Newsletter of
The Farnham Geological Society

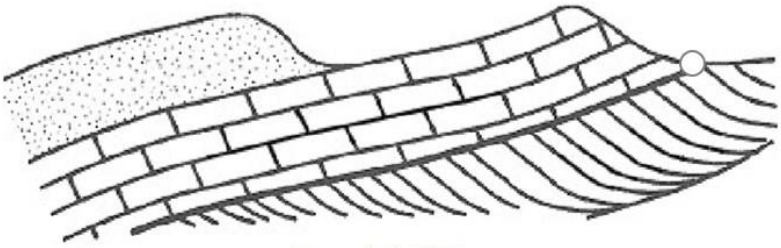
Volume 27, Number 2, May 2024

Volcanic deposits in the caldera walls below the town of Oia on the island of Santorini in Greece

Photo by Sally Pritchard

Farnham Geological Society

Farnhamia farnhamensis



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Editorial

Welcome to the latest FGS Newsletter. This month's edition includes, as always, articles that I hope will be of interest, together with reports from our monthly lectures.

In addition, we have a report from our **AGM** held via Zoom in January. Note that it was agreed at that meeting to hold future AGM's in April of each year, with the date for our **next AGM** set for **11 April 2025.**

Don't forget to join us at **The Maltings (and via Zoom)** on **Friday, 17 May** at **8:00pm** for **Lesley Dunlop's** talk entitled **"From Chalk to Peat – 100 million years in the Lambourn Valley"** which promises to be an excellent presentation. This will be followed at **The Maltings** by "**Conservation: past, present and future"** by **Colin Prosser** on Friday, 14 June and our **Members Evening** on Friday, 12 July**,** which will include a talk by FGS's **Sally Pritchard** entitled **"Peru".**

The Committee would like to encourage as many members as possible to come along to The Maltings to support the excellent speakers assembled by Janet Catchpole, who take time out of their busy schedules to travel to Farnham on a Friday evening to present to the Society.

I would also encourage members to check out our field trip section both in the Newsletter and on our FGS website. **Tessa Seward**, our **Field Trip Secretary**, is working hard to organise interesting and accessible trips and I would urge you to join those that interest you, as well as pass on any suggested trips that you would like FGS to organise. You can find Tessa's email in the Field Trip section.

If you have visited a site of geological interest, listened to an interesting Zoom talk, webinar or TV programme, and would like to share with your fellow Members, then please feel free to get in touch with the **Newsletter Editor**, **Mick Caulfield** (newsletters@farnhamgeosoc.org.uk).

We are still looking for members to both join the FGS Committee, particularly IT/Sound, as well as help with organising the Societies various activities. Please contact our Chair Mick Caulfield (newsletters@farnhamgeosoc.org.uk) **if you would like to help.**

Contents

Front Cover

Santorini (Thera), in the Aegean Sea, has steep-walled caldera rim with villages that overlook an active volcanic island in the centre of a caldera bay. The circular island group is composed of overlapping shield volcanoes cut by at least four partially overlapping calderas.

Its land area is 96 sq km, whereas its coastline stretches to almost 69 km. The capital of Santorini is Fira, while the main port is Athinios, which gets extremely busy in summer. Even though thousands of travellers visit the island every year, its permanent residents are around 13,500.

Santorini has been prone to volcanic eruptions from ancient times. The most recent eruption produced a small lava dome and flow in 1950, accompanied by explosive activity.

Photo courtesy of Sally Pritchard, our Membership Secretary.

References:

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3. https://www.livescience.com/planet-earth/volcanos/santorini-volcano-freak-eruption-1300-years-ago-was-as-violent-as-2022-tonga-eruption?utm_term=8DEBC9E5-6C7F-4337-AFFF-D9A51CC6C2C0&lrh=840a98cbe34ba22d824f6df096d90a0be8fe4763876a779b0361304855882d8f&utm_campaign=368B3745-DDE0-4A69-A2E8-62503D85375D&utm_medium=email&utm_content=2B35A65F-3BC3-4FA7-AE6E-777503BD80C7&utm_source=SmartBrief
4. https://www.farnhamgeosoc.org.uk/newsletters/2000_2004/v6n3oct2003.pdf

See also pages 43 and 57.

Farnham Geological Society Committee 2024

Chair	**Mick Caulfield**
Treasurer	**Mike Millar**
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**
Without portfolio	**Peter Luckham**
Ad Hoc Member	**Liz Aston**

Meeting Programme 2024

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

From Chalk to Peat – 100 million years in the Lambourn Valley
Lesley Dunlop Friday, 17 May
Consultant

Conservation: past, present, and future
Colin Prosser Friday, 14 June
English Heritage

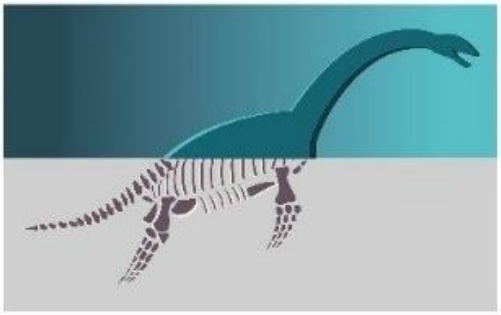
Members Evening
Peru
Sally Pritchard Friday, 12 July

Field Trip Programme 2024

Our programme for this year has yet to be finalised. Preliminary programme:

DAY TRIPS

- **Sun, 19 May** … Fossil walk along the Fleet, near Wyke Regis, Dorset *plus* visit to the Etches Collection Museum of Jurassic Marine Life.



- **2024** … Local walk near Farnham.
- **2025** … Dryhill Quarry near Sevenoaks.

RESIDENTIAL TRIPS

- **23 to 26 Sept 2024** … Northern Ireland
  - Led by Karen Parks, this will include the Antrim Coast, Giant's Causeway and the Portrush sill.
- **Mid-June 2025** … Glamorgan Coast
  - Led by John Nudds, Dept of Earth Science, Manchester. Late Triassic/Jurassic rocks. Could include a visit to the Geological Museum of Wales in Cardiff.
- **Sept 2025** … Isle of Anglesey.

Please let our Field Trip Secretary, Tessa Seward (wessa2006@hotmail.co.uk), know if you are interested in any of these trips or if you have other ideas for places of geological interest to visit.

Geologists' Association
Lecture Programme 2024

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

Catastrophic volcanic flows - understanding pyroclastic density currents
Dr. Rebecca Williams, Friday, 7 June
University of Hull

Theropod forelimb claws and implications to dinosaur-bird evolution
Dr. Zichuan Qin, Friday, 5 July
University of Bristol

The Geology of Woodsmith Mine, Yorkshire
Lisa Gillespie, Friday, 4 October
Anglo American

Reading Geological Society
Lecture Programme 2024

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

Applications of Google Street View in geological teaching and research
Dr. Ian Watkinson Monday, 13 May
RHUL

Melting Under Mountains: the soft centre of the Himalayas
Dr. Tom Argles, Monday, 3 June
The Open University

Construction in Jurassic-aged Mudstones for the HS2 Railway
Dr. Kevin Briggs, Monday, 2 September
Bath University

A Hot Topic!: The Geology Supporting Geothermal Energy
Dr. Duncan Macgregor, Monday, 7 October
Macgeology

Adventures in Martian deep time: tales from the Perseverance and Curiosity rovers
Prof. Sanjeev Gupta, Monday, 4 November
Imperial College, London

Mole Valley Geological Society
Lecture Programme 2024

http://mvgs.org.uk

A compressed account of the Himalayas
Dr. Danny Clark-Lowes, Thursday, 9 May
Nubian Consulting Ltd.

Geothermal energy and underground energy storage
Prof. Matt Jackson, Thursday, 11 July
Imperial College

An introduction to the geology of Somerset
Dr. Mark Eller, Thursday, 5 September
MVGS

Horsham Geological Field Club
Lecture Programme 2024

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

AGM
Antarctica
Tom Lees Wednesday, 8 May

Out of the frying pan into the freezer – Fieldwork tales from extreme environments around the world
Dr. Ian Carr Wednesday, 12 June
Collyers

Life as a Geology Student
Tessa Collins Wednesday, 10 July
Portsmouth University

Wealden fossils - it's not all dinosaurs!
Peter Austen Wednesday, 11 September
Hastings & District Geological Society

Minerals and their properties
Dr Ian Carr Wednesday, 9 October
Collyers

Next Lecture

Friday, 17 May 2024

From Chalk to Peat – 100 million years in the Lambourn Valley

Lesley Dunlop, Consultant

The **River Lambourn,** along with many other Berkshire Downs dip slope streams, flows SE along an almost linear valley. Over this area many of the streams follow a dominant SE alignment and it is likely that this relates to an underlying structural control. It has a catchment which is approximately 30km length and 10km wide in West Berkshire Downs. The source of the River Lambourn is at Lynch Wood Springs, Lambourn, giving a length of approximately 23km, although the perennial source is at West Shefford, 7km downstream The upper part is a dry valley reaching up to the Ridgeway escarpment.

This talk will focus on the bedrock and also the evolution of the valley during periglacial times. This will include looking at the fields of sarsens near Ashdown House in the northern part and the Holocene peat deposit at Boxford. The peat at Boxford has accumulated in a deepened section of the valley close to a fault intersection where the river changes course slightly and gives evidence of climate change and human occupation during the Holocene.

Lesley Dunlop is a Geologist with over 40 years of experience who has most recently worked at Northumbria University lecturing in geology, geophysics and geoconservation. In recent research she has used techniques such as palynology, ground penetrating radar and passive seismics. In addition to this she has led many field trips in the UK and Western Europe for universities, geology groups and others.

Also, Lesley is currently Chair of the Geological Society of London's Geoconservation Group, the Northern Regional Group, GeoConservation UK, and the English Geodiversity Forum and is active in local groups in Berkshire and Oxfordshire as well as ProGEO (International Geoheritage).

Lecture Summary

Friday, 8 March 2024

On Friday, 8 March 2024, 47+ members of the FGS & other associated societies including Reading, Harrow & Hillingdon, & Mole Valley welcomed Dr. Stuart Archer via Zoom.

The De-glaciation of Deeside, Aberdeenshire

Dr. Stuart Archer

In Aberdeenshire, the Dee Valley is well recognised as the **'Jewel in the Crown'** of the landscape of NE Scotland. This talk illustrated the glacial scenery from the Cairngorms to the coast, including, the Pools o' Dee, the Lairig Ghru, Devil's Point, Linn o' Dee and down past the B's of Braemar, Ballater, Banchory, Bieldside to Balnagask.

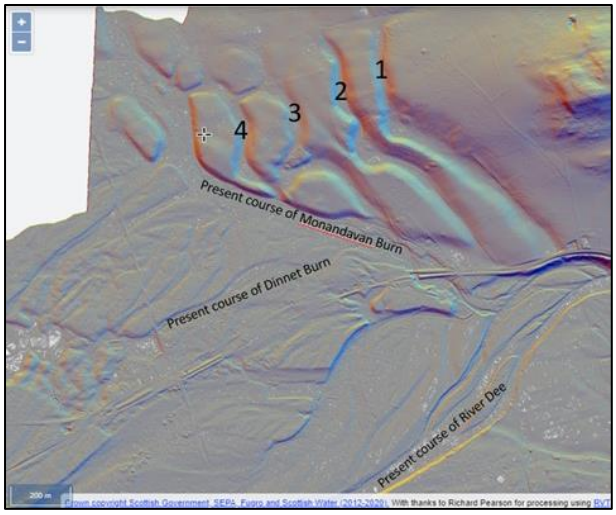
Just north of the River Dee and to the east of the Morven massif, lie two kettle hole lakes called **Loch Davan** and **Loch Kinord**. Geomorphological and sedimentological evidence suggests that both lochs were once higher and linked, forming a large palaeo-lake that has been named for the purposes of this talk as palaeo-lake **"Davord"** (linked Davan and Kinord).

Although there are many lines of self-supporting data to support the existence of the palaeo-lake, the most dramatic evidence is a series of outflow channels that are prevalent on the southeast of the former lake basin and these channels were the focus of the second part of this talk.

There appears to be a palaeogeographic requirement for an ice dam to the south of the palaeo-lake to explain the higher lake levels. It is likely that the gradual release of the southerly ice dam controlled the timing and tempo of lake level fall as the Dee Valley

glacier gradually retreated and down wasted at the end of the last glaciation.

Looking NW up Outflow Channel 2 towards the palaeo-lake with the east flank of Morven in the distant background. (Credit: S. Archer)



SEPA Lidar Data showing the 4 palaeo-channels with no headwaters or catchment areas – highly suggestive that their discharge was sourced from a lake. (Credit: Ref. 2)

Intriguingly, the diatomite deposits of the late glacial palaeo-lake link Dinnet to the Nobel Peace Prize. Alfred Bernhard Noble bought large quantities of diatomite to use in his Dynamite Works in Ardeer, Ayrshire in the late 1800's-early 1900's. He had discovered that nitro-glycerine could be made much more stable if absorbed in diatomite.

Stuart Gordon Archer was born in Glasgow in 1972, and later attended Kingussie High School in the Scottish Highlands. It was living in Aviemore, with a view of the northern corries of the Cairngorms, that catalysed his interest in glaciation as a schoolboy.

In 1994, he obtained a First Class Honours in Geology and Geography from the University of Glasgow. An MSc and PhD were later gained from the University of Aberdeen. He has been in the oil industry since the late 90's after joining Conoco in Aberdeen and has also worked in Houston and Copenhagen as an exploration geologist.

Stuart has always been interested in geology and geomorphology in equal measures, viewing the interlinkage between both disciplines as a powerful and iterative sense check on ideas. This talk on the glaciation of Deeside is based on years of "hillwalking with a geo-eye".

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1. https://onedrive.live.com/view.aspx?resid=C1DF1ECFC42EC115!65548&authkey=!AIL0E_OxAelJLZA
2. https://maps.nls.uk/geo/explore/side-by-side/#zoom=13.7&lat=57.08406&lon=-2.88186&layers=1&right=LIDAR_1m_dtm1

Lecture Notes

Friday, 9 February 2024

Lecture Summary to follow.

What did the last Ice Age do for us? – Scotland during the last Ice Age

Prof. Emrys Phillips, BGS

BSc Hons (Manchester), MSc (Manchester), PhD (Cardiff)

Hi Janet,
I'm really pleased to hear that members of Farnham Geological Society enjoyed my talk.

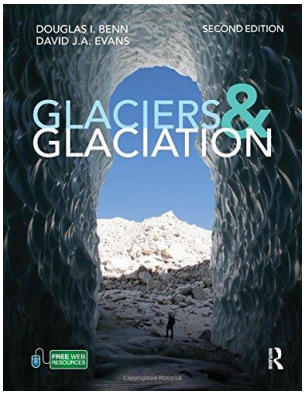
As requested attached are a couple of drumlin references (Refs 3 & 4). They are research papers so they may be a little "heavy weight" – but they are some of the most current research on the subject.

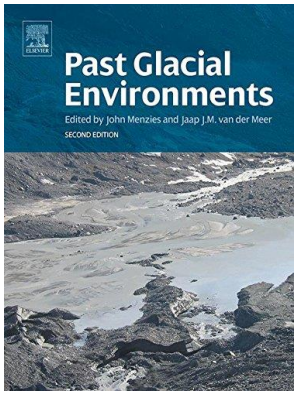
In terms of textbooks for glacial sciences then the most comprehensive one is Ref. 1, followed by Ref. 2.

The textbooks are aimed at early career research scientists, undergraduates and PhD students.

Best Wishes
Emrys

References:





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2. Menzies and van der Meer, 2017, Past Glacial Environments https://shop.elsevier.com/books/past-glacial-environments/menzies/978-0-08-100524-8
3. 2011, Stokes CR, Spagnolo M, Clark CD. The composition and internal structure of drumlins: Complexity, commonality, and implications for a unifying theory of their formation. **Earth-Science Reviews** 107, 398-422. https://eprints.whiterose.ac.uk/152447/8/11135%20%281%29.pdf
4. 2007, Menzies J & Brand U. The internal sediment architecture of a drumlin, Port Byron, New York State, USA. ***Quaternary Research Reviews*** 26, 322-225. https://www.academia.edu/49921603/The_internal_sediment_architecture_of_a_drumlin_Port_Byron_New_York_State_USA

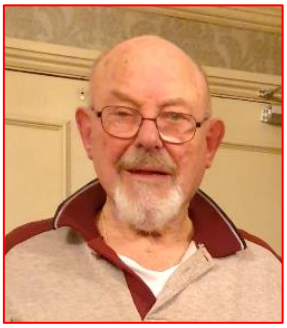
Lecture Summary

Friday, 8 December 2023

On Friday, 8 December 2023, 58 members of the FGS & other associated societies including Reading, Harrow & Hillingdon, & Mole Valley welcomed Dr. Bob Maurer via Zoom.

The rotating Earth and plate tectonics

The Separation of the forces that drive Tectonic Movements and Subduction



Summary of a lecture by Dr. Bob Maurer (HHGS)

This talk offers an alternative explanation to the present Hess and Wilson models of supercontinent break-up and reassembly driven by heated convection currents in the Asthenosphere. By considering the planet Earth as an unbalanced rotating body it is possible to derive equations that can quantify the circumferential forces that process tectonic processes

During a field visit to Bolivia in 2001, the sight of undisturbed marine sedimentary strata high in the Andes (Fig. 1) led to the consideration of the magnitude and direction of the tremendous forces involved in causing:

a) The unrelenting unidirectional movement of the South American plate away from Pangea,
b) The formation of the Cordilleras by compression and
c) The lifting of the oceanic crust and sediments from below sea level to five kilometres above it.

From an engineering perspective, however, the driving forces associated with heated convection currents as per the accepted model of **Hess** (1962) (Ref. 2) at convergent plate margins appeared to be neither large enough nor sustainable over geological time spans of

say 150 Ma to cause this level of orogenic activity.

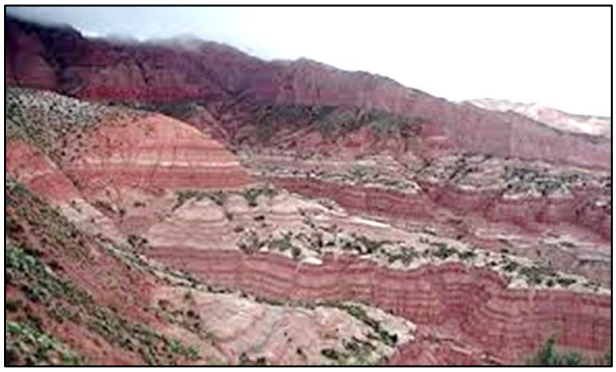


Figure 1: Undisturbed sedimentary beds near Potosi, Bolivian Andes. (Credit: Google & Bob Maurer)

This talk offered an alternative analysis based on the forces associated with the rotational speed of the Earth to explain tectonic plate movements, subduction, and orogenic processes.

Current thinking is that the movement of a **continental plate (CP)** is the result of the **'pulling action'** applied to it by the subduction of the higher density **oceanic lithosphere (OL)** as it descends below the CP. The direction of the heated convection currents considered to cause subduction must vary over time and distance. Thus, it is difficult to reconcile unidirectional tectonic plate movements breaking up a supercontinent such as Pangea with omnidirectional changing forces due to convection currents.

Analysis of the forces generated by the rotational velocity of the Earth (Maurer, 2022) (Ref. 4) suggests a quite different mechanism to explain the currently accepted 500-million-year cyclical break-up and reassembly of supercontinents.

Earth's Offset Centre of Mass (COM)

It was noted that the 'wobbling' Earth, with its change in the orientation of the inclined spin axis, the associated Milankovitch Cycles, the nutation (nodding motion) as well as the variable and cyclical 'Chandler Wobble', closely mimics that of an unbalanced rotating shaft whose **Centre of Mass (COM)** is offset from its spin axis. An everyday example is the vibration of an unbalanced wheel on a motor vehicle.

To date current wisdom considers the planets to be fully rotating bodies about the Centre of Mass (COM) which is coincident with principal axis of rotation and thus free of torque moments. However, illustrations of the break-up and dispersal of Pangea since the Jurassic period show that the South American plate moved west while the Australian plate moved east relative to the essentially central position of the African plate. The Indian plate also moved east before turning north-east. At the same time, the Laurasian plate moved north, later splitting into the Eurasian and North American plates with the opening of the North Atlantic. These movements suggest that the major plates were being redistributed from the heavier side of the Earth, occupied by Pangea, to the lighter side, occupied by the proto-Pacific. Taken together with the similar inclination, daily rotational rate, same hand of rotation as the Sun (Venus and Mercury excepting) it became obvious that both the rotational and orbital motions of the planet are controlled by the mutual gravitational pull of the Sun (Ref: Keplar Laws of Motions c.1645, Steiger and Bunton - Caltech) (Ref. 5). These actions can be readily explained by having an 'offset detached Centre of Mass (COM)' which will be the focus point of a gravitational pull. This offset most probably occurred when the embryonic planets were captured by the Sun at the start of our Galaxy.

Differential Circumferential Tensile Forces (DCTS)

To quantify the forces associated with the offset COM it was necessary to mathematically model the Earth as a rotating unbalanced body. The COM was thus only given a 1Km offset. By approaching the problem in terms of a thin shell moving relative to the mantle (Fig. 2), it is possible to consider which increments of the tensile force are responsible for putting the Pacific Basin under compression and the African Plate under tension. The African Rift Valley is today a case in point.

In calculating the effects of the circumferential tensile forces (F) at the Earth's surface due to the COM being offset from the spin axis or geometric centre, the term '**Radius of Eccentricity' (E)** is introduced to denote the magnitude of the offset. Figure 2 shows this approach as a vector diagram in which the differential circumferential stresses are

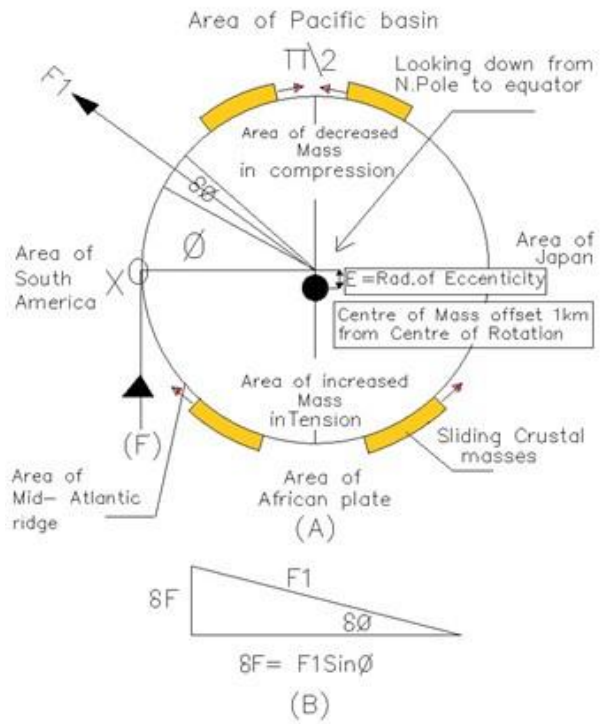


Figure 2: (A) Principal forces superimposed across a section of the equator; (B) force diagram used to determine the total force, F, acting in the direction of the maximum effective radius.

Figure 3: Pictorial to understand the immense tensile forces pushing a continental plate . 118 people each weighing 81.8 kg pushing a motor 1m x 1.3m rear on a 1:120 incline.

annotated. To simplify discussion and further calculations, E was placed at 1km offset from the spin axis. Seen in context, this equates to (1/6400) x 100 or 0.016% of the Earth's mean radius of 6,400km. The magnitude of the derived differential circumferential stress (F) will thus be dependent on E. In a limiting case, if E=0, the differential tensile stress will be zero, as the Earth will be balanced. The derived equation **$F = MR\omega^2 E\pi/4$** relates **F** to **E**, where R is the mean radius of the Earth, ω its angular velocity and M is the mass of a segment of the crust 1,000m x 1m x 1m … *the actual mathematical approach is shown in Appendix A*. Using averaged published data for M, R and ω, sourced from USGS and National Geographic Society publications, the stress value is calculated to be 0.074 Newtons/mm^2 (10.8 lb/in^2). To understand a stress value of 0.074 N/mm^2, this figure equates to 118 people each weighing 81.8 kg (180 lb) pushing a braked motor vehicle with a rear surface area of 1.3 m^2 (Fig. 3).

