our Net Zero ambitions. The new measures introduced today will propel that sector forward, while supporting up to 50,000 jobs to benefit Scotland and the whole of the UK. Not only will this accelerate our transition to using cleaner, greener energy and enhance our energy security but it will also bring a welcome economic boost to aid our priorities of reducing debt and halving inflation.'

Other forthcoming amendments to the Energy Bill announced by the government:

- Backing **Energy Intensive Industries (EIIs)**, such as those in the steel sector, by introducing a compensation scheme that will lower the costs they EIIs have to pay to use the electricity grid. This will bring key UK businesses in line with global competitors and help make the UK one of the most attractive places to do business

as part of delivering on the Prime Minister's plan to grow the economy.

- Setting out the statutory role of the new nuclear body **Great British Nuclear** to carry out the long-term mandate the government intends for it in support of the commitment to unleashing the new generation of new nuclear for it to comprise up to 25% of the UK's energy supply by 2050.
- Plans to **develop new business models** to encourage investment in the transport and storage of hydrogen. This will be key to boosting the UK's future energy security.

Business and Trade Minister Nusrat Ghani said:

'Energy-intensive industries like steel are hugely important to our economy. This measure will cut costs and help ensure they can bring high-quality jobs and investment into the UK. This support will mean that these key industries stay in line with their global competitors, helping deliver on the Prime Minister's priority to make the UK the most attractive place to do business and grow our economy.'

The Energy Bill first entered Parliament in July last year and commits to providing a cleaner, more affordable, and more secure energy system by:

- Leveraging private investment in clean technologies.
- Reforming the UK's energy system so it is fit for the future.
- Ensuring the safety, security and resilience of the UK's energy system.

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Two interesting articles from The BBC News, before and after, illustrating how Earth Science and Engineering can help predict potential disasters. Editor

Swiss village of Brienz told to flee imminent monster rockslide

By Imogen Foulkes, BBC News, Bern
9 May 2023

Residents of the tiny Swiss village of Brienz have been told to pack their bags and leave immediately.

The reason: **two million cubic metres** of rock from the mountain above them is set to come loose and crash down to the valley in the next few days.

The evacuation order has not come as a complete surprise to the remaining population of about 70 villagers.

This aerial view of Brienz shows the mass of rock directly threatening the village of Brienz beneath it. (Credit: CHRISTOPH NÄNNI, TIEFBAUAMT GR, SWITZERLAND)

Brienz, in the eastern canton of Graubünden, has been judged a geological risk for some time. The village itself is built on land that is subsiding down towards the valley, causing the church spire to lean and large cracks to appear in buildings. Work was under way to try to stabilise that and there were signs the slippage might be slowing down. But ominously, the mountainside above Brienz was in the meantime breaking apart.

Villagers had become accustomed to quite large boulders tumbling down to their gardens below.

Geologists warned that the rock movement was accelerating. Part of the rockface, innocently nicknamed "the island", was by 2023 slipping at a rate of 32m every year. And yet no one thought they would have to leave so soon.

The authorities had warned of a possible evacuation later this summer, and at the end of this week a regular village meeting was scheduled to bring everyone up to date.

Instead, after latest risk assessments showed a rockslide was imminent, the order to get out came suddenly on Tuesday morning. From now on, no-one who doesn't live in Brienz will be allowed to enter, while all villagers must be out by Friday at the latest.

"I love it here, Brienz is a lovely village, it's quiet," one young woman told Swiss media. "It's happened so quickly," said another. "We all thought we would have more time, it's a very strange feeling."

Most have been offered accommodation in neighbouring villages, such as the resort of Lenzerheide, which has plenty of space as the ski season is over and summer has not yet started.

But it's not a permanent solution, and it's not an easy one. "I'm ready," said one elderly lady, standing on her doorstep with her suitcase. "But I think I'll wait till the last minute."

Many are now asking why a village should suffer such a fate in Switzerland, where building regulations are strict and risk assessment is a continuous process. But Switzerland's Alpine regions are especially sensitive to global warming.

As the glaciers shrink, and the permafrost high in the mountains begins to thaw, the rock becomes unstable.

Lower down, heavier rainfall linked to global warming causes erosion and slippage, and this is what appears to have happened in Brienz. Forecasts of further heavy rain all this week was what prompted the sudden decision to evacuate.

In 2006 huge chunks of rock fell off Switzerland's famous Eiger, causing the closure of hiking trails and prompting geologists to warn that such events could be expected more often.

In 2017, a massive landslide struck the village of Bondo, also in Graubünden, burying half the village and killing eight people.

Last summer, latest measurements showed that Swiss glaciers had lost more than half their volume in the last 100 years.

On Tuesday evening, Brienz's residents, some already with their cars packed outside, gathered for one last update from the authorities.

That innocent sounding "island" is moving even faster, and geologists now say its two million cubic metres of rock is **expected to fall in the next seven to 24 days**.

How exactly all that rock will fall is not yet clear. It could come down fairly gradually, avoiding most of the village. Or it could come down fast, destroying Brienz entirely.

The consensus among the villagers is that they hope and expect to come back to their homes. The problem is, they don't know if they will still be standing.

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https://www.theguardian.com/world/2023/may/10/brienz-village-switzerland-evacuated-over-alpine-rockslide-fears

Massive Swiss rockfall stops short of evacuated village of Brienz

By Imogen Foulkes, BBC News, Bern
16 June 2023

Millions of cubic metres of rock have thundered on to a tiny Swiss village, with huge boulders

blocking roads - some landing within inches of houses.

The entire village of Brienz, population 70, was evacuated in mid-May, when geologists warned a massive rockfall was imminent.

The rockface immediately above the village, nicknamed "the island", had been unstable for decades. But this spring, the rock slippage began to accelerate.

The overnight rockfall just missed the village, coming to a halt close to the local school (IMAGE SOURCE,MICHAEL BUHOLZER /EPA-EFE/REX/SHUTTERSTOCK)

Many Brienzers had expected they would to leave their homes temporarily, but were unhappy the evacuation order had come so suddenly. Days before the order came, they had been told to expect to move some time in late summer.

Instead, they were summoned to an emergency village meeting on 9 May and told they had 48 hours to leave.

In the weeks since, some voiced frustration that the predicted massive rockfall had not happened. They asked why they could not go home when the rocks seemed to be trickling down slowly and harmlessly.

On Thursday night, the mountain answered back and authorities in the eastern canton of Graubünden say the village had a very lucky, narrow escape.

Two-thirds of the loose rock, estimated to measure more than two million cubic metres in total, crashed down.

To the villagers' relief, helicopters assessing the scene reported no obvious damage to houses, but there is little prospect of going home soon. There is up to a million cubic metres of loose rock still on the mountain above. Christian Gartmann, spokesman for the village authorities, told Swiss TV that large boulders crashing into one another as they fell could create rock splinters that hurtled "like cannonballs", smashing windows and causing serious injuries.

The masses just missed the village but left behind a meter-high deposit on the main road near the school building. (IMAGE SOURCE,MICHAEL BUHOLZER /EPA-EFE/REX/SHUTTERSTOCK)

The aftermath of the 15/16 June 2023 landslide, as captured by a high resolution Planet SkySat instrument. (Image copyright Planet)

Some wonder whether Brienz's situation is due to climate change. Switzerland's Alpine regions are especially sensitive to global warming.

As the glaciers shrink, and the permafrost high in the mountains begins to thaw, the rock becomes unstable.

In fact, the mountain above Brienz has no permafrost, but this spring's unusually heavy rain, also linked to global warming, was certainly a factor in the evacuation order. The mountainside, sodden with water, began to slip faster towards the valley.

Geologists warn that mountain areas can expect more rockslides as the climate changes. For now, the wait to go home continues for the population of Brienz.

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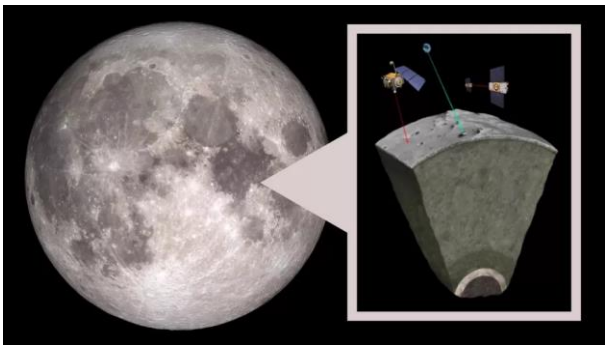
The moon's heart of iron revealed for the 1st time

By Robert Lea
9 May 2023

The findings uncover details of the internal structure of the moon that were previously hidden.



