Farnham Geological Society

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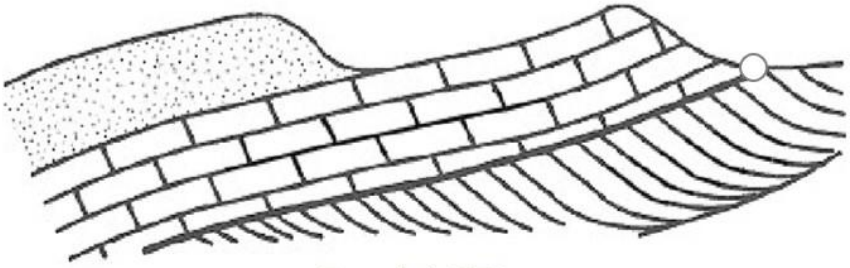

Founded 1970

A local group within the GA

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Contents

Editorial

Welcome to the latest FGS Newsletter, the first since we returned to having meetings with our 50th Anniversary Celebration, all be it in the virtual world.

On Friday, 10 July about 50 past and current members of the Society joined online to hear our Chair Liz Aston describe what life was like in 1970, Green Shield Stamps and all. Peter Luckham, our treasurer, who is an original member, gave us a fascinating potted history of the Society, with amusing anecdotes along the way. And finally, Liz thanked everyone past and present for all the hours of dedication, organisation and fun that has gone into making the past 50 years of the Society such a pleasure to be involved in. She also asked us to "raise a glass" as a toast to the ongoing success of the FGS and to the next 50 years!

Our return to Monthly Lectures is scheduled for next month on Friday, 18 September at 7:00pm when we will be welcoming Dr. Marina Barcenilla via Zoom. I do hope as many of you as possible will be able to attend.

Stay Safe,
Mick Caulfield

Farnham Geological Society
Meeting Programme 2020

Update 31 July 2020

All meetings in 2020 will be conducted remotely.

Please note the change in lecture time: 6:50 pm for 7:00 pm start.

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

FGS Committee Thu, 24 September

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

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

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

Farnham Geological Society
Field Trip Programme

Cancelled until 2021

Geologists' Association
Lecture Programme 2020

Update 31 July 2020

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

Presidential Address: Exploring for Hydrocarbons - a Risky Business (Part 2)
Nick Pierpoint Fri, 2 October
Senior Vice President of the GA

No lecture due to the Festival of Geology Fri, 6 November

TBA Fri, 4 December

Reading Geological Society
Lecture Programme 2020

Update 31 July 2020

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

Lectures are open to all and there is no charge for admission. However, regular attendees are expected to be members of the society.

Time: 7:45pm for 8:00pm

Venue: Sorby Room
Wager Building (formerly Geoscience),
The University of Reading,
Whiteknights, Reading.
Use Car Park 8

Presidential Address: From millimetres to metres – case studies of damaging ground movement Mon, 7 September
A "Zoom" talk: time to be confirmed.
Dr. Clive Edmonds
RGS President

Sand!
Dr. Ian Selby Mon, 5 October
University of Plymouth

TBA Mon, 2 November

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

Meeting Summary

10 July 2020

The Farnham Geological Society: Celebrating 50 Years

Liz Aston & Peter Luckham

Liz Aston welcomed everyone to the Societies first online meeting to celebrate 50 years of the Farnham Geological Society (FGS).

About 50 past and present members and some of their partners "Zoomed" in to hear Liz describe what life was like in 1970, the year the FGS was formed.

Britain was enjoying:

- The first supersonic flight of Concorde (>1235kmph or >767mph).
- The first Glastonbury Festival, known as the "Pilton Pop, Blues & Folk Festival", was mounted by Michael Eavis on Saturday, 19 September 1970 and attended by 1,500 people. The headline act was Tyrannosaurus Rex, later known as T. Rex. Tickets were £1.
- Brazil won the World Cup for the third time in Mexico and got to keep the Jules Rimes Trophy.
- In April Paul McCartney announced the upcoming release of his debut solo album initiating the break-up of The Beatles.
- The dockers strike and a State of Emergency was declared by the Ted Heath, the newly elected PM.

In the world of geology, Dewey *et al* were discussing Sea Floor Spreading, while Tuzo Wilson was talking about Basin Development and Janet Watson the Lewisian of the UK. In addition, Pepsi cans were being naturally cemented into limestones in the Bahamas!

And everyone was collecting Green Shield Stamps which could be used to buy gifts from a catalogue or from any affiliated retailer. The scheme was introduced in 1958 by Richard Tompkins. For just a few years, the scheme was so widely adopted that it was referenced in rock songs. But it suffered when Tesco ceased to use them. To retain business, Green Shield allowed customers to buy gifts from the catalogue with a mix of stamps and cash, but soon the catalogue became cash-only, and the operation was re-branded as Argos. Stamps were withdrawn altogether in 1991.

Peter Luckham thanked Liz for the introduction and the excellent Anniversary Brochure that she compiled and sent out to everyone.

Peter began his historical reminisces in September 1969 when the "Workers' Educational Association" decided to hold geological classes in Farnham – one in the boys' grammar school and one in girls' grammar school – one was for fossils and the other for minerals. Due to undersubscription, the students were asked whether they would like to join together; they agreed and became one group under Ted Finch who was the tutor for that initial period.

The membership of the amalgamated class was very different to today's ranging from newlyweds, young parents with babies, dogs, and children to ancient retirees. Their disposable income proved a problem for many a field trip leader – on one trip to Okehampton members were spread around in hotels and B&B's, while others were camping, and one man actually slept in a caver's hut on the Mendips. This always made it difficult to get everyone together before they could set off in the morning. One member, Jack Sheppard, always carried a sledgehammer with him; this meant that

most of his time was spent cracking rocks for other people and not looking at the rocks himself.

The Inaugural Meeting was held on Monday, 6 April 1970 in the Council Hut, South Street, Farnham. There is no record of how many people attended that meeting or joined the Society.

The Farnham Society was "officially" established on 1 January 1971. The first Chairman was Stanley Smith, Secretary Audrey Hewins and Field Trip Secretary Ted Finch.

The first newsletter was edited by Roger Ashcroft – he and his wife were at the Royal Aircraft Establishment in Farnborough and then moved to Milton, Buckinghamshire. It was produced in the autumn of 1970 and was "optimistically numbered one". The following newsletter, in the Spring of 1971, had to be delivered by hand due to a postal strike! Both are available on the FGS website.

The Society had a particularly important benefactor at this time – Basil Crosby. He was a factory owner who, with his wife and secretary, took on most of the expenses and admin. Subscription was £1 at the time but they financed the society quite considerably in the early days. Basil decided to come on the field trip to Okehampton in his brand-new BMW but in the end spent most of his time searching for 5-star petrol! Crosby Way in Farnham is named after Basil.

A fish was found by a young boy, one of the members' children, who was having great fun on another field trip bashing open iron nodules in the Folkestone Sands of the Coxbridge Sand Pit (now Coxbridge Business Park); luckily Maurice Ewing was watching him and when he discovered this rare fish, showed it to Ted Finch who examined it and wrote it up for a scientific journal - it was a new species named to reflect the boy who found it … *Watkinseii*.

Rab Colvine was the next field trip leader. His leadership was particularly interesting as every itinerary and route was governed by the CAMRA good beer guide and certain hostelries! (CAMRA, the Campaign for Real Ale, a UK wide guide put together by a very enthusiastic group of individuals in the 70s).

