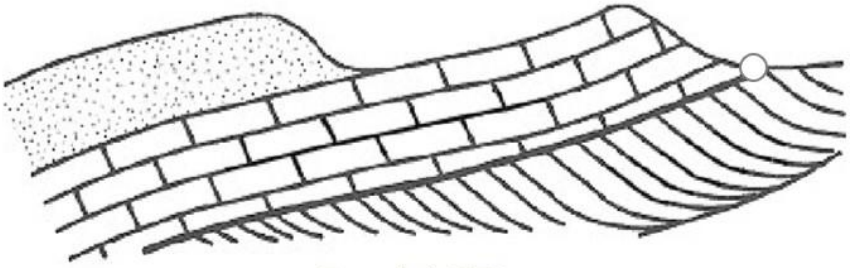
Farnham Geological Society

Farnhamia farnhamensis



Founded 1970

A local group within the GA

Volume 23, No. 5 | **Newsletter** Issue No. 108 | July 2020 Monthly

www.farnhamgeosoc.org.uk

Contents

Editorial	1	**North Sea gas**	10	**Rejection of drilling plans**	15
Meetings & Field Trips	2	**Largest waterfall on Earth**	11	**Possible dinosaur DNA**	16
FGS Committee	2	**Geoscience for the Future**	11	**Ancient crocodiles**	18
NHM Virtual Events	2	**Crossword**	12	**Asteroid hit just right**	19
Plate Tectonics	3	**Calvin and Hobbes**	13	**Crossword solution**	19
Ancient Earth	9	**First dinosaurs' soft eggs**	13	**FGS News Letter No.1**	20
It Happened in July	9	**Huge fossilised egg**	14	**GA Letter**	21

Editorial

In July 1970, a field meeting in the Mendips saw the beginning of the Farnham Geological Society. Twelve members made the journey to Burrington Coombe led by the late Edward Finch, RIP. Fifty years later we are celebrating that small beginning in a way that none of the original members would surely have envisaged, i.e. in the midst of a global pandemic.

Today the Society has grown to about 85 members with a vibrant Meeting and Field Trip programme … at least prior to "lockdown". The Committee would like to continue our meetings virtually beginning with a 50th Anniversary Celebration on Friday 10 July. You should receive details of how to "attend" the meeting via email.

We will then continue our meetings via Zoom with the original calendar of speakers from September onwards, probably at least until the end of this year; note, however, the earlier 6.55 pm for 7.00 pm start time.

Once again I hope you enjoy this newsletter and feel free to let me know of anything you would like to see included; you can email me at caulfm@hotmail.com.

Stay safe.
Mick Caulfield

Farnham Geological Society
Meeting Programme 2020

Update 24 June 2020

All remaining meetings in 2020 will be conducted remotely via Zoom.

Please note the change in meeting time: 6.50 pm for 7.00 pm start.

FGS Committee 24 June

FGS 50th Anniversary Celebration 10 July
Liz Aston & Peter Luckham

Extremophiles: The search for extra-terrestrial life 18 September
Dr Marina Barcenilla
University of Westminster

FGS Committee 24 September

Mass accumulations of Chalk Ophiuroids in Lewes 9 October
Dr Tim Ewin
Dept. of Earth Sciences, Natural History Museum

The smallest things can make a difference 20 November
Dr Liam Gallagher
Consultant

Tongan pumice raft 11 December
Dr Isobel Yeo
National Oceanography Centre, Southampton

Farnham Geological Society
Field Trip Programme 2020

Update 24 June 2020

All 2020 FT's Cancelled

Farnham Geological Society
Committee 2020

Chair	**Liz Aston**
Treasurer	**Peter Luckham**
Secretary	**Judith Wilson**
Programme Secretary	**Janet Catchpole**
Membership Secretary	**Sally Pritchard**
Field Trip Secretary	**John Williams**
Newsletter Editor	**Mick Caulfield**
Web Manager	**Michael Hollington**
Advertising	**Peter Crow**
IT / Sound	**Mike Millar**
Without portfolio	**Alan Whitehead**

NATURAL HISTORY MUSEUM

Virtual events

Watch the NHM Nature Live Online team every Tuesday at 12.00 BST and Friday at 10.30 BST for interactive talks featuring topical discussions with scientists and cutting-edge research.

All events are free to watch online on the Museum's website, YouTube channel or Facebook page.

Previous broadcasts that are available and may be of interest:

- Water on Mars
- CO2 in Earth's atmosphere - guide from climates in the past
- Amazing ammonites
- Rivers of Mars
- Volcanoes
- Corals and climate change

https://www.nhm.ac.uk/visit/exhibitions/nature-live.html

Plate Tectonics

By Liz Aston

PLATE TECTONICS is a scientific theory describing the large-scale motion of seven large plates and the movements of a larger number of smaller plates of the Earth's lithosphere, since tectonic processes began between 3.3 and 3.5 Ga (Fig. 1). The theory builds on the concept of continental drift, an idea developed during the first decades of the 20th century. The geoscientific community accepted plate-tectonic theory after seafloor spreading was validated in the late 1950s and early 1960s.

The key principle of plate tectonics is that the lithosphere exists as separate and distinct tectonic plates, which ride on the fluid-like (visco-elastic solid) asthenosphere. Plate motions range up to a typical 10–40 mm/year (Mid-Atlantic Ridge; about as fast as fingernails grow), to about 160 mm/year (Nazca Plate; about as fast as hair grows).

SO, WHAT MOVES PLATES? – an intriguing and much debated topic

1. **Convection currents in mantle** – are they too deep to be effective and are they hindered near surface by the weak asthenosphere?
2. **Convection currents in asthenosphere** – is it too weak to move a major plate, e.g. the AFRICAN Plate?
3. **Slab pull** – is that strong enough? – Could the Juan de Fuca subduction zone pull the huge plate North American plate? Where are the subduction zones of the other large continents? (Fig. 2).
4. **Subducted slabs** – slab suction - do these continue to, and contribute to, the disturbance at the Core-Mantle-Boundary (CMB)?
5. **Small plumes** – possibly big enough for Hawaiian Island Chain passage, but would they be big enough to break up a huge supercontinent like Pangaea?
6. **Superplumes from Large disturbances at CMB** – these could give rise to major upward moving plume-like bodies – would they be capable of breaking up a supercontinent?

Supercontinents have existed for over 4 Ga, gradually getting larger, Pangaea was the largest.

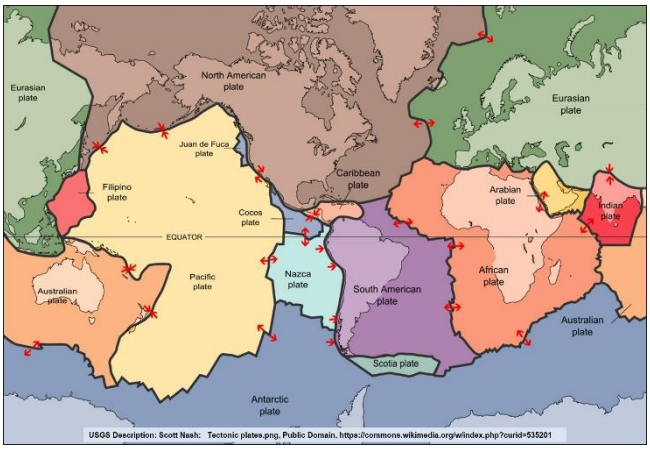


Fig. 1: Tectonic plates (USGS).

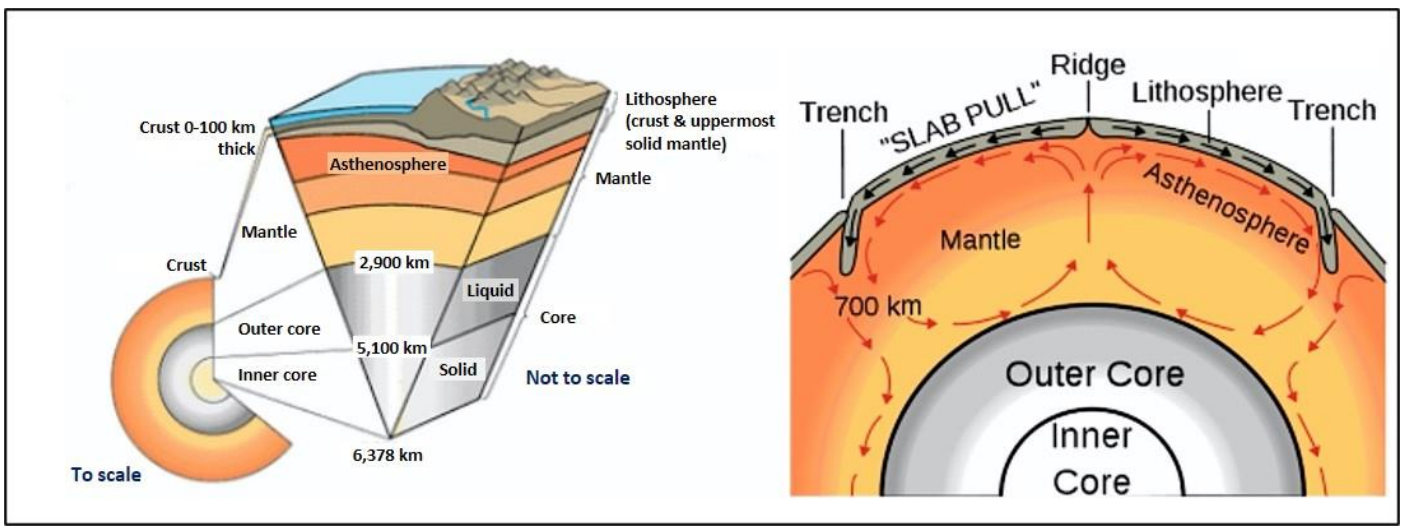


Fig. 2: Cross section through the Earth and the slab pull process for plate movements (Source: Wikipedia).