A diagram showing a cross-section of the moon at the approximate region where the Apollo 11 mission touched down on the lunar surface. (Image credit: NASA/Géoazur/Nicolas Starter/Robert Lea)

Around 20 years ago, scientists were able to use the rotation of the moon to determine it had a fluid outer core, but the relatively small size of the inner core made it harder to investigate.

Now, new research has revealed the heart of the moon as never seen before, demonstrating that it has a solid core that is composed of iron like Earth. The findings uncover details of the internal structure of the moon that were previously hidden and could explain why iron-rich materials are present in the lunar crust.

The investigation of the moon's deep interior was conducted by scientists from the CNRS, Université Côte d'Azur, the Côte d'Azur Observatory, Sorbonne Université, and the Paris Observatory-PSL and follows in the footsteps of the Apollo 11 mission, which half a century ago paved the way for geological surveys of the moon.

The formation and evolution of Earth's natural satellite is still something of a puzzle to scientists, and debates still surround the nature of its deeper layers — debates that this study could settle.

Using data from several space missions and from a process called laser ranging which precisely measures the distance between Earth's surface and that of the moon, the team behind this research found that the moon's outer core exists over a solid inner core. This inner core appears to be composed of metal with a density resembling that of iron and is around 310 miles (500 kilometers) wide, making it around 15% the size of the moon.

In addition to this discovery, the researchers also found evidence that supports the idea that material in a layer between the moon's core and its crust called the mantle moved around as the moon has evolved since its formation.

The process, which is called lunar mantle overturn, could explain why iron-rich elements are found at the surface of the moon, as the mantle material would be carried upwards as volcanic rock left in the lunar crust. The materials in this rock that were too dense would then sink back through the lighter crust material to the core-mantle boundary.

The findings may eventually help solve another mystery surrounding the evolution of the moon, namely what caused the moon's magnetic field, once 100 times stronger than that of Earth's today, to almost completely dissipate.

"Our results question the evolution of the moon's magnetic field thanks to its demonstration of the existence of the inner core and support a global mantle overturn scenario that brings substantial insights on the timeline of the lunar bombardment in the first billion years of the solar system," the team writes in a paper published on May 3 in the journal ***Nature***.

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How did Earth's continents form? Leading theory may be in doubt

New research ultimately poses more questions than it answers.

By Robert Lea, SPACE.com
4 May 2023

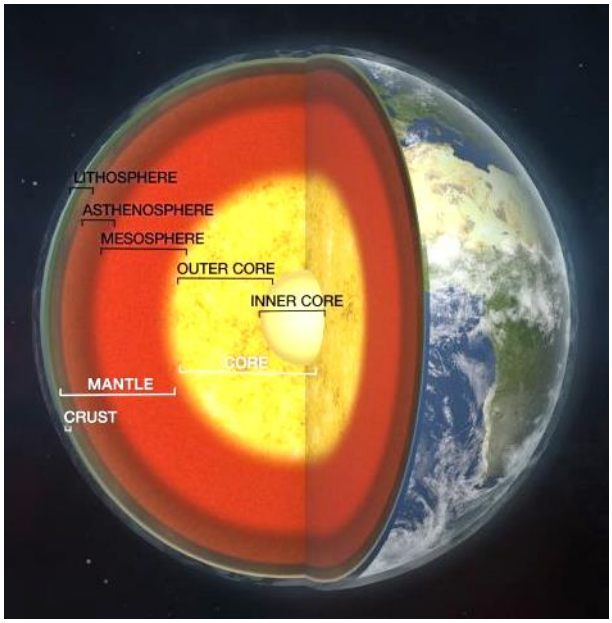
Scientists have eliminated one possible origin for Earth's continents.

Despite the importance of Earth's continents, the huge pieces of the planet's crust that divide its oceans, very little is known about what gave rise to these large landmasses that make our planet unique in the solar system and play a key role in allowing it to host life.

For years, scientists have theorized that the crystallization of garnet in magma beneath volcanoes was responsible for removing iron from Earth's crust, allowing the crust to remain buoyant in the planet's seas. Now, new research is challenging that theory, forcing geologists and planetary scientists to rethink how this iron may have been removed from the material that would go on to form the continents we see today on Earth.

The crust of Earth, the planet's outer shell, is divided into two rough categories: the older, thicker continental crust; and the younger, denser oceanic crust. New continental crust forms when its building blocks are passed to Earth's surface from continental arc volcanoes. These are found in parts of the globe where oceanic plates sink beneath continental plates, regions called subduction zones.

The El Tatio Geyser in Chile's Atacama desert. (Image credit: Tatsiana Volskaya/Getty Images)



A cross section of Earth showing the various layers that make up the planet. (Image credit: Science Photo Library/Getty Images)

The distinction between dry continental crusts and oceanic deep-sea crusts is the **lack of iron** in the continental crust. This means continental

crusts are buoyant and rise above sea level to form the dry land masses that make terrestrial life possible.

The low levels of iron found in continental crust has been hypothesized to be the result of the crystallization of garnet in the magmas beneath these continental arc volcanoes. This process removes non-oxidized iron from the terrestrial plates, while also depleting iron from molten magma thus leaving it more oxidized as it forms continental crust.

A team of researchers led by Cornell University assistant Professor Meghan Holycross and Smithsonian National Museum of Natural History geologist Elizabeth Cottrell improved the understanding of the continents by setting about testing and eventually eliminating this hypothesis first formulated in 2018.

"You need high pressures to make garnet stable, and you find this low-iron magma at places where the crust isn't that thick and so the pressure isn't super high," Cottrell said in a release, adding that the team was skeptical of the crystallization of garnet as an explanation for the buoyancy of continental crust.

Creating the intense conditions of Earth's interior in the lab

To test the garnet theory, the team recreated the massive pressure and heat found below continental arc volcanoes using piston-cylinder presses located at the Smithsonian Museum's High-Pressure Laboratory and at Cornell University. These mini-fridge-sized pistons composed of steel and tungsten carbide can induce massive pressures on tiny rock samples while they are simultaneously heated by a surrounding cylindrical furnace.

The pressures induced were equivalent to 15,000 to 30,000 times that created by Earth's atmosphere and temperatures generated were between around 950 to 1,230 degrees Celsius, hot enough to melt rock.

In a series of 13 different lab tests performed by the team, Cottrell and Holycross grew samples of garnet from molten rock under pressures and temperatures mimicking conditions inside magma chambers deep in Earth's crust.

These lab-grown garnets were analyzed using X-ray absorption spectroscopy which can reveal the composition of objects based on how they absorb X-rays. The results were compared to garnets with known concentrations of oxidized and unoxidized iron.

This revealed that the garnets grown from rocks in conditions resembling the interior of Earth didn't take up enough unoxidized iron to explain the levels of iron depletion and oxidation seen in the magmas that form continental crust.

"These results make the garnet crystallization model an extremely unlikely explanation for why magmas from continental arc volcanoes are oxidized and iron-depleted," Cottrell said. "It's more likely that conditions in Earth's mantle below continental crust are setting these oxidized conditions."

The geologist added that what the team's results can't currently do is provide an alternative hypothesis to explain the creation of continental crust, meaning the findings ultimately pose more questions than they answer.

"What is doing the oxidizing or iron depleting?" Cottrell asked. "If it's not garnet crystallization in the crust and it's something about how the magmas arrive from the mantle, then what is happening in the mantle? How did their compositions get modified?"

These questions are difficult to answer, but Cottrell is currently mentoring researchers at the Smithsonian that are investigating the idea that oxidized sulfur is causing the oxidation of iron beneath the Earth's surface.

The team's research was published Thursday (May 4) in the journal ***Science.***

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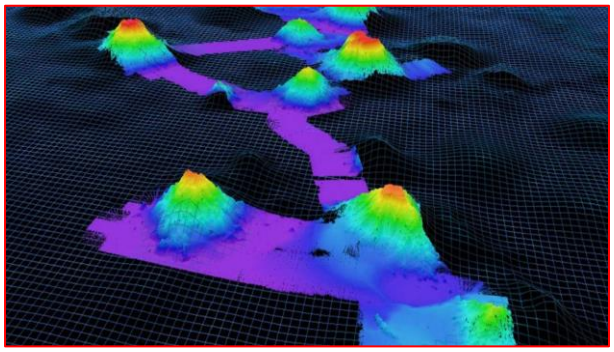
More than 19,000 volcanoes discovered at the bottom of the Ocean

Geologyin.com
3 May 2023

Over 19,000 new underwater volcanoes have been discovered across the ocean floor by scientists.