In 1974/75 Paul Olver came to Surrey and was made an official at the Adult Education Centre in Farnham. He was courting his wife Sue and running local courses in geology. Membership grew when all his students joined the FGS and a lot of those who enrolled had come from Woking. Some of them joined the committee and then wanted to move the Society to Woking to become the "Woking Geological Society" – but their coup was overturned, they lost out and so it remained the "Farnham Geological Society".

Paul continued to run trips and in 1975 Dr. James Graham, Head of Chemistry at the University of Ghana, wrote to the committee asking whether he had the correct qualifications to join the society. He was worried about being black balled! But he was welcomed and joined the Society; he was an avid mineral collector. Many of his samples he bought at Sotheby's – often very large and exotic; this made committee meetings at his house very unusual and interesting when the committee sat round a new huge spectacular mineral. Another member, Stanley Young, who worked in The City, joined in the mineral collecting from Sotheby's and competition grew between them to see who could get the best minerals and so the Society's collection grew. Stanley's evenings were adorned with UV light. On James' death his widow sold the largest and most exotic pieces, but the vast majority of the collection was donated to the FGS.

Paul and Sue got married and they became the first couple to meet at the FGS and became the first wedding in the Society.

John Williams joined in 1978 and he has been a great stalwart for the Society ever since, with many contacts at NHM for lecturers, organising numerous walks and field trips up to the 1990s and beyond.

When Paul and his wife Sue moved to Herefordshire, it was determined that field events could be run as a series of trips through the Field Studies Council. These were undertaken by David Cronshaw, the course lecturer, with the group travelling by coach and minibus from Farnham to Shropshire, Malham, etc.

On one trip to Portugal organised by Lyn Linse and her husband John, David Caddy (who was awaiting a hip operation) fell over on the very first day of the trip. He was promptly hospitalised and got an instant hip replacement – in the UK he was on a waiting list and was expecting to have to wait for months! An incredibly good result for him - but not to be recommended!

In 1999 there was another great increase in membership when Paul Olver took more than 50 people from his classes on a trip to Europe. This included the visit to the meteorite impact crater at

Nördlingen in Germany and on to Szombathely, Hungary to view the solar eclipse. But in order to get insurance cover for the trip, they had to be members of the FGS – hence, the Society gained many new members from places such as Kingston, Epsom, and Ewell.

One of Paul Olver's happiest trips was in 1981 to the volcanoes of Italy – to Etna, Stromboli, and Vesuvius.

A trip to the USA was organised by a friend of Lyn Linse, Ivan Dyreng – he ran it rather like a school trip requiring you to provide your "name and seat number" when you returned to the coach. Notwithstanding the school trip nature, it was an excellent field trip.

In 2004 Graham Williams joined the FGS and after a while, he took over field trips which he ran for many years; they were very well organised and highly successful. He put together a variety of trips for individual days to local sites, weekends further afield and residential weeklong visits to the Highlands of Scotland, Cornwall, Madeira, and other distant locations.

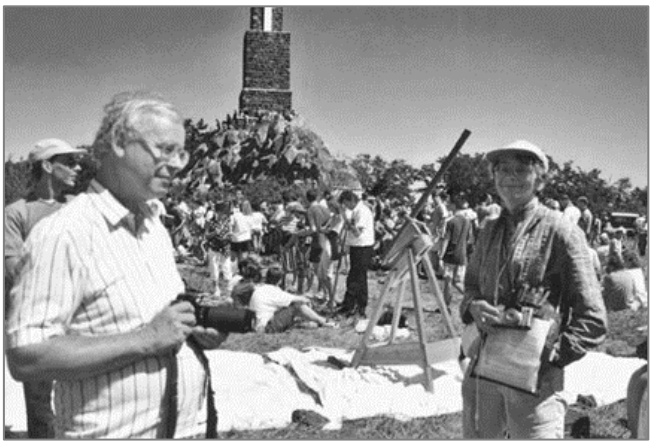
Once the FGS became affiliated to the Geologists Association, group insurance for all affiliated societies was provided. That made life a lot easier for the committee who had been spending hours trying to sort out insurance to ensure that they were not personally liable for payment of any serious injuries and the possibility of losing one's house, etc. in the process. There have been several near misses but no real claims – in the earlier years there were no hard hats, etc. Ian Carollan did have a bad fall and broke his wrist; it turned out that he was the driver, luckily others were able to sort out the driving and got everyone home. One person, Veronica Kilgour, aged 80, on a trip to the USA, did make a claim - for her glasses - these had been lost whilst white water rafting! Luckily, no one has had to make a serious claim – the FGS seems to be a very resilient group!

Sadly, due to the COVID-19 virus the FGS have had to cancel all field trips including the planned Residential Excursion to northwest England.

Liz Aston has included the following additional comments from **Shirley Stephens** who remembers many anniversary field trips, which she recollected for the Society and which are included in the Newsletter for June 2010 (available on the website), at the time of the 40th Anniversary.

"In 1981, the 10th Anniversary was led by Paul Olver to the volcanoes of Italy and at Vesuvius several members children (20 years old) ran down to leave the message "Farnham 1981" in rocks on the crater floor. At the top of Vulcano some people forgot Paul's advice not to sit down because of the sulphur, so that when they went on to the beach afterwards, the seawater reacted with the sulphur and many found that sulphuric acid had burnt holes in their trousers and haversacks! On Lipari where Paul had done his PhD, he pointed out the unconformity which is named after him.

The FGS's 20th Anniversary trip was to the Auvergne in 1990 led by Reg Bradshaw from Bristol University. The 25th, in 1996, went to Western USA: Yellowstone and Canyon Lands led by Ivan Dyreng from Utah University. On this trip, Veronica Kilgour celebrated her 80th birthday on the North Rim of the Grand Canyon with everyone singing "Happy Birthday". The 30th was to Europe - to the Solnhofen limestone and Ries Crater; then through Austria where they panned for emeralds before going on to Hungary for the solar eclipse. The 35th was led by Roger Suthren from Derby University who took members to Languedoc where members stayed in Alet and Lodeve. For the 40th Anniversary, the FGS went to Madeira, led by Graham Williams."



Paul Olver & Mary Clarke on Sag hill, Szombathely, Hungary, awaiting the solar eclipse.

Liz Aston thanked various past and present members (too many to mention here) including the original founding members: Stanley Smith, Audrey Hewins, Ted Finch, Julian Bentinck, Gordon Dearing, Maurice Hewins (*not Audrey's husband*), Richard Pinker and Peter Luckham, as well as the current committee.

At the end of the first official year the membership was 27; at the end of 1972, it had risen to 50 and

by March 1986 it stood at 66. Today we have around 85 members signed up.

Going forward what does the future hold for the FGS? There is certainly a need to continue to attract members, in particular younger members and the committee will be working on ideas for ways to make that happen.

In addition, the use of online meetings, such as this one, in conjunction with "live" lectures could allow members who are unable to get to The Maltings to stay connected with the Society.

The website requires some updating and information on the local Farnham geology is now available online.

In March next year an "Introduction to Geology" course is planned. It will be designed to provide first year undergraduate level teaching without the exams!

And finally, Liz asked everyone to "raise a glass" to toast the last 50 years of the Society and to look forward to the next 50!

References

1. http://www.farnhamgeosoc.org.uk/oldnewsletters_3.html
2. http://www.farnhamgeosoc.org.uk/Geology%20In%20&%20Around%20Farnham.pdf
3. http://www.farnhamgeosoc.org.uk/FGS%20Field%20Trips.pdf

ARTICLE

UNESCO Geoparks

In this, the first of a number of articles, Liz Aston describes the Geoparks recognised by UNESCO in Portugal (this issue) and Spain.