When considering the movement of plates, one has to find a process which can break up a huge continent like Pangaea or coalesce two continents together such as India or Africa with Asia. Furthermore, it must be a process which can continue unhampered for long periods of time. The movement of plates which include the San Andreas Fault, the Hawaiian Island Chain, the Southern Alps have all drifted for x00 Ma, as has the anticlockwise rotation of New Zealand. The drift of India probably lasted ca. 100 Ma. Movements in the mantle are not short-lived.

There are many hypotheses, but the three main processes are briefly described below:

1. Convection current theory (*push* from midocean ridges, MORs)

Radiogenic heat (decay of radioactive minerals) from deep within the mantle causes convection currents (hot rocks rise, cold rocks descend) much as boiling jam. These currents move very slowly in the solid state, and cause stress in the crust (wrinkles in scum on jam).

Initially convection currents were thought to be responsible for plate tectonics, moving plates across the Earth's surface.

This is now out of favour as there is no real evidence.

2. Slab-Pull theory (*pull* from subducting slabs) and Slab Suction

These days, plate movement is thought to be caused by 'slab pull' at subduction zones.

Normal oceanic crust is formed at mid ocean ridges and as it cools and thickens, it becomes denser (oceanic crust is believed to be less than ca. 200 Ma old and less than ca. 150km thick with a density of ca. 3.0 g/cm^3).

The oceanic plate is significantly denser than continental plate which has a density of ca. 2.7 g/cm^3 – thus when the two plates meet the continental plate automatically rides up over the oceanic plate (or the oceanic plate sinks under it).

The oceanic plate plunges into the mantle at subduction zones, pulling the rest of the oceanic plate behind it.

This is believed to result in sea floor spreading and rifting, pulling the plates apart.

Once started, subduction can continue uninterrupted for millennia. It is like a conveyor belt and slabs may break off at places, but it can also continue in a dribble through the entire mantle, to the CMB (this is called "slab suction").

The older the plate, the thicker it is and the thicker it is when it starts to subduct, the more difficult it will be to break it up which means this type of rupture will have very large earthquakes (as in Japan where the Pacific Crust is oldest). It also means that it has the potential to forge a route through the phase change at the top of the Lower Mantle.

3. Plume/Superplume Theory

The evidence for plume/superplume development at the CMB appears to be indisputable thanks to geophysicists.

The evidence from the Hawaiian Island chain seems to be due to the passage of the oceanic plate across a plume. The hot spot has been relatively static for x00 Ma.

This process may be assisted by the semi-continuous delivery of subducted slabs to the CMB from some of the numerous subduction trenches along the western rim of the Pacific.

COMMENTS ON SUBDUCTION

The following comments on subduction, slab rollback, trench retreat and back arc basins are all taken from Nui's work.

1. Slab Rollback

The primary driving force for subduction initiation is believed to be gravity, an initial low angle fault plane favours the foot of the subducting slab to sink and subduction commences.

With continued subduction, the slab tends to rotate towards vertical – this is called slab rollback.

2. Angle of Subduction

The angle of subduction may be small locally (e.g. the shallow part of the Nazca plate beneath South America), but flat subduction cannot (in theory) happen on a large scale as there is no force to drive flat subduction – gravity takes over.

However, researchers at UCL have discovered that a vertical plume that is east of, but which is extremely close to the

Kermadec Trench (east of Fiji), has stopped the vertically descending slab and sent it travelling horizontally away from the trench.

This would explain the ophiolite bodies which have been thrust onto North Island New Zealand which are believed to have been sourced from the South Fiji Basin.

3. Trench Retreat

As subduction continues, the slab rolls back, but at the same time, the trench migrates seaward with time (relative to the overriding continental plate). This is called trench retreat.

The overriding continental plate passively follows the retreating trench and is under extensional, not compressional, stresses thus the continental plate is under extension.

4. The Growth of Back-arc Basins

In the above scenario there are rifting and extensional basins on land, and some of these close to and behind the magmatic arc become "back-arc basins" with a spreading centre.

If the back-arc basin continues to grow it can become an "island arc" suggesting that all intra-oceanic island arcs have split off continental margin.

With continued trench retreat the open ocean basin shrinks and a back-arc basin can evolve to a large open ocean basin and the "island arc" or "island arc system" may become micro continents.

SEISMIC TOMOGRAPHY

A lot of work has been, and is still being done, in collecting more and more seismic images of the mantle. Algorithms developed for CT scans have been applied to seismic waves, giving amazing cross-sectional density images to deep into the Lower Mantle.

The seismic tomography shows mantle dynamics across the globe by providing constraints on three-dimensional temperature and composition, using distributions of elastic velocities from the inversion of seismic phases and travel time data. Supposed superplumes, in the lowermost mantle, have locations, under the south-central Pacific and under Africa, which correlates with the global distribution of hotspots, as well as two major geoid[1] highs. Recent tomographic S-wave velocity models suggest that superplumes rise high above the core-mantle boundary (CMB) and may be active upwellings.

[1] A geoid is a hypothetical solid figure whose surface corresponds to mean sea level and its imagined extension under (or over) land areas.

The faster the seismic wave, the denser the material so that is coloured blue rather than red.

TOMOGRAPHIC IMAGES

Note: In places I have included the comments from various authors in italics as it shows the level of discussion and uncertainty amongst the experts.

Figure 3 shows subducting slabs in the trench along the east coast of Japan, where the dense oceanic plate subducts below the less dense continental plate.

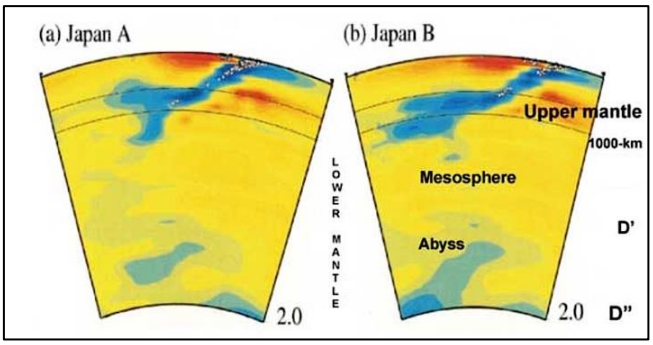


Fig. 3: Cold slab subducting beneath Japan (and to the CMB) (from Fukao et al., 2001).

The blue parts are the cold dense oceanic lithosphere (plate) subducting down through hotter mantle rocks. The plate begins to break into slabs.

Much of the plate/many of the cold slabs are deflected at the top of the Lower Mantle, spreading laterally under the overlying continental plate but other parts continue down into the Lower Mantle. Similar cooler zones are visible above the core-mantle-boundary, CMB. **BUT note, no convection cells can be seen**.

These sinking plates are colder than their surroundings and remain colder for a very long period of time – x00 Ma. As a result, the speed at which seismic waves travel through them is a little higher than in the surrounding hot mantle. Since the 1980's, the technique of seismic tomography has been developed that has provided a 3D image of the seismic velocity structure of the Earth's crust and mantle, from the surface to the boundary

between the mantle and the liquid outer core at a depth of 2,900km.

The scientists mapping mantle plumes are "*analysing the paths of seismic waves bouncing around Earth's interior after 273 strong earthquakes from the past 20 years*".

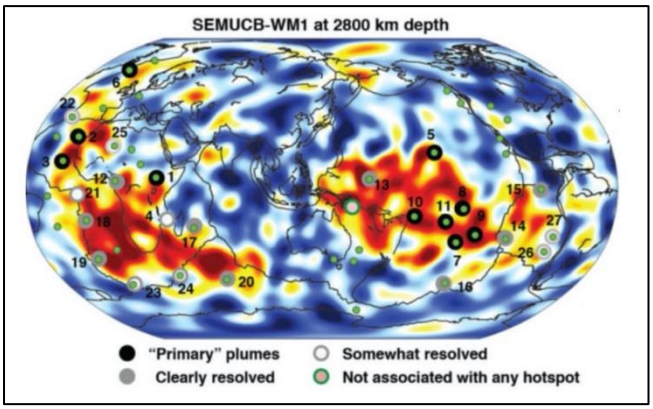


Fig. 4: A CT (computed tomography) scan of the Earth's interior (NERSC, Lawrence Berkeley National Laboratory).

This 'CT scan' of the Earth shows deep mantle plumes with overlying volcanic hotspots. The scans suggest that plumes of hot rock anchored at CMB rise to form island chains, such as Hawaii. "*Seismologists from the University of California, Berkeley, have produced a sharp, 3D scan of Earth's interior that conclusively connects plumes of hot rock rising through the mantle with surface hotspots that generate volcanic island chains like Hawaii, Samoa and Iceland*".

Previous attempts to image mantle plumes have detected pockets of hot rock rising in areas where plumes have been proposed, but it was unclear whether they were connected to volcanic hotspots at the surface or the roots of the plumes at the CMB at 2,900km.