New seamount maps could aid in studies of ecology, plate tectonics, and ocean mixing. Less than one-quarter of Earth's entire ocean floor has been mapped, leaving gaping holes in our understanding of the underwater realm.

A team of oceanographers at the Scripps Institution of Oceanography, working with a colleague from Chungnam National University and another from the University of Hawaii, has mapped **19,000 previously unknown undersea volcanoes** in the world's oceans using radar satellite data. In their paper published in the journal ***Earth and Space Science***, the group describes how they used radar satellite data to measure seawater mounding to find and map undersea volcanoes and explains why it is important that it be done.



A chain of undersea volcanoes, also known as seamounts. (Photo: NOAA Ocean Exploration)

The ocean floor, like dry land masses, features a wide variety of terrain. And as with dry land, features that truly stand out are mountains—in the ocean they are called **seamounts**. And as on land, they can be created by tectonic plates pushing against one another, or by volcanos erupting. Currently, just one-fourth of the sea floor has been mapped, which means that no one knows how many seamounts exist, or where they might be.

This can be a problem for submarines—twice U.S. submarines have collided with seamounts, putting such vehicles and their crew at risk. But not knowing where the seamounts are located presents another problem. It prevents oceanographers from creating models depicting the flow of oceanwater around the world.

In this new effort, the research team set themselves the task of discovering and mapping as many seamounts as possible, and to do it, they used data from radar satellites. Such satellites cannot actually see the seamounts, of course, instead they measure the altitude of the sea surface, which changes due to changes in gravitational pull related to seafloor topography; an effect known as ***sea mounding***. In so doing, they found 19,000 previously unknown seamounts.

In their paper, the team notes that other important reasons for mapping the ocean floor include things like assisting with sea-floor mining efforts—seamounts harbor vast amounts of rare-earth minerals. More complete seamount maps would also help geologists better map the planet's tectonic plates and geomagnetic field. Also, some seamounts provide a habitant for a vast array of marine life.

But most importantly, they have a very strong impact on deep-sea ocean flow. As currents run into seamounts, they are pushed upward, carrying colder water with them, and mix in unknown ways. Mapping such currents has become more important as the oceans absorb more heat and carbon dioxide from the atmosphere and freshwater melt, due to ongoing climate change.

Migrating magma

“Because of the impact seamounts have on the ocean and ecosystems, they are important features to study, map, and classify,” Gevorgian wrote.

Seamounts are basaltic in composition, volcanic in origin, and formed in one of three tectonic settings: near mid-ocean ridges,

intraplate hotspots, and island arcs, the researchers also highlight in their article.

Most small seamounts form near mid-ocean ridges. The lithosphere at divergent plate boundaries is thin and fractured; this allows magma to migrate through the lithosphere and form small seamounts tens to thousands of meters high, they conclude.

Reference:

The above story is based on Materials provided by Scripps Institution of Oceanography.

https://www.geologyin.com/2023/05/more-than-19000-volcanoes-discovered-at.html

Middle Ordovician 'marine dwarf world' found in Castle Bank, Wales

by Chinese Academy of Sciences
1 May 2023

An unusually well-preserved "Marine Dwarf World" from 462 Ma ago was found at **Castle Bank, Wales** by a team led by the Nanjing Institute of Geology and Palaeontology of the Chinese Academy of Sciences (NIGPAS). The site comprises over 150 species, with many of miniaturized body size. It is one of the world's most unexpected fossil sites.

The study is published in ***Nature Ecology & Evolution*** on May 1, 2023.

Reconstruction of the Castle Bank community. (Credit: YANG Dinghua)

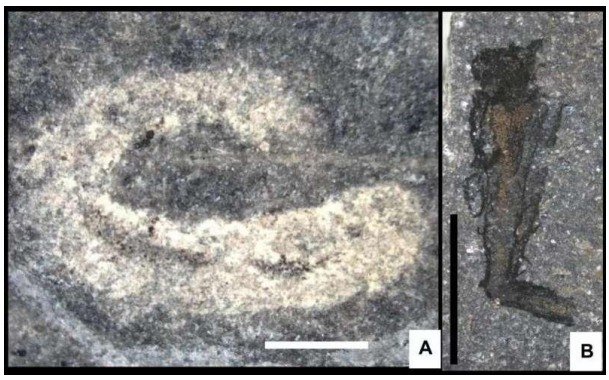
Castle Bank, in Powys, is one of the very rare sites where soft tissue and complete organisms are preserved, providing an unrivaled view of the evolution of life. Among the best of these sites are Burgess Shale-type faunas, named after the classic Burgess Shale fossil-bearing deposit in Canada.

Many of these sites occur in rocks from the Cambrian period (542–485 Ma ago), when recognizable animal fossils first appeared. However, almost none occur in post-Cambrian rocks. As a result, paleontologists know a lot about Cambrian marine life, but less about how it evolved in the periods immediately afterwards.

Castle Bank is from the middle of the succeeding Ordovician Period, some 462 Ma ago, and rivals the best of the Cambrian deposits in diversity of fossils and extraordinary levels of preservation.

The remarkable new assemblage was discovered in 2020 by Dr. Joe Botting and Dr. Lucy Muir, two authors of this study, near Llandrindod, central Wales.

So far, well over 150 species have been recovered, almost all of them new. Many of the animals are very small, at only 1–3 mm long, but they preserve minute details. They range from arthropods like crustaceans and horseshoe crabs to various types of worms, sponges, starfish, and many, many more. In some animals, internal organs such as digestive systems and even nerves are preserved, together with the limbs of tiny arthropods and delicate filter-feeding tentacles. Such exquisite detail is known from the best Cambrian faunas, but not previously from the Ordovician.



(A) probable priapulid (NIGP175887); (B) tubicolous problematic organism (NIGP175892). (Credit: NIGPAS)

The Castle Bank fauna represents a community of diverse marine organisms from the Middle Ordovician, and many of the shelly fossils were normal for these rocks.

In addition, the range of fossils also includes several unusual discoveries, from unexpectedly late examples of Cambrian animals looking like opabiniids (weird proto-arthropods with a long proboscis) and wiwaxiids (slug-like mollusks armored with scales), to tantalizing, unexpectedly early fossils that resemble modern goose barnacles, cephalocarid shrimps (which have no fossil record at all) and possibly even a marine relative of insects.

The Cambrian witnessed the origin of the major animal groups. The Ordovician was a critical time in the history of life as well, with an extraordinary diversification of animals that produced hard skeletons and abundant fossils. In addition, more familiar ecosystems like today's coral reefs appeared by the end of the Ordovician. Until now, however, a big "gap" has existed between these two evolutionary events.

A new Burgess Shale-type fauna from the middle of this interval will help close this gap by answering questions about the animal shift from Cambrian fauna to Palaeozoic fauna and about the shift in ecosystems from the Cambrian style (which were similar across much of the world) to the much more diversified ecology we see today.

A few papers describing sponges and one on a primitive relative of modern arthropods called *Mieridduryn* have been published based on this fauna. Many more papers will follow and collections are ongoing. According to Dr. Muir, "Most fossil deposits of this importance are studied for many decades, and this is likely to be no different."

Joseph Botting and two collaborators from NIGPAS (Y. D. Zhang, and J. Y. Ma) have been collaborating on the Konservat-Lagerstätte of Ordovician, and parts of this work, including the observation and analysis of some specimen and reconstruction, are completed in NIGPAS under the support of CAS.

The Castle Bank fauna has important implications for the evolution of sponges, especially *Hexactinellida*, and is considered as transitional interval between sponges of Cambrian and those of Anji fauna, another Burgess-Shale type fauna from Zhejiang, China, which the researchers have been devoting themselves to for years.

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T. rex sells for more than $6m at auction in Switzerland

BBC News
20 April 2023

Forget classic paintings, rare gemstones, or big fancy pieces of jewellery - dinosaur skeletons look like the new auction must-have.

A giant ***Tyrannosaurus rex***, that went on sale at an auction in Switzerland on Tuesday, has sold for a massive **$6.2m** (£5m).