It is thus postulated that the magnitude of these differential circumferential tensile stresses (DCTS) even with an offset COM as small as 1km are more than sufficient in overcoming the very low tensile strength of basalt to cause the continental plates (CP) to break away from a supercontinent like Pangea.

Consideration of Momentum and the Subduction Cycle

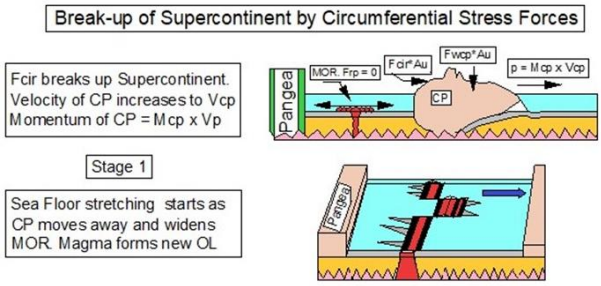
Perhaps the most important aspect in the breaking up of the supercontinent Pangea is that the plates will accelerate from almost zero velocity (Vo) to the present-day velocity (Vcp) of about 11mm/year. In doing so the CP has momentum imparted to it as per Newton's Second Law of Motion, which is

Momentum = Mass x Acceleration, so the equation will be:
Mcp (Mass of CP) * Acceleration (Vcp-Vo) = Mcp*Vcp.

Whilst the velocity is low, the continental mass is extremely large. The overall momentum will make the slow but relentless movement of the CP unstoppable until it meets another CP at a convergent margin. India crashing into the Eurasian plate creating the Himalayas is a case in point. A literature survey showed that the introduction of the concept of '**momentum**' into the study of tectonics appears to be a new innovation.

As the CP is forced away from the **supercontinent (SC)** by the DCTF forces, the weight of the CP will push the oceanic crust under it into the asthenosphere (i.e., the ductile upper mantle) and finally into the lower mantle. Seismic observations have shown that a **'knee bend'** forms in the oceanic lithosphere (OL) as it bends downwards as a 'slab' into the asthenosphere. The force associated with the weight of the slab is currently credited as being the major force aiding subduction and tectonic plate movements. The resistive forces associated with slab-pull are essentially the buoyancy, friction, and viscosity.

Examination of the major forces presently considered responsible for subduction are summarized pictorially in the different stages in Fig. 4.



The introduction of an Offset Centre of Mass has allowed for the introduction of i) Sea Floor stretching, ii) Momentum, and iii) Quantifying the forces responsible Supercontinent Break and CP movements.

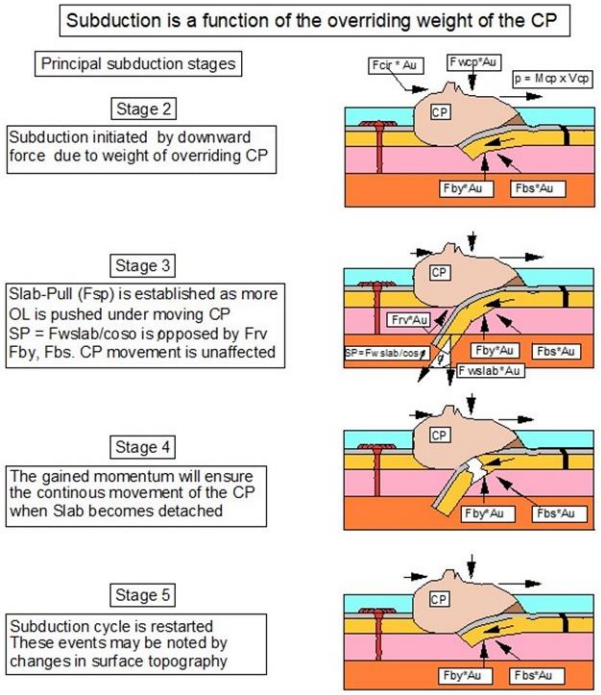


Figure 4: The separation of the forces responsible for Supercontinent break-up and Subduction represent a major change in the study of Tectonics. (Credit: R. Maurer)

Stage 1: Sea Floor Stretching

The first phase of the breakup of a supercontinent will be by the **circumferential tensile forces (DCTF)** acting on a suture boundary of to detach what will be a continental plate (CP). As, the ultimate tensile stress (UTS) of basalt is approx. 1/10th that of the circumferential forces, the detachment force will have no difficulty in performing this task. It should be noted at this point that the tensile strength of the OL is thickness, age and composition dependent. Separation is most likely to occur at the thinnest and youngest part of the OL. Once separated the CP will move away and magma will issue through this ridge.

The lack of distortion of the paleomagnetic lines shows a distinct absence of any compressive force to push continents apart. The present term **'Sea floor Spreading'** is now referred to as **'Sea Floor Stretching'**. As such **'Ridge Force'** is set to zero

Stage 2: Initiation of Subduction

Once the CP is detached from the supercontinent (Pangea) it gains momentum. Momentum as explained above is quantified by the equation Mcp*Vp.

At this phase the forces associated with subduction may be expressed as follows:

Subduction Force (N) =
Resultant (Fcir + Fwcp)* Au >(Fby + Fbs) * Au

As there is some uncertainty regarding the principal CP driving force at this stage, the term 'resultant' is used.

Other notations include are:

- Fcir = DCTF
- Fwcp = downward force due to the weight of the CP
- Fby = upward force due to density differences
- Fbs = resisting bending stress of the OL

Stage 3: Subduction Continuation

As the CP progresses over the OL the subducting part of the OL will lengthen and exert what is normally referred to as **'Slab-Pull'** The **Hess and Wilson models** credit this 'Slab-Pull' as a major driving tectonic plate forces. The downward movement is stated to be driven by the circulating heated convection current driven is in addition to its weight.

At this phase the forces associated with subduction may be expressed as follows:

Subduction Force (N) =
Resultant (Fcir + Fwcp + Fsp) * Au > (Frv +Fby + Fbs) * Au

Stage 4: Slab detachment

The Slab breaks away and falls towards the lower mantle when it is comingled with existing magma. It is this mixture that gives rise to the rock type Andesite that issues through the volcanoes in the Andean Mountain range.

The subduction equation now becomes:

Subduction Force (N)=
(Fwcp +Fcir)*Au > (Fby + Fbs.)*Au

Stage 5: Subduction cycle restarted

The subduction cycle is restarted by the momentum of the moving CP.

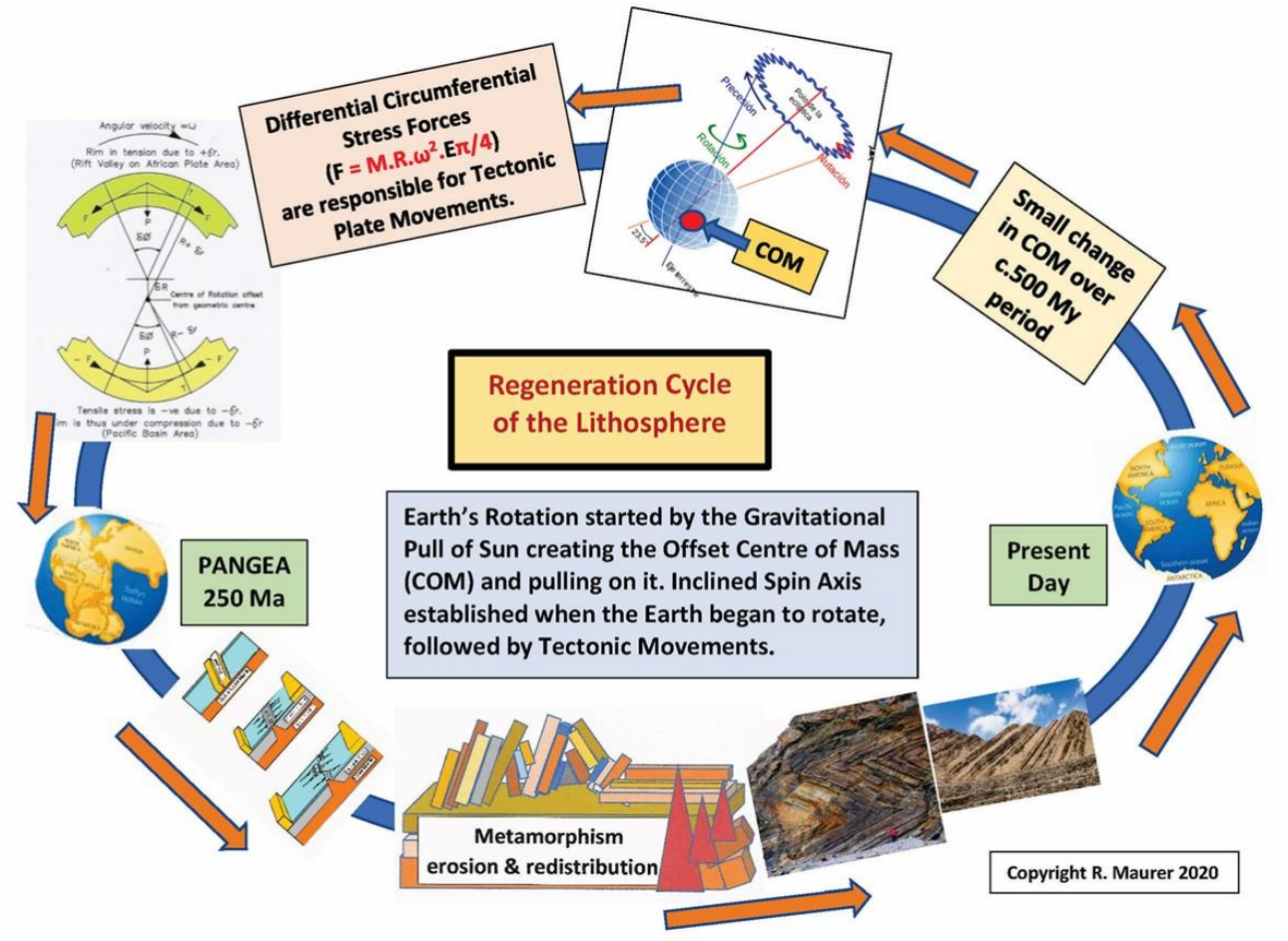
The only way the CP can be stopped is at a convergent margin of another CP. It is this collision that that starts the orogenic process of mountain building. The collision of the Indian plate into the Eurasian Plate is the most noticeable example.

The introduction of the offset COM, the differential circumferential tensile force (DCTF) and Momentum gives a very new perspective on the forces driving tectonics. It can now be readily shown that as the CP continues to move with zero hesitation, Slab-Pull together with the heated convection currents are now seen as a **consequence of tectonic movements and not the driving forces**.

This is a major advance in the study of tectonics as it allows for the separation of the forces responsible for tectonic movement and subduction.

The Separation of the Forces responsible for Tectonic Movements and Subduction

The separation of the forces responsible for tectonic movements and subduction are illustrated in Fig. 5.



Maurer Cycle: The separation of the forces for Tectonic Movements from the forces driving subduction has allowed for the introduction of a different lithosphere recycling diagram to the Wilson Cycle regeneration cycle to be proposed.

Figure 5: Earth continuous regeneration cycle. The break-up of Pangea is given as an example.

Separation of Subduction from Tectonic Plate Movement

The introduction of momentum and circumferential forces is new to the study of subduction. This innovative introduction has thrown up some interesting and far-reaching conclusions. The inevitable loss of the slab and thus the slab-pull force, either by detachment or by partial melting in the asthenosphere, has not hindered the movement of the CP. The momentum of the continental masses will keep them in motion.

The logical and unexpected conclusion is that continental plate movement is independent of slab-pull and subduction. The separation of subduction from tectonic plate movements is a major change in the study of plate tectonics. Subduction is now seen as being a consequence of tectonic plate movements rather than the driving force.

This has brought with it the observation that slab-pull is applicable to the tensile stressing of the OL and possibly the ridge-push forces that may now be considered as *'ridge-pull'* ones. The origin of these forces associated with rifting and ocean ridges is still seriously debated (Fig. 4).

Birth of Tectonic Plate Movements

It is interesting to note that all the planets (except Venus – considered as being upside down) rotate on their axes with the same anti-clockwise motion as the Sun. The terrestrial planets have an almost identical polar/equatorial diameter ratio, but the gaseous planets are more oblate. Apart from Mercury and Venus, the planets rotational periods are within the range 10 to 24 hours, and have the same bottom left to top right inclined spin axis (except for Venus and Uranus). The uniformity of planet behaviour is puzzling as the gravitational pull of the Sun alone does not yield a satisfactory explanation regarding the rotation of the planets. Current wisdom favours the concept that the angular momentum of the low angular velocity swirling gas cloud during the formation of our galaxy, is now being shared between the Sun and the planets rotating at higher angular velocities.

As it is impossible to rotate a body about its dimensionless centre line, it is likely that the COM offset was created when the Sun pulled on the embryonic partially cooled planets, towards the end of their accretionary stage, to cause them to rotate in the same direction as the Sun. The momentum imparted to the larger accretionary masses would ensure their permanent rotational mode. This approach also gives a plausible explanation regarding the creation of the tilted N-S spin axis of a planet.

Furthermore, the lower density silica-rich 'slag' or 'dross' floating on the surface would have been swirled about at this stage and plate tectonics on the Earth, as we know it today, was set in motion.

Regeneration of the Lithosphere

From the arguments put forward it is also possible to construct the regeneration cycle of the Earth's lithosphere as shown in Fig. 5. The vibrational patterns associated with the Radius of Eccentricity offset of the COM will create the circumferential stresses that will cause the crustal masses to move to the lighter side or hemisphere. These tectonic plate movements with their associated orogenic, volcanic and erosion processes will shape the upper lithosphere. Over an extended time span the Radius of Eccentricity need only be varied by a small value to restart the cycle of moving crustal masses to a new position.

Robert Maurer, December 2023

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Appendix A

Notation			Value
M	=	Mass per unit length of crust	2.8×10^6 kg
R	=	Radius of Earth	6.4×10^6 metres
E	=	Radius of eccentricity	1×10^3 metres
ω	=	Angular velocity	7.27×10^{-5} rad.sec^{-1}
θ	=	Angle. (rad)	
δe	=	Effective eccentricity at angle θ	
F	=	Total force at point X (N)	
F_1	=	Radial force due to eccentricity at θ	

Then from the 'force vector diagram' at surface at an angle θ:

Vertical component of F_1	δf	=	$F_1 \sin\theta$
Effective eccentricity at angle Θ	δe	=	E sinθ
Mass of segment	R δθ	=	M R δθ.

Thus,

$F_1 = M R \delta\theta \omega^2 E \sin\theta$

$= M R \omega^2 E \sin\theta \delta\theta.$

The vertical force component $\delta f = F_1 \sin\theta =$

$= M R.\omega^2 E \sin\theta \sin\theta \delta\theta$

$= \mathbf{M R \omega^2 E \sin2\theta \delta\theta}$ **Equation 1**

Thus, the total vertical force

$F = \int_0^{\pi/2} M R \omega^2 E \sin^2\theta \delta\theta$

$= M R \omega^2 E (½\theta - ¼\sin^2\theta)^{\pi/2} - (½.\theta - ¼ \sin2\theta)^0$

$= M R \omega^2 E (\pi/4 - ¼.0) - (½.0 - ¼.0)$

Total vertical force (F) = M R ω^2 E π/4. **Equation 2**

The derivation of the equation of the total force at the maximum effective radius allows for the determination of the circumferential tensile stress on the crust. The approach given above considers the forces developed as a direct function of the radius of eccentricity.

AGM Summary

Friday, 12 January 2024

On 12 January, 34+ attendees via Zoom welcomed our Interim Chair Mick Caulfield, along with the FGS Committee members, in holding our AGM.

This was followed by an interesting presentation by Mick Caulfield, FGS.

Report by Mick Caulfield, FGS

There were 34 attendees and 1 apology for absence from Peter Luckham who, for the first time in 50 years, was not able to attend the AGM.

The 2023 AGM minutes were approved with the matters arising to be discussed in the various Committee reports.

In Peter Luckham's absence, **Mike Millar** gave a brief report on FGS Society accounts. Total operating costs were low, due partly to the use of Zoom, although the necessary purchase of IT equipment offset any savings. "Cash in hand" at the end of the year was £2,381.

Subscriptions were charged in 2023, the first time since the pandemic and subscriptions for 2024 have been kept at existing levels. Sally Pritchard will email membership forms for all members to complete with their details.

Committee members reported on their areas of responsibility. The key items were:

Judith Wilson, Secretary: 2023 saw 11 meetings, 4 by Zoom and 7 in The Maltings where attendance varied between 24 and 58. Members from other local societies are invited to view Farnham lectures via Zoom.

In addition, 4 committee meetings were held in the year.

Janet Catchpole, Programme Secretary: in a similar way to the previous year, 2023 started on Zoom but moved to The Maltings in April with Zoom an option for members who were unable to get to The Maltings.

Topics ranged across a variety of geological subjects:

- "One small typo and two igneous adventures: Island hopping from the Scillies to Sicily".
- "Impact Craters and Planetary Science".
- "Sir Alfred Russell & his mineral collection".
- "Bumps in the bay: enigmatic circular sea-floor structures off the Jurassic coast".
- "Carboniferous wildfires revisited".
- "The Anthropocene: a new geological epoch?"
- "A whistlestop geological road trip through America's old west".
- "Coccoliths and coccolithophores - a brief introduction".
- "Minerals of the Mourne Mountains".
- "Asteroids & Comets: an introduction".
- "The rotating Earth & plate tectonics".

Zoom has worked well, benefiting older and more distant members but is a disappointment for others. Janet found it easier to get a wider selection of speakers. The committee decided that it is prudent to continue to use Zoom for December to March inclusive and then to hold hybrid meetings at The Maltings and on Zoom for the other months. We continue to have a relationship with the local geological societies of Reading, Harrow & Hillingdon and Mole Valley. It was a successful venture during the pandemic and will continue for 2024; it will again be reviewed at the end of the year.

Sally Pritchard, Membership Secretary: membership stands at 67 and extends from Cornwall to Scotland. Sadly, we had to say goodbye to Peter Norgate a long-standing member and a regular on field trips.

Tessa Seward, Field Trip Secretary took up her role in mid-year and has been planning trips for 2024 and beyond. Note that Reading Geol Soc has been contacted with a view to joint trips.

Mick Caulfield, Newsletter Editor: the Newsletter is published quarterly with news of

Society events, technical and geological news items and the occasional crossword, quiz, etc. Mick is pleased to receive articles and summaries of FGS talks and field trips and other geological news from members so please continue to send them to him.

FGS display at the GA Festival of Geology (Credit: M Caulfield)

Bob Rusbridge, Website Report: all is working well and is fully operational. Thanks go to **Walter Bonnici** for all his work and assistance. The website contains a contact page and a search facility.

Mike Millar, IT/Sound: during 2023 we had issues with our audio system. The lapel microphone stopped working and the loudspeaker unit failed. This meant that we replaced the system in June with like-for-like models. It was noted that members who are unable to attend meetings at The Maltings will have to be prepared for the variable quality on Zoom.

Peter Crow, Publicity Report: has continued spreading the word and leaflets around the local area. Over the summer, Peter provided FGS content to The Maltings for inclusion on their *Regular Activities* web page. There is a new GCSE in Natural History which may provide an opportunity to engage with local schools. The Society took its display to the Churt Village Fete and the recent GA's Festival of Geology.

Mick Caulfield, on behalf of all the FGS Members paid tribute and offered a vote of thanks to Peter Luckham on his retiring as the FGS Treasurer after 50 Years. With Liz Aston having stepped down as Chair at the July 2023 meeting two committee members stood for the Chair and Treasurer positions.

The 2024 Committee was elected by a clear majority of the members present:

• Chair	Mick Caulfield
• Secretary	Judith Wilson
• Treasurer	Mike Millar
• Programme Secretary	Janet Catchpole
• Membership Secretary	Sally Pritchard
• Field Trip Secretary	Tessa Seward
• Newsletter Editor	Mick Caulfield
• Website Manager	Bob Rusbridge
• IT/Sound	Mike Millar
• Publicity	Peter Crow
• Without Portfolio	Peter Luckham
• Ad-hoc Member	Liz Aston

Should anyone else like to be considered to serve on the 2024 Committee, **particularly IT/Sound**, please contact the Secretary, Judith Wilson (judith.wilson30@ntlworld.com).

Under **AOB** there was a proposal to change the month of the AGM from January to April, with finances at the end of March. Over 90% of the members present voted in favour of this proposal.

Mick Caulfield, FGS

The Great Dying: The end-Permian Mass Extinction

More than 99% of all organisms that have ever lived on Earth are extinct. This talk described the events around the Permian mass extinction or the "Great Dying" which occurred some 252 Ma ago and led to 90% of all life being wiped out!

The extinction's single biggest cause was the Siberian Traps, an immense volcanic complex across what is now Siberia … the deadliest volcanic event in Earth's history. Global temperatures rose by at least 6°C to 10°C. It's thought toxic halogens destroyed the Earth's ozone layer.

The Earth's rich complexity vanished … seemingly for good!

Note that an extinction event (also known as a *mass extinction* or *biotic crisis*) is a widespread and rapid decrease in the biodiversity on Earth.

Such an event is identified by a sharp change in the diversity and abundance of multicellular organisms. It occurs when the rate of extinction increases with respect to the rate of speciation. Estimates of the number of major mass extinctions in the last 540 Ma range from as few as five or six to more than twenty, depending upon how you define a "major" extinction event.

However, a mass extinction is difficult to achieve. They are believed to be the result of drastic or gradual changes to the environment, but there doesn't seem to be a common cause or single set of changes, although all show evidence of **climate change**.

Though mass extinctions are deadly events, they open up the planet for new forms of life to emerge. ***Extinction is a vital part of evolution*** … if nothing ever went extinct there would be no room for new species to evolve.

Permian-Triassic Extinction – *the mother of all extinctions when life was on the brink!*

At the end of the Permian, over about 20,000 years, 96% of all marine species and 70% of land species died out … about 90% of all species! That's 9 out 10 living things died!

The world's forests were wiped out taking about 10 Ma to recover. Of the five mass extinctions, the Permian-Triassic is the only one that wiped out large numbers of insect species.

Marine ecosystems took 4 to 8 Ma to recover, and the event saw the end of the trilobites, Orthida brachiopods, and the Tabulate & Rugose corals.

The extinction's single biggest cause was the **Siberian Traps**, an immense volcanic complex that erupted more than 3,000,000 kms^3 of lava across what is now Siberia (enough to bury Australia hundreds of metres deep).

The eruption triggered the release of at least 14.5 trillion tons of CO2.

The resulting global warming was extreme. In the million years after the event, seawater and soil temperatures rose between at least 6°C to 10°C, maybe as much as 14°C to 19°C. By 250.5 Ma ago, sea surface temperatures at the Equator rose to 40°C.

Trilobite Acadoparadoxides briareus (Credit: Photograph by Sandy Grimm. Houston Museum of Natural Science, HMNS 1284) & Tabulate coral Acervularia (Credit: unknown).