New, high-resolution maps of the mantle show these connections for many hotspots on the planet, and, reveal that below about 1,000km the plumes are between 600-1,000km across, up to five times wider than geophysicists thought. The plumes are likely to be at least 400°C hotter than the surrounding mantle rock. The comments from the researchers vary as below:

"*No one has seen before these stark columnar objects that are contiguous all the way from the bottom of the mantle to the upper part of the mantle"* said Scott French. *"Connections between the lower mantle plumes and the volcanic hotspots are not direct because the tops of the plumes spread out like the delta of a river as they merge with the less viscous upper mantle rock"* (asthenosphere)."

"These columns are clearly separated in the lower mantle and they go all the way up to about 1,000km below the surface, but then they start to thin out in the upper part of the mantle, and they meander and deflect. … So, while the tops of the plumes are associated with hotspot volcanoes, they are not always vertically under them."

"The new picture shows that the bases of these plumes are anchored at the CMB in two huge blobs of hot rock, each about 5,000km in diameter, that are likely denser than surrounding rock. Romanowicz estimates that the two anchors, directly opposite each another under Africa and the Pacific Ocean have been in the same spots for 250 Ma."

Nui notes "*The confusing use of 'mantle plumes' … for within-plate magmatism has led to the great debate on whether mantle plumes exist or not. This debate is currently rather heated and is perhaps one of the greatest in the history of the solid Earth Science. The mantle plume concept is not yet a mature theory, but a hypothesis that remains to be tested.*"

"Forsyth & Uyeda (1975) recognized that the velocity of plate motion is independent of the size, circumference and ridge length of the plate, but shows a marked correlation with the trench portion of that plate's circumference. This indicates … that Slab Pull … is the primary driving force for plate motion. Ridge push … is one order of magnitude less than Slab Pull. … plate motions are driven by plates themselves without the need of an internal force such as "mantle convection" ... The ultimate subduction of the oceanic plates … back into the mantle … is both surface expression and actual driving force for mantle convection … the Pacific type (subduction) *is an active and dynamic limb of the convecting mantle""*

Nui continues *"… there would be no plate tectonics if there were no subduction zones. Ocean ridges are thus largely a passive feature. … It should be noted however that such Slab Pull concept of plate driving force readily explains the Pacific type seafloor spreading connected to subduction zones but is NOT straightforward to explain the Atlantic type seafloor spreading and continental drift. On a global scale … the largest buoyancy contrast is at the passive continental margins ... so these are the*

… loci of future subduction zones … The Ryukyu subduction zone in the Northwest Pacific is the present-day example of subduction initiation at a passive continental margin".

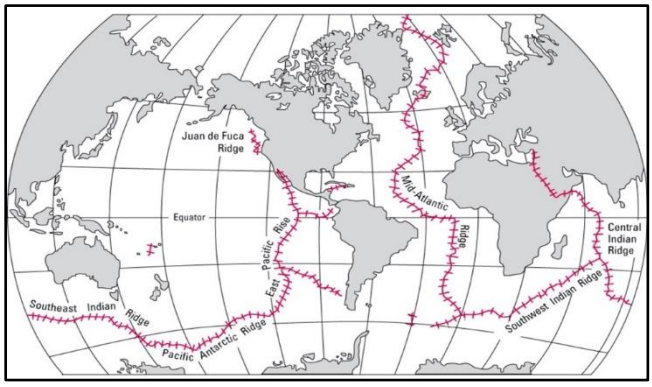


Fig. 5: World distribution of mid-oceanic ridges (JM Watson, USGS).

Figure 5 shows the system of mid-ocean ridges (MOR's) around the World. The USGS claim that this MOR system is one long mountain chain. But note – most of the MOR's shown on it, have resulted from the breakup of Pangaea. There are no slabs pulling apart the Mid-Atlantic Ridge or the Red Sea Rift, or most of the other MOR's, as noted above.

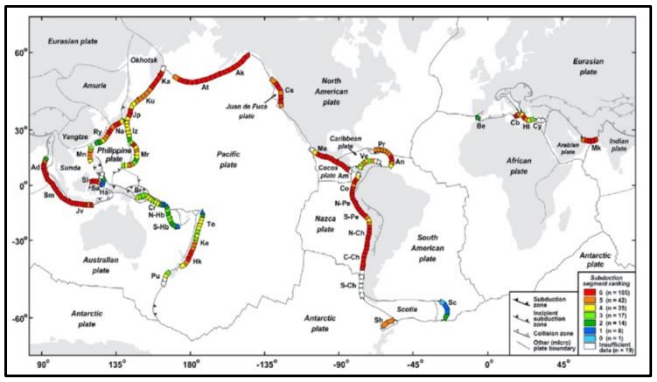


Fig. 6: Global map of the active subduction zones (Schellart, Wouter, et al, 2013).

Figure 6 shows the active subduction zones globally – the 200km segments are ranked in terms of predicted capability of causing an earthquake M_w>8.5 The parameters include:

- overriding plate deformation,
- angle & velocity at the trench,
- subduction thrust dip angle and curvature.

The lowest possible score is 0, the highest is 6 when a M_w>8.5 quake is likely to occur.

The map also shows that whilst the long trench along the west coast of the South American plate could contribute to the formation of the Atlantic MOR by slab pull, there is no similar trench anywhere along the north or east coast of Africa. As noted earlier, these MORs reflect the areas where Pangaea broke up.

The huge disturbance at the CMB in the cross section M-N (Fig. 7) and the huge Super Plume rising up and ending under Africa could have been large enough to affect Pangaea and Africa, and to spread all the plates to their current location. For many, the superplume process rules the roost.

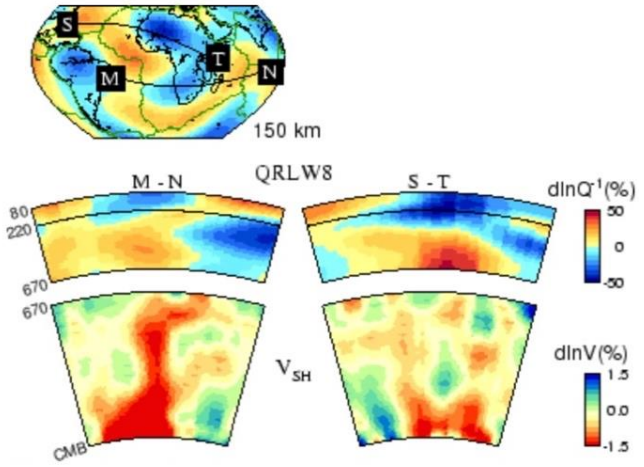


Fig. 7: Depth cross-sections under Africa along profiles indicated in the top panel showing, for each profile (top to bottom), Q distribution in the upper mantle (to degree 8), and V_{SH} distribution in the lower mantle (to degree 24)(Fig. 33.3 http://seismo.berkeley.edu/annual_report/ar01_02/node37.html).

Comparing the sections in Figure 7:

- Section M-N is under Africa - South America and represents the lower half of an ideal superplume.
- Cross section S-T, which is under northern Mid Atlantic Ridge / North Africa is another superplume. The differences can be due the angles of cross sections through vaguely circular shapes of a plume.

Note that the mantle and asthenosphere are heterogeneous showing large variations in elastic velocity from seismic data.

Data are displayed as [Q^{-1} = inverse of Q, (1/Q); Q= quality factor].

SO HOW DO PLATES MOVE?

I suspect it can be one source, or a mixture of two, three or all sources, either working together or against each other, but I feel the CMB is the source of major, long term, superplumes and major plate

tectonics. The breakup of Pangaea would have required a huge and continuous energy - the cratons were more than 100km thick, typically >250-350km thick and stable for 4 Ga. Something like the enormous disturbance shown in cross section M-N (Fig. 7) would be required and I suggest this is the type of superplume that could have broken up Pangaea.

But that is not the end of the story – how does the superplume form – just from the disturbances at the CMB or is it the influence of the subducted slabs which have arrived at the CMB (called slab suction) and increased any disturbance that is already there.

Yaoling Niu is an advocate of **slab pull and slab suction** – these slabs are portions of a subducting plate and he considers they **DRIVE** plate tectonics – both by slab pull (pulling the rest of the plate to which they are attached) and by inciting downward currents in the mantle (slab suction) to the CMB.

These slabs are often seen to falter at the seismic discontinuities - phase boundaries where the density suddenly increases - as between the upper and lower mantle; but once through, they can accumulate near the CMB. He notes that ca. 100 slabs have been described at depth and where and when they subducted. Slab subduction is the mechanism by which lithospheric material is mixed back into the Earth's mantle.

To me this latter concept (slab suction) is very important, perhaps the most important - it is the conveyor belt effect that continually brings a steady supply of detached slabs down to the CMB to mix with or enhance the disturbances there which help create the plumes. The longer the geographical length of the trench and the longer the trench conveyer belt is active, the larger the volume of subducted slabs which will accumulate and agitate the CMB area and when joining with natural disturbances from the surface of the liquid outer core it would be possible to activate a plume; after x00 Ma it can become a superplume.

Also, I feel it is only the continual upsurge of energy from a superplume that is capable of breaking up a huge supercontinent like Pangaea - it had to break through ancient mountain chains and cratons comprising granite, gneiss, migmatite. Similarly, it has to be something like a superplume to have the energy to drive one large plate of continental crust into another and to finally weld them together.