The skeleton is nicknamed Trinity because it's made from three different dino skeletons. (IMAGE SOURCE: KOLLER)

The prehistoric carnivore named TRX-293 Trinity was dug up by archaeologists in America, across three different sites.

It's the first time a T. rex has ever been auctioned in Europe.

Why is the auctioned T. rex skeleton so special?

The auction house, Koller, said the skull in particular was incredibly well preserved, and a rare find.

In the auction catalogue that listed the T. rex, scientific advisor Nils Knoetschke said: "When dinosaurs died in the Jurassic or Cretaceous periods, they often lost their heads during deposition (of the remains into rocks.) In fact, most dinosaurs are found without their skulls. But here we have truly original Tyrannosaurus skull bones that all originate from the same specimen."

The bones were found in Hell Creek and Lance Creek, which are rock formations in Montana and Wyoming in the US, between 2008 and 2013.

Who bought the auctioned T. rex skeleton?

We don't know who snapped up the ancient beast. The auction house said the dinosaur was bought by a private individual and will remain in Europe. Adding they hope it will go on public display, but it is not clear at this stage what the new owner's plans are.

The skull is in very good condition, which is most unusual. (IMAGE SOURCE,MICHAEL BUHOLZER / EPA)

What is the most a dinosaur has sold for at auction?

Despite fetching more than $6m, Trinity is not the priciest dino to go under the hammer. A triceratops skeleton, known as **Big John**, (because it held the Guinness World Record for being the biggest) was sold for **6.6 million euros** ($7.2 million) to a private collector at a Paris auction.

Reference:

https://www.bbc.co.uk/newsround/65316113

T. rex fact file

- ***Tyrannosaurus rex* means 'king of the tyrant lizards'.**
- **They were HUGE - around 12m long and 6m tall.**
- **Scientists believe their distinctive tiny arms may have been virtually useless.**
- **The first T. rex skeleton was found in Montana, US, in 1905.**

TV Preview

Natural History Museum: World of Wonder - Series 2

NHM Press Release
10 May 2023

The Natural History Museum is set to be the star of a second series of ***Channel 5's*** **Natural History Museum: World of Wonder.**

This 60-minute series will air weekly from Wednesday 10 May at 8pm on **Channel 5** and will be available to stream and download via **My5.**

Narrated by acclaimed actor Bill Nighy, this returning series builds on the success of the first series and takes an unmissable look at one of the greatest and most popular museums in the world – **the Natural History Museum, London.** The series is produced by award-winning production company, The Garden.

We meet the teams keeping the museum up and running and the scientists working behind the scenes uncovering incredible discoveries about our natural world; from billion-year-old meteorites and dinosaur fossils to the wildlife in the Museum's own garden. They are on a mission to learn more about the natural world and protect it for future generations.

Ground-breaking science

Ashley King, Future Leader Fellow, UKRI, makes the greatest discovery of his career as he studies the ***Winchcombe Meteorite*** – the first meteorite to land and be recovered in the UK in 30 years – as he hopes to answer if meteorites hold the key to all life on Earth.

Dr. Erica McAlister, Senior Curator, heads to the beautiful Knepp Estate in Sussex in search of new insect species, and to discover if their re-wildling project is boosting the wildlife there.

Sir Patrick Vallance, the new Chairman of the Board of Trustees at the Museum pays a visit to the museum's 40,000 bat specimens. He sees how, incredibly, a strain of coronavirus has been detected in some bat specimens which are hundreds of years old showing how bats have been able to live with the virus for centuries.

In Wiltshire **Dr. Tim Ewin** explores a quarry where thousands of marine fossils have been uncovered. He unlocks the mystery of what happened 167 million years ago to wipe out so many creatures in one terrible event.

Dr. Tori Herridge, Research Fellow, and **Piotr Cuber**, Molecular Biologist, visit Kent where the Wilder Blean Project has introduced bison to the landscape to re-energise the ancient woodland there. We see how soil sampling for DNA can monitor improvements in the woodland.

Engaging Events

The series also aims to show how the museum engages the public with its science through an exciting array of events and activities.

We follow Events Producer, **Georgina Hallett**, as she manages our popular ***Dinosnores*** event for 300 children after hours!

The Special Events team pull off the awards ceremony for the world's biggest wildlife photography competition, attracting around 40,000 entrants from over 90 countries to the Wildlife Photographer of the Year.

And an after-hours Halloween themed event gives visitors in fancy dress a chance to find out more about the spookier corners of the natural world whilst also enjoying a silent disco in one of the greatest dancehalls you could imagine.

Much more

Down in the basement **Kieran Miles**, Fossil Preparator, is delicately repairing a 67-million-year-old triceratops.

Learning Facilitator, **Kathryn Whitfield**, shows surprised visitors some dinosaur poo, engaging children with objects they can touch and hold.

And it's all in a day's work for **Hattie Frakes**, Visitor Experience Manager, as she opens the museum's great doors which welcome five million visitors annually.

*Look out for **FGS Member, Ben Dixon**, in Episode 1 helping a young South London schoolgirl identify an emerald found, rather surprisingly, in her school playground.*

Reference:

https://www.nhm.ac.uk/press-office/press-releases/natural-history-museum--world-of-wonder--series-2-.html

https://www.channel5.com/show/natural-history-museum-world-of-wonder/season-2/episode-1

https://www.farnhamgeosoc.org.uk/newsletters/2019_2022/v24n4nov2021.pdf

TV Review

Forget Jurassic Park: inside the gorgeous David Attenborough series that's redefining dinosaurs

Prehistoric Planet's intimate, moving CGI footage is revolutionising natural history –

and it's presented by a national treasure. We meet the creators of a unique TV series

Stuart Heritage, The Guardian
19 May 2023

Jurassic Park was released 30 years ago, but in those three decades our perception of dinosaurs has largely remained static. In the public consciousness, they were giant, scaly beasts with huge claws and teeth who spent their days chasing down victims and ripping them apart in brutal fashion. Think dinosaur and you will probably picture a primal, primitive force of unbelievable fury.

And then along comes the new series of **Prehistoric Planet *(Apple TV+)***, which, in a single instant, undoes almost everything we thought we knew. The instant in question concerns the *Hatzegopteryx*: a vast, vicious-looking, giraffe-sized pterosaur. Had the *Hatzegopteryx* been depicted on screen at any point until now, it would undoubtedly have been to swoop down like a monster and gobble up its prey.

But **Prehistoric Planet** shows us something different. It shows us *Hatzegopteryx's* mating ritual, which may qualify as one of the most beautiful things you will ever see. A male carefully arranges various naturally occurring trinkets around himself on the spit of an island and gently starts dancing, eyes never leaving the sky, in the vain hope that a female might pass overhead and take interest. It's heartbreaking, lovelorn and gorgeous to watch. *Hatzegopteryx* – who knew?

"Nothing is primitive about dinosaurs," says Tim Walker, Prehistoric Planet's series producer, over a video call. "They weren't lone hunters or killers. They were really social, and they would have been really flamboyant because of the social mindset. Our mission, if you like, was to show the audience that these are not mindless monsters."

The **second series** marries two irresistibly compelling forces: MPC, the visual effects house that helped Jon Favreau create his photorealistic remakes of The Lion King and The Jungle Book; and BBC Studios Natural History Unit. The results of this union are astonishing. You have all the respect and scientific rigour that you would find in a traditionally shot documentary such as Planet Earth presented with thoroughly convincing CGI. After a while, you stop noticing that it's not real-life footage.

Part of this is down to the producers' approach to what they depict. Mike Gunton, a Natural History Unit mainstay and the show's executive producer, says their approach stems from the horrifying sequence in Planet Earth II where an iguana hatchling runs for its life from dozens of speeding snakes. "The reason that sequence felt so powerful was because it felt uncontrived," says Gunton. "It was very much: 'Oh my God, we didn't know that was going to happen!' We're definitely copying that feeling here. The CGI can do anything, but we've tried to make it feel as if we turned up to shoot one thing, but then: 'Oh my God! Look at this!' We've tried to shoot and edit as if it were found footage."

This approach – treat the camera as if it had been placed by a flesh-and-blood documentarian – plays out through the series. There are ***T rex*** sequences, but don't expect any extreme closeups. When we see a *T rex*, Gunton explains, it's depicted as being "pretty much shot on the longest telephoto lens in our armoury", to stop the camera operator from being eaten. "It's a subtle difference, but I think it's a critical one in terms of authenticity," he says.