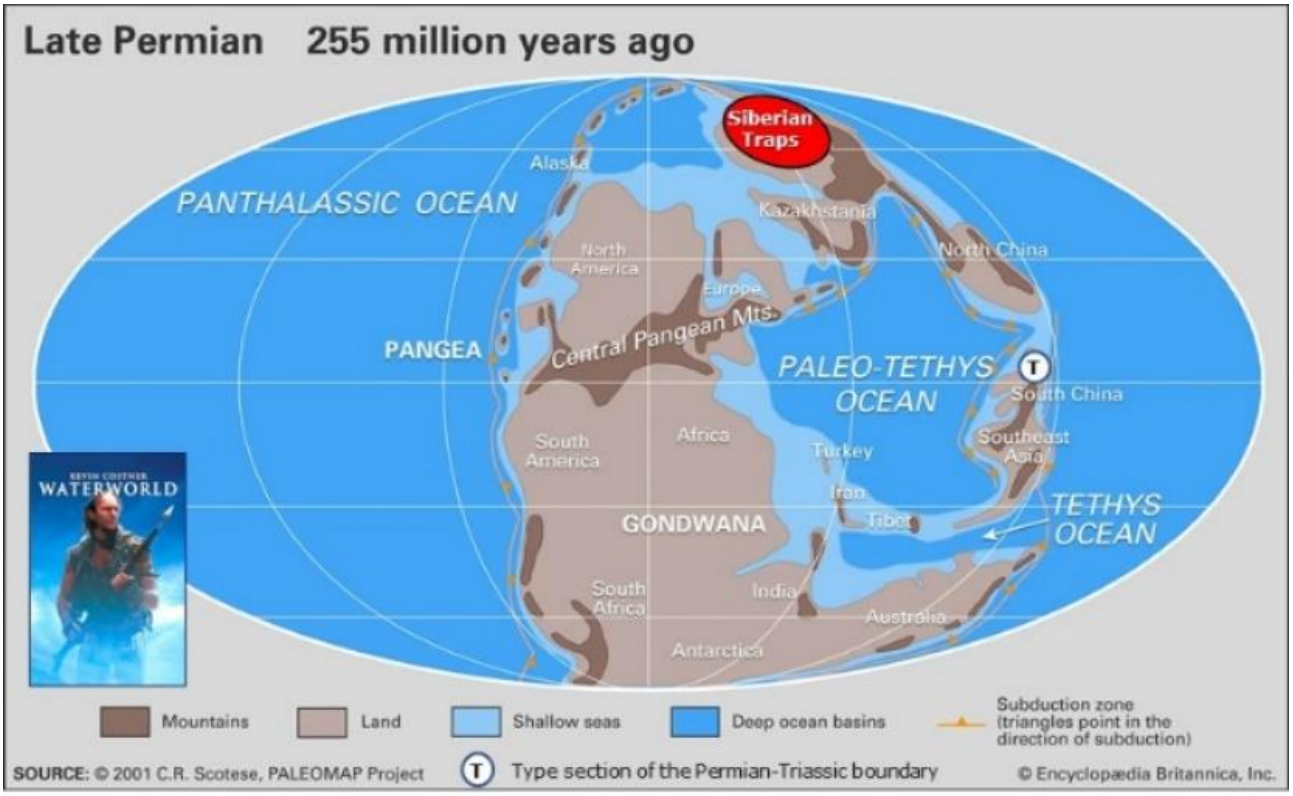
Dibunophyllum bipartitum, a solitary rugose coral. (Credit: BGS © UKRI)

As temperatures rose, rocks on land weathered more rapidly, hastened by acid rain that formed from volcanic sulfur dioxide. Increased weathering would have brought on anoxia that suffocated the oceans.

Climate models suggest the oceans lost about 76% of their oxygen. They also suggest that the warming and oxygen loss account for most of the extinction's species losses.

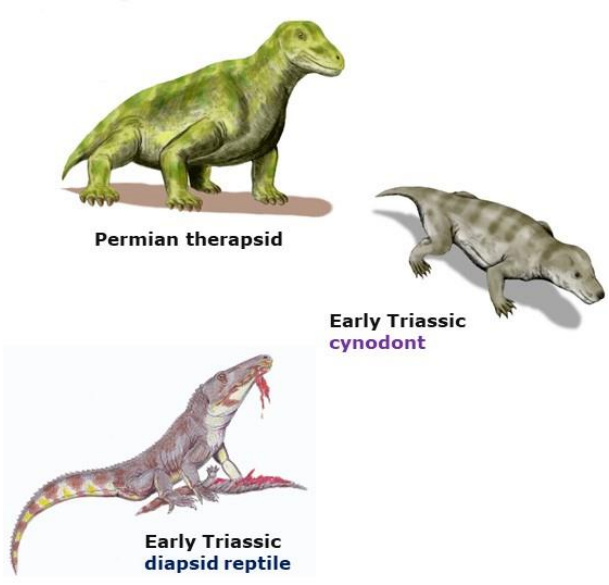
The Permian-Triassic boundary marks the divide between Palaeozoic and Mesozoic biota.

Large, carnivorous therapsids (synapsids) were the top predators in the Late Permian period, but most didn't survive the **"The Great Dying"**; diapsid reptiles (ancestors of the dinosaurs) grew in size and became the dominant species of the Mesozoic era.



(Credit: © 2001 C.R.Scotese, PALAEOMAP Project / © Encyclopedia Britannica, Inc. & Universal Pictures 1975)

Among the few synapsids who survived, the cynodonts became the much smaller, mainly nocturnal ancestors of early mammals.



(Credit: Nobu Tamura - Own work and Dmitry Bogdanov - dmitrchel@mail.ru)

There are still many questions to be answered regarding mass extinctions not least when an apparent crisis has not had much of an effect on life:

- There have, for e.g., been numerous vast flood basalt eruptions when nothing really became extinct.
- There have also been many meteorite and comet impacts on the Earth that have not led to extinction. Some of them were nearly as large as that which resulted in the Chicxulub crater (66 Ma) and yet the palaeontological record passes them by without any elevated extinction rates.

Palaeontologists and geologists are beginning to identify common aspects of mass extinctions and identifying those species that are more prone to extinction than others.

In addition, identifying those **"disaster species"** that are able to radiate soon after a crisis appears to be important. What special features do they have that allow them to radiate or are they just lucky?

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History Of Geology

Barnum Brown

Barnum Brown (February 12, 1873 – February 5, 1963), commonly referred to as **Mr. Bones**, was an American palaeontologist.

Named after the circus showman P. T. Barnum, he discovered the first documented remains of ***Tyrannosaurus*** during a career that made him one of the most famous fossil hunters working from the late Victorian era into the early 20th century.

Sponsored by the **American Museum of Natural History (AMNH)**, Brown traversed the USA bargaining and trading for fossils. His field was not limited to dinosaurs. He was known to collect or obtain anything of possible scientific value.

After working a handful of years in Wyoming for AMNH in the late 1890s, Brown led an expedition to the Hell Creek Formation of southeastern Montana. There, in **1902**, he discovered and excavated the first documented remains of ***Tyrannosaurus rex.***

Credit: D. Finnin/© AMNH

Mikhail Lomonosov

Mikhail Vasilyevich Lomonosov (19 November 1711 – 15 April 1765) was a Russian polymath, scientist and writer, who made important contributions to literature, education, and science.

This portrait is a copy of the original work by G. Prenner.

On January 25, 1755, Moscow University is established by Elizabeth of Russia and

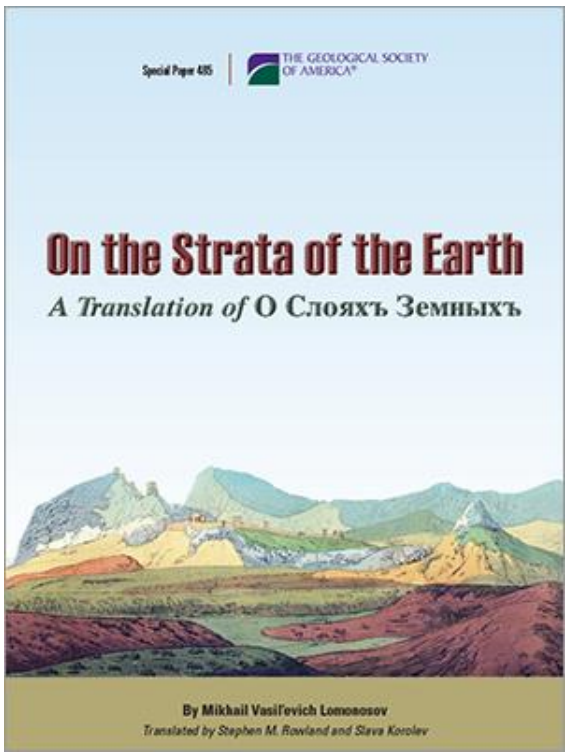
founded by artist, naturalist & **geologist Mikhail Lomonosov**.

In 1763, he published **"On The Strata of the Earth"** – his most significant geological work. This work puts him before James Hutton, who has been traditionally regarded as the founder of modern geology.

Lomonosov based his conceptions on the unity of the Earth's processes in time, and necessity to explain the planet's past from the present.

A Mid-Oceanic Ridge in the Arctic is named after him.

Note that after some 25 years of work, James Hutton's "Theory of the Earth" was first read to meetings of the Royal Society of Edinburgh in 1785.



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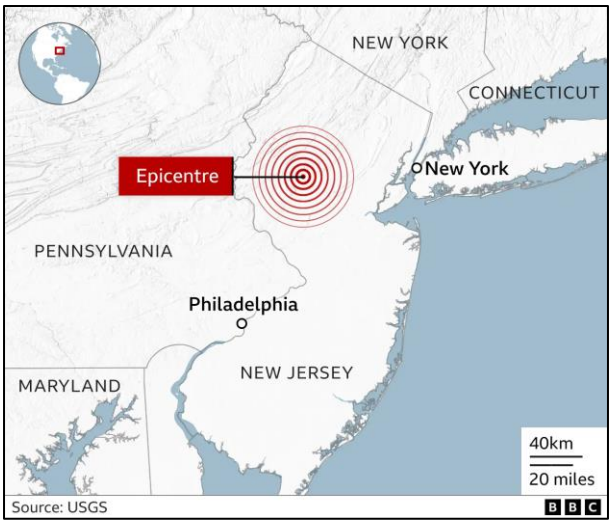
News

Rare magnitude 4.8 and 3.8 earthquakes rock Northeast, including Greater New York area

By Laura Geggel, Live Science
5 April 2024

Magnitude 4.8 and 3.8 earthquakes struck New Jersey and rocked the Northeast on Friday (April 5)



The earthquake's epicentre was near Whitehouse Station in New Jersey, about 40 miles (64 kilometres) from Manhattan. (Image credit: USGS / BBC)

Magnitude 4.8 and 3.8 earthquakes rocked the Northeast, including the Greater New York area, on Friday (April 5), according to the U.S. Geological Survey (USGS).

The **first earthquake** struck at 10:23 a.m. EDT at a depth of 2.9 miles (4.7 km), USGS reported. It hit 4.3 miles (7 km) north of Whitehouse Station in New Jersey, about 40 miles (64 km) from Manhattan.

The **second earthquake** hit at 5:59 p.m. EDT at a depth of 5.8 miles (9.4 km), with an epicentre 4.3 miles (7 km) southwest of Gladstone, New Jersey, USGS reported. It was originally reported as a magnitude 4.0, but later downgraded to a magnitude 3.8 "based on more complete physical modelling," USGS said.

For the first quake, shaking was felt as far south as Baltimore, Maryland, and as far north as Springfield, Massachusetts, according to the USGS' "Did You Feel It?" map. Some airports on the East Coast issued ground stops to halt air traffic directly after the morning quake, but there were no immediate reports of damage, according to The New York Times.

Earthquakes in the Greater New York area are rare, but smaller and occasionally more powerful earthquakes have previously rattled this region spanning New York, Philadelphia, and Wilmington. Smaller earthquakes hit around every two to three years, and larger ones strike roughly twice a century, according to USGS.

"It's unusual to get really big earthquakes in the Northeast of the U.S., but you do occasionally get these intermediate-size earthquakes, which is what we had this morning," Benjamin Fernando, a postdoctoral fellow in the Department of Earth and Planetary Sciences who studies seismology at Johns Hopkins University, told **Live Science**.

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Taiwan earthquake: The mountain 'rained rocks like bullets' - survivor

By Rupert Wingfield-Hayes & Kelly Ng, BBC News in Hualien and Singapore
4 April 2024

Rescuers in Taiwan are working to reach more than 600 stranded people, a day after the island experienced its **worst earthquake in 25 years**.

One survivor has recounted how tremors unleashed rockslides "like bullets" around the coal mine he was working at.

The **7.4 magnitude earthquake** hit near the eastern county of Hualien, killing nine and injuring more than 1,000.

Some stuck in tunnels and near a national park have been rescued by helicopters, but 34 are still missing.

The official number of people trapped or stranded rose considerably - from about 100 to 646 - on Thursday as people started getting phone signal back in the mountainous regions.

Most are not believed to be in danger but are stuck due to roads being cut off. Officials are now trying to work out the best way to get them out.

Food supplies have been air-dropped to dozens trapped in these areas, local reports say.

"The mountain started raining rocks like bullets, we had nowhere to escape to, everyone ran beside the sandbags for cover," the survivor, identified by his surname Chu, told Taiwan's Central News Agency.

Three of the nine who died were hikers on a trail leading towards Taroko National Park, named after a landmark gorge, just outside Hualien.

In Hualien city, the capital of the county where the earthquake struck, relief efforts are proceeding quickly, with workers using excavators and other heavy equipment to demolish several damaged buildings.

On Thursday morning, the BBC also witnessed relief workers removing huge boulders - the size of cars - that had fallen close to railway lines so as to get normal train services running again.

They are also using large amounts of gravel and rocks to shore up a 10-storey structure known as the Uranus building, which has been

leaning downwards since the quake struck - to prevent it from falling over in case of another aftershock.

Local reports said one female teacher had died in the building when she returned to rescue her cat.

The red brick Uranus building is seen leaning precariously (Credit: Reuters)

Hsu Chiu-yueh, who was working opposite the Uranus building when it collapsed, told the BBC: "It was so shaky I could barely walk. I was really scared. I felt my legs were not in control anymore. Thanks to my colleagues, they dragged me so we could get out. There was a lot of dust coming into our building on our way out... We [later] realised that it came from the building across the street that had partially collapsed," said the 50-year-old.

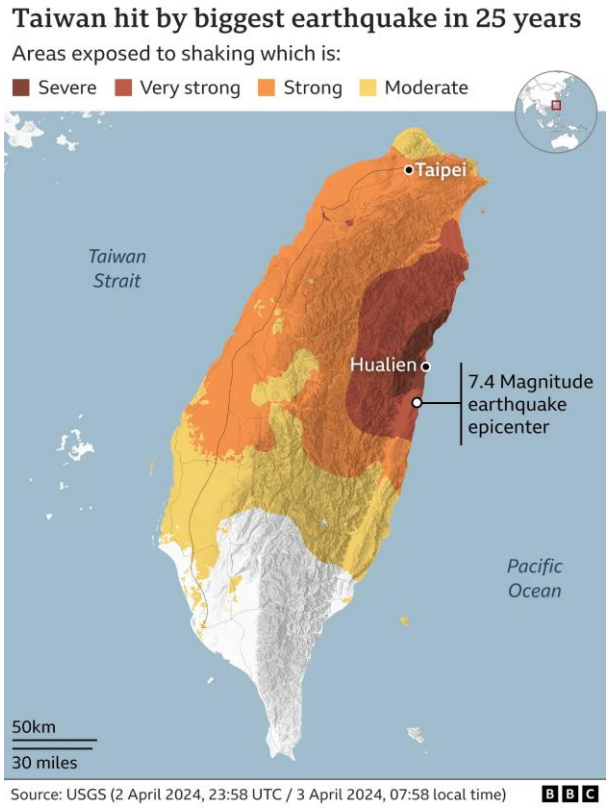
Another Hualien resident recounted how the quake threw her home into disarray.

"I was just getting out of bed when a clothes rack and a low cabinet fell over," Ocean Tsai told BBC Chinese. "It kept getting stronger, and I started worrying about our belongings at home. Fortunately, apart from the motorcycle tipping over, the damage was minimal."

The earthquake, which struck **18km (11 miles) south of Hualien**, was followed by **more than 200 aftershocks**, dozens of which were at least **6.5 magnitude or more**, hindering search and rescue efforts. Taiwanese authorities expect there to be more aftershocks in the next few days.

Pictures show how the road outside Hualien's Qingshui tunnel - one of many winding roads that run along Hualien's rocky coastline - had simply fallen away.

Routes like Qingshui are popular among tourists because of their spectacular views from the mountains out across the Pacific Ocean. But they are also known to be treacherous, not least because of the possibility of landslides.



Map of Taiwan showing areas hit most severely by earthquake. (Source: USGS / BBC)

Further north, the capital Taipei was also shaken violently with footage showing damaged buildings and people being evacuated. Local TV stations aired clips of smashed vehicles and stores in disarray.

"The earthquake is close to land and it's shallow. It's felt all over Taiwan and offshore islands. It's the strongest in 25 years," Wu Chien Fu, the director of Taipei's Seismology Centre said on Wednesday.

Power cuts and internet outages were reported across the island.

The earthquake also triggered tsunami alerts earlier in the day on Wednesday in nearby Japanese and Philippine islands, but these alerts were later downgraded.

While Taiwan has a history of quakes, both locals and foreigners who have lived in Taipei for years say this is the strongest quake they have experienced in decades.

The last major quake at 7.6 magnitude hit in September 1999, killing 2,400 people and destroying 5,000 buildings.

Additional reporting by Fan Wang in Singapore and BBC Chinese's Tzu-Wei Liu in Taipei

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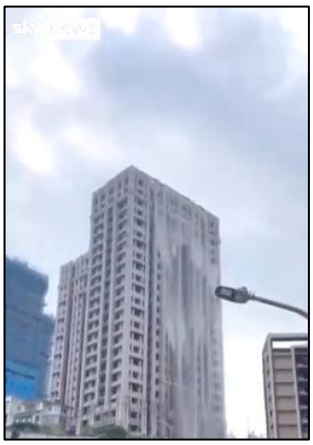
Rooftop pool water spills downside of skyscraper during earthquake in Taiwan



Water was seen pouring down the side of a building in Taipei, Taiwan, after the country was hit by its strongest earthquake in 25 years.

Thanks to Angela Snowling for this link.

Reference:

https://news.sky.com/video/rooftop-pool-water-spills-down-side-of-skyscraper-during-earthquake-in-taiwan-13106991

Kermit the Frog honoured in new fossil find

By Maddie Molloy, BBC News Climate & Science
21 March 2024

A 270-million-year-old fossil that sheds light on the murky origins of amphibians has been named after **Kermit** - the world's most famous frog.

Arjan Mann (right) and Calvin So (left) holding the fossil skull of Kermitops in front of the Kermit the Frog. (Image source: James D. Tiller and James Di Loreto, Smithsonian)

Scientists found the fossilized skull in a collection at the **Smithsonian National Museum of Natural History.**

They say it's a new species of proto-amphibian and have named it ***Kermitops gratus*** because it bears a likeness to the iconic Muppet. The much-loved, but famously shy frog would doubtless blush at the attention.

The researchers said the fossil was part of a group of relatives of amphibians that lived for more than 200 million years but was totally unique.

There were a lot of features that were different from those in older tetrapods, amphibians' ancient ancestors.

For example, the region of the skull behind the animal's eyes was much shorter than its elongated, curved snout. Unique features like these led scientists to conclude that it belonged to a new species.

'What really jumped out to us was how [the fossil looked] bug-eyed, and due to slight crushing during the preservation it gave it kind of like a lopsided, crooked smile, and it really evoked Kermit's smile," said Calvin So, a doctoral student at George Washington University and lead author of the study.

The prehistoric fossil had spent decades in the Smithsonian's National Fossil Collection waiting for a scientist to take a closer look at it.

That would likely resonate with Kermit, whose hit song ***"It's Not Easy Being Green"*** reflected on how it felt to be constantly overlooked.

The Kermitops fossil (left) next to a modern frog skull. (right). (Image source: Brittany M. Hance, Smithsonian)

But *Kermitops gratus* is a fossil of enormous significance, the scientists say.

The early fossil record of amphibians and their ancestors is largely fragmentary which makes it hard to figure out how frogs, salamanders and their kin evolved.

Discovering new species like *Kermitops* is essential for fleshing out the early branches of the amphibian family tree, the researchers said.

Reference:

https://www.bbc.com/news/science-environment-68575911

Triassic 'tank' unearthed in Texas was a croc cousin that lived 215 million years ago

By Patrick Pester, LiveScience
20 March 2024

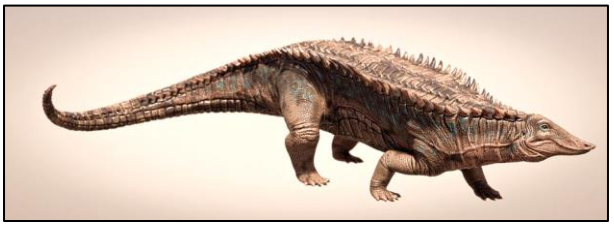
Fossil discovered in 1989 found to be new species of aetosaur — a massive, armoured crocodile cousin that lived during the late Triassic

A huge, armoured crocodile cousin with plates embedded in its skin and curved spikes along its flanks roamed our planet **215 million years ago**, scientists reveal.

The newfound species, discovered in the Cooper Canyon Formation in northwestern Texas, was an **aetosaur**. These stout-limbed beasts grew up to 16 feet (5 meters) long and were covered in bony plates called osteoderms for protection. They were "tanks of the Triassic," according to a statement released by The University of Texas at Austin.

Researchers unearthed a large portion of the creature's dorsal carapace, or back armour, the researchers said in a study, published Jan. 11 in the journal ***The Anatomical Record***.

"We have elements from the back of the neck and shoulder region all the way to the tip of the tail," lead author William Reyes, a doctoral student at The University of Texas at Austin, said in the statement. "Usually, you find very limited material."



An illustration of the newly discovered aetosaur, Garzapelta muelleri. (Image credit: Márcio L. Castro)

Aetosaurs ruled Earth during the late Triassic (237 million to 201 million years ago), living on every continent except Australia and Antarctica, according to the statement. Unlike modern crocodiles, which are strictly carnivores, aetosaurs were primarily omnivores.

The late palaeontologist Bill Mueller discovered the newly described fossil with local amateur collector Emmett Shedd in 1989. Preliminary research in the early 2000s found that the animal was likely a new species of aetosaur but didn't decipher its evolutionary history.

Reyes and his colleagues named the animal *Garzapelta muelleri*. The genus name combines "Garza" from Garza County, where it was found, with "pelta," meaning "shield" in Latin. The species name honours Mueller.

The fossil stands out among known aetosaurs thanks to a variety of unique features, including

a never-before-seen combination of bony plates. However, the team had trouble figuring out where it sat on the aetosaur family tree.

Most aetosaurs fit into one of two major groups: Aetosaurinae and Stagonolepidoidea. However, *G muelleri* had osteoderms on its back that resembled a species of Aetosaurinae called *Rioarribasuchus chamaensis* and lateral osteoderms — midsection spikes — that resembled a genus of species in Stagonolepidoidea called *Desmatosuchus*, according to the study.

William Reyes examines the fossilized remains of Garzapelta muelleri. (Image credit: William Reyes)

The team cautiously concluded that *G muelleri* had more in common with Aetosaurinae overall and that its spikes likely evolved independently in a process called *convergent evolution*, where two unrelated or distantly related species evolve similar traits independently.

"Convergence of the osteoderms across distantly related aetosaurs has been noted before, but the carapace of *Garzapelta muelleri* is the best example of it and shows to what extent it can happen and the problems it causes in our phylogenetic analyses," Reyes said.

Reference:

https://www.livescience.com/animals/extinct-species/triassic-tank-unearthed-in-texas-was-a-croc-cousin-that-lived-215-million-years-ago?utm_term=8DEBC9E5-6C7F-4337-AFFF-D9A51CC6C2C0&lrh=840a98cbe34ba22d824f6df096d90a0be8fe4763876a779b0361304855882d8f&utm_campaign=368B3745-DDE0-4A69-A2E8-62503D85375D&utm_medium=email&utm_content=FF1BE4B3-55AA-4329-A1AB-5156F7AF9A71&utm_source=SmartBrief

Reykjanes volcano update: New eruption started last night, 4th in row since October

By MARTIN, Volcano Discovery
17 March 2024

The oozing lava advances toward Grindavík (image: Almannavarnir)

A new effusive eruption commenced on the Reykjanes Peninsula at 20:23 local time.

A 2.9 km-long eruptive fissure opened between the Hagafell and Stóra Skógfell mountains. The eruption site location is very similar to that of the recent February eruption.