UNESCO Global Geoparks are single, unified geographical areas where sites and landscapes of international geological significance are managed with an holistic concept of protection, education, and sustainable development. At present, there are 161 UNESCO Global Geoparks in 44 countries.

UNESCO's work with geoparks began in 2001. In 2015, the 195 Member States of UNESCO ratified the UNESCO Global Geoparks, during the 38th General Conference of the Organisation.

PORTUGAL

By Liz Aston

The Açores (Azores) Geopark lies in middle of the North Atlantic Ocean, some 1,815km from Portugal (Fig. 1).

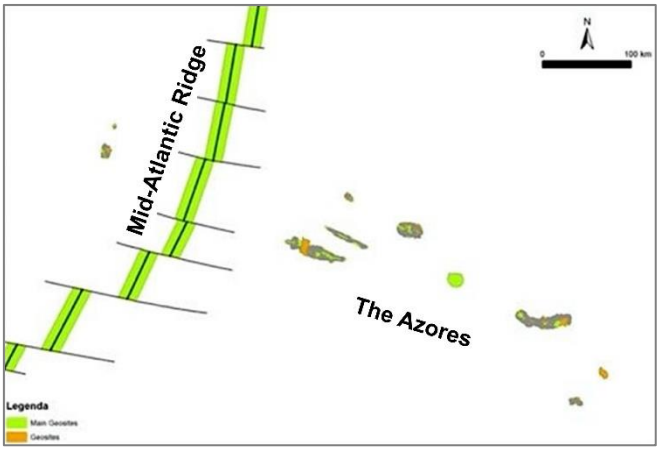


Fig. 1: The Azores & the Mid-Atlantic Ridge

- It comprises a total area of 12,884km^2
  - 9 islands lie in a 600km long "string" striking WNW-ESE (2,324km^2),
  - 10,560km^2 of ocean with 4 marine sites.
- There are 1,750 features: tectonic structures, monogenetic volcanoes, offshore deep-sea hydrothermal fields, seamount volcanoes, lava fields, fumaroles, hot springs and thermal waters, volcanic caves, "fajãs", fault scarps and marine fossil deposits (Figs. 2 & 3).

Fig. 2: Pico island noted for its eponymous volcano, Ponta do Pico, which is the highest mountain in Portugal.

- Sedimentary rocks are Miocene.
- The archipelago (Fig. 4) lies at the triple junction of the North American, Eurasian & African Plates.
- The Azores Plateau (everything <2,000m bathymetry) runs N-S around the Mid-Atlantic Ridge.

- The oldest terrestrial volcanism (~8 Ma) is on Santa Maria Island; the youngest, Pico island emerged ~300 Ka ago.
- There are 27 main volcanic systems, comprising:
  - 16 central volcanoes (12 Si-rich with caldera),
    - 9 of these are polygenetic volcanoes.
  - 11 volcanic ridges with basaltic fissure volcanism,
    - 7 fissure ridges are active.

Fig. 3: Vila Franca do Campo near São Miguel island

The islands form 3 groups (Fig. 4):

1. Western Group (Flores & Corvo).
2. Central Group (Terceira, Graciosa, São Jorge, Pico & Faial).
3. Eastern Group (São Miguel & Santa Maria islands & Formigas islets).

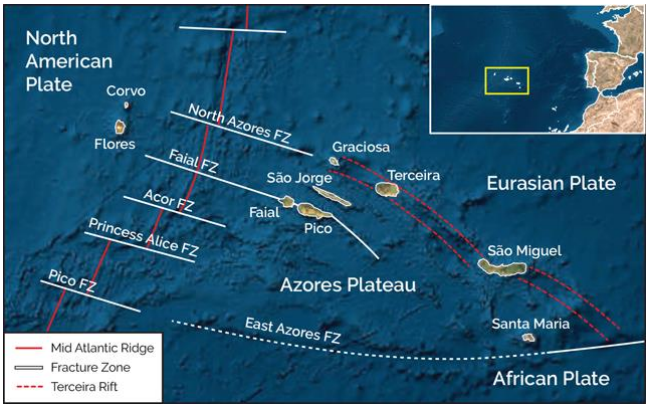


Fig. 4: The Azores formed from volcanism associated with both tectonic extension and an underlying mantle plume. (Credit: K. Cantner, AGI)

The Arouca Geopark is in Northern Portugal, lying on W border of N sub-plateau of Iberia, and contains 41 geosites (geological points of interest) (Fig. 7).

- Average altitude is 200-600m with mountains at Freita (1100m) and Montemuro (1222m).
- The rocks range from 520-420 Ma ago (Iberia was in Gondwana) to 250 Ma ago (Pangaea).

The Hesperian Massif (Fig. 5) is the largest part of the Variscan basement that crops out in Europe. *See also Figures 6 and 7.*

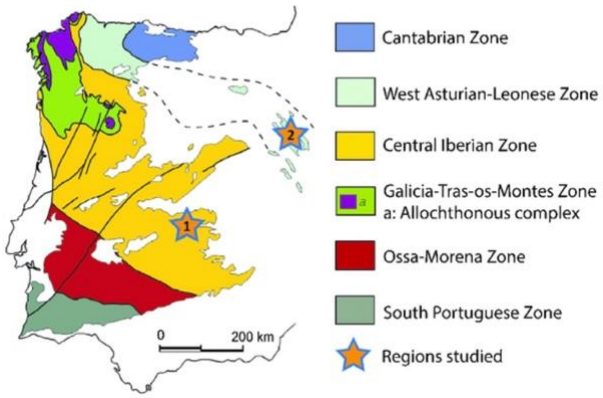


Fig. 5: Map of the Hesperian Massif. 1 – Central Iberian Zone; 2 – Iberian Chains (after Vera, 2004).

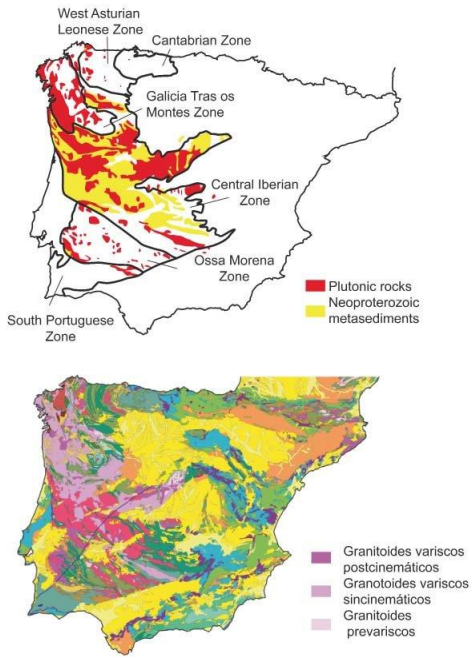


Fig. 6: Geological maps of the Iberian Peninsula (adapted from Ribeiro and Sanderson 1996; Vera 2004).

- There are 3 main lithological groups:
  - i) Basement, Neoproterozoic to middle Cambrian meta-sediments 630-520 Ma; Cadomian magmatic / metamorphic.
  - ii) Palaeozoic sequence - Ordovician, Silurian, Carboniferous rocks with highly fossiliferous Ordovician slates (460-470 Ma) and giant trilobites ~90cm in length, the Giant Trilobites of Canelas,***T***
  - iii) Synorogenic (Variscan) granites differentiated into 6 main plutonic bodies of diverse chemistry.