A family scene from Prehistoric Planet. (Photograph: Apple TV)

Speaking of authenticity, Prehistoric Planet presents itself with the swaggering confidence of any Natural History Unit project. What we see, we are told, is how it is. That seems like a

tall order, especially when making a show set millions of years ago based on data that is constantly developing. I ask Walker how the team managed to land on what to create for the series.

“Everything starts with the fossil record,” he says. “That’s our baseline. The show is set **66 Ma ago**. So, if you look at the fossil record, what was around? Not just the big dinosaurs, but everything else that lived alongside. All animals have got to perform a suite of behaviours. They’ve all got to mate, they’ve all got to eat. All this will be dictated partly by what type of animal they are and what their environments are like. It’s a combination of the fossil record, then the experience of wildlife film-makers who have observed animals in the field. And so, you can start to bring all these different disciplines together, marry them with the CGI, and you build the plan.”

This new view of dinosaurs takes some getting used to. When I first heard of Prehistoric Planet, my reaction was to write it off as a slightly jazzier version of ***Walking With Dinosaurs***. After all, these animals are many millions of years old. What more could we have learned in the space of a couple of decades?

Going for a swim … an adult T rex with a juvenile in Prehistoric Planet. (Photograph: Apple TV+)

Quite a lot, it turns out. “We have a weekly scene meeting with our production team,” says Walker. “Our lead scientific consultant, Darren Naish, is part of that team. Each week, we have Dr. Darren’s Dino Download, in which he gives us the latest news from palaeontology world, and we have to guess how many new dinosaurs have been described. On average, each year, over the last couple of years, a new dinosaur has been described every week.”

That is a lot of new dinosaurs, I say. “Who knew that palaeontology was such a fast-moving science?” Walker replies, with a grin.

In fact, Prehistoric Planet has even helped to nudge our understanding of dinosaurs forwards a little further. “There’s a mosasaur sequence, where we show it jumping out of the water,” says Walker. “The team that we were working with didn’t fully know how the mosasaur could propel itself as fast as we show it. And so, they set about doing a bit of academic work to find out the velocity that this particular type of animal could achieve.”

Gunton adds: “They knew the mosasaur was an ambush predator. But they weren’t sure how it could generate the thrust to accelerate at such speed. They had some suspicions, so they formulated a calculation.”

“Look, here it is,” says Walker, palpably giddy as he holds up his phone and shows me a mathematical formula that takes up his entire screen. “There is extraordinary scholarship here,” says Gunton. “Every single minute, every single second, is underpinned by serious and deep scientific interpretation. That’s one of the things that we’re super-proud of. The science and the reality of how you shoot this, forces you into a position where it feels true. And we know from watching documentary, the truth of the world is always more engaging than something that we make up.”

More of the creatures brought to CGI life in Prehistoric Planet. (Photograph: Apple TV)

Realism was less important in terms of the CGI, however. The series may be consistently breathtaking, but, to sell it to viewers, Gunton

and Walker found themselves having to pare it back. “Some of the photography that we can now do in the real world, and that we’re currently doing with Planet Earth III, is insane,” says Gunton. “But if we did that in Prehistoric Planet it would look wrong.

“This is a conversation we’ve had with Jon Favreau. We’ve dialled down the photography, because otherwise it would have looked like a VFX show. The footage here feels more akin to what we were filming maybe eight years ago. It’s a really weird mind game to play.”

Another thing that helps to sell the show, of course, is the participation of **Sir David Attenborough**, who not only narrates but also presents several sequences to camera. He is such a warm and reassuringly authoritative presence that you sense the producers could have staged a CGI dinosaur dance sequence and Attenborough would be able to convince you that it was scientifically accurate. “Not bad for 96,” says Gunton of his longtime collaborator.

Attenborough’s participation was not a done deal, however. “He was very assiduous,” says Gunton. “If he was going to do this, then it had to be the last word on the matter. And it had to be all about authenticity. No fantasy. I remember the day we first showed him footage; he sat there watching on the computer, tapping his fingers. When it finished he turned to me – he’s so theatrical – and he paused. Eventually, he said: ‘I don’t know how you could have done it any better.’ He works on the scripts. He’s been a fantastic asset, of course, a fantastic supporter. But also, you still get notes. He’s 96 and he still gives notes.”

Earlier this year, there were reports that the BBC series ***Wild Isles*** would be Attenborough’s last appearance filming on location. Gunton is one of his closest professional collaborators – and perhaps his most qualified successor – so, as we wrap up, I ask if the rumours hold any truth.

“I’ve been working with him for 35 years,” Gunton says. “The first show I worked on with him was The Trials of Life, and the news then was that this would be David Attenborough’s final series.”

So that’s a no? “The only person who knows when it’s David’s last year is David. He’s in this project, and I’m working with him on at least two other projects in which he is a significant contributor.” Could one of them be Planet Earth III? “Could be,” says Gunton, grinning. “He’s still working and he’s still amazing.”

Reference:

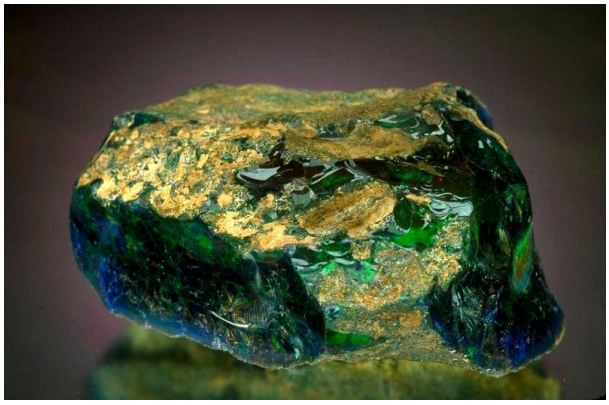
Prehistoric Planet Season 2 is on Apple TV+ from 22 May 2023.

https://www.theguardian.com/tv-and-radio/2023/may/19/forget-jurassic-park-inside-the-gorgeous-david-attenborough-series-thats-redefining-dinosaurs

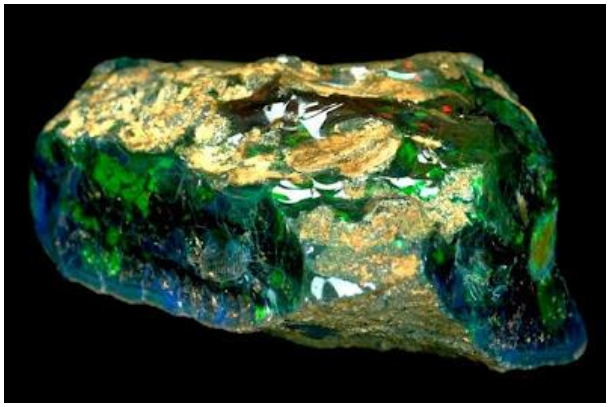
Mineral Corner

Rare huge green-blue Opal found in Nevada

The **Roebling Opal** is an extraordinary 2,585-carat piece of opal rough and is also the largest unpolished black Opal.



Rare Huge Green-blue Opal Found in Nevada. (Image credit: Chip Clark)



Green-blue Opal. (Image credit: Chip Clark)

It came out of the tunnelled portion of the **Rainbow Ridge Mine** in 1917 from **Virgin Valley, Nevada**. The opal was deposited from silica-rich water in voids that remained after buried tree limbs had rotted away, in some cases resulting in opal casts of the original tree parts.

Although extremely beautiful, opal from this locality is not commonly used in jewellery because it tends to craize, or crack. Opals with a vivid play-of-colour and a black or other dark body colour are called black opals. The Roebling Opal is a black opal with flashes of blue and green play-of-colour.

The Roebling Opal was donated by John A. Roebling in 1926 and now rests with the **Smithsonian National Museum of Natural History** in Washington DC.

Reference:

https://www.geologyin.com/2017/06/rare-huge-green-blue-opal-found-in.html?fbclid=IwAR1JoOBFiVLbqVO15F697-CJEOjPPRafh4znPk1IbkgEnTYDsVbIql41wVs

Carat: a unit of mass equal to 200 mg or 0.0071 ounces, which is used for measuring gemstones and pearls.

Interesting Photographs 2

The Strait of Gibraltar

NASA Earth Observatory
April 14, 2023

An astronaut aboard the **International Space Station** captured this photograph of the **Strait of Gibraltar**, a natural water channel connecting the Atlantic Ocean and the Mediterranean Sea. At the strait's narrowest point, Spain is only 13 km from the coast of Morocco.