Impressive lava fountains began to shoot several dozens of meters following the eruption onset. Fountaining continues to pour incandescent and fluid lava from a cluster of vents, feeding a new lava flow in the west direction. A new lava arm branched off the main flow, heading south towards the protective barriers. Unfortunately, the lava is (highly likely) on the way to the Grindavík and might hit the town.

At about 22:10 local time, the lava lobe front was approx. 200 meters from the artificial barrier, located in the eastern part of the town of Grindavík. At 22:20 local time, the lava flow was about 700-800 meters away from the Grindavíkurvegur road.

Given a current magma supply rate, about 1 km per 1-1.5 hour, the lava might reach the shoreline and enter the sea.

The eruption came during a very short phase of generally a low seismic activity and had only 40 minute-long precursor. The Department of Civil Protection and Emergency Management received the first signal at 19:43 local time, the eruption followed 40 minutes later. Sulfur dioxide is contained in solution in magma at greater depths, but as magma is getting closer to the surface and is under less pressure, i.e. undergoes decompression, its solubility decreases with decreasing pressure, thus leaves magma sooner through cracks fumaroles form or by diffuse degassing. Since gas is much more mobile than molten rock (magma) itself, it usually arrives at the surface before eruption starts.

From initial reconnaissance flight, aerial images and web cameras, the fourth eruption in a row since October 2023 is considered among the largest of previous three events so far.

Source: Icelandic Met Office volcano activity update 17 March 2024

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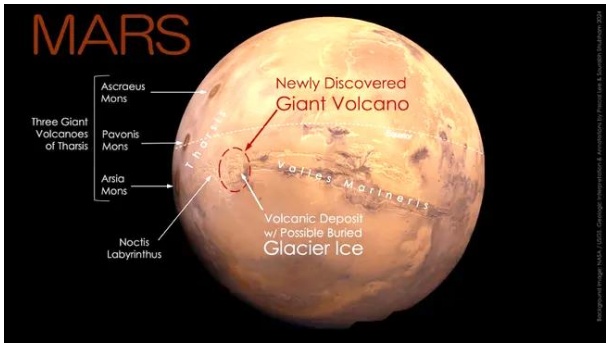
Giant Mars volcano discovered 'hiding' in plain sight

By Leonard David (space.com)

14 March 2024

The giant volcano had been hiding in plain sight for decades in one of Mars' most iconic regions.

The Red Planet continues to surprise us. New research has unveiled a giant volcano and possible sheet of buried glacier ice.



The newly discovered giant volcano on Mars is located just south of the planet's equator, in Eastern Noctis Labyrinthus, west of Valles Marineris, the planet's vast canyon system. The volcano sits on the eastern edge of a broad regional topographic rise called Tharsis, home to three other well-known giant volcanoes: Ascraeus Mons, Pavonis Mons, and Arsia Mons. (Image credit: Background image: NASA/USGS Mars globe. Geologic interpretation and annotations by Pascal Lee and Sourabh Shubham 2024)

The site for this groundbreaking announcement is in the eastern part of the Tharsis volcanic province on Mars, near the planet's equator. Due to its eroded, tough-to-spot nature, the feature has been missed since Mariner 9 collected imagery of the site in 1971.

The finding was reported during the **55th Lunar and Planetary Science Conference** now under way in The Woodlands, Texas, according to a statement from the SETI Institute. The study was conducted using data from NASA's Mariner 9, Viking Orbiter 1 and 2, Mars Global Surveyor, Mars Odyssey, and Mars Reconnaissance Orbiter missions, as well as the European Space Agency's Mars Express mission.

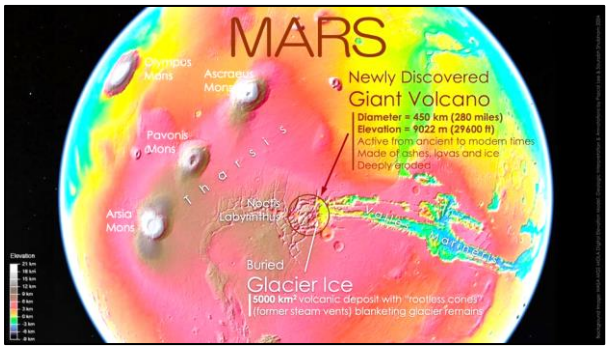
Potential destination?

The giant volcano had been hiding in plain sight for decades in one of Mars' most iconic

regions, at the boundary between the heavily fractured maze-like Noctis Labyrinthus (Labyrinth of the Night) and the vast canyon system of Valles Marineris (Valleys of Mariner).

The area in which the newly documented volcano sits is home to three other well-known giant volcanoes: Ascraeus Mons, Pavonis Mons, and Arsia Mons.

Although more eroded and less high than these other volcanic counterparts, the newly discovered volcano rivals the others in diameter: about 280 miles (450 kilometres) and measures roughly 29,600 feet (9,022 meters) in elevation.



Topographic map showing the iconic location of the Noctis volcano between the largest volcanic and canyon provinces on Mars. (Image credit: Background image: NASA Mars Global Surveyor (MGS) Mars Orbiter Laser Altimeter (MOLA) digital elevation model. Geologic interpretation & annotations by Pascal Lee and Sourabh Shubham 2024)

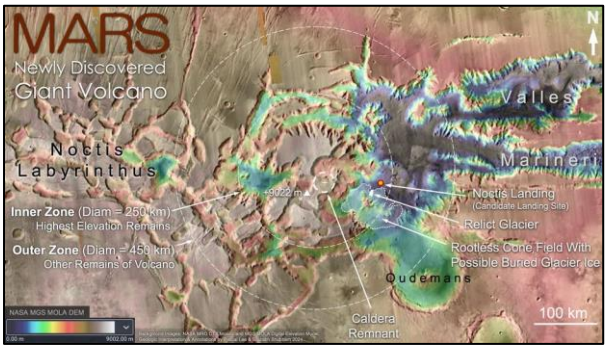
"Its discovery points to an exciting new place to search for life, and a potential destination for future robotic and human exploration," notes the SETI Institute's statement.

Long-sought "smoking gun"

Lead author of the study is Pascal Lee, a planetary scientist with the SETI Institute and the Mars Institute based at NASA Ames Research Center.

"We were examining the geology of an area where we had found the remains of a glacier last year when we realized we were inside a huge and deeply eroded volcano," Lee explains.

The volcano's enormous size and complex modification history indicate that it has been active for a very long time. Furthermore, in its southeastern part lies a thin, recent volcanic deposit beneath which glacier ice is likely still present.

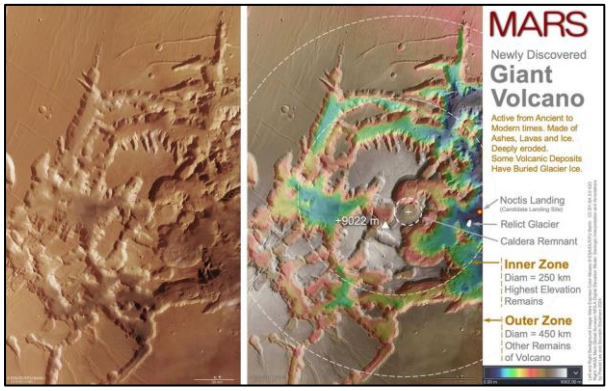


The Noctis volcano does not present the conventional cone shape of a typical volcano because a long history of deep fracturing and erosion has modified it. However, upon close inspection, key features indicative of a volcano are recognizable. Within the "inner zone" delineating the highest elevation remains of the volcano, an arc of high mesas marks the central summit area, culminating at +9,022 m (29,600 ft). Preserved portions of the volcano's flanks extend downhill in different directions to the outer edge of the "outer zone," 225 km (140 miles) away from the summit area. A caldera remnant – the remains of a collapsed volcanic crater once host to a lava lake – can be seen near the centre of the structure. Lava flows, pyroclastic deposits (made of volcanic particulate materials such as ash, cinders, pumice and tephra) and hydrothermal mineral deposits occur in several areas within the perimeter of the volcanic structure. The map also shows the rootless cone field and possible extent of shallow buried glacier ice reported in this study, in relation to the "relict glacier" discovered in 2023. Noctis Landing, a candidate landing site for future robotic and human exploration, is also shown. (Image credit: Background images: NASA Mars Reconnaissance Orbiter (MRO) Context Camera (CTX) mosaic and Mars Global Surveyor (MGS) Mars Orbiter Laser Altimeter (MOLA) digital elevation model. Geologic interpretation & annotations by Pascal Lee & Sourabh Shubham 2024)

"This area of Mars is known to have a wide variety of hydrated minerals spanning a long

stretch of Martian history," explains Sourabh Shubham, a graduate student at the University of Maryland's Department of Geology and the study's co-author.

"A volcanic setting for these minerals had long been suspected. So, it may not be too surprising to find a volcano here," Shubham added. "In some sense, this large volcano is a long-sought 'smoking gun.'"



Detailed analysis of the altimetry of the region using NASA's Mars Global Surveyor (MGS) Mars Orbiter Laser Altimeter (MOLA) data, in combination with high resolution imaging data from NASA's Mars Reconnaissance Orbiter (MRO) High Resolution Imaging Science Experiment (HiRISE) and Context Imager (CTX), and from the European Space Agency's Mars Express (MEX) High Resolution Stereo Camera (HRSC) enabled the discovery of the Noctis volcano. In addition to the volcano's summit, caldera remnant, and inner and outer zones, the topographic map on the right shows the "relict glacier" discovered in 2023 and Noctis Landing, a candidate landing site for future robotic and human exploration. (Image credit: Left: Mars Express HRSC colour mosaic © ESA/DLR/FU Berlin CC BY-SA 3.0 IGO; Right: Background image: same as Left; NASA MGS MOLA digital elevation model. Geologic interpretation and annotations by Pascal Lee and Sourabh Shubham 2024)

Unknowns and mysteries

This new discovery, however, also underscores several mysteries.

For one, while it is clear that it has been active for a long time and began to build up early in Mars' history, what is unknown is exactly how early. Likewise, although it has experienced eruptions even in geologically speaking "modern times," it is not known if the feature is still volcanically active and might erupt again.

Mix in yet another unknown. If it has been active for a long time, could the combination of sustained warmth and water from ice have allowed the site to harbour life?

"It's really a combination of things that makes the Noctis volcano site exceptionally exciting," Lee senses. "It's an ancient and long-lived volcano so deeply eroded that you could hike, drive, or fly through it to examine, sample, and date different parts of its interior to study Mars' evolution through time."

Prime location

Lee concludes that its long history of heat interacting with water and ice "makes it a prime location for astrobiology and our search for signs of life."

Finally, with glacier ice likely still preserved near the surface in a relatively warm equatorial region on Mars, "the place is looking very attractive for robotic and human exploration," Lee said in the SETI statement.

The possible presence of glacier ice at shallow depths near the equator means that humans could potentially explore a less frigid part of the planet while still being able to extract water for hydration and manufacturing rocket fuel.

That made-on-Mars propellant is feasible by breaking down the water into hydrogen and oxygen.

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Scientists reject proposal to define the Anthropocene, a geological age marked by human activity

Experts had suggested a new epoch started in the mid-20th century, but the recent vote demonstrates how tough it is to pinpoint when humans' impact on the planet began

Will Sullivan, Smithsonian Magazine, Daily Correspondent
6 March 2024

A group of scientists has **voted against defining a new geological period called the Anthropocene**, marked by humans' impact on the planet, the **New York Times' Raymond Zhong** reports.

In October, the Anthropocene Working Group proposed that an Anthropocene epoch started in the mid-20th century, when nuclear weapons tests left radioactive fallout across the planet. They submitted this proposal to the Subcommission on Quaternary Stratigraphy (SQS), which establishes a standard timescale for the past 2.6 million years and is part of the International Union of Geological Sciences.

Twelve SQS members rejected the proposal, while **four voted in favour** and **two abstained**, according to the New York Times. This decision came as a surprise to many scientists, per New Scientist's Chen Ly.

"We've provided ample evidence that the rate at which humans have an impact on the planet has increased dramatically," working group member Francine McCarthy, a palaeontologist at Brock University in Canada, tells the Washington Post's Sarah Kaplan. "It's hard to understand how anyone who looks at the science can say that there wasn't a massive tipping point in the mid-20th century."

One reason the proposal was rejected is that human impacts on the planet started before the mid-20th century, Mike Walker, an SQS voting member who studies climate change at the University of Wales, tells **New Scientist**. As a result, some experts thought the proposed definition of the epoch was too limited.

"It constrains, it confines, it narrows down the whole importance of the Anthropocene," Jan A. Piotrowski, an SQS voter and geologist at Aarhus University in Denmark, tells the New York Times. "What was going on during the onset of agriculture? How about the Industrial Revolution? How about the colonizing of the Americas, of Australia?"

The current period of geologic time is the **Holocene epoch**, which began 11,700 years ago. Its start coincides with the end of the last ice age, and it has been a relatively warm period.

Homo sapiens evolved hundreds of thousands of years ago and have significantly reshaped the planet by cutting down forests, detonating nuclear weapons, dumping plastics on land and in the oceans, driving the extinction of many species and burning fossil fuels, releasing greenhouse gases into the atmosphere.

The term **"Anthropocene"** was devised in 2000 to describe the present geological time period shaped by humans' impact on the planet. "Anthropo," from Greek, means "human."

Fifteen years ago, the working group started searching for a geological site that would best represent humanity's impact on Earth and provide evidence for the Anthropocene, per CNN's Katie Hunt. Last year, they settled on **Crawford Lake** in Ontario, Canada. The lake's sediment has preserved a record of human activity, including microplastics, evidence of burning fossil fuels and a measure of radioactive plutonium from testing nuclear weapons.

"All these lines of evidence indicate that the Anthropocene, though currently brief, is—we emphasize—of sufficient scale and importance to be represented on the geological time scale," working group members Simon Turner, a geographer and University College London, and Colin Waters, a geologist at the University of Leicester in England, write to New Scientist in an email.

The working group decided to propose that the Anthropocene started in 1952, when radioactive fallout from hydrogen bomb tests was first measured, Erle C. Ellis, an ecologist at the University of Maryland, Baltimore County, writes in the Conversation. Ellis used to be a member of the working group but resigned because he thought the group was defining the Anthropocene too narrowly.

“By tying the start of the human age to such a recent and devastating event—nuclear fallout—this proposal risked sowing confusion about the deep history of how humans are transforming the Earth, from climate change and biodiversity losses to pollution by plastics and tropical deforestation,” Ellis writes in the Conversation.

Ultimately, the SQS rejected the working group’s proposal. “It suggests that all of a sudden, within my lifetime, the changes that are affecting the planet suddenly appeared,” Philip Gibbard, a geologist at the University of Cambridge in England who voted against the proposal, tells the Washington Post. “But humans have in fact been influencing the natural environment for 40,000 years.”

For its part, the working group has many members “who wish to carry on as a group, in an informal capacity, that will continue to argue the case that the evidence for the Anthropocene as an epoch should be formalized,” Waters writes to CNN in an email.

Importantly, the decision is not a rejection of the idea that humans have had a profound impact on the Earth.

“This has nothing to do with the evidence that people are changing the planet,” Ellis tells the New York Times. “The evidence just keeps growing.”

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World's earliest fossilised forest discovered in Minehead, Somerset

By Greg Brosnan, Digital Editor, BBC News Climate and Science
8 March 2024

Scientists have found what they believe to be the world's earliest known fossilised forest in cliffs on the coast of South West England.

It was discovered in high sandstone cliffs near **Minehead, Somerset, close to a Butlin's holiday camp.**

Researchers from Cambridge and Cardiff Universities say they are the **oldest fossilised trees ever found in Britain and the oldest known forest on Earth.**

The cliffs where the forest was discovered. (Image Source, Neil Davies)

The trees, known as *calamophyton*, resemble palm trees.

Described as a kind of 'prototype' of today's trees, the largest were between two and four metres tall.

The researchers identified the fossils of plants and their debris as well as fossilised tree logs and traces of roots.

They show how early trees helped shape landscapes and stabilised riverbanks and coastlines hundreds of millions of years ago.

"When I first saw pictures of the tree trunks I immediately knew what they were, based on 30 years of studying this type of tree worldwide," said co-author Dr Christopher

Berry from Cardiff's School of Earth and Environmental Sciences.

"It was amazing to see them so near to home. But the most revealing insight comes from seeing, for the first time, these trees in the positions where they grew."

Dr. Paul Kenrick, an expert on plant fossils at the Natural History Museum, who was not involved in the study, said that these clues as to how plants grew together at the time were deeply significant.

The researchers say the fossil forest is about four million years older than the previous record holder in New York State.

Detail of a fallen tree trunk. (Image Source, Chris Berry)

The cliffs where the forest was discovered. (Image Source, Neil Davies)

It was found in the **Hangman Sandstone Formation** along the Devon and Somerset coasts and dates back to the **Devonian Period**, between 419 and 358 million years ago, the time of life's big expansion onto land. The period is named after Devon because of marine rocks emblematic of the period, which geologists found off the coast.

The researchers say that the area of the find was at the time a semi-arid plain, attached not to England, but to parts of Germany and Belgium, where fossils of such trees have also been found.

"This was a pretty weird forest - not like any forest you would see today," said Prof. Neil Davies from Cambridge's Department of Earth Sciences, the study's first author. "There wasn't any undergrowth to speak of and grass hadn't yet appeared, but there were lots of twigs dropped by these densely-packed trees, which had a big effect on the landscape."

Dr. Kenrick, from the Natural History Museum said that the trees were very different from any we know today. The most similar modern counterpart might be *Dicksonia antarctica*, a type of tree fern native to Australasia, but popular in Britain as an ornamental plant.

Dicksonia antarctica - perhaps the nearest modern-day equivalent to the ancient forest's trees. (Image Source, Getty Images)

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New Royal Mail stamps will feature dinosaurs and celebrate Mary Anning

By Josh Davis, NHM
5 March 2024

Royal Mail is releasing a trove of new **palaeontological-themed** stamps.

One set will feature the pioneering scientist **Mary Anning** and three of the fossils she unearthed along the Dorset coastline, while another eight stamps will feature a **range of dinosaurs, pterosaurs** and **marine reptiles**.

This year you can get your claws on a range of roar-some stamps, which depict iconic dinosaurs such as *Tyrannosaurus*, *Diplodocus* and *Stegosaurus.*

In collaboration with The Natural History Museum, Royal Mail is releasing a new series of stamps that showcase a range of ancient animals, in addition to a set depicting a handful of the amazing finds made by palaeontologist Mary Anning.

The stamps celebrating Mary Anning show a portrait of the pioneering palaeontologist and a selection of fossils she unearthed. (©Royal Mail)

'It is fitting in the week of **International Women's Day** that we pay tribute to Mary Anning with four images of some of the fossils she discovered,' explains David Gold, the Director of External Affairs and Policy at Royal Mail. 'She was one of the greatest fossil hunters of the 19th century, making a major contribution to our understanding of the majestic creatures that roamed Earth hundreds of millions of years ago.'

Working with digital concept illustrator Joshua Dunlop to bring these animals to life, the stamps capture a number of exciting scenes.

In one, a *Tyrannosaurus* faces off against a *Triceratops*, whilst in another a herd of *Iguanodon* are set against a fiery background as *Coloborhynchus* pterosaurs soar through the sky. As this year is the 200th anniversary of the naming of *Megalosaurus*, it seems only fitting that the stamps show one wading in the shallow sea and interacting with a *Cryptoclidus plesiosaur*.

All the stamps are available to pre-order on the Royal Mail's website. (©Joshua Dunlop/Royal Mail)

'We were thrilled when Royal Mail approached us to collaborate on these brilliant sets of stamps' says Maxine Lister, the Head of Licensing at the Natural History Museum.

'It's perfect timing too, as we have just celebrated the 200th anniversary since the naming of the first dinosaur, *Megalosaurus*, which features as part of this collection.'

'Our mission is to create advocates for the planet, and we hope these stunning designs inspire everyone to discover a bit more about our natural world, whether that be the creatures that lived here before us, or the pioneering figures who shaped our understanding of them today."

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Geological training for tour guides in Geopark bid

Charles Vivian, BBC News, Jersey
1 March 2024

Jersey tour guides have been given training as part of the island's bid for Geopark status.

In 2021, the Aspiring Jersey Island Geopark (AJIG) project launched **Jersey's plans to become a UNESCO Geopark** - which would see it recognised as a unified geographical area and landscape of international geological significance.

Tour guides have been given training to help boost Jersey's chances of achieving Geopark status. (Credit: BBC)

Dr. Yunus Baykal, researcher for the Past Climates of Jersey project, has taught local tour guides and ambassadors about Jersey's "very rare" geology to help boost the island's chances to become a Geopark.

He said Jersey was "perfectly suited for Geotourism".

Dr. Baykal said: "These cliffs for example here in Portlet, but also in other places, they are ... visual records of past climate. You can really walk along, you can touch sediments that have been deposited 150,000 years ago. This is really a very rare and complete record of this period that we have in North Western Europe."

Millie Butel, Jersey Heritage's Landscape Engagement & Geopark Development Curator, said the island was a popular destination for researchers.

She said Dr. Baykal had provided the guides and ambassadors with the right "terminology" and "knowledge" so that they could "integrate it to what they are doing already".

Ms. Butel said giving Jersey Geopark status would give Jersey "international recognition".

"Putting it on the map internationally to be an outstanding place, not just for our geology, but our cultural and natural heritage as well - and joining over 195 places around the world and having access to that network of all these places as well," she said.

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2. https://www.jerseyislandgeopark.org.je/
3. https://www.bgs.ac.uk/geology-projects/geoparks/

Fossil reveals 240-million-year-old 'dragon'

By Victoria Gill, Science correspondent, BBC News
23 February 2024

Scientists have revealed a new, remarkably complete fossil - a 16ft (5m)-long aquatic reptile from the Triassic period.

The creature dates back 240 million years and has been dubbed a **"dragon"** because of its extremely long neck.

It is called *Dinocephalosaurus orientalis*, a species that was originally identified back in 2003.

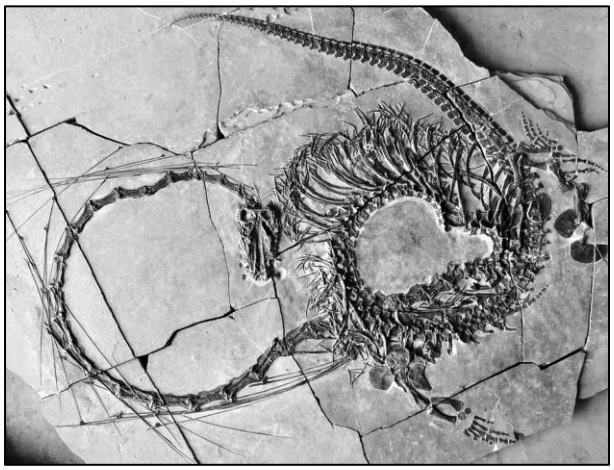
This spectacular new fossil has allowed scientists to see the full anatomy of this bizarre prehistoric beast.

Dr. Nick Fraser, from **National Museums Scotland**, who was part of the international team that studied the fossil, said this was the first-time scientists had been able to see it in full. He described it as "a very strange animal".

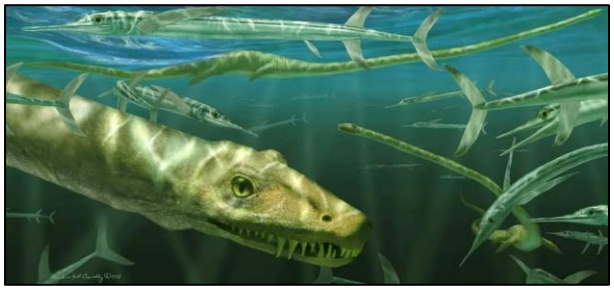
"It had flipper-like limbs, and its neck is longer than its body and tail combined," he said.

The researcher speculated that a "long, bendy and flexible neck", with its 32 separate vertebrae, might have provided a hunting

advantage - allowing *Dinocephalosaurus orientalis* to search for food in crevices under the water.