Ma = millions of years, Ga = billions of years

OTHER CROSS SECTIONS

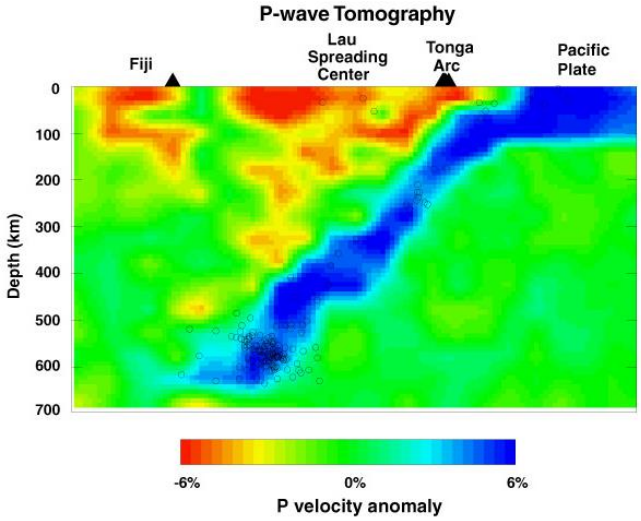


Fig. 8: This is an example of seismic tomography producing a 2D image of a subduction zone: the Tonga-Kermadec subduction zone boundary between Pacific plate (in blue) and Australian Plate (in red). Note the Pacific Plate is the colder and therefore older plate, while the yellow/red region is the hotter Australian plate. A cluster of earthquakes (black circles) at ca. 600km indicate the upper/lower mantle transition zone (www.geosci.usyd.edu.au).

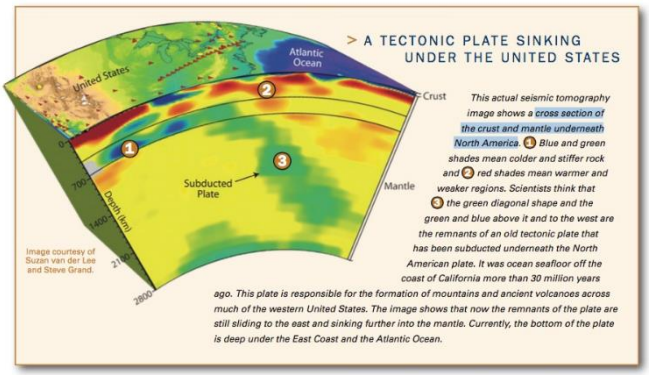


Fig. 9: A tectonic plate sinking under the United States (www.iris.edu).

FURTHER READING

Slab Pull & Slab Suction
https://www.researchgate.net/publication/265162711

Plate tectonics & Plumes
http://www.le.ac.uk/gl/art/gl209/lecture7/lecture7.html

Hot spots
www.sciencedaily.com/releases/2015/09/150902134939.htm

Others

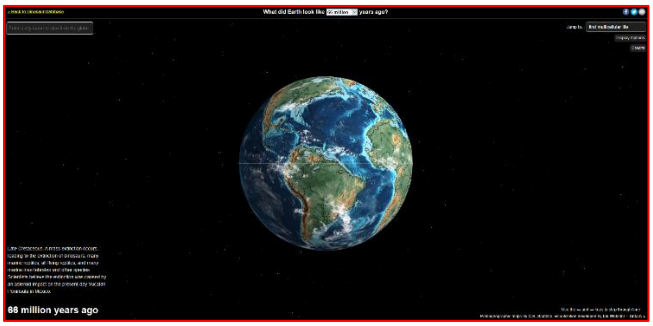
- http://seismo.berkeley.edu/annual_report/ar01_02/node37.html
- https://pubs.er.usgs.gov/publication/70024148
- http://www.atlas-of-the-underworld.org
- http://www.atlas-of-the-underworld.org/wp-content/uploads/2015/06/Atlas_map_global_UU_P07SL2013-S40RTS.mov *(a good movie).*

References

1. Fukao, Y., Widiyantoro, S., and Obayashi, M., (2001). Stagnant slabs in the upper and lower mantle transition region, *Rev. Geophys.*, **28**, 291–323.
2. Schellart, Wouter & Rawlinson, N. (2013). Global correlations between maximum magnitudes of subduction zone interface thrust earthquakes and physical parameters of subduction zones. Physics of the Earth and Planetary Interiors, **225**, 41–67.

(additional comments by Mick Caulfield)

Ancient Earth



What did the Earth look like 120 million years ago? You can enter a city and country to see what that location looked like in the past.

Visit: https://dinosaurpictures.org/ancient-earth#105

It Happened in July

10 July 1057

Lady Godiva rode naked on horseback throughout Coventry on a dare from her husband, the Earl of Mercia, who abolished taxation in this year.

4 July 1776

Congress accepted the Declaration of Independence written by Thomas Jefferson, formally ending American links with Britain.

1 July 1838

British scientist Charles Darwin presented a paper to the Linnean Society in London, on his theory of the evolution of species and natural selection.

9 July 1956

The 7.7 Mw Amorgos earthquake shakes the Cyclades island group in the Aegean Sea with a maximum Mercalli intensity of IX (“Violent”). The shaking and the destructive tsunami that followed left fifty-three people dead. A damaging 7.2 Mw aftershock occurred minutes after the main shock.

9 July 1958

A 7.8 Mw strike-slip earthquake in Alaska causes a landslide that produces a mega-tsunami. The run-up from the waves reached 525 m (1,722 ft) on the rim of Lituya Bay; five people were killed.

21 July 1969

The Apollo 11 Lunar Excursion Module (LEM), aka “Eagle”, lands on the moon and US astronaut Neil Armstrong is the first man in history to walk on its surface; Edwin “Buzz” Aldrin becomes the second.

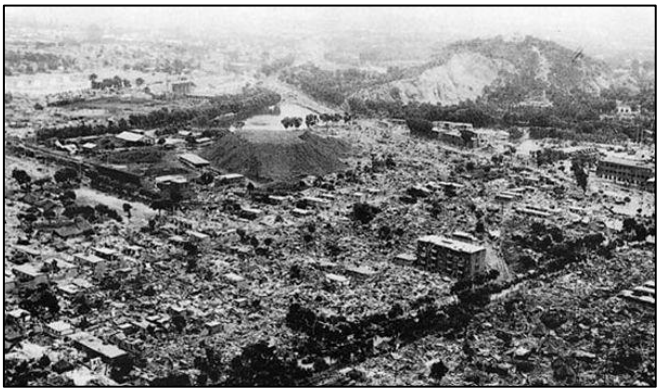
They, together with the Command Module (“Columbia”) pilot Michael Collins, returned to Earth and splashed down in the Pacific Ocean on July 24 after more than eight days in space.

12 July 1970

The first Farnham Geological Society field meeting was held, when 12 members met at Burrington Coombe in the Mendips. The trip was organised by the late Edward M. Finch, RIP.

28 July 1976

Tangshan earthquake



(Image credit: whoi.edu)

At 3:42 am on July 28, 1976, the Chinese city of Tangshan and its surroundings were rocked by a magnitude 7.8 earthquake.

Tangshan, an industrial city, had a population of about a million people, and the official death toll was a staggering 255,000. Another 700,000 people were injured, according to "The Great Tangshan Earthquake of 1976: An Anatomy of Disaster" (*Pergamon Press, 1988*). Many of Tangshan's buildings were completely destroyed, according to that history, and 150,000 people moved into new residences in the six years following the quake.

10 July 1997

In London, scientists report the findings of the DNA analysis of a Neanderthal skeleton which supports the "out of Africa theory" of human evolution, placing an "African Eve" at 100,000 to 200,000 years ago.

11 July 2008

Oil hits an all-time high of $147 a barrel following further missile testing by Iran in the Middle East and concerns over oil supplies should tensions increase further between Iran and Israel over Iran's nuclear program.

Today (1 July 2020) oil trades at circa $40 a barrel having fallen to around $10 a barrel (with WTI very briefly trading as low as -$37 a barrel) at the end of April 2020.

Article

North Sea gas has lower carbon footprint than imported LNG

The production of natural gas from the UK Continental Shelf (UKCS) creates less than half as much greenhouse gas as imported Liquefied Natural Gas (LNG), according to data published today by the Oil and Gas Authority (OGA).

May 26, 2020

In this analysis, gas extracted from the UKCS has an average emission intensity of 22 kgCO2e/boe, whereas imported LNG has a significantly higher average intensity of 59 kgCO2e/boe.

Importing gas via by pipeline, particularly from Norway, produces an even lower average of 18 kgCO2e/boe, which suggests there is still potential for the UKCS to continue to improve its operations and lower emissions further.

The process of liquefaction, combined with the emissions produced by the transportation and regasification of the LNG once in the UK, are responsible for the considerably higher emissions intensity of LNG.

In 2019, the UKCS supplied 46% of UK gas consumption. Imported LNG supplied around 21% and the remaining 33% was imported via pipeline. Estimates predict that while gas demand will decline slightly from the current level of 69 billion cubic metres (bcm) in 2019 to 60 bcm in 2035, UK gas production will fall at a faster rate from 35 bcm in 2019 to 16 bcm in 2035.

Current government forecasts suggest that gas will remain a vital part of the UK's energy mix as we move towards Net Zero. As long as this demand exists, managing declining North Sea production to maximise value, minimising greenhouse gas emissions and reducing reliance on hydrocarbon imports are all essential.