Associated late Variscan dykes contain various minerals that have been mined in this region. One granite contains abundant nodules 1−12cm in diameter, *"Birthing Stones of Castanheira, with magical properties in terms of female fertility – the dark lumps pop out spontaneously from a cream matrix during hot weather!"*

Fig 7: Political Map of the Iberian Peninsula (https://www.onestopmap.com/iberian-peninsula-733/).

Naturtejo da Meseta Meridional Geopark lies in the centre of Portugal, near the border with Spain (Fig. 7).

- It lies on S Iberian Meseta, a polygenetic peneplain (Fig. 8 and Fig. 9).
  - The Tagus river cuts a deep valley on the southern end of the geopark. It is bordered on north by the Central Iberian Belt. This Belt is one of the terranes that form the Iberian Massif, created in the Variscan Orogeny.
- The landscape comprises a wide eroded plain with flat-topped faulted blocks.
  - All deeply incised by rivers and streams that are more prominent in north.
- The rocks range from Neoproterozoic (600 Ma ago - deep sea turbidites with simple Ediacaran) to Quaternary.

Fig. 8: Cruziana is a trace fossil with elongate, bilobed, almost bilaterally symmetrical burrows, usually preserved on bedding planes, with a sculpture of repeated striations that are mostly oblique to the long dimension. It is found in marine and freshwater sediments.

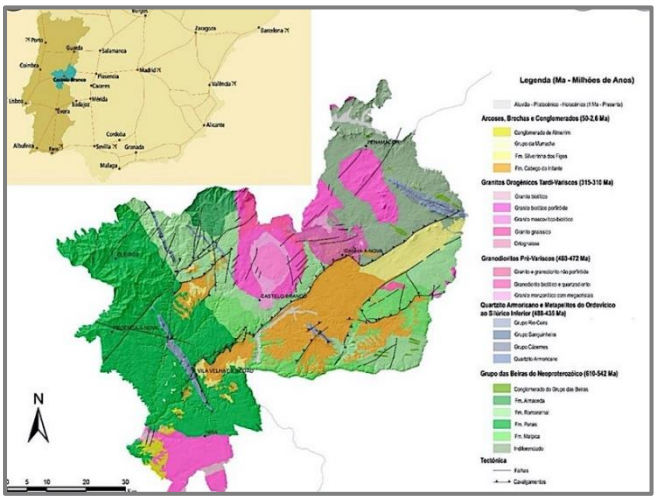


Fig. 9: Geological map of the Naturtejo da Meseta Meridional Geopark, Portugal.

- 50 Ma old Meseta Meridional peneplain has white Ordovician marine sandstones, now quartzites.
- There are 170 geosites within the park, including:
  - The Ichnological Park of Penha Garcia, Portas do Ródão and Vale Mourão gorges, the Roman gold mine of Conhal do Arneiro & granite landforms from Serra da Gardunha and Monsanto.
  - An important trace fossil site, large trilobites of the Ordovician biodiversification event.
- The Variscan orogeny includes:
  - Anatectic granite (*a granite melts & reprecipitates as another granite*),
  - Elated tin-wolfram (gold) ore bodies.
- The Alpine orogeny includes:
  - Reactivation of older very large faults,
  - Examples of Inselberg (isolated high hill) and Appalachian-type landforms (multiple hilly or mountainous landscape).
  - Alluvial terraces along the Tagus river.
- The first hominids in the region thrived 300 Ka ago.
- The last remains of forest elephants in Europe were found here.
- Iron age-to-1960s mining heritage is also preserved in nationally important sites.

Terras de Cavaleiros Geopark is located in NE Portugal (Fig. 7).

- Average altitude ranges from 400m to 800m; Nogueira Mt is highest point at 1320m, while Sabor River is the lowest 200m amsl.
- Another river was dammed to create the Azibo's Lagoon.
- The geological history is >500 Ma & well documented.
- The geology comprises 4 allochthonous (originated at a distance) complexes:
  - Pre-Mesozoic Parautochthonous Complex (equivalent to Iberian Massif autochthonous stratigraphic sequence),
  - Allochthonous Basal Complex (continental passive margin of the Iberian Terrane),
  - Allochthonous Ophiolite Complex (complete sequence) and
  - Allochthonous Upper Complex (complete continental lithospheric sequence).
- Comprise sediments of an ancient fluvial network that once drained to the interior of the Iberian Peninsula.
- Has many active faults, such as the Vilariça fault, which crosses the whole of the Geopark.

Fig. 10: Gneisses, Terras de Cavaleiros Geopark.

Fig. 11: Metasediments, Terras de Cavaleiros Geopark.

Fig. 12: View of the lake in Terras de Cavaleiros Geopark.

Madeira

Madeira is a volcanic island 600km W of Morocco. Its volcanic nature produces dramatic scenery with steep gorges radiating from rugged central mountains that rise to 1861m. The coastal scenery is spectacular with cliffs up to 600m high. Climate and vegetation vary from the desert of the E peninsula, through coastal vineyards and banana plantations, to lush deciduous vegetation on the mountain slopes with eucalyptus and pine forests in the cooler mountains.

British visitors, particularly Lyell (1854), were the first to give geological accounts of the island. Madeira rises 5000m from the 140 Ma old oceanic crust of the Madeira Abyssal Plain, part of the African Plate. It is the product of a mantle plume above a 'hot spot' deep in the mantle. The African plate has drifted N over this 'hot spot' for >70 Ma, forming a string of volcanic piles of which Madeira in the south is the most recent. Today, the hot spot is just SW of Madeira.

Geological History

• **Miocene** - Madeiran 'shield' built up from abyssal plain as a series of scoria & composite cones (Basal Volcanic Complex, B1).

Fig. 13: The Madeira Islands

- Erosion & subsidence allowed local formation of reef limestone (~mid Miocene).

• **Pliocene** - 'main shield building' stage - huge volumes of lava and pyroclastic deposits (Main Shield Building Stage Volcanic Complex B2 & B3).

- Between eruptions, soils formed with terrestrial flora and fauna.
- Subsequent volcanic activity continued on a reduced scale.

• **Pleistocene** - 'mature' stage; fissure eruptions extended pile in E-W direction forming high plateaux (Mature Stage Fissure Eruptive Complex B4).

- Intense erosion created alluvial, fluvial and coastal deposits composed of volcanic detritus, and aeolian calc-arenites.

• **Late Pleistocene and Holocene** - local volcanic eruptions filled valleys with lava in N of the island (Late Stage B5), ash cones around Funchal, and cones and flows in the far E (Late Stage B6).

The eruptive phases were accompanied by intrusion of numerous dykes and sills. Recent earthquakes suggest volcanic activity is not extinct. Lavas vary from basalt to alkali-basalt, trachyte, rhyolite, pyroclastic deposits, dykes, and rare gabbro.

There is a Miocene reef limestone, >400m amsl, an indication of the uplift caused by the mantle plume.

Fig. 14: Ash deposits cut by dykes.