Dinocephalosaurus orientalis. (Image Source, National Museums Of Scotland)



An artist's impression of Dinocephalosaurus orientalis swimming alongside prehistoric fish known as Saurichthys. (Image Source, Marlene Donelly)

The fossil was discovered in ancient limestone deposits in southern China.

"This discovery just adds to the weirdness of the Triassic," Dr. Fraser told BBC News. "And every time we look in these deposits, we find something new."

The paper describing a set of new fossils of the animal is published in the journal **Earth and Environmental Science: Transactions of the Royal Society of Edinburgh**.

Reference:

https://www.bbc.com/news/science-environment-68374520

Iceland volcano erupts for 3rd time, triggering lava fountains over 200 feet tall

By Harry Baker, Live Science
8 February 2024

The underground volcano near Grindavík has begun its third major eruption in three months, opening up a 2-mile-long fissure that is pumping out large amounts of lava and ash.

The volcano in Iceland erupted for the third time at around 6:00 a.m. local time on Thursday (Feb. 8). (Image credit: Iceland Civil Defense/Handout/Anadolu via Getty Images)

A volcano in the southwest of Iceland has erupted for the third time in three months on Thursday (Feb. 8), opening up a new 2-mile-long (3km) fissure and spewing out large plumes of lava and ash. At present, the eruption poses no risk to local people, but has caused damage to nearby infrastructure.

The volcano, which is located to the north of the evacuated fishing town of Grindavík in the Reykjanes Peninsula, first erupted on Dec. 18, 2023, after weeks of seismic activity and ground deformation, and again in January this year.

Earlier this week experts warned that the volcano could imminently erupt again after large quantities of molten rock began to pool in the volcano's magma chamber. At around 6:00 a.m. local time, the volcano burst through a fissure following a brief period of increased seismic activity, according to the **Icelandic Met Office** (IMO).

The eruption started strong, with giant lava fountains reaching between 164 and 262 feet

tall (50 and 80 meters). The eruption plume, which is made up of ash, smoke, and toxic gases, reached up to 2 miles above the surface and the lava's glow could be seen from outside the Reykjanes peninsula before the sun rose, IMO reported.

The new eruption began at the **Sundhnúksgígar crater** near Mount Sundhnúkur to the north of Grindavík. Shortly after the eruption began, a team of scientists were flown to the site in a helicopter to assess how the event might develop, the Icelandic Coast Guard reported.

Molten lava is seen overflowing the road leading to the famous tourist destination "Blue Lagoon" near Grindavik, western Iceland on February 8, 2023. (Image credit: Kristinn Magnusson / AFP / Iceland OUT via Getty Images)

The rate of lava flow is believed to be slightly less than the first eruption, which at its peak was spewing out enough molten rock to fill an Olympic swimming pool every 20 seconds.

Lava flows from the fiery fissure are expected to flow north, east, and west, away from Grindavík, according to Icelandic news site RÚV. The famous Blue Lagoon spa resort and geothermal Svartsengi power plant are also safe at the moment. However, flowing lava has already crossed the road at the exit to the Blue Lagoon, RÚV reported.

There is a chance that another fissure could open up to the south of the new eruption, which could unleash lava flows toward Grindavík, Kristín Jónsdóttir, head of IMO's volcano department, told RÚV. "But we're not seeing that right now."

However, wind-blown pyroclastic slag from the eruption has been found in the town, according to RÚV, who are also reporting that authorities are having difficulties in protecting the region's water supply.

"The situation is simply that we are not managing to protect this as much as we had hoped, and that could lead to lava flowing in such a way that all of Suðurnes [region in southwest Iceland] would be without hot water," Víðir Reynisson of the Icelandic Police told the national broadcaster.

Reference:

1. https://www.livescience.com/planet-earth/volcanos/iceland-volcano-erupts-for-3rd-time-triggering-lava-fountains-over-200-feet-tall?utm_term=8DEBC9E5-6C7F-4337-AFFF-D9A51CC6C2C0&lrh=840a98cbe34ba22d824f6df096d90a0be8fe4763876a779b0361304855882d8f&utm_campaign=368B3745-DDE0-4A69-A2E8-62503D85375D&utm_medium=email&utm_content=70220FCF-D070-44FF-8E01-6A8C1C943147&utm_source=SmartBrief
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New pterosaur from Skye reveals the hidden diversity of the Middle Jurassic

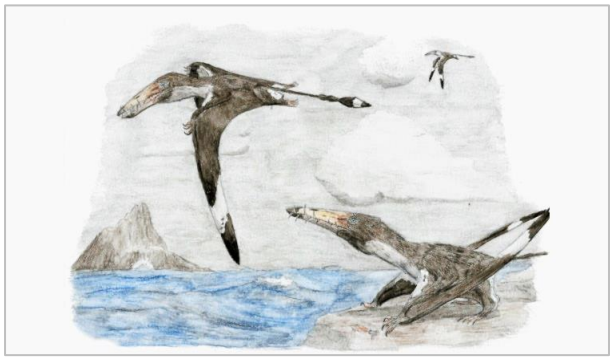
By James Ashworth, Science News
6 February 2024

A newly described species of flying reptile is helping to bridge a major gap in our knowledge of pterosaur evolution.

Discovered in Scotland, Ceoptera evansae shows that Middle Jurassic pterosaurs were more species-rich than previously realised.

A well-preserved fossil uncovered on the Isle of Skye has been revealed as a new species of pterosaur.

With an estimated wingspan of 1.6 metres, *Ceoptera evansae* would have soared through the Jurassic skies over 165 million years ago. Its fossil gives scientists an insight into a poorly understood time during pterosaur history, when well-preserved remains are hard to come by.



An artist's impression of Dearc sgiathanach pterosaurs roosting and flying above a sea. The pterosaur is one of the few well-preserved pterosaurs of the Middle Jurassic. (Image © El fosilmaníaco, licensed under CC BY-SA 4.0 via Wikimedia Commons)

Professor Paul Barrett led the expedition which discovered the fossil and has co-authored the description of the new species.

'This new species is the first of its particular group to have been found in Scotland and is only the second flying reptile to be named from the country,' says Paul. 'It reveals that these animals were much more widespread than would otherwise be known from their generally patchy fossil record, and dates important events in pterosaur history to an earlier time.'

'It also adds another species to the growing fauna we have from the Scottish Middle Jurassic, where we already know of an ancient aquatic turtle, dinosaurs, fossil mammals, salamanders and another pterosaur.'

'As fossil vertebrates are poorly known in the Middle Jurassic, Skye is proving an important locality in increasing our knowledge of this period.'

The description of *Ceoptera* was published in the **Journal of Vertebrate Paleontology**.

Pterosaurs and the mysterious Middle Jurassic

Pterosaurs first appeared in the fossil record in the Late Triassic and are believed to have evolved as close relatives of **the lagerpetids**, a group of small dinosaur-like animals. However, the lack of transitional forms in the evolution of pterosaurs makes it hard for scientists to be completely certain of their origin.

'Pterosaur fossils have a very poor fossil record in general, as their bones are quite fragile,' Paul explains. 'As flying animals, they're also not spending as much time on the ground near the rivers and lakes where fossils usually form.'

'Most of what we know about pterosaurs, especially in the Early and Middle Jurassic, comes from a handful of sites known as **Lagerstätten** where fossil preservation is exceptional. Almost everything we know about pterosaur biology and evolution comes from only eight or nine of these key areas around the world.'

Derived from the German word for deposits, *Lagerstätten are rich fossil beds where important remains, such as Archaeopteryx, were first found.* Other sites containing significant numbers of pterosaur fossils, such as China's Jehol Biota, are known for the Late Jurassic and Early Cretaceous, but not for other periods.

This gives the impression that pterosaur diversity peaked during these times, but this is just a consequence of the otherwise poor preservation of these animals throughout the rest of their history.

One exception to this is *Dearc sgiathanach*, another pterosaur discovered on the Isle of Skye. Described in 2022, this species is incredibly well-preserved, and may represent one of largest pterosaurs in the Middle Jurassic skies.

Specimens like *Dearc* and *Ceoptera* suggest that the Jurassic was much richer in pterosaurs than previously known. Finding more new species will help palaeontologists to understand how the main types evolved.

The fossils of Ceoptera, still partly encased in the rocks they were discovered in. A combination of physical preparation and digital scanning allowed the researchers to reconstruct the pterosaur. (Image © The Trustees of the Natural History Museum, London)

What does *Ceoptera evansae* reveal about pterosaurs?

The fossil was discovered in **2006** near Elgol on the southwest coast of the **Isle of Skye** during a Natural History Museum field trip.

'This area of Skye is a **Site of Special Scientific Interest**, so we could only collect specimens from rocks that had fallen naturally onto the beach,' Paul says. 'While crawling over these boulders to examine them for fossils, we noticed a few bones sticking out.'

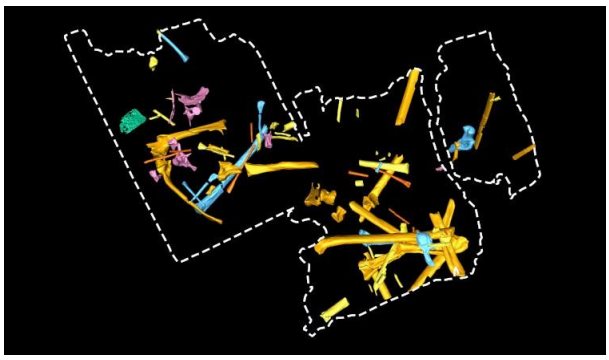
'We collected the top of the boulder, and Lu Allington-Jones then spent over a year stabilising it at the Natural History Museum. She then used a variety of techniques, such as acid preparation and pneumatic pens, to expose the bones for study.'

In addition to physical preparation, the team also took **CT scans** to expose areas of the bone that were too fragile to be removed from the rocks. They revealed features such as a bony flange on the shoulder that set the specimen apart from other pterosaurs.

Lead author Dr. Liz Martin-Silverstone, a palaeobiologist from the University of Bristol, says, 'The time period that the fossil is from is one of the most important in pterosaur evolution, meaning it was already a significant find.'

'However, to find that there were more bones embedded within the rock made this an even better find than initially thought. It brings us one step closer to understanding where and when the more advanced pterosaurs evolved.'

The team's research has now culminated in the specimen being formally described as a new species. The genus name is derived from the Scottish Gaelic word for mist, 'ceò', in reference to the Isle of Skye sometimes being known as the Isle of Mist, combined with the Latin word for wing.



Scans of the rocks containing Ceoptera evansae, showing the bones contained within. As pterosaur bones are fragile, scans of the rocks have allowed researchers to investigate the fossils without damaging them. (Image © Liz Martin-Silverstone)

Meanwhile, its specific name recognises **Professor Susan Evans** of University College London for her research career as well as introducing the team to the area of Skye where the new species was found.

Comparisons of *Ceoptera* with other pterosaurs suggest that it belongs to a group known as the darwinopterans, which appear to represent the transition between early pterosaurs and the later pterodactyloids. However, it had been uncertain whether the darwinopterans were all descended from a single ancestor or are instead a group of similar looking but unrelated organisms.

Using *Ceoptera*, researchers have been able to identify features, such as a reduced toe on the foot, in many different species, which suggests that they do form a single group of related pterosaurs.

'The new species fits very well within the darwinopterans and helps to extend the geographic range of the group from well-preserved material in China to the UK and Argentina,' Paul says. 'It also reveals that these reptiles originated in the Early Jurassic, which is much earlier than had previously been known.'

'We now think that the darwinopterans persisted for around 25 million years alongside a rich diversity of other pterosaurs, including *Dearc*. This overlap is very rarely found in the fossil record, with China and the UK currently the only places where this is known.'

The researchers hope that *Ceoptera* will be one of many new species of Middle Jurassic pterosaurs to be found, opening up new avenues to investigate how pterosaurs diversified during the Mesozoic era.

Reference:
https://www.nhm.ac.uk/discover/news/2024/february/new-pterosaur-skye-reveals-hidden-diversity-middle-jurassic.html

Major 'magnetic anomaly' discovered deep below New Zealand's Lake Rotorua

By Patrick Pester, Live Science
1 February 2024

Lake Rotorua, which sits at the heart of a dormant volcano and is the setting for one of New Zealand's most famous Māori love stories, has been mapped in detail for the 1st time.

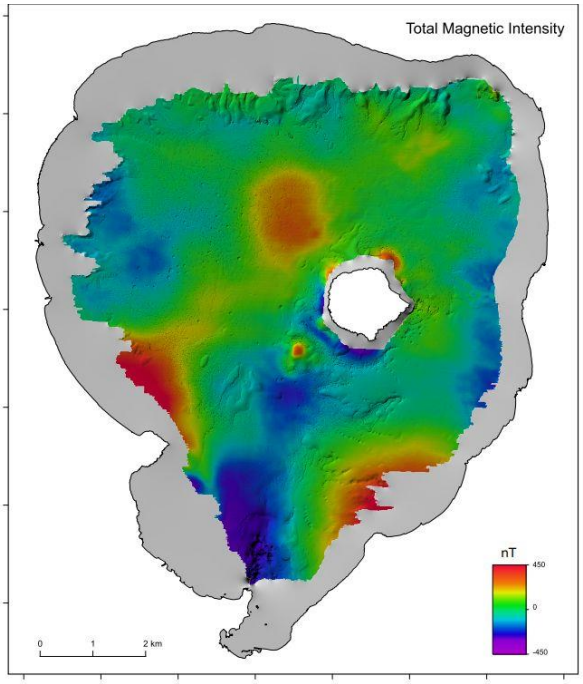


Image showing the large magnetic anomaly in the southern part of the lake. (Image credit: Institute of Geological and Nuclear Sciences Limited (GNS Science)

New maps have revealed a hidden hydrothermal system beneath a legendary lake in New Zealand, which serves as the setting for a famous Māori love story.

Lake Rotorua sits at the heart of a massive ancient crater of a dormant volcano on New Zealand's North Island. The lake has a storied history: it is where the daughter of an influential chief is said to have overcome forbidden love by swimming across the lake to be with a young warrior.

The Rotorua area is also well known for hydrothermal activity, with the Tourism New Zealand website stating that clouds of steam drift around the lake's shore, and that sulfur gives a "magical green-blue" colour to the water.

Researchers at **GNS Science**, a research institute in New Zealand, have now mapped Lake Rotorua's floor in never-before-seen detail, revealing eruption craters, an ancient river and a large magnetic anomaly in the southern part of the lake. These new maps

prove for the first time that Rotorua's mainland hydrothermal systems extend into the lake's hidden depths.

Cornel de Ronde, a principal scientist at GNS Science, told **Live Science** that seeing the maps was like wearing glasses for the first time when you didn't realize you needed them. "You finally put those glasses on, and you can see the fine print," he said.

The maps cover 21 square miles (55 square kilometres), which is around 68% of the lake's floor, according to a statement released by GNS Science. The Royal New Zealand Navy collected some of the data, mapping the lake floor's physical features using a multibeam echo sounder — a type of sonar. They also carried out magnetic surveys, which revealed the magnetic anomaly.

"Normally with volcanic rocks, when you run a magnetometer over the top of them, you get very positive anomalies, but in this case we're getting negative anomalies, likely due to very low magnetic susceptibilities," de Ronde said.

Volcanic rocks typically contain the highly magnetic mineral magnetite, but in Lake Rotorua, researchers believe hydrothermal fluids have passed through the rock and transformed the magnetite into pyrite, or fool's gold, which has almost no magnetic signal. This hydrothermal process would severely diminish the magnetic signal and explain the negative anomaly.

Lake Rotorua sits in the crater of a dormant volcano on New Zealand's North Island. (Image credit: GLV Images via Getty Images)

The researchers also found other evidence of hydrothermal activity in the same general area as the magnetic anomaly. A heat flow map shows heat, which is probably hot water, rising up to the lake floor from beneath. Craters are also visible in this same region, which de Ronde noted are likely hydrothermal eruption craters.

Despite all of this activity, water temperatures near the bottom of the lake are usually around a cool 57 degrees Fahrenheit (14 degrees Celsius), according to de Ronde. That's because the lake is so large that there's enough cool water to counteract heat coming up from below, and the temperature only fluctuates by around 1.8 degrees F (1 degree C) over a month.

"Nobody swimming in the lake would notice it, but with instrumentation, we do," de Ronde said.

Reference:

https://www.livescience.com/planet-earth/bizarre-magnetic-anomaly-discovered-deep-below-new-zealands-lake-rotorua?utm_source=facebook.com&utm_content=livescience&utm_campaign=socialflow&utm_medium=social&fbclid=IwAR35UgJRiMh2avUdUUO0dJxY5N0Jn2U3R8fgfLXz1rnkAcTbZrrtFjT6zTg

365-million-year-old 'alien' fish had one of the most extreme underbites on record

By Kiley Price, Live Science
1 February 2024

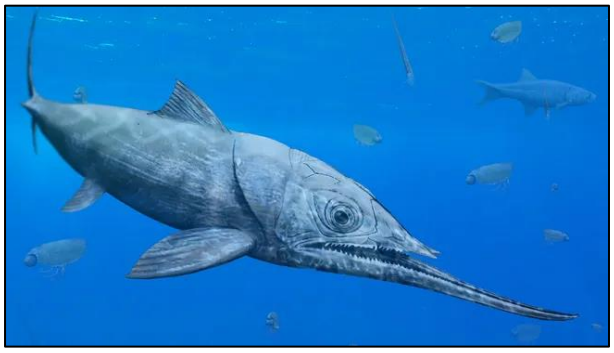
Scientists think the toothy fish may have used its mismatched jaw to trap prey.

Scientists recently discovered that an ancient, fossilized fish may be one of the top contenders for nature's most extreme underbite.

When a researcher first unearthed the first known fossil of this fish in Poland in 1957, he thought it had a long set of fin spines, leading to the alien-inspired name *Alienacanthus*. But the new analysis reveals that these "spines" were actually an immensely elongated lower jaw studded with teeth, giving this species the

oldest — and one of the longest — underbites ever recorded, according to the study, which was published Wednesday (Jan. 31) in the journal **Royal Society Open Science**.

"The new *Alienacanthus* finds set the record straight about what this animal actually looks like, as in it doesn't have a weird fin spine but a rather unique lower jaw," lead study author Melina Jobbins, a palaeontologist at the University of Zürich in Switzerland, told **Live Science** in an email.



The large ancient fish Alienacanthus had a giant underbite. (Image credit: Artist illustration courtesy of Beat Scheffold and Christian Klug)

Alienacanthus lived during the Devonian period (419 million to 358.9 million years ago), when Earth's land was separated into two supercontinents. Since the initial discovery of *Alienacanthus,* several fossil specimens have been found in the mountains of what is now central Poland and Morocco, which were situated on the northeastern and the southern coasts, respectively, when these ancient fish existed. The presence of the same species on both ends of this supercontinent suggests that Alienacanthus migrated across the ocean, despite sea level fluctuation, the new study's authors wrote in **The Conversation**.

To learn more about the oddball fish, researchers looked at two nearly complete skulls discovered in the Anti-Atlas mountain range of Morocco. They soon realized that the long protrusion jutting from the head of *Alienacanthus* was a lower jaw — and it was twice the size of the individual's skull.

Alienacanthus is a **placoderm**, a group of armoured fish that includes some of the first jawed vertebrates. But unlike its placoderm brethren, *Alienacanthus'* upper jaws could move a tad independently of the skull, which helped to accommodate its lengthy lower jaw, the team wrote in The Conversation. "This animal is so unique that the entire jaw mechanism had to work a little differently to accommodate for the lower jaws," Jobbins told **Live Science**.

The researchers compared *Alienacanthus* to modern-day species with mismatched jaws, such as swordfish, to formulate three main hypotheses for how these fish may have capitalized on their underbite: to trap living prey, to confuse or injure prey, or to sieve through sediments in the ocean basin.

The fossilized skull of Alienacanthus. Its bottom jaw, unfortunately, is broken in this specimen. (Image credit: Melina Jobbins and Christian Klug)

"The most compelling to us is the first hypothesis, trapping live prey, which is based on the teeth," Jobbins said. "The teeth pointing to the back prevent the prey from escaping the mouth once trapped."

The top competitor for the title of "world's worst underbite" is the modern-day halfbeak (*Hemiramphidae*), a family of tiny fishes with long, beak-like jaws found in warm oceans and some estuaries around the world.

The Late Devonian period presented "literally jaw-dropping diversity in jaw forms and proportions evolved," study senior author Christian Klug, an adjunct professor of paleontology at the University of Zürich, told **Live Science** in an email. This included the huge, rod-like jaws of the filter-feeder *Titanichthys*, he added.

Now that this "fin spine" mishap has been cleared up, the researchers are studying

Alienacanthus to better understand its jaw mechanics and how the rest of its body looked.

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More than 60 new CO2 storage units added to BGS national CO2 storage database

BGS has delivered its first major update of the national carbon dioxide storage database, CO2 Stored, adding more than 60 CO2 storage units located offshore UK.

BGS Press
30 January 2024

The **UK Industrial Decarbonisation Research and Innovation Centre** (IDRIC) funded research by BGS and Heriot-Watt University (HWU) to update the UK national carbon dioxide (CO2) storage database, **adding 61 new and updating more than 210 CO2 storage units offshore UK**.

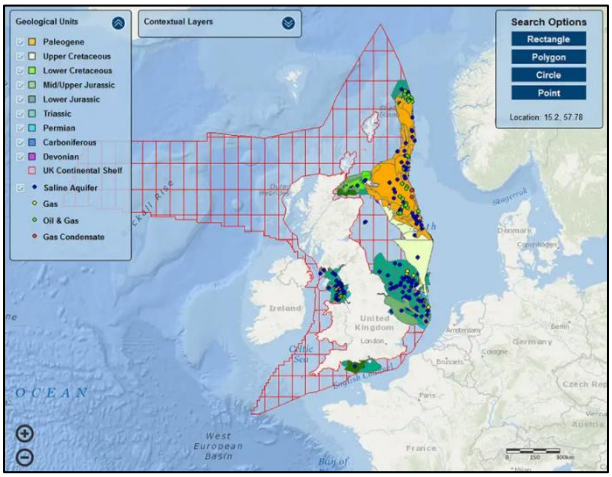
CO2 Stored is the UK's national online evaluation database that identifies the geological storage potential under the UK seabed. Geological storage of CO2 is a key component of industry **carbon capture and storage (CCS)** projects to permanently reduce release of emissions to the atmosphere.

IDRIC CO2 Stored 2.0 has delivered the first major update of the underpinning data in the UK national database since its population in 2011. Information on oil and gas is confidential for the first five years; this update has added new hydrocarbon field storage data from a 15-year period.

The updated database provides access to 630 potential storage units in the UK, including saline aquifers and depleted oil and gas fields.

The update provides:

- remapping and updated information for stores in the East Irish Sea Basin,
- data from the Government- and industry-supported Peterhead and White Rose CCS and Strategic Storage Appraisal projects,
- updates for 205 and addition of 61 hydrocarbon field storage units.



A map of CO2Stored, which shows CO2 Storage units offshore UK. (BGS © UKRI)

The UK is a global leader in provision of online information via its national CO2 storage resource. Data is freely available and gives users access to detailed information on the storage units within the database. It has been the starting point for industry CO2 storage projects, as well as informing Government strategy and providing data for academic research to reduce CO2 emissions in the UK and more widely.

Reference:

https://www.bgs.ac.uk/news/more-than-60-new-co2-storage-units-added-to-bgs-national-co2-storage-database/

North Sea remains a vibrant hotbed of technology innovation

NSTA Press Office
26 January 2024

- ***Net zero solutions and digital applications drive growth***
- ***1,200 innovative equipment and services reported as sector seeks continuing offshore growth with cost-effective solutions***
- ***Focus on new technology to support security of supply, net zero and the energy transition***

The triple targets of supporting production, reducing emissions, and accelerating the transition to net zero are **driving technological innovation** in the North Sea.

The **North Sea Transition Authority's (NSTA) 2023 Technology Insights report** shows that 1,200 new technologies, including aerial drone and self-driving subsea vehicles, have been reported in the latest survey, a significant upswing from the 1,080 developments recorded the previous year, and 880 in 2021.