However, while avoiding higher emissions imports, there is still scope to significantly reduce UK production carbon footprint. The industry should rapidly progress this or risk losing its social licence to operate. **The OGA considers the oil and gas industry to be well-placed to unlock solutions which will help the UK reach Net Zero greenhouse gas emissions by 2050.**

To support this, the OGA is currently consulting on integrating the Net Zero target into its overall Strategy and across all its work, including updating the 'central obligation' to include emissions reduction.

Hedvig Ljungerud, OGA Director of Strategy, said: "The oil and gas industry is currently having to deal with the effects of the global pandemic and the rapid fall in commodity prices, and we're working with the government and the industry to safeguard supply and thousands of jobs.

"This data highlights both the need to continue producing our own gas as long as we consume it, to minimise emissions, and support the drive to Net Zero, while pushing ahead with emissions reductions from UK production."

Reference:

https://expronews.com/resources/north-sea-gas-has-lower-carbon-footprint-than-imported-lng/

Article

Where is the largest waterfall on Earth?

The world's largest waterfall is in the ocean, beneath the Denmark Strait.

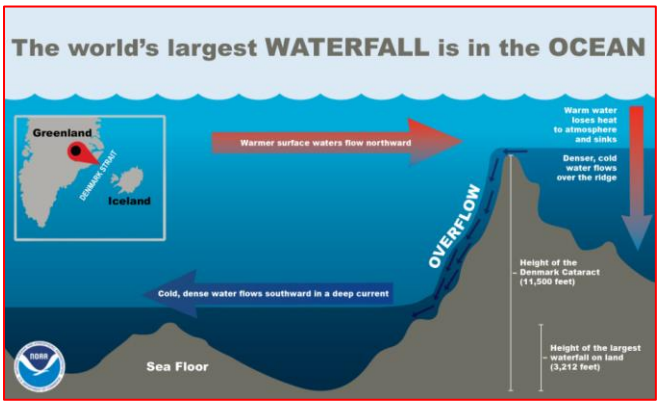
National Oceanic and Atmospheric Administration

25 June 2018

Rivers flowing over Earth's gorges create waterfalls that are natural wonders, drawing millions of visitors to their breathtaking beauty, grandeur, and power. But no waterfall is larger or more powerful than those that lie beneath the ocean, cascading over immense cataracts hidden from our view.

Indeed, the world's largest waterfall lies beneath the Denmark Strait, which separates Iceland and Greenland. At the bottom of the strait are a series of cataracts that plunge to a depth of 3,505m (11,500ft) at the southern tip of Greenland—a three-and-a-half-kilometre drop.

The Denmark Strait cataract is more than 3 times the height of Angel Falls in Venezuela (979m), which is considered Earth's tallest waterfall on land. And the Denmark Strait cataract carries an estimated 5 million cubic metres (175 million cubic feet) of water per second. That's equivalent to almost 2,000 Niagara Falls at peak flow.



In the Denmark Strait, southward-flowing frigid water from the Nordic Seas meets warmer water from the Irminger Sea. The cold, dense water quickly sinks below the warmer water and flows over the huge drop in the ocean floor, creating a downward flow estimated at 5 million cubic metres per second (Image via NOAA).

But how can there be waterfalls in the ocean? It is because cold water is denser than warm water, and in the Denmark Strait, southward-flowing frigid water from the Nordic Seas meets warmer water from the Irminger Sea. The cold, dense water quickly sinks below the warmer water and flows over the huge drop in the ocean floor, creating a downward flow estimated at well over 5 million cubic metres per second. Because it flows beneath the ocean surface, however, the massive turbulence of the Denmark Strait goes completely undetected without the aid of scientific instruments.

Reference:

1. https://oceanservice.noaa.gov/facts/largest-waterfall.html?fbclid=IwAR0501LeTWTwqvb9rNOzmlG2xdt2MOZvjYffSeS-nmoKJVhTFkPwQQnmLQ8#transcript
2. https://earthsky.org/earth/earths-largest-waterfall

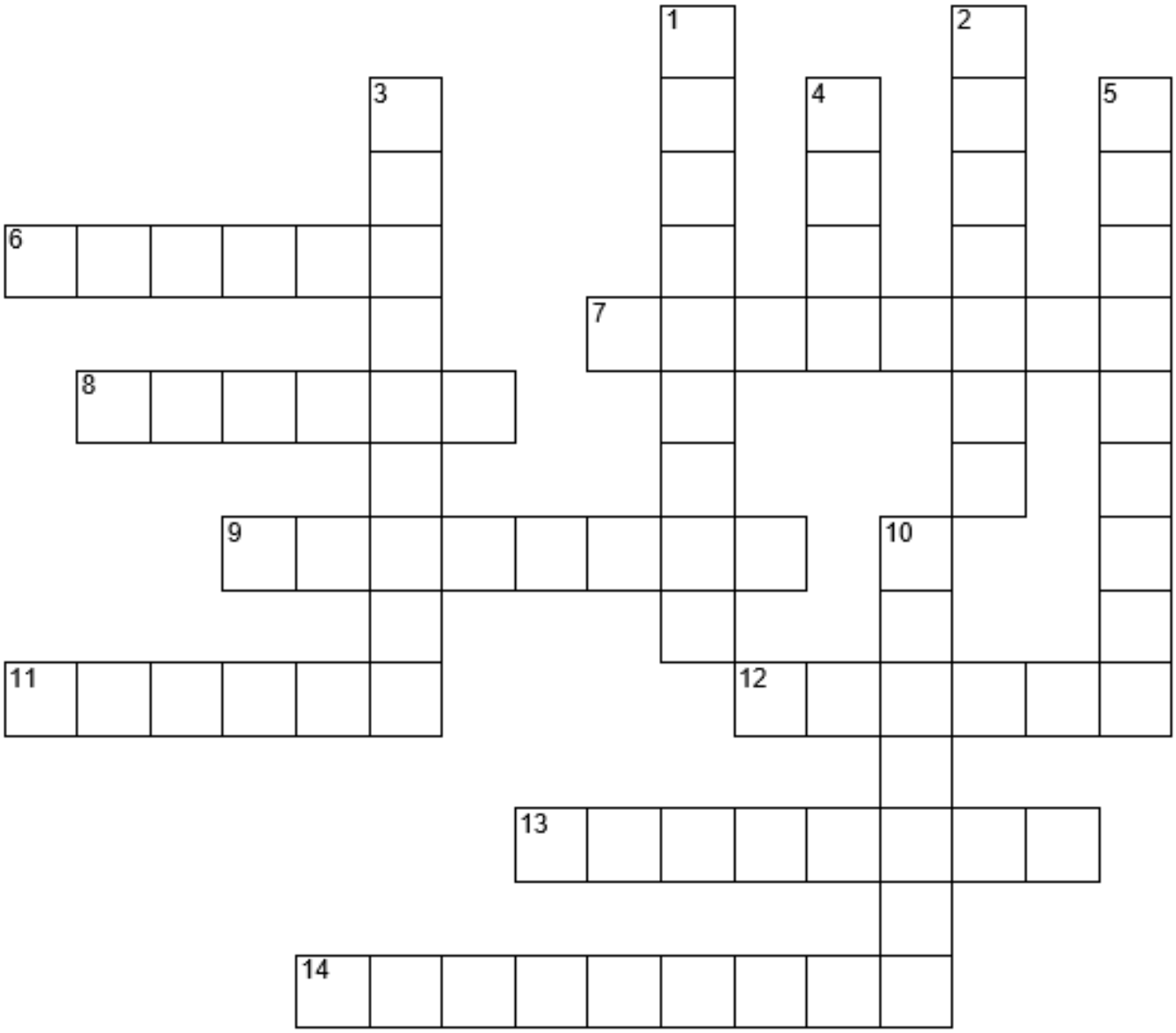
https://geoscienceforthefuture.com/

This interesting website highlights how geologists are tackling the major challenges facing our society.

In recent years, geoscience has had a bad press. This site wants to change that, with stories from around the world that show how geoscientists are working towards making our planet a better place. From developing renewable energies, to understanding geohazards and risk, to extracting minerals vital for a sustainable future!

It also wants to highlight ways for geoscience to change and progress in the future; geoscience needs to be more inclusive, and more representative of the diverse planet we study. The main contributors, Dr. Natasha Dowey, a Geology Lecturer at the University of Hull, and Dr. Hazel Beaumont, a Geology Lecturer at UWE Bristol, are keen to publish contributions from authors of a range of ethnic and cultural backgrounds, abilities, and genders.

The Common Minerals Crossword



www.rocksandminerals4u.com

ACROSS

6. The main source of lead.
7. An iron ore sometimes used in jewellery.
8. Sometimes called “fool’s gold”.
9. Sulphide mineral, long metallic slender bladed crystals.
11. A very heavy sulphate mineral.
12. Rock salt.
13. Calcium fluoride.
14. A bright green copper carbonate.

DOWN

1. A naturally magnetic rock.
2. A bright blue copper carbonate.
3. Metamorphic quartz sandstone.
4. A silicate mineral known for its perfect cleavage into thin sheets.
5. Strontium silicate, its name means celestial.
10. A common carbonate mineral, often a replacement mineral in fossils.

Answers on page 19.

Calvin and Hobbes by Bill Watterson

Article

The first dinosaurs may have laid soft eggs without hard shells

New Scientist (Life)

17 June 2020

By Michael Marshall

This fossilised egg was laid by Mussaurus, a type of long-necked, plant-eating dinosaur that grew to 6 metres in length and lived in what is now Argentina (Image credit: Diego Pol)

The first dinosaurs laid soft eggs and it was only later that some groups evolved eggs with hard shells, according to new research. The finding overturns a long-standing assumption that dinosaurs always laid hard-shelled eggs like modern birds.