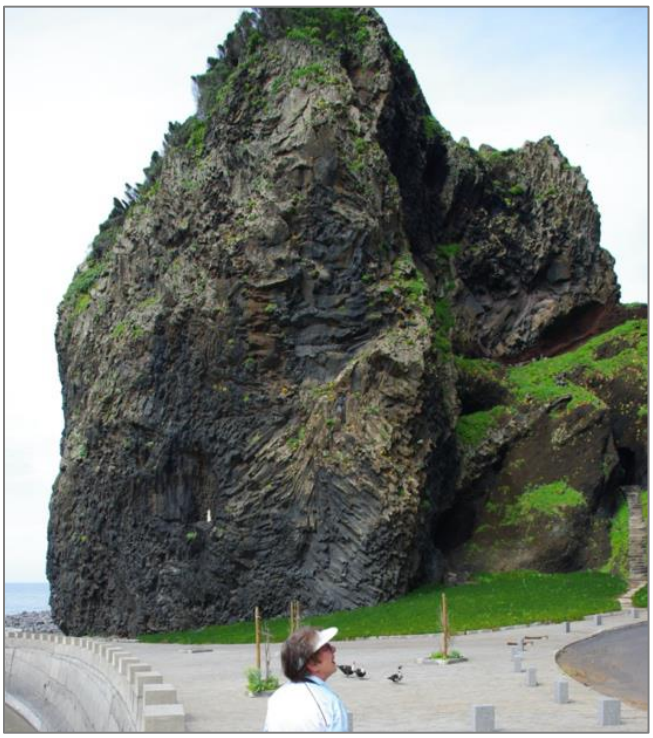


Fig. 15: Volcanic plug.

Siliciclastic rocks comprise red lateritic soils (from tropical climate) between lavas; periods between volcanic episodes were often long enough to allow a rich fauna (snails, insects) and flora (laurel, tree heather, fern and cedar) to be established, sometimes producing lignite.

A typical selection of their volcanic features are shown in Figures 16 to 22.

Periods of rapid elevation allowed massive and rapid weathering and erosion with landslides, steep alluvial fans of unsorted material with

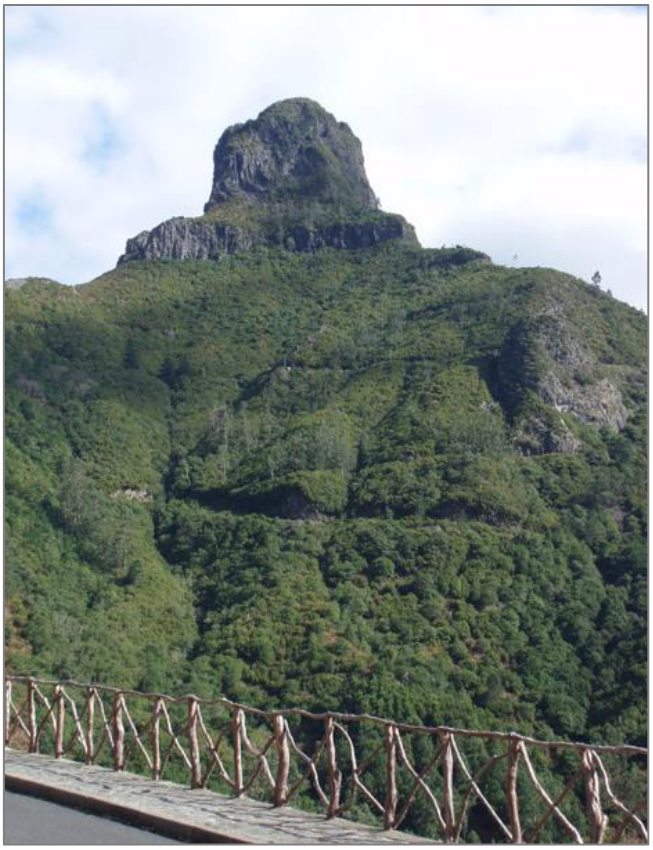


Fig. 16: Volcanic neck.

Fig. 17: Lavas and interbedded ash beds.

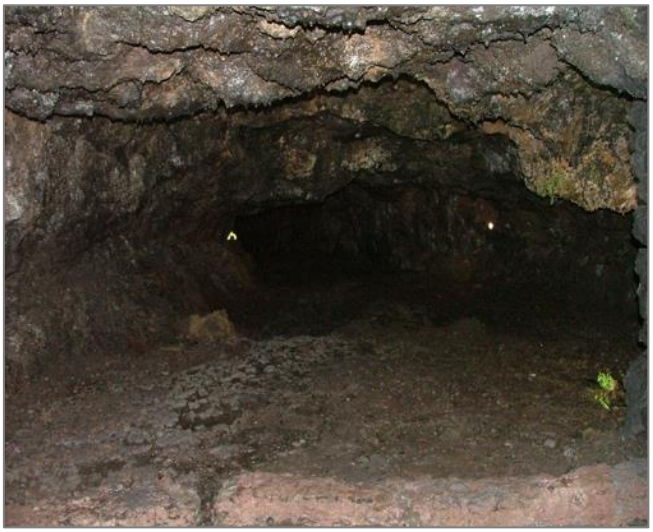


Fig. 18: Lava tube.

Fig. 19: Lava pile, inland.

Fig. 20: 'Traps' Stacked Basalt Lava Flows (1)

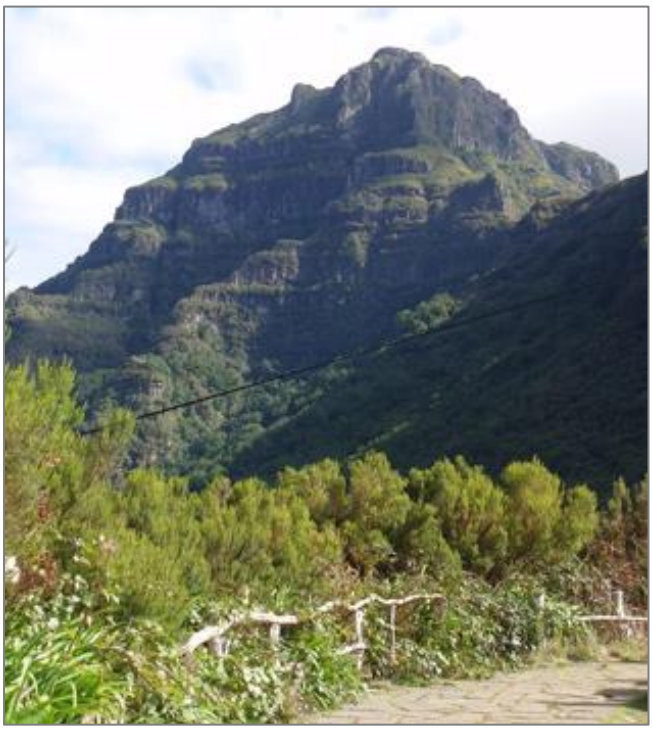


Fig. 21: 'Traps' Stacked Basalt Lava Flows (2)

Fig. 22: Interbeds of red laterite soils.

boulders ~5m; also incised rivers and raised beaches. This indicates 'pulsing' of the underlying mantle plume.

Reference

http://www.unesco.org/new/en/natural-sciences/environment/earth-sciences/unesco-global-geoparks/

(additional comments by Mick Caulfield)

The GA now has a **YouTube** channel!

https://www.youtube.com/channel/UC7uQUhrjfMzbiZsN-yTC56g/featured?fbclid=IwAR30eq0xAEd9BfHkHtoDcCRInvjGLLb4Z2F0llkASor5E6MYOV4_dXNcQos

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Go on a **virtual tour** of the Museum:

https://www.nhm.ac.uk/visit/virtual-museum.html?utm_content=header-cta&utm_campaign=general&utm_medium=email&utm_source=1773804_Copy%20of%20ma-enews-southken-20200708&dm_i=2XEG,120OC,6L3SCQ,41BCL,1

Article

Are the Earth's magnetic poles about to swap places?

Strange anomaly gives reassuring clue

By Yael Annemiek Engbers & Andrew Biggin

20 July 2020

Deep inside the Earth, liquid iron is flowing and generating the Earth's magnetic field, which protects our atmosphere and satellites against harmful radiation from the Sun. This field changes over time, and also behaves differently in different parts of the world. The field can even change polarity completely, with the magnetic north and south poles switching places. This is called a reversal and last happened 780 Ka ago.