A total of 55 operators contributed to the NSTA survey which showed that innovations in the fields of Net Zero and digital have risen significantly. **Net Zero technologies** have risen from 61 recorded in 2021 to 140 in 2023, and **Data and Digital technologies** has grown from 190 to 381 in the same time period.

Facilities management technologies, including deployment of monitoring equipment by aerial drones and autonomous underwater vehicles remain the single largest place for innovation, while there has been significant growth in the areas of installations and topsides, and reservoir and well management.

But innovative thinking remains vibrant across the industry with exciting new ideas being implemented in the areas of seismic and exploration, well drilling and construction, subsea systems, well P&A and facilities decommissioning.

Overall spend was distributed across the disciplines with the largest sums spent on well drilling and construction and installations. Overall, operators committed £200m to transfer spending – where they bought technology from suppliers – and £65m in their own research and development. Both figures were up on the previous year where £156m and £49m were invested respectively.

The report, a web version of previously circulated analysis to industry specialists via the **Technology Leadership Board**, is now accessible easily to everyone. It details the latest developments across 10 categories and gives examples of innovations which demonstrate how the new technology is being implemented and the benefits they are having.

The **growth of technology to support net zero** is demonstrated in the Installations and Topsides section of the report which highlights the emphasis that operators are placing on emission reduction and low carbon power technologies.

Specific examples include fixed Forward-Looking InfraRed cameras for methane emission measurement, a greater uptake of flare gas recovery technologies to reduce hydrocarbon waste, and wider use of digital twin technologies to support offshore asset interactions.

Also, the growing adoption of low carbon power technology and energy efficiency technologies reduce carbon emissions - illustrated by the use of hybrid power systems, waste heat recovery and electrification-enabling technologies.

Similarly, the focus on security of supply is demonstrated in the Reservoir and Well Management section which highlights the adoption of advanced modelling techniques and water shut-off systems being introduced alongside other techniques to improve and enhance recovery.

The NSTA is committed to supporting industry in using technology to enhance energy security, reduce emissions and accelerate the transition to net zero and has therefore helped to boost awareness of the UK Energy Technology Platform which provides a showcase for new technologies and brings together suppliers and end users.

Ernie Lamza, NSTA Technology Manager, said: "The North Sea is full of opportunities related to hydrocarbons and net zero, but at the same time can be a difficult place to work.

Operators must focus on finding solutions to many challenging problems. Their innovative approach is clear in the continuing development and use of the new technologies highlighted in this report.

“World-leading technologies, skills and experience boost production and support the energy transition, placing UKCS workers and companies in a great position to secure work and deliver products and services in the UK and in other producing regions around the world.”

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https://www.nstauthority.co.uk/news-publications/north-sea-remains-a-vibrant-hotbed-of-technology-innovation/

https://www.nstauthority.co.uk/regulatory-information/technology/technology-insights-2023/

Underwater Santorini volcano eruption 520,000 years ago was 15 times bigger than record-breaking Tonga eruption

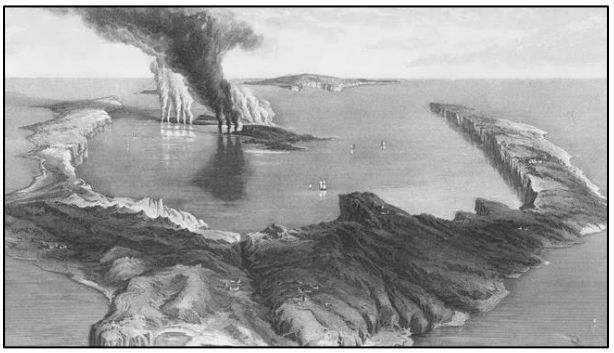
By Sascha Pare, Live Science
26 January 2024

A 500-foot-thick layer of pumice rock on the Mediterranean seabed indicates Santorini volcano ejected 15 times more material than Hunga-Tonga during a previously unknown eruption.

Deep beneath the Mediterranean seabed circling the **Greek island of Santorini**, scientists have discovered the remnants of one of the most explosive volcanic eruptions Europe has ever seen.

A giant layer of pumice and ash, which is up to 500 feet (150 meters) thick, revealed that around half a million years ago, the Santorini volcano erupted so explosively it was **15 times more violent** than the **Hunga Tonga-Hunga Ha'apai eruption of 2022**. The Tonga eruption shattered several records, triggering the fastest atmospheric waves ever seen and the first known mega-tsunami since antiquity.

"We know that this volcano's had many big, explosive eruptions — sort of Krakatoa style," study lead author Tim Druitt, a professor of volcanology at the University of Clermont Auvergne in France, told **Live Science**. But the newly discovered deposits point to a cataclysmic blast "that we didn't even know had existed."



An illustration of the islands of the Greek archipelago of Santorini with the submarine volcano erupting. (Image credit: mikroman6 via Getty Images)

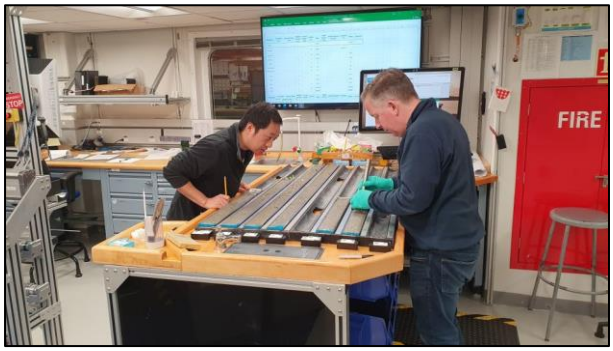
Extensive land-based research has previously painted a relatively detailed picture of past volcanism across the Hellenic Island Arc — a string of volcanic islands stretching from Greece to Turkey along a curved line where the African tectonic plate plunges beneath Europe. For instance, geologists knew that Santorini emerged from the sea about 400,000 years ago, as successive eruptions piled volcanic debris onto the seafloor. The present-day Santorini archipelago formed during the Late Bronze Age (1600 to 1200 B.C.), when the explosive Minoan eruption blasted the top off what was then one island. A magma chamber beneath the Kameni islands, in the centre of the Santorini caldera, still feeds the volcano today.

But there's only so much scientists can learn on land, Druitt said, because erosion from rain and wind wipes away some geological evidence. "That's why we moved to the marine realm, because in the sea it's calmer," he said.

To find out more about the region's volcanic activity, Druitt and his colleagues drilled into marine sediments around Santorini in late 2022 and early 2023. With help from the **International Ocean Discovery Program**, the

researchers extracted sediment cores from up to 3,000 feet (900 m) below the seafloor at 12 drilling sites.

The team could then read the different layers of sediment "like a book," Druitt said. "What you see is volcanic layers from all the eruptions that we knew on land," he said. "But then we go down to deeper levels before the volcano became emergent, when it was still submarine."



Scientists examine core sections from the expedition. Each recovered core is 31 feet (9.5 m) long and is cut into sections 4.9 feet (1.5 m) long for handling. The sections are then sliced in half along their length for detailed description and collection of samples for further laboratory analysis. (Image credit: Tim Druitt)

It's in these deeper levels that researchers discovered the remnants of a 520,000-year-old eruption that was "bigger than anything else Santorini's produced and probably one of the two biggest eruptions that the whole Hellenic volcanic arc has ever had," Druitt said.

The eruption ejected at least 21.6 cubic miles (90 cubic kilometres) of volcanic rock and ash, according to the study, published Jan. 15 in the journal **Communications Earth & Environment**. The Tonga eruption of 2022, by comparison, produced 1.4 cubic miles (6 cubic km) of debris.

"It's a lot bigger — 15 times bigger — there, in the heart of Europe" Druitt said.

The discovery is big because it shows that the Hellenic volcanic arc is capable of producing tremendous underwater eruptions. "It gives us an example to study in detail of a very large version of Hunga-Tonga" Druitt said.

Santorini probably won't see an eruption on this scale for another several hundred thousand years, Druitt said. The volcano last erupted in 1950, emitting lava that didn't pose a significant threat.

However, the magma chamber "will continue to feed eruptions of lava and small explosive eruptions for the coming decades and maybe even centuries" Druitt said.

Reference:

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Gargantuan 'star lizard' was one of the last (and largest) dinosaurs of its kind

By Patrick Pester, Live Science
25 January 2024

Scientists spent years retrieving fossils of the Cretaceous sauropod, which they've named Sidersaura, or "star lizard."

Researchers have identified a newfound sauropod species that was the largest of its kind and one of the last living members of its family.

Paleontologists first discovered fossils from the species, now named *Sidersaura marae*, in 2012 in the Huincul Formation in Argentina's Neuquén Province. It took researchers multiple excavations over several years to retrieve the giant dinosaur parts, which came from four individuals, according to a study published Jan. 3 in the journal **Historical Biology**.

The newly discovered animals likely died in a muddy area near a river, and while scavengers and water displaced some of their bones, many were preserved. Researchers found one of the new sauropods lying next to a giant meat-eating dinosaur called *Meraxes gigas*, unveiled in 2022, while the other three were 65 feet (20 meters) away.

S. marae's fossils are around **93 million to 96 million years old** and date from the early stages of the late Cretaceous period (100.5 million to 66 million years ago), which represents the last swansong of the dinosaurs before a devastating asteroid strike wiped out the non-avian dinosaurs.

The newly described sauropod Sidersaura marae lived during the Cretaceous period in what is now Argentina. We see the predator Meraxes gigas in the background. (Image credit: Gabriel Diaz Yantén)

The newfound sauropods were up to 65 feet long and weighed 16.5 tons (15 metric tons). There are much larger dinosaurs on record, but *S. marae* is a rebbachisaurid sauropod — which usually weighed up to 10 tons (9 metric tons) — raising questions about how these animals grew to be so large.

"This discovery opens the field to new investigations and research in order to study how these animals could reach these huge sizes," study lead author Lucas Nicolás Lerzo, a doctoral student at Maimónides University in Argentina, told **Live Science**.

Rebbachisaurids were a family of sauropods with duck-like faces that fed on vegetation close to the ground, according to a statement released by the Argentine National Scientific and Technical Research Council (CONICET).

Lerzo began studying the bones in 2017 and found that many features separated them from other rebbachisaurids. Some of those differences were connected to the new species' massive size. For example, the hind limbs of *S. marae* were much more robust than those of its relatives, probably to support more weight.

The researchers named *S. marae* after the unusual stellar shape of its haemal arches — bony structures in the tail. *Sidersaura* combines "sider," the Latin word for star, with the Greek word "saura," meaning " lizard" or "reptile."

Lerzo and his team also looked at the evolutionary relationship between the new species and other rebbachisaurids. The study authors noted that *S. marae* was more closely related to older members of the group from the early Cretaceous, rather than to other late Cretaceous rebbachisaurids.

The discovery sheds new light on the evolution of the rebbachisaurid family just as their time was coming to an end. *Rebbachisauridae* went extinct around 90 million years ago, so *S. marae* was among the last to walk Earth. "It's the last form of the group," Lerzo said.

Reference:

https://www.livescience.com/animals/dinosaurs/gargantuan-star-lizard-was-one-of-the-last-and-largest-dinosaurs-of-its-kind?utm_term=8DEBC9E5-6C7F-4337-AFFF-D9A51CC6C2C0&lrh=840a98cbe34ba22d824f6df096d90a0be8fe4763876a779b0361304855882d8f&utm_campaign=368B3745-DDE0-4A69-A2E8-62503D85375D&utm_medium=email&utm_content=129624F5-F6E6-4529-B456-D402973CCDD5&utm_source=SmartBrief

Shell sanctions North Sea tie-back to TotalEnergies' UK gas hub

Melisa Cavcic, Offshore Energy
17 January 2024

UK-headquartered energy giant Shell has taken a final investment decision (FID) to develop a gas field in the UK sector of the North Sea, located approximately 47 km northwest of the Shetland Islands.

After completing the acquisition of a 100% interest in **Corallian Energy Ltd** in November 2022, which exclusively comprised the P2596 Victory license, Shell worked on the FID for the **Victory gas field** in the UK North Sea. With the FID now out of the way, the development will feature a single subsea well which will be tied back to the existing infrastructure of TotalEnergies' **Greater Laggan Area** (GLA) system, using a new 16 km pipeline.

TotalEnergies' West of Shetland gas project covers the producing Greater Laggan Area fields – Laggan, Tormore, Edradour, and Glenlivet gas fields – and the undeveloped Glendronach gas field, located up to 125 km northwest of the Shetland Islands. Based on the North Sea Transition Authority's data, **only 38% of the UK's 2022 gas consumption** was domestically produced, as the rest was imported.

According to Shell, the Victory field will come online in the middle of the decade and at its peak, produce enough gas to heat almost 900,000 homes per year. As this is around **150 million standard cubic feet per day of gas** – *approximately 25,000 barrels of oil equivalent per day* – the field is expected to help maintain domestically produced gas for Britain's homes, businesses, and power generation, once on stream.

Simon Roddy, Shell UK Upstream Senior Vice President, commented: "The UK North Sea is a critical national resource, providing a steady supply of the fuels people rely on today and strengthening the country's energy security and resilience. Continued investment is required to sustain domestic production, which is declining faster than the UK's demand for oil and gas."

Furthermore, most of the field's recoverable gas is expected to be extracted by the end of the decade. The Victory field's gas will be processed onshore at the Shetland Gas Plant before being piped to the UK mainland to enter the National Grid at St. Fergus, where Shell UK is also helping develop the Acorn carbon capture and storage (CCS) project.

Since Victory will be developed as a tie-back to existing infrastructure, its operational emissions are anticipated to be lower than for many current UK North Sea gas fields. Shell claims that this project supports its Powering Progress strategy to deliver more value with less emissions, providing the energy people need today while developing the low-carbon energy system of the future.

Located in **block 207/1a**, approximately 80 km NW of the Shetland Isles, and 17 km from the closest pipeline infrastructure, the Victory gas field is situated in the shallow water of 158 meters. **Texaco discovered this field in 1977** and the environmental statement for its development was submitted in early July 2022.

Shell's acquisition of the Victory gas development came after the UK government disclosed its plans to accelerate various energy projects in late September 2022, including this one. The first gas was previously slated for the fourth quarter of 2024.

Aside from making arrangements to sell its Nigerian onshore subsidiary, the UK oil major also recently joined a long line of companies, which decided to steer clear of the Red Sea shipping route in response to rising Houthi vessel attacks.

Reference:

https://www.offshore-energy.biz/shell-sanctions-north-sea-tie-back-to-totalenergies-uk-gas-hub/?utm_source=offshore-energy&utm_medium=email&utm_campaign=newsletter_2024-01-18

Dinosaur prints 130 million years old found on Sussex beach

Zac Sherratt, The Argus
16 January 2024

Four dinosaur footprints dating back 130 million years have been uncovered on a beach.

Retired biology teacher Sue Lea said she first discovered the imprints on a rock at Bexhill beach around 25 years ago, just before she moved away from the area.

She still visits the beach three times a year but had been unable to find the rock again due to changes in the shoreline.

But on her latest visit last Thursday she was overjoyed to find them again.

“Every time I go down there I look for the footprints. It was really exciting to find them again,” said Sue, who now lives in Oxford. “There are apparently six there, but I’ve only ever found four."

The footprint has resurfaced after years beneath the sand. (Image: Sue Lea)

Dinosaur fanatics have confirmed the footprints were made by an **iguanodon** from the early Cretaceous period.

“I just stumbled across them because usually they are covered up by the sand and shingle,” said Sue. “Of course, they are quite robust, being 130 million years old, but I never know if they may have been washed away.”

Biology buffs can often be found scouring the Sussex coastline in search of dinosaur remains.

Sue said that items can be taken to the nearby Bexhill Museum where staff can identify whether “it’s just a piece of rubbish” or dinosaur remains.

A statement from the museum’s website supports Sue’s findings that the prints are from an iguanodon from around 130 million years

It says: “The landscape would have been dominated by dinosaurs and most of the fossil remains that can be identified belonged to iguanodon, a five- to ten-metre-long plant eating dinosaur.

“Bexhill is famous for the fossil dinosaur footprints that are sometimes exposed on the beach, most of these footprints have been attributed to iguanodon.

“Remains have also been found of the armoured plant-eating dinosaur *hylaeosaurus* and the meat eating *megalosaurus* and *baryonyx* as well as fragmentary remains of other small dinosaurs.”

In 2018, a man found the world’s first known fossilised dinosaur brain on a beach in Bexhill. It was a 133-million-year-old sample of mineralised tissue from inside a dinosaur’s skull.

Reference:

https://www.theargus.co.uk/news/24051329.dinosaur-prints-130-million-years-old-found-sussex-beach/

Lewotobi Laki-Laki volcano (Flores, Indonesia) field report: continuing lava flows on eastern flank

Martin, Volcano Discovery
16 January 2024

The elevated effusive-explosive eruption of the Lewotobi Laki-Laki volcano continues.

The lava flow on the eastern flank continues to be active. Strombolian activity at the summit continues to generate glowing ejecta that is being thrown up to several dozens to a hundred meters above the crater.

Dense ash emissions may reach the airport in Larantuka city (68 km from the volcano) and even further to Maumere (74 km).

The ongoing volcanic tremor suggests continued high effusion rates of magma.

The alert level for the volcano remains at the **highest, IV level**.

People are advised to avoid an area of about 4 km from the main crater and 5 km in the north-northwest direction, respectively.

Glowing steam from emissions of lava on the eastern slope of the volcano. (image: Andi/VolcanoDiscovery Indonesia)

This photo provided by Indonesia's Center for Volcanology and Geological Hazard Mitigation (PVMBG) shows the Lewotobi Laki-Laki volcano spewing volcanic material and smoke as seen from Pulolera village in Flores Timur district, East Nusa Tenggara, Indonesia, on January 17, 2024.

Reference:

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Massive tectonic collision causing Himalayas to grow may also be splitting Tibet apart

Stephanie Pappas, Live Science
16 January 2024

The Indian plate may be peeling into two as it slides under the Eurasian plate, tearing Tibet apart in the process.

Tibet may be tearing in two beneath the rising Himalayas, with pieces of the continental plate peeling off like the lid off a tin of fish, researchers have discovered.

According to new research presented at the annual meeting of the **American Geophysical Union** and posted as a pre-peer-reviewed pre-print online, this shows that the geology beneath the world's highest mountain range may be even more complex than previously believed.

The Himalayas are growing because two continental tectonic plates, the Indian and Eurasian plates, are colliding beneath the colossal mountain range. In cases where oceanic and continental plates collide, the denser oceanic plate slides beneath the lighter continental plate in a process called *subduction*. When two similarly dense continental plates collide, however — as is the case below the Himalayas — it's not so simple to predict which plate will end up under the other, and geoscientists are still unsure exactly what's going on in Tibet.

Some suggest that the bulk of the Indian plate may simply be sliding under the Eurasian plate without diving deeply into the mantle, a process called *underplating*; others believe that perhaps deeper parts of the Indian plate are subducting, while the upper parts are wedging themselves stubbornly against the bulk of Tibet.

The new research suggests that the answer could be both these explanations. The researchers found evidence that the Indian plate is subducting, but it's warping and tearing as it does so, with the upper half delaminating, or peeling away.

"We didn't know continents could behave this way, and that is, for solid earth science, pretty fundamental," Douwe van Hinsbergen, a

geodynamicist at Utrecht University in the Netherlands, who was not involved in the work, told **Science Magazine**.

To get a clearer picture of what's happening below Tibet, the researchers investigated earthquake waves traveling through the crust at the region where the two plates collide. They reconstructed images from these waves showing what appear to be tears in the slab of the Indian plate's crust. In places, the bottom of the Indian plate is 124 miles (200 kms) deep, Science Magazine reported. In others, it is only 62 miles (100 km) to the bottom of the plate, suggesting some of it has peeled away.

Previous work, published in 2022 in the journal **PNAS**, also showed variations in the types of helium bubbling up from geothermal springs in the region. One variation of helium, known as helium-3, is found in mantle rocks, while helium with lower concentrations of helium-3 is likely to come from the crust. By mapping the variations in helium over multiple springs, the researchers found the boundary where the two plates currently meet just north of the Himalayas. The findings from these geochemical studies support the earthquake wave results in hinting at a splintering plate, the researchers wrote.

The new research may also point to areas of increased earthquake risk along the plate boundary, according to Science, though researchers don't yet fully understand how tearing and warping deep within the crust translates to the buildup of stress at the surface.

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Pontypool: Orange river down to iron works pollution

By Nathan Bevan, BBC News

14 January 2024

The water took on a copper-like appearance as it flowed through Pontypool on Friday. (Image Source, NRW)

A large stretch of river in Torfaen left those living nearby shocked after it turned orange. The **Afon Lwyd** became a rust colour as it flowed through the Charlesville area of Pontypool on Friday.

Locals posted photos of it on social media and commented on what could be behind the copper-like transformation.

Natural Resources Wales (NRW) said the water pollution came from a former iron works, and appeared to be subsiding as the river was becoming clearer.

Some residents posted suggestions for the cause of the problem, ranging from sewage to it being an advertising gimmick for the new Willy Wonka film.

However, a spokesperson from NRW pinpointed the true cause on Sunday. "By working closely with The Coal Authority, we have confirmed the source of mine water pollution as the **Cwmsychan Brook Culvert**, a former iron works site near Abersychan in Torfaen," they said.

They added that by Sunday the discolouration had subsided leaving the water much clearer, "although orange sediment remains on the riverbed".

Reference:

https://www.bbc.com/news/uk-wales-67976110

Columbia, Rodinia and Pangaea: A history of Earth's supercontinents

By Patrick Pester, Live Science
13 January 2024

An illustration of Earth 200 million years ago as Pangaea, the last supercontinent, began to break apart. (Image credit: Walter Myers/Stocktrek Images via Getty Images)

Scientists have identified three definitive supercontinents in Earth's history and predict the landmasses we live on today will come together again in the future.

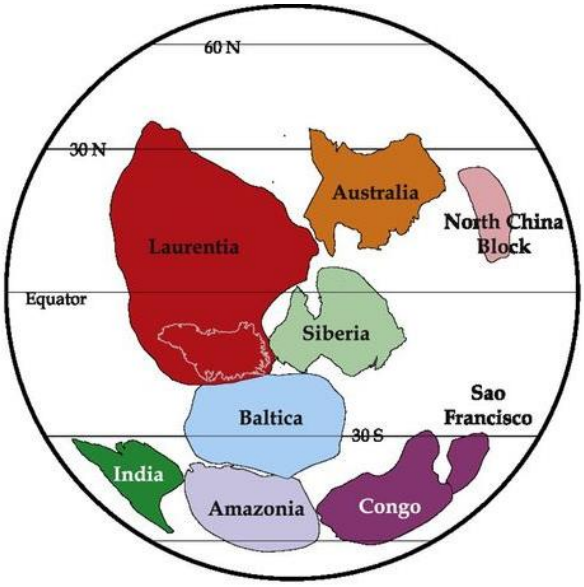
The continents we live on today are moving, and over hundreds of millions of years they get pulled apart and smashed together again. Occasionally, this tectonic plate-fuelled process brings most of the world's landmasses together to form a massive supercontinent.

There's no strict definition for a **supercontinent**, but researchers like Joseph Meert, a professor of geosciences at the University of Florida, say they **should include around 75% of the available landmass**.

Scientists are still debating how many supercontinents have existed in Earth's history, but they're sure of at least three. Here are all of the known supercontinents that have existed and a few honourable mentions. **Live Science** spoke with Meert, to check the dates of the supercontinents on this list, but keep in mind they're still only estimates.

Columbia / Nuna

The first supercontinent, called **Columbia**, or **Nuna**, existed from around 1.7 billion years ago to 1.45 billion years ago in the **Precambrian** period (4.6 billion to 541 million years ago). It is named "Columbia" because scientists posited that the landmass connected what is now eastern India with the Columbia basalts region in what is now the U.S., according to a 2017 study in the journal **Gondwana Research**.