Paleontologists have struggled to find eggs from certain dinosaur groups, says Mark Norell at the American Museum of Natural History in New York. If dinosaurs had always laid hard-shelled eggs, they would all be equally easy to find, as soft-shelled eggs barely fossilise, says Norell.

But while the eggs of some dinosaurs are “a dime a dozen”, he says, there are no preserved eggs of others such as *Triceratops*.

In Mongolia, Norell and his team found a clutch of embryos that they believe belonged to a type of dinosaur called *Protoceratops* that lived between 83 and 72 million years ago. When they found the fossils, “they were in the foetal position, all curled up”, says Norell. Each was surrounded by a thin film.

The team also examined preserved embryos of *Mussaurus*, a type of early dinosaur that lived around 200 million years ago. These were also surrounded by a thin outer layer.

Soft-shelled eggs

Team member Jasmina Wiemann at Yale University found that the films around the embryos contained the degraded remains of egg proteins.

Wiemann then examined 26 kinds of egg from extinct and living animals and found that hard-shelled and soft-shelled eggs had different kinds of proteins that left traces after they were fossilised. When she analysed the *Protoceratops* and *Mussaurus* samples, “both of them matched the soft-shelled eggs”, she says.

To find out whether the earliest dinosaur eggs were soft or hard-shelled, team member Matteo Fabbri, also at Yale University, compiled a database of information about eggs from 112 living and extinct reptiles and birds whose evolutionary relationships are known. It turned out that the first

members of many groups, including lizards and dinosaurs, laid soft-shelled eggs.

Evolutionary relationships

The first dinosaurs eventually gave rise to three major groups: the **sauropodomorphs**, which included *Mussaurus*; the **ornithischians**, which included *Protoceratops*; and the **theropods**, which included large meat-eaters like *Tyrannosaurus rex* and birds. "Each branch of dinosaurs evolved, independently, a hard eggshell," says Fabbri.

The first dinosaurs were more reptilian in their physiology and in their behaviour. They probably buried their soft-shelled eggs to keep them warm and then later abandoned them. "Dinosaurs were, to a certain extent, less bird-like than we thought," says Wiemann.

Journal reference:
***Nature*, DOI: 10.1038/s41586-020-2412-8**

Reference:
https://www.newscientist.com/article/2246238-the-first-dinosaurs-may-have-laid-soft-eggs-without-hard-shells/

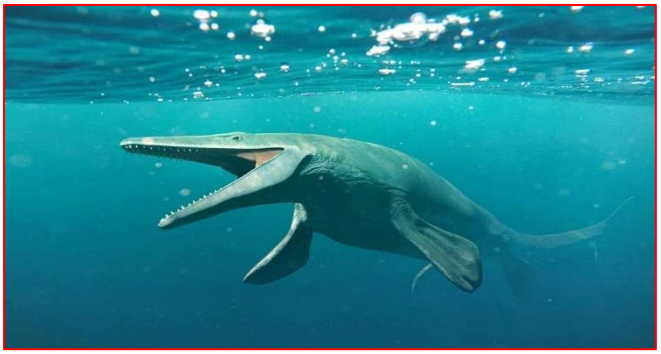
Article

Huge fossilised egg may have been laid by a massive marine reptile

New Scientist (Life)

17 June 2020

By Michael Marshall



Mosasaurs were a type of aquatic lizard that lived between 70 and 66 million years ago (Image ref: DottedZebra/Alamy).

A dinosaur-era animal laid one of the largest eggs ever, measuring 29 by 20 centimetres. The egg is the second largest ever discovered, only beaten by that of the extinct Madagascan elephant bird. We don't know what animal laid the huge egg, but the prime candidate is a mosasaur: a giant marine reptile that looked a bit like a toothed whale.

The fossilised egg was discovered on Seymour Island, off the west coast of Antarctica, by a team of Chilean paleontologists including David Rubilar-Rogers of the National Museum of Natural History in Santiago.

They showed it to Julia Clarke at the University of Texas at Austin. "I had never seen anything like that before in my life," says Clarke. It was found in a 68-million-year-old rock formation – from near the end of the dinosaur era. Despite its huge size, it had almost no shell and must have been very soft.

At first, the researchers were baffled. "We had no idea what could have laid it," says co-author Lucas Legendre, also at the University of Texas at Austin.

No fossilised eggs have ever been found in Antarctica. "We've got dinosaurs from Antarctica, but they're not big enough to lay this egg," says Clarke.

Instead, the team thinks the egg could have been from a mosasaur. Although mosasaurs lived during the dinosaur era, they were not dinosaurs. They belong to a group of reptiles called squamates, which also includes lizards and snakes. The ancestors of squamates split from those of dinosaurs around 240 million years ago.

Other groups of marine reptiles, like the long-necked plesiosaurs, are believed to have given birth to live young. "But for mosasaurs, the evidence is much more limited," says Clarke. One adult has been found with embryos inside, curled up as if inside eggs, but with no eggshell preserved.

Given that the egg was so soft, Clarke and Legendre suspect it hatched as soon as it was laid – a halfway house being egg-laying and giving birth to live young, known as ovoviviparity.

"In lizards and snakes, live birth with a vestigial eggshell has evolved over and over again," says Clarke. It would not be surprising if some mosasaurs also evolved it, she says.

Journal reference:
***Nature*, DOI: 10.1038/s41586-020-2377-7**

Reference:
https://www.newscientist.com/article/2246262-huge-fossilised-egg-may-have-been-laid-by-a-massive-marine-reptile/

News

Villagers applaud surprise council rejection of UKOG's Dunsfold drilling plans

By Ruth Hayhurst

June 29, 2020

Dunsfold residents have welcomed a county council vote to refuse plans to drill near their Surrey village.

UK Oil & Gas, which was seeking permission to explore and test for oil and gas, said it was disappointed by the refusal and was likely to appeal.

The surprise decision went against the advice of council planning officers.

Six members of Surrey's 11-strong planning committee voted to refuse permission.

The committee then agreed by 9-1 on the grounds for refusal: that the need for the scheme had not been demonstrated and that the adverse impacts of the scheme on highways, noise, lighting and air quality would not be significant, had not been demonstrated, contrary to local planning policy.

Surrey County Council now joins Waverley District Council and five parish councils which opposed the scheme. 84% of people who took part in a public consultation also objected.

The campaign group, Protect Dunsfold, said in a statement this afternoon:

"Councillors rejected officers' suggestions that everything objected to was either taken care of or would be mitigated – be it highways safety, loss of local business incomes, destruction of rural environment.

"We must applaud the councillors who showed they had listened to the valid concerns put before them and were prepared to take a stand and show that the Surrey County Council climate change strategy actually does have importance, as do the lives of local people.

"Maybe 2020 really will see the start of fresh innovative thinking at Surrey County Council."

UKOG had applied to drill vertical and sidetrack wells to explore and test for gas in the Portland sandstone formation and oil in the deeper Kimmeridge limestone. It called the proposed well site Loxley, after the nearby hamlet.

In statements to the committee, the company said hydrocarbons from the site would "make a timely contribution" to the post-Covid-19 recovery in Surrey and the UK. The company also said Dunsfold could provide raw materials to produce personal protective equipment, of which there were UK shortages during the Covid-19 pandemic.

One councillor said this prediction was premature because the planning application was for exploration not production.

Another member warned the council that it could face costs if the application was refused and went to appeal. Council planners had said there were no valid reasons to refuse the application.

But Cllr Stephen Cooksey, who voted against the scheme, said: "The right thing to do is to oppose the application."

A statement from UKOG said:

"We are obviously disappointed by Surrey County Council's refusal of planning consent for our Loxley-1 appraisal project.

"Unfortunately, the precise reason or reasons for refusal and why the Planning Officer's recommendation was overturned, remain unclear, which is less than ideal.

"The general structure and conduct [of the meeting] also opens up further questions on the validity of the decision. We also note that the Environment Agency granted the scheme a full environmental permit on 26 June covering all environmental aspects of the proposed scheme.

"Furthermore, we note that the meeting's main discussion centred around a possible highways issue regarding the suitability of the Dunsfold road adjoining the site to accommodate the envisaged traffic flows. However, the County Highways and Planning Officers supported this aspect of the application, stating that the traffic mitigation plan would permit safe use of the road during operations.

"As UKOG made clear at the meeting, we believe Loxley is a material regional natural gas resource, which could have made, and could still make, a timely contribution to Surrey and the UK's recovery from the Covid-related economic downturn, something that has affected everyone.

"It is particularly disappointing that such a net zero compliant project, which could have been used to generate clean hydrogen fuel for the UK, has had this setback.

"The Company is carefully considering its position. However, it is likely that we will appeal the decision via the planning inspectorate."

The committee was the first virtual meeting held by Surrey. It was interrupted several times when the webcast failed and there were concerns that the meeting was not truly public.