Between South America and southern Africa, there is an enigmatic magnetic region called the "South Atlantic Anomaly", where the field is a lot weaker than we would expect. Weak and unstable fields are thought to precede magnetic reversals, so some have argued this feature may be evidence that we are facing one.

Now a new study, published in the *Proceedings of the National Academy of Sciences*, has uncovered how long the field in the South Atlantic has been acting up – and sheds light on whether it is something to worry about.

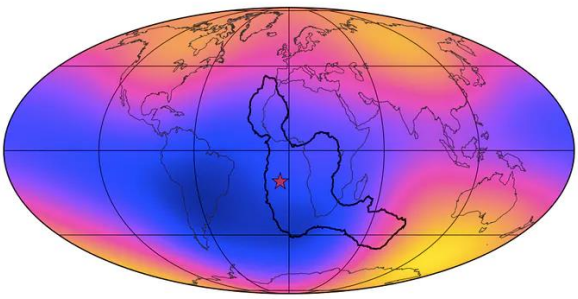

Fig. 1: The geomagnetic field at the Earth's surface with the South Atlantic Anomaly outlined in black and St Helena marked with a star. Colours range from weak fields (blue) to strong fields (yellow). (Richard K. Bono, Author provided)

Weak magnetic fields make us more prone to magnetic storms that have the potential to knock out electronic infrastructure, including power grids. The magnetic field of the South Atlantic Anomaly is already so weak that it can adversely affect satellites and their technology when they fly past it. The strange region is thought to be related to a patch of magnetic field that is pointing a different direction to the rest at the top of the planet's liquid outer core at a depth of 2,889km within the Earth.

This "reverse flux patch" itself has grown over the last 250 years. But we don't know whether it is simply a one-off product of the chaotic motions of the outer core fluid or rather the latest in a series of anomalies within this particular region over long-time frames.

If it is a non-recurring feature, then its current location is not significant – it could happen anywhere, perhaps randomly. But if this is the case, the question of whether its increasing size and depth could mark the start of a new reversal remains.

If it is the latest in a string of features reoccurring over millions of years, however, then this would make a reversal less likely. But it would require a specific explanation for what was causing the magnetic field to act strangely in this particular place.

Volcanic rocks

To find out, the authors travelled to Saint Helena – an island in the middle of the South Atlantic Ocean. This island, where Napoleon was exiled to and eventually died in 1821, is made of volcanic rocks. These originate from two separate volcanoes and were erupted from between 8 Ma and 11.5 Ma.

When volcanic rocks cool down, small grains of iron-oxide in them get magnetised and therefore save the direction and strength of the Earth's magnetic field at that time and place. The authors collected some of those rocks and brought them back to their lab at the University of Liverpool, where they carried out experiments to find out what the magnetic field was like at the time of eruption.

The results showed that the field at Saint Helena had very different directions throughout the time of eruption, suggesting that the field in this region was much less stable than in other places. It therefore challenges the idea that the abnormality has only been around for a few centuries. Instead, the whole region has likely been unstable on a timescale of millions of years. This implies the current situation is not as rare as some scientists had assumed, making it less likely that it represents the start of a reversal.

Fig. 2: Lead author Yael Engbers is drilling a core on Saint Helena. (Andy Biggin, Author provided)

A window into Earth's interior

So, what could explain the odd magnetic region? The liquid outer core that is generating it moves (by convection) at such high speeds that changes can occur on very short, human timescales. The outer core interacts with a layer called the mantle on top of it, which moves far slower. That means the mantle is unlikely to have changed very much in the last ten million years.

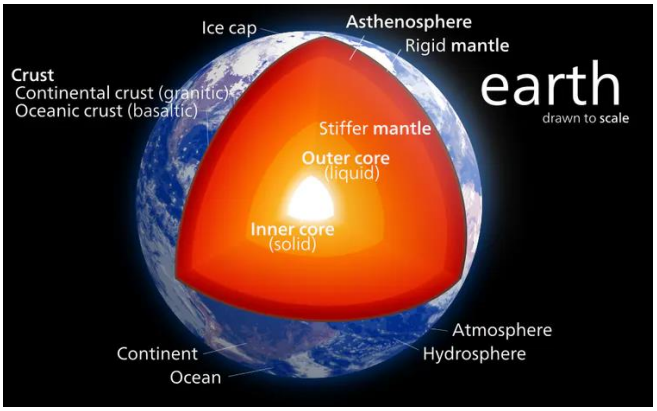

Fig. 3: Earth's inner structure. (Wikipedia, CC BY-SA)

From seismic waves passing through the Earth, we have some insight into the structure of the mantle. Underneath Africa there is a large feature in the lowermost mantle where the waves move extra slow through the Earth – meaning there is, most likely, an unusually warm region of the lowermost mantle. This possibly causes a different interaction with the outer core at that specific location, which could explain the strange behaviour of the magnetic field in the South Atlantic.

Another aspect of the inside of the Earth is the inner core, which is a solid ball the size of Pluto beneath the outer core. This solid feature is slowly growing, but not at the same rate everywhere. There is a possibility that it is growing faster on one side, causing a flow inside the outer core that is reaching the outer boundary with the rocky mantle just under the Atlantic hemisphere. This may be causing irregular behaviour of the magnetic field on the long timescales found on Saint Helena.

Although there are still many questions about the exact cause of the irregular behaviour in the South Atlantic, this study shows that it has been around for millions of years and is most likely a result of geophysical interactions in the Earth's mysterious interior.

Yael Annemiek Engbers

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Andrew Biggin

Professor of Palaeomagnetism, University of Liverpool

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It happened in August

3 August 1936

The town of Kursha-2, named after a road sign, was an industrial community in the Central Meshchyora, Ryazan Oblast, Russia. It was built soon after the October Revolution for the exploitation of the local forests and was annihilated by a firestorm in 1936. The disaster caused 1200 deaths, making it one of the world's deadliest wildfires.

15 August 1984

Lake Monoun, Cameroon

Lake Monoun is a lake in West Province, Cameroon, that lies in the Oku Volcanic Field. On August 15, 1984, the lake exploded in a limnic eruption*, which resulted in the release of a large amount of carbon dioxide that killed 37 people.

15-16 August 1868

Ecuadorian earthquakes occurred on August 15 and 16 causing severe damage in northeast Ecuador and southwest Colombia. They had an estimated magnitude of 6.3 and 6.7 and together caused up to 70,000 casualties.

18 August 1868

French Astronomer Pierre Janssen discovers helium in the solar spectrum during an eclipse.

21 August 1986

Lake Nyos, Cameroon

A limnic eruption* at Lake Nyos in north western Cameroon killed 1,746 people and 3,500 livestock.