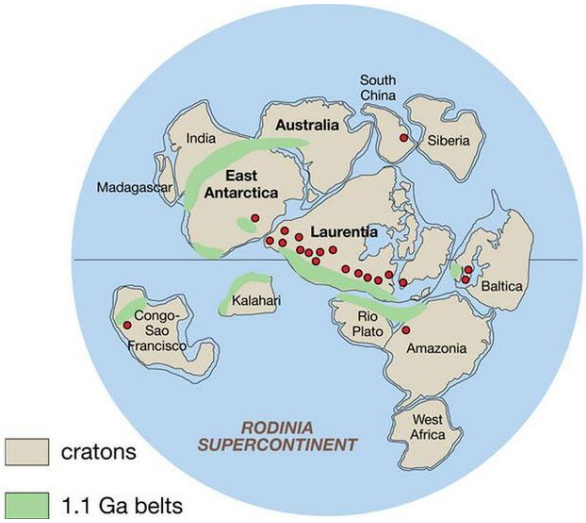
An illustration of what Nuna looked like 1.45 billion years ago. (Image credit: Meert and Santosh/Gondwana Research)

While Earth is much older than the Columbia supercontinent, scientists aren't sure supercontinents formed before 2 billion years ago, and it's possible only smaller and separated landmasses existed back then, according to a 2021 review of the supercontinent cycle published in the journal **Nature Reviews Earth & Environment**.

Rodinia

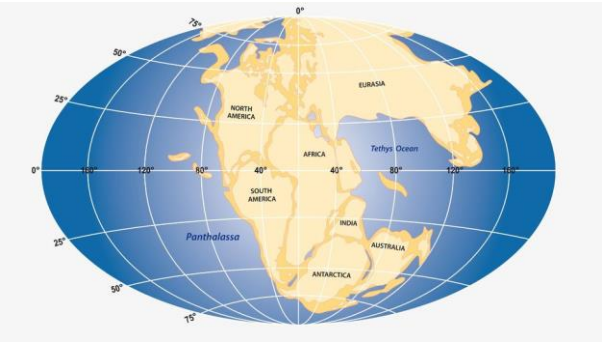
Rodinia was the second supercontinent to form in the **Precambrian** period, coming together around a billion years ago and breaking up around 700 million years ago. Researchers don't know exactly how big Rodinia was, but North America was likely the core of the landmass, according to **Smithsonian Ocean**.

The continents we know today were unrecognizable when Rodinia existed. For example, the Americas were merged while Asia and Africa were broken up into pieces. Rodinia was still around when the first animals evolved around 800 million years ago.



An illustration of the Rodinia supercontinent. (Image credit: Eraza Collection/Alamy Stock Photo)

Pangaea



An illustration of what the supercontinent Pangaea would have looked like when today's continents were smashed together. (Image credit: Rainer Lesniewski via Getty Images)

The most recent supercontinent, **Pangaea**, formed around **320 million years ago** and broke up around 175 million years ago. Geophysicist and meteorologist **Alfred Wegener** first proposed the existence of Pangaea and the concept of supercontinents in 1912 after noticing that the shorelines of Africa and South America seemingly fit together like giant jigsaw puzzle pieces. His theory that continents moved, named *continental drift*, was rejected for decades until scientists confirmed some of his ideas with the modern *theory of plate tectonics*, which explains Earth's crust is split into plates that move across the mantle.

The name **"Pangaea"** comes from Ancient Greek words meaning "all Earth." However, Pangaea never included all of Earth's landmasses. For example, modern-day north and south China were independent islands separated to the east of Pangaea throughout the Carboniferous period (359 million to 299 million years ago).

Pangaea split when the Central Atlantic Ocean opened, and **Gondwana** (what are now Africa, South America, India and most of Antarctica and Australia) separated from **Laurasia** (modern-day Eurasia and North America). The two landmasses then further broke apart and eventually formed the seven continents we live on today.

Honourable mentions

Gondwana and Pannotia

An illustration of Gondwana. (Image credit: Mark Garlick/Science Photo Library via Getty Images)

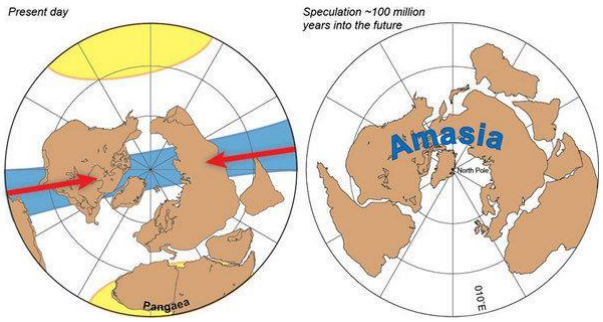
Gondwana formed around **530 million years ago** and was the largest landmass on Earth for more than 200 million years, before becoming part of Pangaea, but the jury is still out on whether it was a supercontinent. Gondwana brought together around 64% of today's landmass, according to a 2013 study published in the journal **Gondwana Research**.

Pannotia is another debated supercontinent, which may have briefly existed around **560 million years ago**, combining parts of Gondwana, North America and Northern Europe.

Amasia and Pangaea Ultima

Scientists believe that supercontinents form on a cycle every several hundred million years or so, and we should expect another one in around 250 million years. Researchers have proposed a few different scenarios for how the next supercontinent will form. One of these hypothesizes that the Americas and Asia drift northward and merge as the Arctic Ocean closes, meaning many of Earth's future inhabitants could live on **"Amasia."** Another option is Pangaea reforms, with the Atlantic

Ocean closing and the Americas, Europe and Africa coming together as **"Pangaea Ultima."**



An illustration of how the next supercontinent, Amasia, will form. (Image credit: Mitchell et al, Nature)

Reference:

https://www.livescience.com/planet-earth/geology/columbia-rodinia-and-pangaea-a-history-of-earths-supercontinents

Study uncovers potential origins of life in ancient hot springs

Newcastle University Press Office
12 January 2024

Newcastle University research turns to ancient hot springs to explore the origins of life on Earth.

Thermal spring at Haukadalur valley. (Credit: Newcastle University)

The research team, funded by the UK's **Natural Environmental Research Council**, investigated how the emergence of the first living systems from inert geological materials happened on the Earth, more than 3.5 billion years ago. Scientists at Newcastle University found that by mixing hydrogen, bicarbonate, and iron-rich magnetite under conditions mimicking relatively mild hydrothermal vent results in the formation of a spectrum of organic molecules, most notably including fatty acids stretching up to 18 carbon atoms in length.

Published in the journal ***Nature Communications Earth & Environmen***t, their findings potentially reveal how some key molecules needed to produce life are made from inorganic chemicals, which is essential to understanding a key step in how life formed on the Earth billions of years ago. Their results may provide a plausible genesis of the organic molecules that form ancient cell membranes, that were perhaps selectively chosen by early biochemical processes on primordial Earth.

Fatty acids in the early stages of life

Fatty acids are long organic molecules that have regions that both attract and repel water that will automatically form cell-like compartments in water naturally and it is these types of molecules that could have made the first cell membranes. Yet, despite their importance, it was uncertain where these fatty acids came from in the early stages of life. One idea is that they might have formed in the hydrothermal vents where hot water, mixed with hydrogen-rich fluids coming from underwater vents mixed with seawater containing CO_2.

The group replicated crucial aspects of the chemical environment found in early Earth's oceans and the mixing of the hot alkaline water from around certain types of hydrothermal vents in their laboratory. They found that when hot hydrogen-rich fluids were mixed with carbon dioxide-rich water in the presence of iron-based minerals that were present on the early Earth it created the types of molecules needed to form primitive cell membranes.

Lead author, **Dr. Graham Purvis**, conducted the study at Newcastle University and is currently a Postdoctoral Research Associate at Durham University.

He said: "Central to life's inception are cellular compartments, crucial for isolating internal chemistry from the external environment. These compartments were instrumental in fostering life-sustaining reactions by concentrating chemicals and facilitating energy production, potentially serving as the cornerstone of life's earliest moments.

The results suggest that the convergence of hydrogen-rich fluids from alkaline hydrothermal

vents with bicarbonate-rich waters on iron-based minerals could have precipitated the rudimentary membranes of early cells at the very beginning of life. This process might have engendered a diversity of membrane types, some potentially serving as life's cradle when life first started. Moreover, this transformative process might have contributed to the genesis of specific acids found in the elemental composition of meteorites."

Principal Investigator **Dr. Jon Telling**, Reader in Biogeochemistry, at School of Natural Environmental Sciences, added:

"We think that this research may provide the first step in how life originated on our planet. Research in our laboratory now continues on determining the second key step; how these organic molecules which are initially 'stuck' to the mineral surfaces can lift off to form spherical membrane-bounded cell-like compartments; the first potential 'protocells' that went on to form the first cellular life."

Intriguingly, the researchers also suggest that membrane-creating reactions similar reactions, could still be happening in the oceans under the surfaces of icy moons in our solar system today. This raises the possibility of alternative life origins in these distant worlds.

Reference

1. Purvis, G., Šiller, L., Crosskey, A. et al. Generation of long-chain fatty acids by hydrogen-driven bicarbonate reduction in ancient alkaline hydrothermal vents. ***Commun Earth Environ*** **5**, 30 (2024). https://doi.org/10.1038/s43247-023-01196-4
2. https://www.ncl.ac.uk/press/articles/latest/2024/01/ancienthotsprings/?_gl=1*17g2v36*_up*MQ..*_ga*MzE5NTgzNjU3LjE3MTMzNTE1NDU.*_ga_VH2F6S16XP*MTcxMzM1MTU0NC4xLjEuMTcxMzM1MTU1OC4wLjAuMTc4MzA5MzY5Mw..

One thousand seconds =	**16.67 minutes**
One million seconds =	**11.57 days**
One billion seconds =	**31.71 years**
One trillion seconds =	**31,709.79 years**

Podcasts

About this Podcast Series

Conversations about geology with researchers making key contributions to our understanding of the Earth and the Solar System.

What moves the continents, creates mountains, swallows up the sea floor, makes volcanoes erupt, triggers earthquakes, and imprints ancient climates into the rocks? Oliver Strimpel, a former astrophysicist and museum director, asks leading researchers to divulge what they have discovered and how they did it.

Geology Bites currently has 85 episodes, each about 30 minutes long.

https://www.geologybites.com/

Desert Island Discs

Clive Oppenheimer, volcanologist

18 February 2024

Clive Oppenheimer, volcanologist and film-maker, shares the eight tracks, book and luxury item he would take with him if cast away to a desert island. With Lauren Laverne.

Clive Oppenheimer (born 1964) is a British volcanologist, and Professor of Volcanology in the Department of Geography of the University of Cambridge.

https://www.bbc.co.uk/sounds/play/m001wgxx?partner=uk.co.bbc&origin=share-mobile

Seismic Soundoff

Seismic Soundoff hosts conversations with geoscientists addressing the challenges of energy, water, and climate. Produced by the Society of Exploration Geophysicists, SEG creates these episodes to celebrate and inspire the geophysicists of today and tomorrow.

https://soundcloud.com/seismicsoundoff/214-the-untapped-potential-of-the-earths-hidden-commons-w-iain-stewart

Interesting Websites

EarthViewer

This interactive module allows individuals to explore **the science of Earth's deep history**, from its formation 4.5 billion years ago to modern times.

EarthViewer dynamically shows how continents grow and shift as individuals scroll through billions of years. Additional layers let you explore changes in atmospheric composition, temperature, biodiversity, day length, and solar luminosity over geologic time.

Reference:

https://www.biointeractive.org/classroom-resources/earthviewer

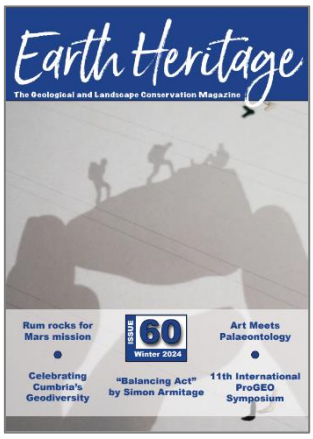
Northern Lights shine over volcano in Iceland in timelapse video

Two of the most awe-inspiring national phenomena captured in one timelapse video: a volcano near the Icelandic town of Grindavik erupts against the backdrop of the Northern Lights.

Reference:

https://www.youtube.com/watch?v=aMc0xzbBpNU

Earth Heritage



Earth Heritage celebrated its 60th edition recently. It is produced twice yearly to stimulate interest in **geodiversity** and a broad range of **geological and landscape conservation issues** within the UK and further afield.

Earth Heritage should interest geological conservation specialists, and those studying Earth and environmental sciences in universities, colleges, and secondary education.

The current issue includes articles on:

- the new Mendip National Nature Reserve
- the refreshed Scottish Fossil Code
- celebrating Cumbria's geodiversity
- the Building Stone Database for England

Earth Heritage is free online.

Reference:

https://www.earthheritage.org.uk/

The Geology of Fair Isle

While enjoying the BBC police drama series "Shetland" ***Liz Aston*** *wondered about some of the TV locations and their geology. This led her to the information about Fair Isle below.*

Credit: The Times, 2018

Where is Fair Isle?

Fair Isle is an island in northern Scotland, lying around halfway between Mainland Shetland and the Orkney islands. It is the most remote inhabited island in the United Kingdom and is roughly equidistant from Sumburgh Head some 38 km (24 mi) to the north-east on the Mainland of Shetland and North Ronaldsay, Orkney, some 43 km (27 mi) to the south-west. Fair Isle is administratively part of Shetland.

Geology

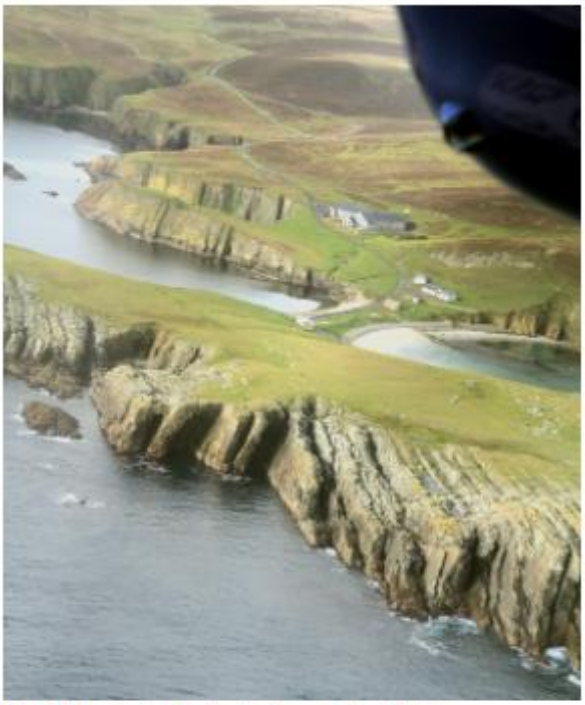
Fair Isle is mainly composed of 385-million-year-old sedimentary rocks and, although they are not particularly red on Fair Isle, these rocks are often known as the **(Middle) Old Red Sandstone.** The cliffs provide excellent, but inaccessible outcrops, but the best areas to get hands-on with the rocks are around Buness and The Haven and South Harbour/Skadan. The commonest rock type is a grey to buff, locally red, sandstone. These are locally interbedded with coarser-grained beds (pebbly grit and conglomerate) and finer-grained beds (dolomitic mudstone and siltstone). The colour is largely the result of weathering, and rock falls often result in the exposure of fresher, much redder rocks (e.g. at Lericum).

The sandstones are thought to have been laid down by an eastward-flowing, braided river system which linked alluvial fans to the west and a lake margin to the east. The finer-grained rocks, or shales, are believed to be of a lacustrine origin. These shales contain rare plant remains and a small number of fish scales and bones.

Everywhere, the beds are steeply inclined to the ESE; the dip varies from 55° to 75° . It is this angle that has led to the profusion of stacks, arches, and caves.

The island is cut by a number of WNW-trending faults, most of which appear to have relatively little throw. The fault planes form belts of soft, intensely shattered rock e.g. at Finniequoy and Geo of Wirvie. The North and South Havens are thought to delineate the site of another fault, where the weakness has been exploited by the sea.

There are also some igneous intrusions (known as dykes), most of which were emplaced along these fault zones. Dykes are most common on the west and south-west coastline, and best seen from the sea. There is some mineralisation associated with the dykes, some of which contains copper ore.



The thin shale beds between the thicker sandstones are more easily eroded and create these characteristic ridges. The layers of rock were deposited horizontally, but are now tilted close to vertical. It is these shales on Buness which have yielded the rare fossil plants © Ian Andrews

Copper Ore And Mining

Copper is known from several inaccessible sites on the west coast. There is no evidence that copper was mined in prehistory, and it is first mentioned by a visitor in 1808, several of whom later attempted to evaluate its significance.

Copper mining at Copper Geo, about 1917. © Shetland Museum and Archives Photo Library

The main site is in Copper Geo, NW of North Naaversgill, where a scapolite-calcite vein complex associated with a dyke contains patches and zones of copper and iron mineralization. Copper ores include the minerals chalcocite, chalcopyrite, covellite and malachite. Silver and gold were found in small quantities in addition to the copper. Small amounts of copper have also been recorded at South Raeva and Ditfield.

Exploration activity peaked prior to the First World War but press reports of "an extremely rich ore" are now known to have been an exaggeration.

Fossil Plants

A specimen of the fossil plant *Svalbardia* found on Buness. Such remains are revealed by splitting the shale along the bedding planes, but they are scarce.

It has to be said that Fair Isle is not a place where you are likely to casually find fossils. Nonetheless, important, but insignificant-looking, remains of some early plants were first found in 1969 and the island is the only site in Britain to yield a flora of this specific age. They provide an important evolutional link in a group of plants known as *progymnosperms* (extinct woody, spore-bearing plants) and they have been the subject of several research projects.

Early Devonian plants were pretty basic and formed no more than a low, carpet-like growth, and it wasn't until the Mid Devonian that these shrub-like forests of primitive plants developed.

A reconstruction of how the Devonian plants found on Fair Isle may have looked. *Svalbardia scotica* (left 3), *Trimerophyton roskiliensis* (4th) and *Thursophyton milleri* (right). Adapted from Ian Perry's 1989 PhD thesis.

Note that the entire Fair Isle outcrop is protected. As part of an SSSI, it is not possible to collect rock specimens without permission from SNH. In any event, if you find a significant fossil, they are so rare that you should consider taking it to a museum.

Further Reading

The primary reference to the geology of Fair Isle is contained in **Bulletin of the Geological Survey of Great Britain No. 41** published in 1972. This contains details of both the Old Red Sandstone sediments and the igneous intrusions and mineralization.

This is available to view online at the BGS website (https://pubs.bgs.ac.uk/publications.html?pubID=B04498)

References:

https://www.fairislebirdobs.co.uk/geology.html

https://www.bbc.co.uk/programmes/p01s711r

FGS trip to the Cyclades - May 2003

The purpose of the study tour, led by John Williams, was to compare the Cycladic islands formed from volcanic products (Milos and Santorini) with those that have been metamorphosed by the processes of tectonics (Naxos and Paros), and also to observe various effects of volcanism, view the products of an eruption and to see how they have weathered over time.

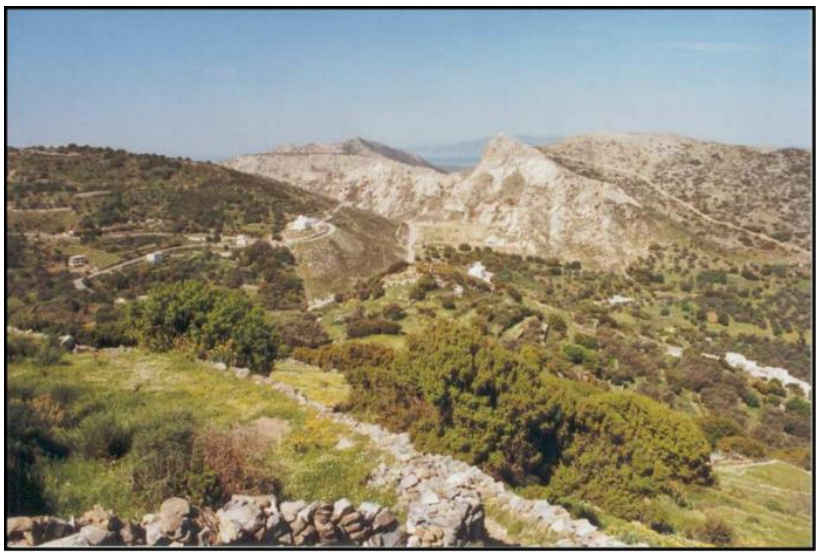
Sixteen members of Farnham Geological Society were thoroughly prepared for this Aegean trip by John's very comprehensive Study Tour Field Guide and the opportunity to attend a Day Course given by Alan Timms and John at the Natural History Museum. This explored the complex geology of the region and how it has dictated historical development and archaeology.

The first and last night were spent in Athens, four nights on Naxos with a day trip to Paros, six nights at Oia on Santorini then three nights at Adamas on Milos. Carole Hodge from Island Wandering was a very able right-hand lady.

"One hundred and ninety million years ago the sun shone, and the seas were warm, clear and blue. Surrounded on three sides by landmasses: Asia to the N.E., EuroAmerica to the N.W. and Africa to the S.W., life in the Tethys ocean was bliss. However, nothing lasts for ever. The supercontinent of Pangaea was breaking up and the Atlantic Ocean far to the west was beginning to open. As a result, Africa rotated anticlockwise and was pushed northwards towards Eurasia.

At the Eurasian border the Tethys Ocean started to subduct, pulling behind it a series of microcontinents, pieces of continental shelf that had once been attached to the African plate but had been separated from it by the formation of a new basin, the Mediterranean. The Tethys gradually shrank in size and by 60 Ma ago, when the most northerly of the microcontinents, Pelagonia, reached the subduction zone, the ocean closed. Pelagonia, being too buoyant to subduct, docked with the Eurasian continent folding and thickening because of being continually pushed from the SSW into the solid continent. One by one the other microcontinents docked behind it each adding to the pile-up and each increasing the deformation of the one in front. Eventually nappes formed with younger, unaltered folds thrust over earlier ones. The whole area became a mountain chain. The limestones and muds originating in the shelf seas metamorphosed with increasing pressures and temperatures to marbles and schists. Pelagonia, where the most deformation took place became known as the Cyclades, and the mountain chain was the Hellinides, the Aegean portion of the Alpine orogeny."

The sun shone and the seas were clear and blue. We wore hats and carried bottles of water wherever we went. We travelled on coaches, local buses, and taxis, took boat trips, walked, swam, went shopping, visited museums and archaeological sites, dined wonderfully at the local tavernas, and rested at the local watering holes. There were those among us who got lost, tired, forgetful, embarrassed, and brown. We all got hot. In fact, a typical field trip.



We were introduced to the metamorphic rocks of Naxos and Paros. 20 Ma of erosion had exposed the roots of the mountains. Marbles formed barren ridges and schists the fertile valleys. Crops and olives were growing in small fields *(see above photo)* that had bamboo windbreaks and the occasional tethered cow. Many hillside terraces were neglected as land had been divided up more and more between successive generations until the portions were too small and uneconomical to work so many had been abandoned.

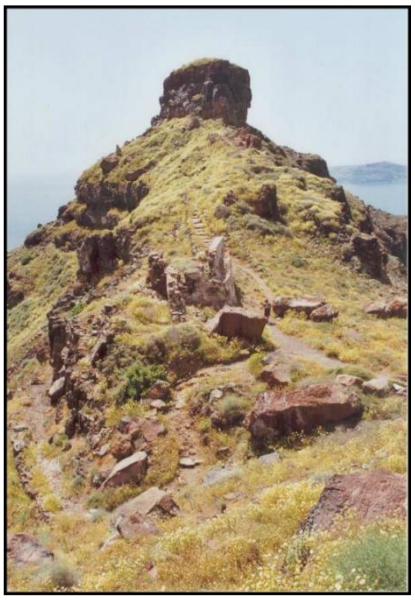
Marble quarries punctured the landscape. We visited a marble mine at Marathi on Paros that descended 2000 ft into the mountain. We walked through the adit and down a slope *(see photo)* away from the bright sunlight to the gloom of the first gallery and peered into passages that led into the depths. The steeply dipping bed had last been mined by the French in the early 18th Century who brought up the beautiful highly metamorphosed marble with such large crystals that the rock was translucent up to 3½ cms. We all applied our torches for confirmation. Ancient Greek civilisations had appreciated its beauty, and Venus de Milo had started life as a piece of Paroan mountainside. Sites on Naxos and Paros had Kouroi statues, considered by some to be idols that had been partly carved from the bedrock in 7th century BC and then abandoned. They lay there still. We were convinced, I think, that a hillside at Melanes, covered with marble boulders was an apprentice's practise ground where they could develop their marble-carving techniques. Emery (Moh's scale 9) was used for carving, and we visited an emery dump to identify the black mineral. Emery is a metamorphosed laterite deposit rich in Fe and Al (corundum) and named after Cape Emeri on Naxos. Emery is no longer mined as there is a synthetic substitute. We visited George's marble works on Naxos (there are, apparently, several islanders called George) and saw how huge white blocks, some streaked with grey, brought from the quarries that dotted the mountainsides were roughly cut to manageable sizes (i.e., large) then sliced, polished, cut to size, and then stacked ready for shipping. Only the 20 kg airline luggage limit prevented us from walking away with some tempting off-cuts.