Reference:

https://drillordrop.com/2020/06/29/villagers-applaud-surprise-council-rejection-of-ukogs-dunsfold-drilling-plans/?fbclid=IwAR21iJ8SKrjH3mcdAYhjYCDX6AhJCVGuO6YPhHTjVxs9pOkiR5WSE2YAV1Y

Article

Possible Dinosaur DNA Has Been Found

New discoveries have raised the possibility of exploring dino genetics, but controversy surrounds the results

Article from Scientific American, 17 April 2020

By Riley Black

The tiny fossil is unassuming, as dinosaur remains go. It is not as big as an Apatosaurus femur or as impressive as a Tyrannosaurus jaw. The object is a just a scant shard of cartilage from the skull of a baby hadrosaur called *Hypacrosaurus* that perished more than 70 million years ago. But it may contain something never before seen from the depths of the Mesozoic era: degraded remnants of dinosaur DNA.

Genetic material is not supposed to last over such time periods—not by a long shot. DNA begins to decay at death. Findings from a 2012 study on the extinct flightless moa bird's bones show an organism's genetic material deteriorates at such a rate that it halves itself every 521 years. This speed would mean paleontologists can only hope to recover recognizable DNA sequences from creatures that lived and died within the past 6.8 million years - far short of even the last non-avian dinosaurs.

But then there is the Hypacrosaurus cartilage. In a study published earlier this year, Chinese Academy of Sciences paleontologist Alida Bailleul and her colleagues proposed that in that fossil, they had found not only evidence of original proteins and cartilage-creating cells but a chemical signature consistent with DNA.

Recovering genetic material of such antiquity would be a major development. Working on more recently extinct creatures - such as mammoths and giant ground sloths - paleontologists have been able to revise family trees, explore the interrelatedness of species and even gain some insights into biological features such as variations in coloration. DNA from non-avian dinosaurs would add a wealth of new information about the biology of the "terrible lizards." Such a find would also establish the possibility that genetic material can remain detectable not just for one million years, but for tens of millions. The fossil record would not be bones and footprints alone: it would contain scraps of the genetic record that ties together all life on Earth.

Centrosaurus (Elena Duvernay, Getty Images)

Yet first, paleontologists need to confirm that these possible genetic traces are the real thing. Such potential tatters of ancient DNA are not exactly "Jurassic Park" quality. At best, their biological makers seem to be degraded remnants of genes that cannot be read - broken-down components rather than intact parts of a sequence. Still, these potential tatters of ancient DNA would be far older (by millions of years) than the next closest trace of degraded genetic material in the fossil record.

If upheld, Bailleul and her colleagues' findings would indicate that biochemical traces of organisms can persist for tens of millions of years longer than previously thought. And that would

mean there may be an entire world of biological information experts are only just getting to know. “I think exceptional preservation is really more common than what we think, because, as researchers, we have not looked at enough fossils yet,” Bailleul says. “We must keep looking.”

The question is whether these proteins and other traces are really what they seem. Hot on the heels of Bailleul’s paper - and inspired by the controversy over what the biomolecules inside dinosaur bones represent - a separate team, led by Princeton University geoscientist Renxing Liang, recently reported on unexpected microbes found inside one from *Centrosaurus*, a horned dinosaur of similar age to *Hypacrosaurus*. The researchers said that they unearthed DNA inside the bone, but it was from lineages of bacteria and other microorganisms that had not been seen before. The bone had its own unique microbiome, which could cause confusion as to whether proteins and possible genetic material belonged to the dinosaur itself or to bacteria that had come to reside within it during the fossilization process.

The discovery that such fossils can harbour bacterial communities different from those in the surrounding stone complicates the search for dinosaur DNA, proteins, and other biomolecules. The modern may be overlaid on the past, creating a false image. “Even if any trace organics could be preserved,” Liang says, “the identification processes would be as challenging as finding a needle in the haystack and thus will likely lead to potential false claims.”

“Right now, molecular paleontology is controversial,” Bailleul says. The first sticking point is that when researchers look for traces of ancient biological molecules, they use technologies invented to find intact traces that have been degraded or altered by vast amounts of time. On top of that issue, there remains much experts do not know about how a dinosaur bone changes from organic tissue in a recently alive animal to a fossil hardened by minerals. “We have not figured out all of the complex mechanisms of molecular fossilization using chemistry. And we don’t know enough about the roles that microbes play,” Bailleul says. For example, it is unclear how modern microbes outside of fossils might interact with those that have been living within the bones.

These unknowns, as well as protocols that are still in development, fuel the ongoing debate over what the biological titbits inside dinosaur bones represent. The research on the *Hypacrosaurus* cartilage looked at its microscopic details and used chemical stains that bind to DNA. In contrast, the study on the Centrosaurus bone used DNA sequencing to understand the nature of the genetic traces inside it - but did not look at its microstructure.

Bailleul acknowledges that considering previously unknown forms of microorganisms when studying dinosaur bone microbiology is important. But she proposes that it is unlikely bacteria would find their way into a cartilage cell and mimic its nucleus in such a way that researchers would mistake the microorganisms for the genuine article. Yet “you can never be too sceptical of your own results,” says paleogeneticist and author Ross Barnett, who was not involved in the two studies described above.

One of the largest difficulties in the ongoing debate, Barnett says, is a lack of replication. And paleogenetics has been through this problem before: Around the time the film Jurassic Park debuted in 1993, research papers heralded the discovery of Mesozoic DNA. Those claims were later overturned when other research teams could not replicate the same results. Even though the science of paleogenetics has changed since that time, the need for multiple labs to confirm the same result remains important. “If a different lab could be independently sent fossils from the same site, work up their own antibodies, do their own staining and get the same results, it would make things more believable,” Barnett says. Such collaboration has yet to take place for some of the assertions of exceptional dinosaurian preservation.

Nevertheless, molecular paleobiology is developing standards of evidence and protocols as it continues to search for clues held inside ancient bones. “I hope that many paleontologists or biologists, or both, are also trying to do this,” Bailleul says. “We can figure out the answers faster if we are all working on this together.”

Even if proposed dinosaur organics turn out to be false, the effort could still yield unexpected benefits. Bacterial communities are thought to be involved in the preservation of bones and in their replacement with minerals, thus helping dinosaur remains become fossils. “Future studies about ancient DNA from past microbial communities that used to live inside the dinosaur bones could shed more light on the roles of microorganisms in the

fossilization and preservation of bones through geological time," Liang says.

"These are very difficult questions," Bailleul says. "But if we keep trying, there is hope that we will figure out most answers." As the situation stands now, nothing is written in stone.

Reference:
https://www.scientificamerican.com/article/possible-dinosaur-dna-has-been-found/

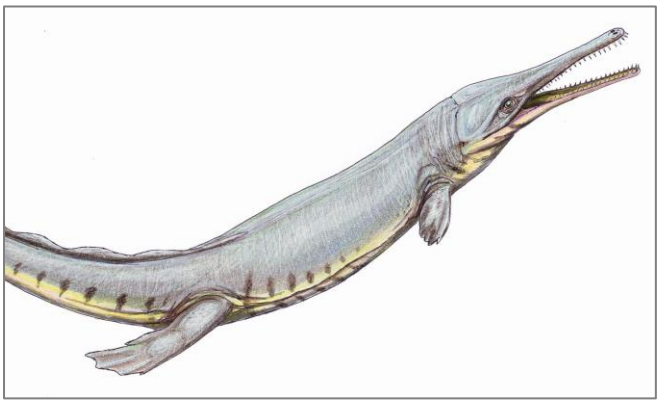
Article

Ancient ocean-going crocodiles mimicked whales and dolphins

Thalattosuchians streamlined bodies and adapted inner ears as they adjusted to marine life

PA Media

Mon 20 Apr 2020



The extinct crocodiles, thalattosuchia, evolved from their land-living ancestors to become fast swimming predators. (Dmitry Bogdanov/The University of Edinburgh/PA).

Deadly prehistoric crocodiles mimicked the shape and senses of whales and dolphins to dominate Jurassic seas, new research has found.

The extinct crocodiles, *thalattosuchia*, evolved from their land-living ancestors to become fast swimming predators.

They adapted their limbs into flippers, streamlined their bodies and formed fluked tails to help them move powerfully through the water.

Experts from the University of Edinburgh have also found they adapted a part of the inner ear, responsible for balance and equilibrium, as they gradually adjusted to their new ocean home 170 million years ago.

Paleontologists analysed CAT scans of more than a dozen fossil skulls to examine the vestibular system of the inner ear, which comprises of three looping semi-circular canals and helps with balance and spatial awareness.

As *thalattosuchia* made their first steps into the water, during a long semi-aquatic phase, their ear canals became markedly fatter and smaller – a shape that made the sensory system less sensitive and one shared with dolphins and whales.

Scientists said this canal shape is better suited to life in the oceans, where buoyancy can hold up an animal, as compared to land, where animals need a highly sensitive sense of balance to cope with gravity and complex landscapes.

A similar change occurred independently in whales. It is thought that each species mimicked each other's changes during this period of adaptation.

Julia Schwab, a PhD student in the University of Edinburgh's school of geosciences, who led the study, said: "Sensory organs such as the inner ear are key to understand how ancient animals lived.

"We found that marine crocodile relatives have a very unique inner-ear shape, similar to other water-living reptiles and today's whales."

Experts said the findings also show the crocodiles' sensory systems evolved in response to their new deep-water environment, rather than driving them into it.

Dr Steve Brusatte, also of the school of geosciences and senior author on the study, said: "The ancient aquatic crocs developed unusual inner ears after modifying their skeletons to become better swimmers.

"Whales also changed their ears in a similar way but did it soon after entering the water. It seems like the crocs and whales took similar but different evolutionary routes from land to water."