The photograph was taken while the space station orbited over the Atlantic Ocean. At the time, the station's position was about 900 km

from the geographic centre of the image as measured on Earth's surface. Photos taken at oblique angles—as opposed to looking straight down—can highlight the three-dimensionality of Earth's topography.

Mountainous terrain borders the coastline of the Alboran Sea, a sub-basin of the Mediterranean, creating a long arc of mountains stretching across both continents. This region, known as the Gibraltar Arc System, was formed by complex tectonic activity that began millions of years ago. The Arc System includes the Baetic range in southwestern Spain and the Rif range in northern Morocco.

An analysis of global datasets suggests that nearly 6 Ma ago, the uplift of the Gibraltar Arc System, in combination with changes in weather patterns around the Mediterranean, caused the area now occupied by the Mediterranean Sea to become disconnected from the Atlantic Ocean. Water that had become isolated from the ocean completely dried up and left behind an enormous, hot basin, approx. 1,500m deep. Another study suggests that about 300,000 years later, precipitation increased, and water from the Atlantic Ocean began to flow into the basin, flooding it and producing the sea that exists today. This flood event is calculated to have been three orders of magnitude larger than the yearly water discharge of the Amazon River.

Dense forests paint the tops of the ranges dark green. Lower-lying areas are lighter in colour, mostly due to agricultural and urban developments. The ancient port cities of Cádiz, Ceuta, Tangier, and Gibraltar display light grey and pink tones from buildings with terracotta roof tiles. Today, the Strait of Gibraltar provides passage for approximately 300 ships every day, including fishing boats, ferries, cargo ships, and yachts.

Astronaut photograph ISS069-E-3412 was acquired on April 14, 2023, with a Nikon D5 digital camera using a focal length of 180mm. It is provided by the ISS Crew Earth Observations Facility and the Earth Science and Remote Sensing Unit, Johnson Space Center. The image was taken by members of the Expedition 69 crew.

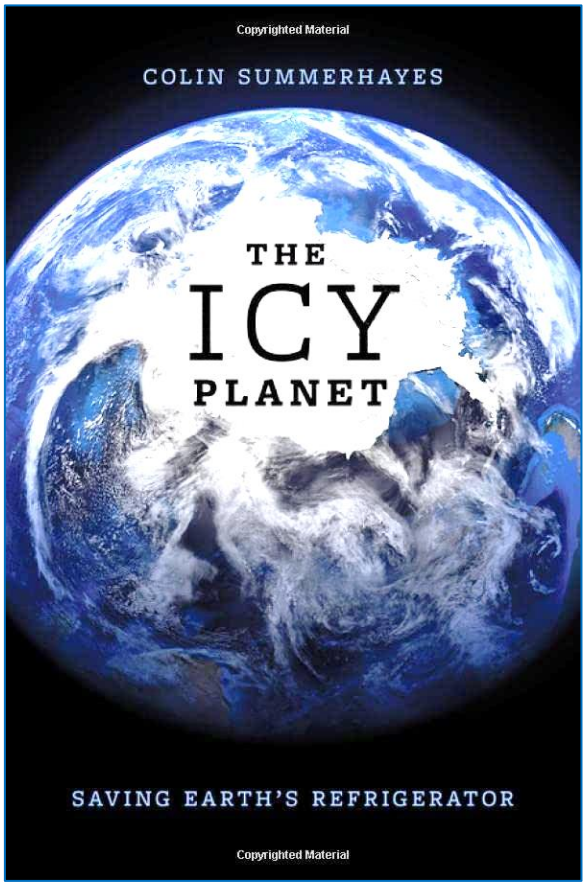
Caption by Sara Schmidt, GeoControl Systems, JETS Contract at NASA-JSC and Justin Wilkinson, Texas State University, JETS Contract at NASA-JSC.

Reference:

https://earthobservatory.nasa.gov/images/151478/the-strait-of-gibraltar?utm_source=FBPAGE&utm_medium=NASA+Earth&utm_campaign=NASASocial&linkId=221235813&fbclid=IwAR3W5o4yZvRbL4CbbxF9RMV9fyYaVvN1zSmwjosKWbeUo80RnuifpAxWyYQ

Book Review

The Icy Planet: Saving Earth's Refrigerator



A message from Dr. Colin Summerhayes:

"My new book ***"The Icy Planet: Saving Earth's Refrigerator"*** has just been published.

I wrote this for the general public. It's structured as a tour around the world's icy places, as a way of reminding people that these are largely out of sight and out of mind, which means that most folk have no idea what is happening there. Why is this important? Well, as you will know, global warming is melting away winter's snow and ice, which means there's less of the white stuff to reflect the Sun's energy back into space. Which in turn means that this energy warms Earth more. It adds a double whammy to the well-understood effect of emissions from burning fossil fuel. But not a lot of people know that. In effect all that ice and snow act as Earth's Refrigerator, helping to keep the planet cool. Right now, it's like we have left the fridge or the freezer door open, and the things inside are gradually going off.

Ideally, we need to reverse that. And with the right political will, economic arguments, and technologies, we can do that. But we will all have to lean hard on our politicians to get that done. For most politicians the long term is the 4 years to the next election. Their focus is on keeping their seats, not saving the planet. We have to hold their feet to the fire if we are to save Earth's Refrigerator. And we have to recognize that the task will not be easy, bearing in mind hysteresis (the planet has to cool quite a bit before the ice will come back)."

"In ***The Icy Planet***, apart from offering the reader all they need to know about the world's coldest places, Colin Summerhayes addresses in well-researched and readable detail the role of ice as the bellwether of global warming. Fascinating and sometimes frightening, it examines the speed with which the frozen environment is being depleted, and the signals that sends out for the future of us all. This is a book both arresting and alarming."

Sir Michael Palin, Writer and Presenter of Travel Documentaries including *Pole-to-Pole* and *Erebus: The Story of a Ship*

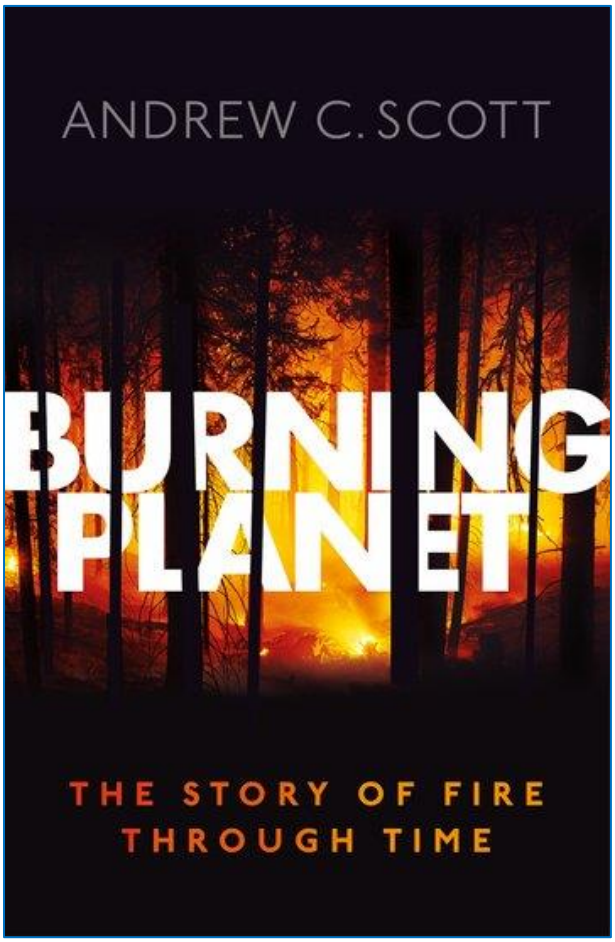
Reference:

https://global.oup.com/academic/product/the-icy-planet-9780197627983?cc=us&lang=en&#

Burning Planet: the Story Of Fire Through Time

Andrew C. Scott, 2018

- Explores the impacts of wildfires on landscapes and ecosystems, and the ways of tackling growing problems of fire associated with climate change.
- Draws on growing evidence for fire in the rock record to give an account of the role of fire over the past 400 million years of Earth history.



- Describes the remarkable information we can extract from fossil charcoal, including the finest details of ancient flowers.
- Discusses the exciting evidence from archaeological sites across the world for prehistoric and early human use of fire.