The intense high temperatures reached during nappe formation had in places further altered areas of schists to form augen gneisses and within these, further alteration had produced migmatites. The highest temperatures of all within the migmatites had actually melted the rocks to produce granites. We inspected samples of granite domes and their aureoles in a roadside exposure in the Koronis area of Naxos. Nearby was a very neat and tidy marble quarry that was removing the top of one of the mountains. At Naoussa in the north of Naxos we saw how quartz in the highly metamorphosed schists at the centre of the nappes had been mobilised to form pegmatites in the highly deformed rocks. We followed the exposure across the bay.

Naxos with its windmills, its mountainous interior and its busy capital was a good introduction to the Cyclades. We looked eastwards through Apollos Gate at the old Venetian fortified Castro guarding Naxos town and the busy port, and then westwards through the Gate out to sea at the setting sun, real Greek holiday stuff.

"When the Hellenides mountain building could no longer accommodate the push from the SSW it became an active margin and a new subduction zone formed as the Mediterranean oceanic lithosphere subducted northwards beneath it. A calc-alkaline volcanic arc erupted through the mountains about 100km above the descending slab.

The opening of the Red Sea affected the absolute motion of the Aegean Plate. In the north, south westerly movement was slowed to 2.5 cm. per year, while in the south nearest the trench it was 2.9 cm. per year. Clearly the middle of the Aegean plate was under tension and being stretched. Old faults and sutures were reactivated as the crust thinned. The result was uplift and erosion of Horst blocks and sinking of Grabens as the Hellinides sank beneath the sea with only the tops of the mountains remaining visible. Extension has given the Hellenic chain its present arcuate shape."



Santorini and Milos became our stamping ground for the rest of the two weeks. It was a good time to visit them, right at the beginning of the tourist season. Brilliant blue and white paint was being applied to all suitable surfaces and everywhere else was fresh and green and completely covered with wildflowers. They had even painted flowers on the road in Milos for the Easter processions. On Santorini we came to grips with the calc alkaline volcanoes. In fact, a little party of 'intrepids', inspired by our leader did just that and scaled a promontory *(see photo)* on Skaros. We discovered that it had been previously inhabited because it was covered with the remains of dwellings dating from the Venetian occupancy of the island. They must have had a good head for heights in those days, and sure feet!

"There are few exposures of the metasediments on Santorini. For 1.5 Ma volcanic activity associated with the subduction zone has gradually shaped the island. At least five large volcanoes have formed since then, Megalo Vouno, Therasia, Skaros, MicroProfitis Ilias and Thera. Eruptions have been of basalt, basaltic-andesite, andesite, dacite, rhyodacite and rhyolite with the longer gaps between eruptions producing the more acid magmas and pyroclastics. Some eruptions formed calderas.

The enormous eruption that shaped present day Santorini and formed the present caldera happened in 1600 BC. Known as the Minoan because it wiped out the Minoan civilisation it was also responsible for the legend of Atlantis. The eruption was so violent that it emptied the magma chamber, and the sea rushing in enhanced the activity still further. 20 cu km of pumice and ashes that were ejected came from a magma chamber situated below the northern half of the present 16km wide caldera. Sections of the previous volcanoes are exposed in its impressive 300m high rim. This rim is broken in three places, so Santorini comprises three islands. In the centre of the caldera volcanic activity since 197 BC has produce the Kameni islands and their eruptions of dacite lavas are gradually filling in the caldera. Volcanic activity is centred on a crustal fault that strikes NE/SW beneath Santorini."

If sailing into Santorini's caldera was breathtaking the drive away from the port up a road cut into the sheer walls of the caldera was even more so. We zigzagged up through the whole range of rocks that Santorini had to offer until on reaching the incredibly thick layer of ash and pumice we knew we were at the top *(see photo)*. The best way to see Santorini's geological history was from our specially commissioned boat (owned by another George). We studied the rocks of the volcanic sections at close quarters and learnt to differentiate between the grey andesitic blocky lavas and lava flows, red pyroclastic scoria, pale dacitic ashfall and the creamy rhyodacite pumice. There were welded tuffs and unconsolidated pumice. The more resistant dark basic dykes stood proud of the weathered cliffs and were in places displaced by faults.

We landed on the Kameni islands and trekked across various lava fields to the crater *(see photo)* where current activity is progressing. Fumaroles were gently leaking hot sulphurous gases. We were in time to see their temperature being taken, a healthy 95°C-97°C just below the surface. The last eruption was in 1956. Sea temperatures and levels and seismic monitoring also takes place regularly.

We were promised a swim at the islands, but nobody explained that the hot springs leached iron from the lavas, which combined with bacterial activity to form a thick red *'gunge'* that squelched through your toes when they landed on the seabed.

Back on land we examined hand specimens and looked at the products of the main Minoan event at Thera quarry. First the well-sorted pumice from the initial blast, followed by surge deposits, fine deposits that filled great channels scoured out by steam from when the magma chamber was breached by the sea. In the third stage a slurry of ash and pumice and blocks of volcano wall were incredibly violently ejected, followed lastly by the high temperature finer ignimbrite flow. The quarry was within a kilometre or so of the vent and here the various layers were thickest, and the largest blocks had fallen. We included one in our group photo complete with its sag *(see photo).* The quarry was no longer being worked for pumice. It used to be tipped over the cliffs into the boats waiting to

carry it away. The Suez canal had used hydraulic cement made from Thera pumice. The demands of tourism however required a pristine blue sea, and the fine dust was also a problem, so quarrying had to stop.

The third stage of the Minoan event dominates the island. It is easy to excavate and original dwellings in the cliff tops were man-made caves. These have subsequently been improved and are very upmarket *des-res*. However, their position on the caldera rim of an island often visited by earthquakes must make life exciting. 3,600 years of ash cover preserved the remains of the better situated fishing village of Acrotiri after the Minoan eruption. Archaeologists are still excavating the site and we had a glimpse of a life that basically differed little from our own.

Milos was our final port of call. It is far richer in minerals than Santorini because small high level magma chambers released gases and hydrothermal fluids through cracks and fissures into the overlying, mainly acid igneous rocks, altering and concentrating the minerals.

From the beginning this mineral wealth was traded. We visited the site near Filakopi where neolithic men worked and traded obsidian tools. The area was covered with obsidian flakes as well as pottery sherds.

The Romans exported sulphur, pumice, clay, and alum from the old Dorian port of Klima as well as oil, wine, and honey until the 6th century when it was abandoned after an earthquake.

At Paliochori on the south coast, groundwater moving up through the vent-agglomerates, ignimbrites and lahar deposits that formed the cliffs, leached out minerals such as copper, sulphur and iron and brought them to the surface. We saw where the rocks were coated with crusts of green chrysocolla, yellow sulphur and red oxides *(see photo).* There were hot springs bubbling through the sea here and steam rising through fissures in the rocks. The last sulphur mines on Milos closed in 1962. On the way to Plathiena we saw baryte crystals that had been brought to the surface by hydrothermal fluids rising through fissures in the rhyolite domes where the rocks were all stained red with iron or altered to white kaolin.

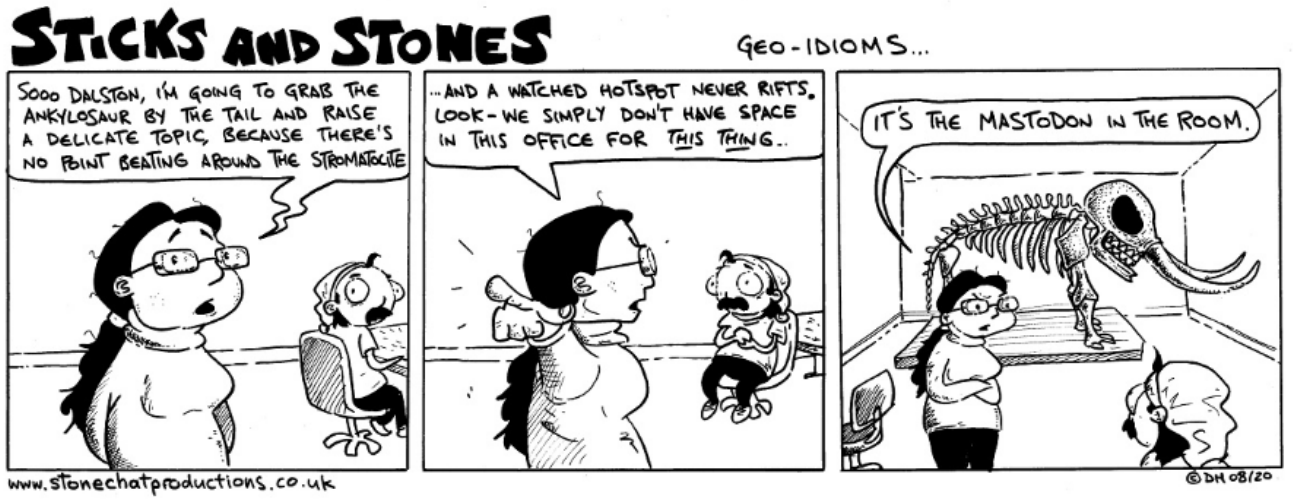
At Voudia we were in the industrial Milos and saw kaolin, formed from altered rhyolitic feldspars; perlite, a quickly cooled volcanic glass that contains water in its structure (its density decreases as it expands on heating and it is used for thermal and acoustic insulation etc) and bentonite, an altered ash that increases its volume when water is added and is used as a sealant in landfill sites, as cat litter, etc.

With trade came wealth, and we saw several archaeological sites including: the Bronze age site at Filakopi (where three ancient cities had stood), the Dorian site above Klima (~1000BC), and near Tripoti, the ancient Roman theatre and the Christian catacombs (2nd - 3rd century AD) which are the most extensive in Greece. Today Milos continues to trade, and tourism is starting to be important. There are no eruptions pending, the sun shines, the warm seas are clear and blue …. I've heard that before!

Many thanks John for an excellent, friendly, well organised, field trip.

Beryl Jarvis

Cartoon



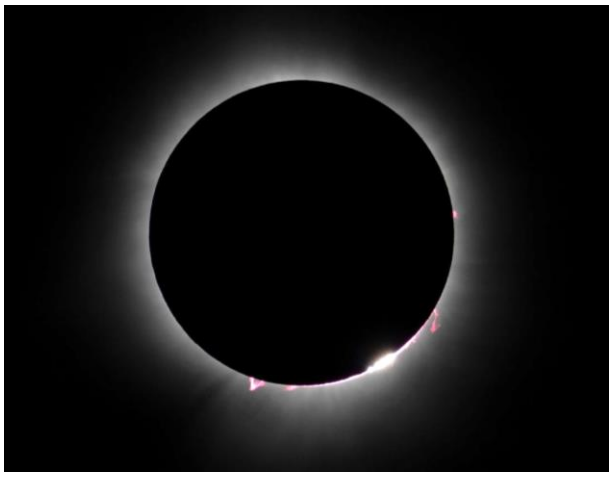
Interesting Photos

Iceland Volcano

On Jan. 17, 2024, the Copernicus Sentinel-2 mission captured this image of a lava flow in Iceland's Reykjanes Peninsula. The lava reached the town of Grindavik, which had already been evacuated. (Image credit: ESA, CC BY-SA 3.0 IGO)

Total Eclipse

A total solar eclipse passed over North America on Monday, 8 April 2024 putting on a dramatic show that was visible to millions of people.



Total Eclipse. The Baily's Beads effect and red prominences coming off the sun are pictured during the eclipse as seen from Magog, in southeastern Quebec, Canada. (Credit: Stan Honda/AFP/Getty Images)

Total Eclipse. An airplane passes by as the total solar eclipse is seen from Bloomington,

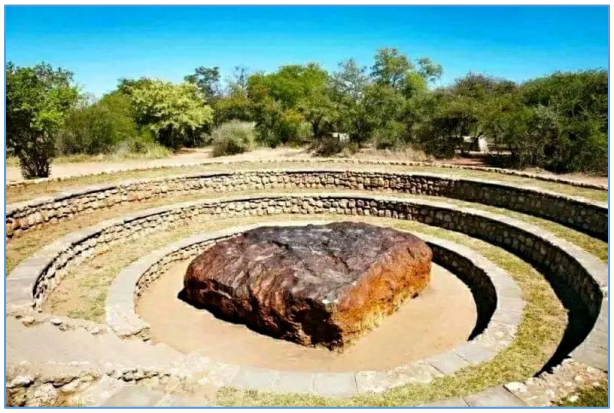
Indiana, USA. (Credit: Bobby Goddin/USA Today Network/Reuters)

Reference:

https://edition.cnn.com/2024/04/08/world/gallery/solar-eclipse-photos/index.html

Interesting Places

The Hoba Meteorite



Hoba is the largest meteorite found on Earth. The rock is located in Namibia, Africa. It fell to Earth about 80,000 years ago, its mass after the fall was 90 tons. The Hoba meteorite, short for Hoba West, is a meteorite that lies on the farm of the same name, not far from Grootfontein, in the Otjozondjupa Region of Namibia. It has been uncovered, but because of its large mass, has never been moved from where it fell. The main mass is estimated at more than 60 tonnes.

It is inferred that the Earth's atmosphere slowed the object in such a way that it impacted the surface at terminal velocity, thereby remaining intact and causing little excavation (expulsion of earth). Assuming a drag coefficient of about 1.3, the meteor appears to have slowed to about 720 mph from an entry speed to the atmosphere typically in excess of 22,370 mph. The meteorite is unusual in that it is flat on both major surfaces.

Reference:

https://en.wikipedia.org/wiki/Hoba_meteorite

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

1. **Thousands of hidden meteorites could be lost forever as they sink in Antarctic ice, taking their cosmic secrets with them**

   https://www.space.com/thousands-of-hidden-meteorites-sinking-in-antarctica?utm_term=8DEBC9E5-6C7F-4337-AFFF-D9A51CC6C2C0&lrh=840a98cbe34ba22d824f6df096d90a0be8fe4763876a779b0361304855882d8f&utm_campaign=58E4DE65-C57F-4CD3-9A5A-609994E2C5A9&utm_medium=email&utm_content=38DA25BC-FE0C-4C9A-9F96-6CE80B09049B&utm_source=SmartBrief

2. **Part of the San Andreas fault may be gearing up for an earthquake**

   https://www.livescience.com/planet-earth/earthquakes/part-of-the-san-andreas-fault-may-be-gearing-up-for-an-earthquake?utm_term=8DEBC9E5-6C7F-4337-AFFF-D9A51CC6C2C0&lrh=840a98cbe34ba22d824f6df096d90a0be8fe4763876a779b0361304855882d8f&utm_campaign=368B3745-DDE0-4A69-A2E8-62503D85375D&utm_medium=email&utm_content=9452B3C4-4706-495B-9C89-7FAB38A0F559&utm_source=SmartBrief

3. **Refurbished Kimmeridge museum reopens with queues for star exhibit**

   https://www.swanage.news/refurbished-kimmeridge-museum-reopens-with-queues-for-star-exhibit/?fbclid=IwAR00sOvjPFtFfVMRywx0qL06jbj1jKu7cUAWQ0Bv2wIjOgzvov4I7ejQ1I4

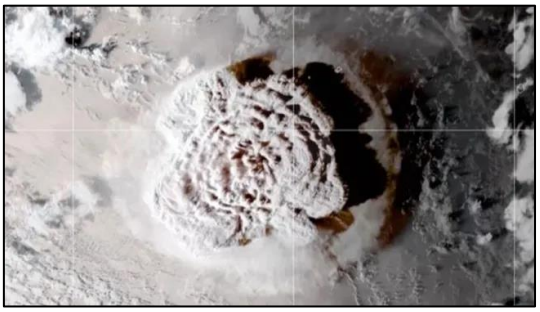
4. **Iceland volcano: Gigantic plume of toxic gas from latest eruption is moving across Europe, satellite data shows**

   https://www.livescience.com/planet-earth/volcanos/iceland-volcano-gigantic-plume-of-toxic-gas-from-latest-eruption-is-moving-across-europe-satellite-data-shows?utm_term=8DEBC9E5-6C7F-4337-AFFF-D9A51CC6C2C0&lrh=840a98cbe34ba22d824f6df096d90a0be8fe4763876a779b0361304855882d8f&utm_campaign=368B3745-DDE0-4A69-A2E8-62503D85375D&utm_medium=email&utm_content=9EE12B50-EA63-462F-B37C-68B0FC5B2A18&utm_source=SmartBrief

5. **Sleeping subduction zone could awaken and form a new 'Ring of Fire' that swallows the Atlantic Ocean**

   https://www.livescience.com/planet-earth/rivers-oceans/sleeping-subduction-zone-could-awaken-and-form-a-new-ring-of-fire-that-swallows-the-atlantic-ocean?utm_term=8DEBC9E5-6C7F-4337-AFFF-D9A51CC6C2C0&lrh=840a98cbe34ba22d824f6df096d90a0be8fe4763876a779b0361304855882d8f&utm_campaign=368B3745-DDE0-4A69-A2E8-62503D85375D&utm_medium=email&utm_content=958E0E60-02F3-47E3-9A6A-8E9E292DFF23&utm_source=SmartBrief

6. **Underwater volcano eruption 7,300 years ago is the largest in recorded history**

   https://www.livescience.com/planet-earth/volcanos/underwater-volcano-eruption-7300-years-ago-is-the-largest-in-recorded-history?utm_term=8DEBC9E5-6C7F-4337-AFFF-D9A51CC6C2C0&lrh=840a98cbe34ba22d824f6df096d90a0be8fe4763876a779b0361304855882d8f&utm_campaign=368B3745-DDE0-4A69-A2E8-62503D85375D&utm_medium=email&utm_content=368F5530-B248-4202-8CB0-D6E84176224D&utm_source=SmartBrief

7. **'Imagine a lush tropical island slipping beneath the waves': Drowned island the size of Iceland found off Brazil**

   https://www.livescience.com/planet-earth/imagine-a-lush-tropical-island-slipping-beneath-the-waves-drowned-island-the-size-of-iceland-found-off-brazil?utm_term=8DEBC9E5-6C7F-4337-AFFF-D9A51CC6C2C0&lrh=840a98cbe34ba22d824f6df096d90a0be8fe4763876a779b0361304855882d8f&utm_campaign=368B3745-DDE0-4A69-A2E8-62503D85375D&utm_medium=email&utm_content=EEE6B991-C52B-4B82-88F0-B5988BB1447A&utm_source=SmartBrief

8. **Huge, bitey, freakishly ugly: is this the world's nastiest prehistoric reptile?**

   https://www.theguardian.com/science/2024/mar/06/khinjaria-acutus-worlds-nastiest-prehistoric-reptile

9. **'It is not very wise to spend the night in Grindavík': Iceland volcano gears up for another eruption**

   https://www.livescience.com/planet-earth/volcanos/it-is-not-very-wise-to-spend-the-night-in-grindavik-iceland-volcano-gears-up-for-another-eruption?utm_term=8DEBC9E5-6C7F-4337-AFFF-D9A51CC6C2C0&lrh=840a98cbe34ba22d824f6df096d90a0be8fe4763876a779b0361304855882d8f&utm_campaign=368B3745-DDE0-4A69-A2E8-62503D85375D&utm_medium=email&utm_content=DC3020F9-FA1A-401C-B94A-3F53F7DFD073&utm_source=SmartBrief

10. **DNV: UK in need of comprehensive energy transition roadmap to usher in low-carbon future**

    https://www.offshore-energy.biz/dnv-uk-in-need-of-comprehensive-energy-transition-roadmap-to-usher-in-low-

carbon-future/?utm_source=offshoreenergytoday&utm_medium=email&utm_campaign=newsletter_2024-02-27

11. **Scientists may have accidentally found mystery magma reservoir in volcanoless region of Alaska**

    https://www.livescience.com/planet-earth/volcanos/scientists-may-have-accidentally-found-mystery-magma-reservoir-in-volcanoless-region-of-alaska?utm_term=8DEBC9E5-6C7F-4337-AFFF-D9A51CC6C2C0&lrh=840a98cbe34ba22d824f6df096d90a0be8fe4763876a779b0361304855882d8f&utm_campaign=368B3745-DDE0-4A69-A2E8-62503D85375D&utm_medium=email&utm_content=64F43B2B-70DE-497F-8009-5E659DD795C1&utm_source=SmartBrief

12. **BP, Shell, TotalEnergies, and Equinor among recipients of second license batch in UK's 33rd oil & gas round**

    https://www.offshore-energy.biz/bp-shell-totalenergies-and-equinor-among-recipients-of-second-license-batch-in-uks-33rd-oil-gas-round/?utm_source=offshoreenergytoday&utm_medium=email&utm_campaign=newsletter_2024-02-02

13. **'Roots' of Colombian mountains 'dripped' into the mantle millions of years ago — but the peaks still stand tall**

    https://www.livescience.com/planet-earth/geology/roots-of-colombian-mountains-dripped-into-the-mantle-millions-of-years-ago-but-the-peaks-still-stand-tall?utm_term=8DEBC9E5-6C7F-4337-AFFF-D9A51CC6C2C0&lrh=840a98cbe34ba22d824f6df096d90a0be8fe4763876a779b0361304855882d8f&utm_campaign=368B3745-DDE0-4A69-A2E8-62503D85375D&utm_medium=email&utm_content=3BA4B344-9A71-4AF2-AB1E-2E489C56BADD&utm_source=SmartBrief

14. **Reykjanes volcano update: New eruption more likely, could be within few days to weeks**

    https://www.volcanodiscovery.com/reykjanes/news/232957/Reykjanes-volcano-update-New-eruption-more-likely-could-be-within-few-days-to-weeks.html?&tx_tphitcounter_pi1[clear_cache]=2&fbclid=IwAR3mvR8DEWaNJJgtiKidp7JAMT7_dobBb9-X2V2VxRozJNRwUEGRW9ck-fw

15. **What was the typical life span of a dinosaur?**

    https://www.livescience.com/animals/dinosaurs/what-was-the-typical-life-span-of-a-dinosaur?utm_term=8DEBC9E5-6C7F-4337-AFFF-D9A51CC6C2C0&lrh=840a98cbe34ba22d824f6df096d90a0be8fe4763876a779b0361304855882d8f&utm_campaign=368B3745-DDE0-4A69-A2E8-62503D85375D&utm_medium=email&utm_content=8777BF97-3DB8-4C3D-B6BA-22D36CFB1F8B&utm_source=SmartBrief

16. **Noble's decarbonization trump card: Sustainable diesel slashing rig's CO2 emissions during North Sea drilling ops**

    https://www.offshore-energy.biz/nobles-decarbonization-trump-card-sustainable-diesel-slashing-rigs-co2-emissions-during-north-sea-drilling-ops/?utm_source=offshoreenergytoday&utm_medium=email&utm_campaign=newsletter_2024-01-29

THE FGS NEEDS YOU!

Credit: LEONELLO CALVETTI / SCIENCE PHOTO LIBRARY / Getty Image

We are still looking for members to both join the FGS Committee, particularly IT/Sound, as well as help with organising the Societies various activities.

Please contact our Chair Mick Caulfield (newsletters@farnhamgeosoc.org.uk) if you would like to help.