26 August 1883

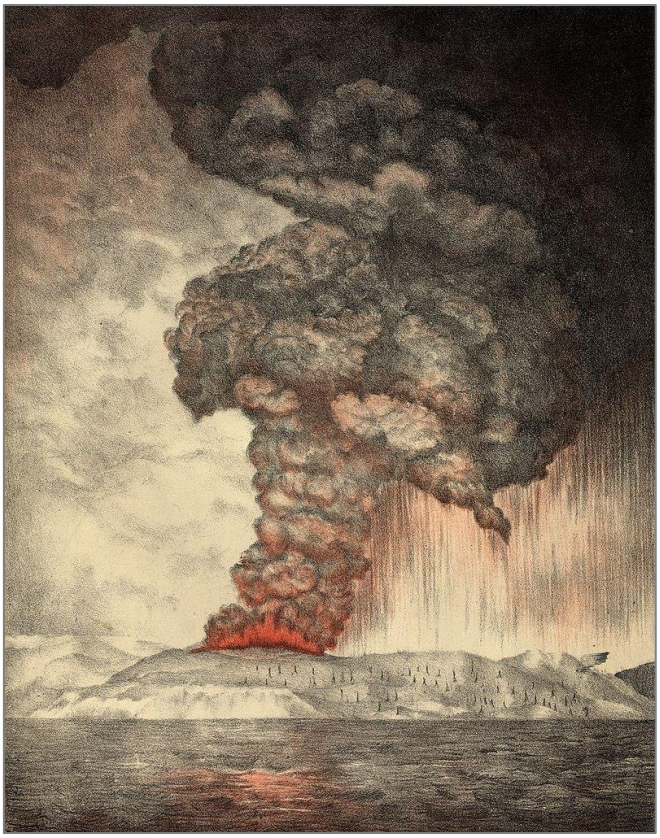
Eruption of Krakatoa

The 1883 eruption of Krakatoa in the Sunda Strait began on the afternoon of Sunday, 26 August 1883 - with origins as early as that May - and peaked on the morning of Monday, 27 August 1883, when over 70% of the island of Krakatoa and its surrounding archipelago were destroyed as it collapsed into a caldera.

The eruption was one of the deadliest and most destructive volcanic events in recorded history and explosions were so violent that they were heard 3,110km away in Perth, Western Australia, and Rodrigues near Mauritius, 4,800km away. At least 36,417 deaths are attributed to the eruption and the tsunamis it created.

Significant additional effects were also felt around the world in the days and weeks after the volcano's eruption. Additional seismic activity continued until February 1884.

In the year following the eruption, average Northern Hemisphere summer temperatures fell by 0.4°C. The eruption injected an unusually large amount of sulphur dioxide (SO_2) gas high into the stratosphere, which was subsequently transported by high-level winds all over the planet. This led to a global increase in sulphuric acid (H_2SO_4) concentration in high-level cirrus clouds. The resulting increase in cloud reflectivity (or albedo) reflected more incoming light from the sun than usual and cooled the entire planet until the sulphur fell to the ground as acid precipitation.



By Lithograph: Parker & Coward, Britain; - Image published as Plate 1 in "The eruption of Krakatoa, and subsequent phenomena". Report of the Krakatoa Committee of the Royal Society (London, Trubner & Co., 1888)., Public Domain, https://commons.wikimedia.org/w/index.php?curid=7696837

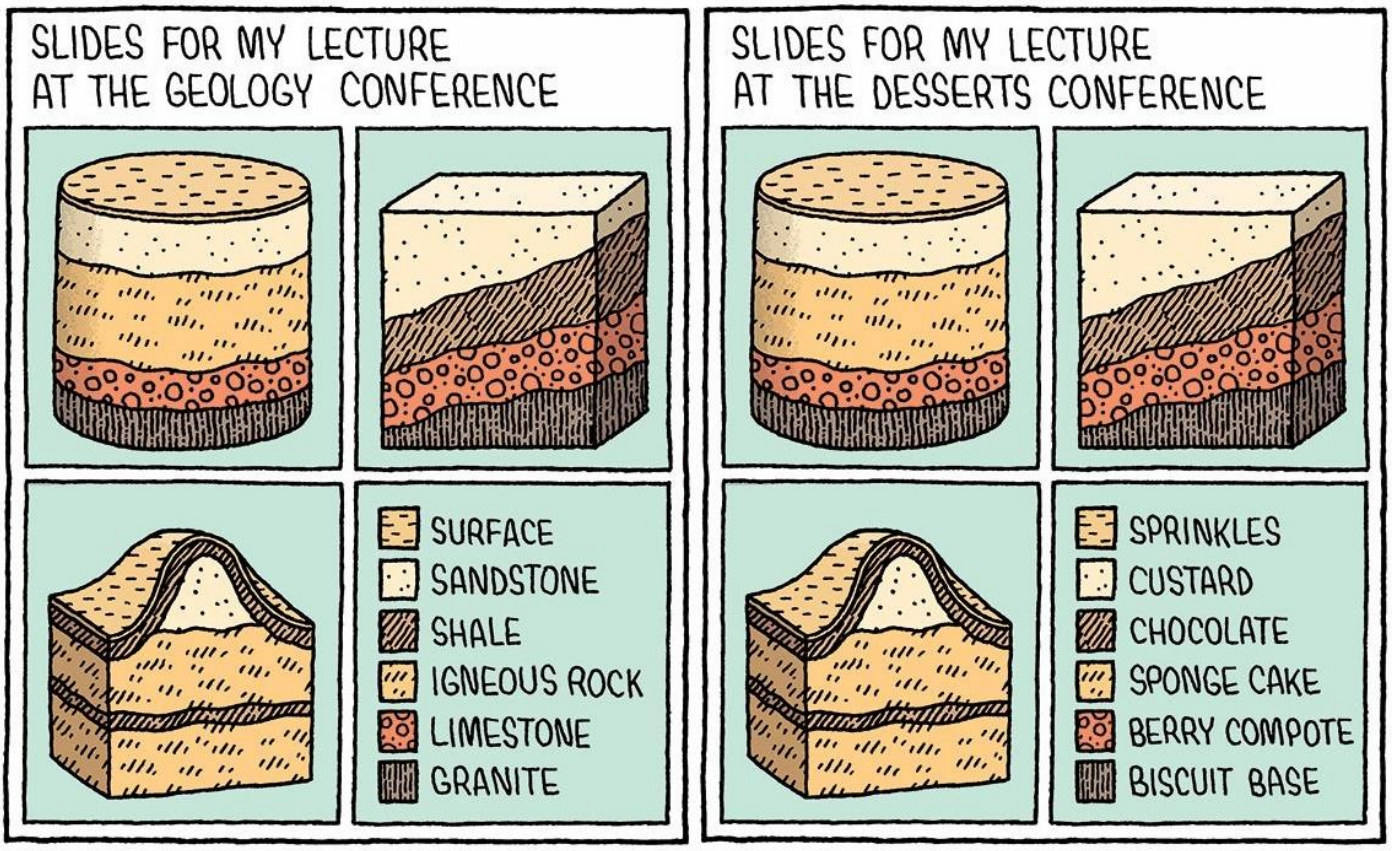
*****Limnic eruption****: a rare type of natural disaster in which dissolved carbon dioxide (CO_2) suddenly erupts from deep lake waters, forming a gas cloud capable of suffocating wildlife, livestock, and humans. A limnic eruption may also cause tsunamis. Scientists believe earthquakes, volcanic activity, and other explosive events can serve as triggers for limnic eruptions. Lakes in which such activity occurs are referred to as limnically active lakes or exploding lakes. Also known as a "lake overturn".*

Reference

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

New Scientist

Tom Gauld *(provided by John Stanley)*
June 2020



Lockdown causes worldwide drop in seismic noise

Dr Paula Koelemeijer
23 July 2020

New research published in the journal *Science* shows that lockdown measures to combat the spread of COVID-19 led to a 50% reduction in seismic noise around the world in early to mid-2020.

By analysing months-to-years long datasets from over 300 seismic stations around the world, the study was able to show the seismic noise reduced in many countries and regions, making it possible to visualise the resulting "wave" moving through China, then to Italy, and around the rest of the world.