"This is an excellent and interesting book. Aimed at lay readers, it hits the target spot-on while including some fascinating scientific insights. The pictures are very good, the

explanations add even more to them - Scott is a good communicator. This book is recommended for all. It should be bought not just read, as readers will want to return to it to confirm items and learn more."

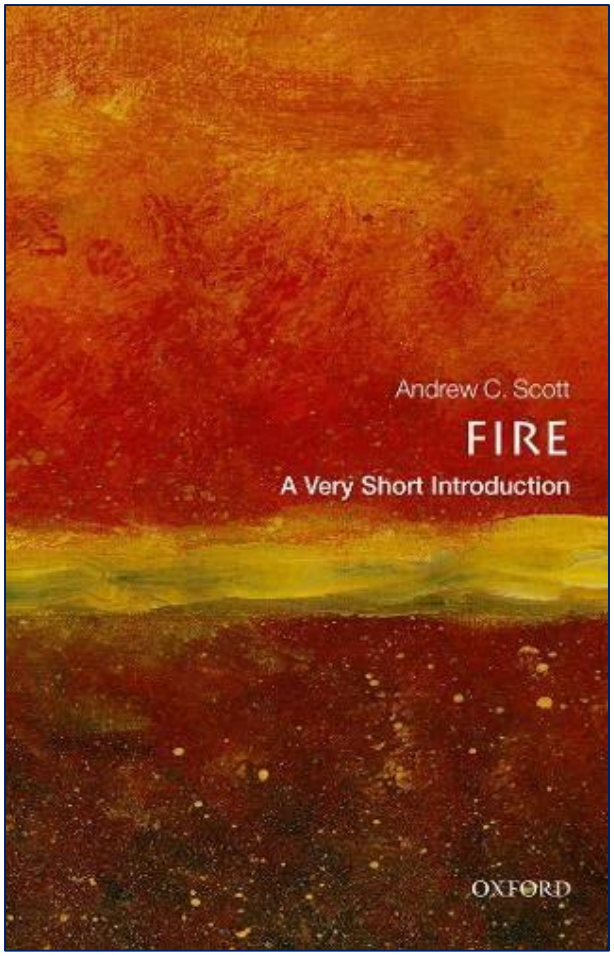
Jeremy Joseph, The Geological Society

OUP ISBN 978-0-19-873484-0

Fire: A Very Short Introduction

Andrew C. Scott, 2020

Fire is rarely out of the headlines, from large natural wildfires raging across the Australian or



Californian countryside's to the burning of buildings such as the disasters of Grenfell tower and Notre Dame. Fire on these scales can represent a serious risk to human life and property. But the advent of fire made and controlled by humans also represented a crucial point in our evolution, allowing us to cook our food, forge our weapons, and warm our homes.

This **Very Short Introduction** covers the fundamentals of fire, whether wild or under human control, starting with the basics of ignition, combustion, and fuel. Andrew Scott considers both natural wildfires and the role of humans in making and suppressing fire. Despite frightening reports of wildfire destruction, he also shows how landscape fires have been part of our planet's history for 400 million years, and do not always have to be extinguished. He also considers the problem of fires in urban settings, including new ways to prevent fires. The cost of wildfire can be steep - as well as the burning, post-fire erosion and flooding can have a great impact on both humans and the environment. It can also have a lasting effect in shaping ecosystems and plant life. Scott ends by examining the relationship between fire and the climate and considering the future of wildfire in a warming world.

Fire: A Very Short Introduction has had a short review in **Nature**, which describes it as a "Thoughtful, global introduction."

OUP. ISBN 0 198830033

(Credit: The Etches Collection)

Further Reading

1. **Massive mineral deposit discovery could meet global battery and solar panel demand 'for next 100 years'**

   https://www.independent.co.uk/tech/norway-phosphate-mineral-solar-panels-battery-b2369512.html?fbclid=IwAR2XMpoKeUGdML1llq-bYRHSYxrtscJ1YaBzTVpDSz3B7KGuuwKXvu5pTmc

2. **Humans' ancestors survived the asteroid impact that killed the dinosaurs, shows fossil record analysis**

   https://phys.org/news/2023-06-humans-ancestors-survived-asteroid-impact.html?fbclid=IwAR1mx9WARlCz3PA-ZUZLb4j1g8jzAlFlws5kdu5N8CDkJricoSbY_n5_h2Y

3. **Never-before-seen 'missing link' dinosaur walks, drinks and socializes in stunning new animation**

   https://www.livescience.com/animals/dinosaurs/never-before-seen-missing-link-dinosaur-walks-drinks-and-socializes-in-stunning-new-animation?fbclid=IwAR13yJm_zHkS41E2lizPPQQZpzylbrUfll_uBHovdsJ2o5p_tBL5iPMNrWw

4. **How volcano magma could help meet green economy's demand for metal**

   https://www.theguardian.com/science/2023/jun/28/how-volcano-magma-could-help-meet-green-economy-demand-for-metal

   https://geoscientist.online/sections/features/mining-the-brine/

5. **Intriguing correlation between Earthquakes and Cosmic Radiation**

   https://spaceref.com/earth/intriguing-correlation-between-earthquakes-and-cosmic-radiation/

6. **The search for Earth's hidden mountains**

   https://www.bbc.com/future/article/20230605-the-hidden-mountains-lurking-deep-within-our-planet?xtor=ES-213-[BBC%20Features%20Newsletter]-2023June17-[bbcfeatures_mountainsinsideearth_future]

7. **A day on Earth stalled at 19 hours for a Billion years, say scientists**

   https://www.forbes.com/sites/jamiecartereurope/2023/06/15/a-day-on-earth-stalled-at-19-hours-for-a-billion-years-say-scientists/?sh=5ea1f6678c2a

8. **It Is easier than ever to view Mars landscapes in High Resolution**

   https://spaceref.com/science-and-exploration/it-is-easier-than-ever-to-view-mars-landscapes-in-high-resolution/

9. **Meteorites and volcanoes may have helped jump-start life on Earth**

   https://www.space.com/meteorites-volcanoes-origin-life-on-earth?utm_term=8DEBC9E5-6C7F-4337-AFFF-D9A51CC6C2C0&utm_campaign=58E4DE65-C57F-4CD3-9A5A-609994E2C5A9&utm_medium=email&utm_content=9020FF16-BA1D-4CFD-918D-253897F79EB7&utm_source=SmartBrief

10. **Land below sea: A new generation of seabed geology mapping**

    https://geoscientist.online/sections/features/land-below-sea-a-new-generation-of-seabed-geology-mapping/

11. **Can 'enhanced rock weathering' help combat climate change?**

    https://www.bbc.com/news/science-environment-65648361

12. **Rock that punched hole in New Jersey house confirmed to be 4.6 billion-year-old meteorite**

    https://www.space.com/meteorite-strike-new-jersey-house-

confirmed?utm_term=8DEBC9E5-6C7F-4337-AFFF-D9A51CC6C2C0&utm_campaign=58E4DE65-C57F-4CD3-9A5A-609994E2C5A9&utm_medium=email&utm_content=45868827-476B-43D2-9F91-C19AAC211670&utm_source=SmartBrief

13. **Oil & gas reinforces Australia's budget surplus while throwing support behind net-zero agenda**

    https://www.offshore-energy.biz/oil-gas-reinforces-australias-budget-surplus-while-throwing-support-behind-net-zero-agenda/?utm_source=offshoreenergytoday&utm_medium=email&utm_campaign=newsletter_2023-05-12

14. **Largest earthquake for 10 years shakes Donegal**

    https://www.bbc.com/news/articles/ce7g37w270no?xtor=AL-72-%5Bpartner%5D-%5Bbbc.news.twitter%5D-%5Bheadline%5D-%5Bnews%5D-%5Bbizdev%5D-%5Bisapi%5D&at_link_type=web_link&at_link_id=163A3EE0-ECC3-11ED-8C83-00FDD772BE90&at_campaign_type=owned&at_link_origin=BBCWorld&at_campaign=Social_Flow&at_bbc_team=editorial&at_medium=social&at_ptr_name=twitter&at_format=link

15. **UK turns to renewables and low-carbon power to bolster energy security**

    https://www.offshore-energy.biz/uk-turns-to-renewables-and-low-carbon-power-to-bolster-energy-security/?utm_source=offshoreenergytoday&utm_medium=email&utm_campaign=newsletter_2023-04-05