The study, published in Proceedings of the National Academy of Sciences (USA), was supported by a grant from the Leverhulme Trust.

It involved a team of scientists from around the world, including colleagues from the National Museum of Scotland.

Reference:

https://www.theguardian.com/science/2020/apr/20/ancient-ocean-going-crocodiles-mimicked-whales-and-dolphins

Article

Asteroid that killed the dinosaurs hit just right for maximum damage

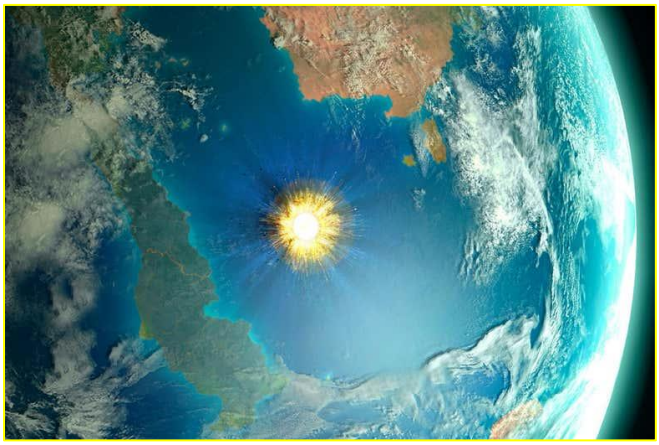
New Scientist, Earth

26 May 2020

By Leah Crane

The trajectory of the asteroid thought to have killed the dinosaurs 66 million years ago was just right to cause maximum damage. A new study of Chicxulub crater in Mexico, where the asteroid struck, has revealed that the angle and speed of the impact were probably in the perfect range to send clouds of choking vapour into the skies.

When an asteroid hits a planet, the resulting crater is highly dependent on the angle of the impact. Gareth Collins at Imperial College London in the UK and his colleagues compared a set of simulations with geological data gathered at Chicxulub crater to reconstruct that impact.



The dinosaur-killing asteroid hit the Yucatan Peninsula in Mexico (Science Photo Library / Alamy)

"That initial impact gouges a huge hole in the ground, which then collapses spectacularly, and you form this huge overshoot, rather like what happens when you throw a pebble into the pond," says Collins. In this "overshoot", the middle of the hole bounces back up to create a plateau at the centre of the crater.

In simulations of the Chicxulub impact, that central plateau was tilted toward the direction the asteroid came from, though how tilted it was depended on the angle of the impact.

The simulations that best matched observations of the crater were those where the asteroid came in relatively fast, around 20 kilometres per second, and hit the ground at an angle of around 60 degrees from horizontal.

Much of the devastation caused by the asteroid impact came from vaporised rock being blasted into the air and blocking out sunlight. It turns out that an impact angle of about 60 degrees is ideal for hurling as much vapour into the air as possible, Collins says – if it came in from straight overhead, the asteroid would have smashed up more rock but not sent as much into the atmosphere, and if it was more of a glancing blow, less rock would have been vaporised.

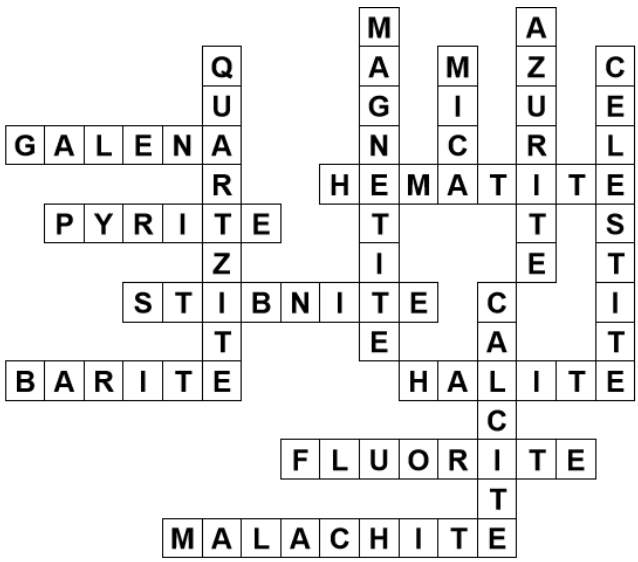
"It's sort of a perfect storm," says Collins, which is good news for us today. "This was a very bad day for the dinosaurs, and the more special the circumstances that had to come together to cause this event, the less likely that it'll happen again."

Reference:

https://www.newscientist.com/article/2244354-asteroid-that-killed-the-dinosaurs-hit-just-right-for-maximum-damage/#ixzz6OZMTChsF

The Common Minerals Crossword

Solution:



FARNHAM GEOLOGICAL SOCIETY

NEWS LETTER No. 1

The first field meeting of the Society was held on Sunday 12th. July 1970, when twelve members met at Burrington Coombe in the Mendips. Eleven localities were visited and although the majority were Carboniferous exposures, Jurassic and Silurian rocks were also examined. Fossils were collected from the Carboniferous and Jurassic rocks and included some fine plants from a coal tip near Radstock. Most of the exposures showed evidence of the Armorican earth movements and at Vobster Quarry a remarkable Upper/Lower Carboniferous reversal was seen. Thanks are due to Mr. E.M. Finch for organising a most informative and enjoyable trip in such splendid scenery. One party was so impressed by the scenery in and around Radstock that they thought it worth more than one circuit of the same route and lead a motorcade in a sort of "Turkish Shepherds' Dance" for a few miles.

Although no formal programme has been finalised, the following topics for lecture meetings are proposed:-

The Folkstone Beds.
Vulcanism.
Geology of South East England.
Continental Drift.

The first of these meetings will be held on Thursday 6th. August at 7-30 p.m. at the Adult Education Centre, Potters Gate, Farnham. Mr. E.M. Finch will talk on the subject of the Folkstone Beds and will detail the Society's research project in this area. This project will require the active support of as many Members as possible so please make a special effort to attend this meeting. If you are unable to attend but will be available for field work, please inform the Secretary so that Mr. Finch can select the various teams on the sixth.

This News Letter is optimistically numbered one as it is proposed to make a regular feature of a News Letter. As the Society ages no doubt Members will wish to contribute items of interest and if the Secretary's typing finger holds out, the Letters will grow.

FGS Newsletter Vol.1 No.1 July 1970

Farnham Geological Society

Vanessa Banks
President

The Geologists' Association
Burlington House
Piccadilly
London
W1J 0DU
www.geologistsassociation.org.uk

29June 2020

Dear Mrs J. Wilson,

Further to our letter on 7 May 2020, the Geologists' Association Council hope that during the current period of social distancing you have had time to engage with the content linked via https://geologistsassociation.org.uk/sofageology/#latest and that you have caught the on line lecture series. We also thought that it was time to update you with regard to the planning and progress with the Virtual Festival of Geology (vFOG) scheduled for 7 and 8 November 2020.

Progress has been made with respect to booking high profile scientists, including Professor Phil Manning from the University of Manchester for the public lectures. Whilst some lecturers may opt to pre-record, others will be live, and we anticipate that all will be available for questions at the scheduled lecture times.

Our Rockwatch leads have been preparing a "virtual discovery room" and some fun activities for children in the context of the Passport system introduced by Adrian Champion last year. To celebrate research activities, we will encourage content from Curry funded projects and plans are in place for the display of the photographic competition. For the commercial side, a nice environment for the sale of rocks and fossils has been created and consideration is being given to how we will engage with commercial equipment suppliers.

With respect to yourselves (Local and Affiliated Groups), we are aware that some of you are well on the way with your contributions, but others may prefer some guidance or templates. If this is the case, please do contact us, via Sarah Stafford, with your requests and we will do what we can to honour them. Our preference would be for you to host your material and provide us with the links to it with access via a stylised virtual window. We are also very aware that this is a very difficult time for museums and were wondering if there is an opportunity to provide some museum support if you can send the links to the local museums that you would recommend.

With respect to the previously mentioned field visits we anticipate that by Sunday 8 November 2020 the lockdown will be sufficiently eased to allow actual, rather than virtual, field trips to take place. To embrace a common theme for the festival we wondered whether you would be able to organise a local building stone walk in your nearest town? The length, number of participants and charge would be up to you, but we would like to advertise them through the vFOG site even though booking arrangements will be made by you locally. Local risk assessments would be required. Do contact us with your ideas. We advise booking and charging as a way of controlling numbers. If you would prefer to arrange a virtual building stones walk that would be a good fit with the proposed theme. After the event we would be pleased to have a report to add to the Festival website, which will probably remain in place at least until details of the Festival of Geology 2021 are posted.

Perhaps one of the most important messages in this letter is regarding timeline. As you will appreciate, this is a large of piece of work for the organising committee and in order to minimise the potential risks we are asking for all content and the associated links to be in place by the end of August 2020. To assist with planning, we would be very grateful if you could notify us of your intentions with respect to contributions by 10 July 2020.

I would like to extend my personal thanks to the vFOG organisers: Susan Brown, Geraldine Marshall, Wendy Kirk, Janet Wright, Alison Barraclough, Amy Edgington, Diana Clements, Gerald Lucy, Barbara Silva, and Sarah Stafford.

We look forward to hearing from you. If there are a number of requests for support we will follow up with a further email providing templates and guidance.

Yours Sincerely,

Vanessa Banks
GA President
The Geologists' Association
Burlington House
Piccadilly
London
W1J 0DU

Mobile: 07813 538077