16. **Active volcano spotted on Venus**

    https://www.space.com/venus-active-volcano-nasa-magellan-mission?utm_term=8DEBC9E5-6C7F-4337-AFFF-D9A51CC6C2C0&utm_campaign=58E4DE65-C57F-4CD3-9A5A-609994E2C5A9&utm_medium=email&utm_content=32B31DE1-1DC1-4C79-B26C-5E831E0DE9A2&utm_source=SmartBrief

17. **A Comprehensive Map Of The Volcanoes On Venus**

    https://spaceref.com/science-and-exploration/a-comprehensive-map-of-the-volcanoes-on-venus-all-85000-of-them/

18. **Most Detailed Geological Model Reveals Earth's Past 100 Million Years**

    https://spaceref.com/earth/most-detailed-geological-model-reveals-earths-past-100-million-years/

19. **The Earth's Rotational Pole is shifting because of groundwater withdrawal**

    https://www.geologyin.com/2023/06/the-earths-rotational-pole-is-shifting.html?fbclid=IwAR1Sok-HE8oXUKwI0CTA_IoaVVTKgBYImTZRDIsW8tDuMteHcm3Jcm-iY4A

20. **Maps of the Atlantic Ocean floor**

    https://www.geologyin.com/2014/08/atlantic-ocean-floor.html?fbclid=IwAR1Sok-HE8oXUKwI0CTA_IoaVVTKgBYImTZRDIsW8tDuMteHcm3Jcm-iY4A

21. **A new giant theropod dinosaur track from the Middle Jurassic of the Cleveland Basin, Yorkshire, UK**

    https://www.lyellcollection.org/doi/10.1144/pygs2022-008?fbclid=IwAR3TZYG95EJwJqUjP4yD1EaSyTU74v0YL8QEfMUTAGjsFp6p6fAZmEqe2zw

22. **Oldest Pterodactylus fossil found in Germany**

    https://phys.org/news/2022-11-oldest-pterodactylus-fossil-germany.html?fbclid=IwAR21fIQMagMFOevvVKFIa6C5AyHrrHeNe064YTeFA3GBNt4zPWVQ2wOEmcs

23. **Miners unearth pink diamond believed to be largest seen in 300 years**

    https://phys.org/news/2022-07-miners-unearth-pink-diamond-believed.html?fbclid=IwAR3p-IKLVGTGj4nN_X96huB03NV21Uc0QS0mySGj-CKITBD1v2TYnpQE74k

---------- ADVERT ----------

An invitation to attend the 2nd Biennial

WEALDEN GEOLOGICAL ASSEMBLY

Saturday 11 November 2023
Kings Church, Brooks Road, Lewes, BN7 2BY

Programme **Conference Organiser: anthony.brook27@btinternet.com**

9.00	**Doors open and Registration**
10.10	**Welcome and Announcements**
10.15-11.00	David Nash (University of Brighton) ***'The Sarsen Stones of Stonehenge: Where from?'***
11.00-11.30	**Coffee and Biscuits**
	Coastal Phenomena
11.30-12.15	Dan Bosence (Royal Holloway, University of London) ***'Bumps in the Bay: Geology of Offshore Dorset'***
12.15-1.00	Richard Hubbard (Kent Geological Group) ***'The Shifting Shorelines of the Thanet Anticline'***
1.00-2.00	**Lunch**
	Earth Movements
2.00-2.45	Richard Edmonds ***'The Great Bindon Landslip of 1839'***
2.45-3.30	Laura Evenstar (University of Brighton) ***'Why are the Andes so High?'***
3.30-4.00	**Tea and Biscuits**
4.00-4.45	Chris Duffin (Natural History Museum) ***'Tyrannosaurus Rex: Top Predator of the Late Cretaceous'***
4.45-5.30	Thomas Hose (University of Bristol) ***'Importance of Conserving the Wealden R.I.G.S.'***

Registration Form **Date: ……..**

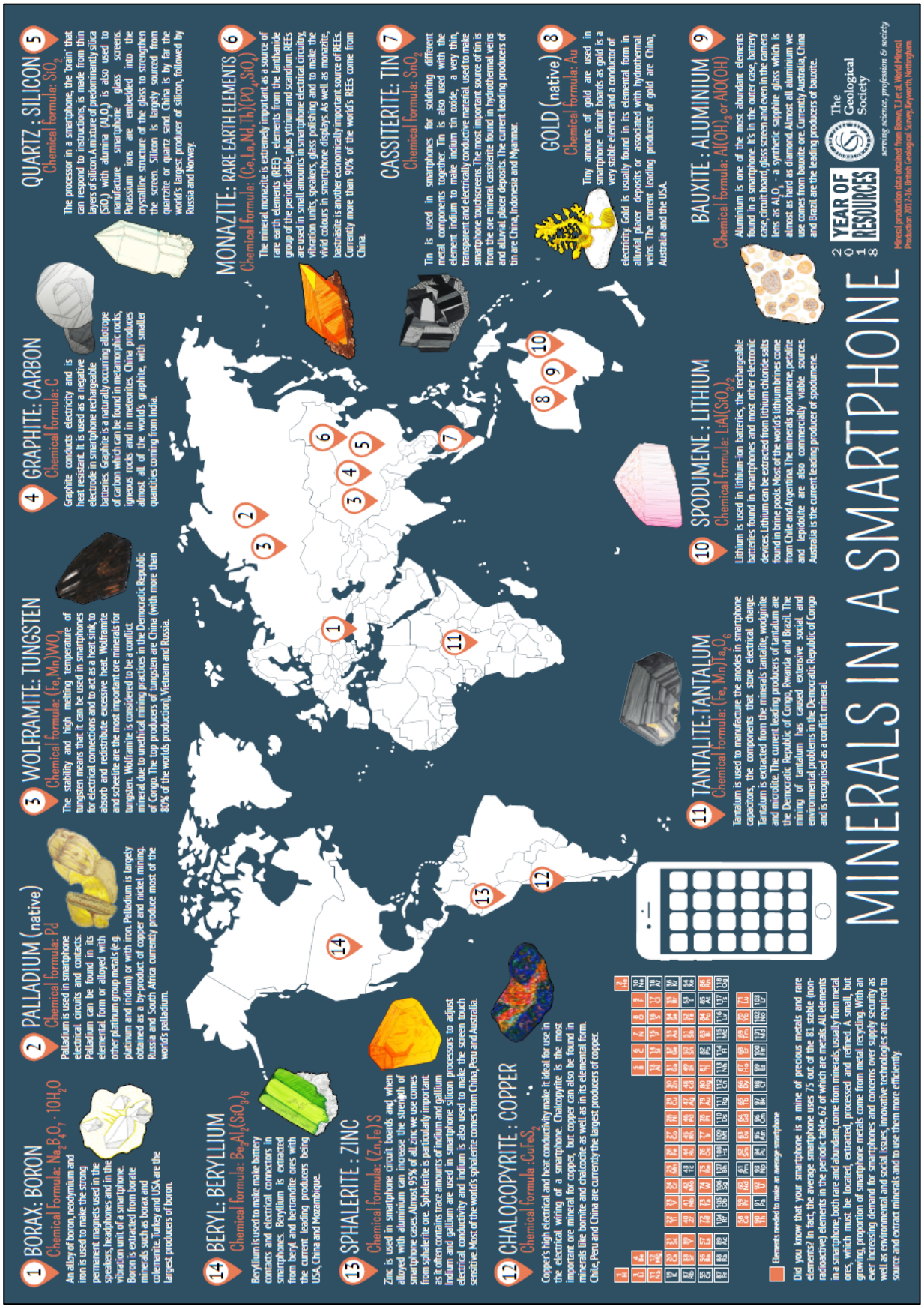
Name: **……**

Address: **……**

…… **Tel: ……**

email: **……**

- **The Conference Fee is £30 per person, including coffee/tea, packed lunch & Conference publication.**
- **Please make your cheque payable to Anthony Brook and forward, with this Registration Form, to Anthony Brook, 15 Cambourne Court, Shelley Road, Worthing, West Sussex, BN11 4BQ.**
- **Conference Fee for Full-time Students is only £25!**



Reference:

https://www.geolsoc.org.uk/~/media/shared/documents/education%20and%20careers/Resources/Posters/Minerals%20in%20a%20smartphone%20poster.pdf?la=en

We need your help in running our Society.

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Please contact a COMMITTEE MEMBER if you are interested in helping YOUR society.