This quiet period, likely caused by the total global effect of social distancing measures, closure of services and industry, and drops in tourism and travel, is the longest and most pronounced quiet period of seismic noise in recorded history.

The relative quietness allowed researchers to listen in to previously concealed earthquake signals and could help us differentiate between human and natural seismic noise more clearly than ever before.

"This unprecedented period of low seismic noise opens up exciting new avenues for seismological research. However, the study is very much a silver lining to what remains a global tragedy" *Paula Koelemeijer.*

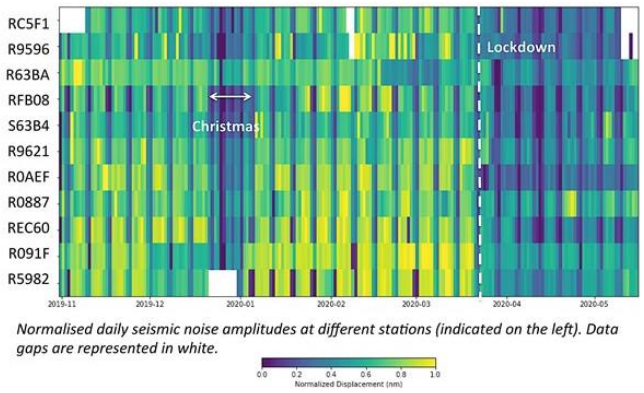


Fig. 1: Temporal changes in seismic noise for stations around London, UK.

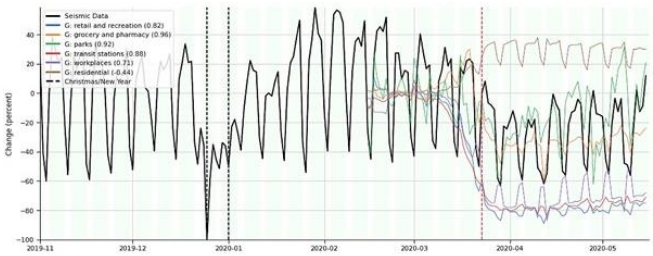
The study was spawned after the lead author, Dr Thomas Lecocq from the Royal Observatory of Belgium, decided to share his method and algorithms with the seismological community. Dr Koelemeijer initially got involved to analyse data

from citizen science instruments around London including one in her own house and subsequently studied data from sensors around the world.

The "seismic lockdown wave" passed through London at the end of March 2020, as governmental restrictions came into effect on the 23 March. London stations saw a moderate reduction in seismic noise of 20% to 30%, though in some locations the reduction was comparable to Christmas time. Worldwide, however, larger drops were observed, especially around universities and schools, while the effects of tourism and travel were also seen in seismic noise reductions.

The study found a strong match between seismic noise reductions and human mobility datasets drawn from mapping apps on mobile phones and made publicly available by Google and Apple. For example, for a station in central London, the correlation between the seismic data and Google's categories for transit, retail & recreation and grocery & pharmacy is typically around 0.9.

This correlation allows open seismic data to be used as a broad proxy for tracking human activity in near-real-time, and to understand the effects of pandemic lockdowns and recoveries without impinging on potential privacy issues.



Percentage changes are given relative to the pre-lockdown baseline. All categories show a strong positive correlation (indicated by the number in the legend), apart from time spent in residential premises, which is anti-correlated.

Fig. 2: Changes in seismic noise in central London compared to population mobility trends.

The study has been a truly unique collaboration involving 76 authors from 66 institutions in 27 countries, initially started through Twitter conversations and sharing of findings. This global community, together with the principles of open data and open code have been crucial for the work to take place in such a short time span.

Dr. Paula Koelemeijer
Global Seismologist,
Royal Holloway University of London
Royal Society University Research Fellow

References

1. https://www.royalholloway.ac.uk/research-and-teaching/departments-and-schools/earth-sciences/news/lockdown-causes-worldwide-drop-in-seismic-noise/
2. https://science.sciencemag.org/content/early/2020/07/22/science.abd2438

Likely active volcanoes found on Venus, defying theory of dormant planet

Researchers identify 37 ring-like structures known as coronae that are believed to be living volcanoes

Agence France-Presse
21 July 2020

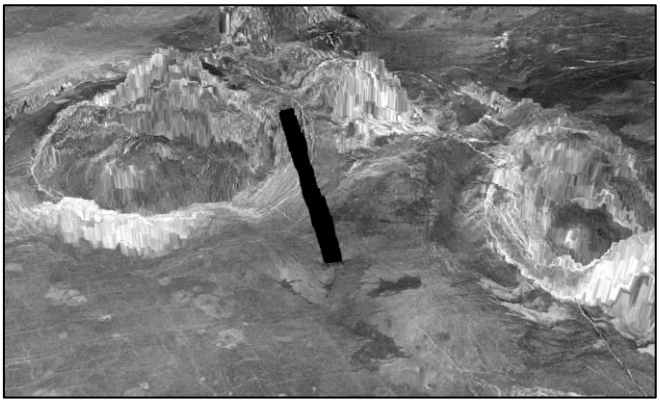


Fig. 1: Two coronae on the surface of Venus which are formed when hot material from deep inside the planet rises through the mantle. The black line shows a gap in the imaging data. (Photograph: Laurent Montesi/Reuters)

Scientists have identified 37 volcanic structures on Venus that appear to have been recently active – and probably still are today – painting the picture of a geologically dynamic planet and not a dormant world as long thought.

The research focused on ring-like structures called coronae, caused by an upwelling of hot rock from deep within the planet's interior, and provided compelling evidence of widespread recent tectonic and magma activity on Venus's surface, researchers have said.

Many scientists had long thought that Venus, lacking the plate tectonics that gradually reshape Earth's surface, was essentially dormant geologically, having been so for the past half billion years.

"Our work shows that some of that interior heat is still able to reach the surface even today. Venus is clearly not so geologically dead or dormant as previously thought," said Anna Gülcher, an Earth and planetary scientist of the Institute of Geophysics in Zurich, and lead author of the research published in the journal *Nature Geoscience*.

The researchers determined the type of geological features that could exist only in a recently active corona – a tell-tale trench surrounding the structure. Then they scoured radar images of Venus taken by Nasa's Magellan spacecraft in the 1990s to find coronae that fit the bill. Of 133 coronae examined, 37 appear to have been active in the past 2 Ma to 3 Ma, a blink of the eye in geological time.

"In my opinion many of these structures are indeed active today," said Laurent Montesi, a University of Maryland geophysicist and study co-author.

Coronae are essentially fields of lava flows and major faults spanning a large circular area. Many of the 37 reside within in a gigantic ring in the planet's southern hemisphere, including a colossal corona called Artemis which is 2,100km in diameter.

Venus, Earth's closest and just slightly smaller planetary neighbour, is covered by clouds of sulphuric acid and has surface temperatures hot enough to melt lead.

Reference:

https://www.theguardian.com/science/2020/jul/21/likely-active-volcanoes-found-on-venus-defying-theory-of-dormant-planet

Triassic reservoirs back on the Carbon Storage stage

In a press release the Norwegian energy company Equinor detailed plans to build a clean hydrogen plant in the UK which includes offshore carbon capture and storage.
2 July 2020

The project is called Hydrogen to Humber Saltend (H2H Saltend) and it will kick-start a hydrogen-based decarbonised industrial cluster in the Humber region of the UK. Blue hydrogen will be produced from natural gas (with CCS) and green hydrogen from electrolysis of water using renewable power. This article provides some background to the selected destination of the captured CO_2, the Triassic "Endurance" structure in the Southern North Sea (Fig. 1).

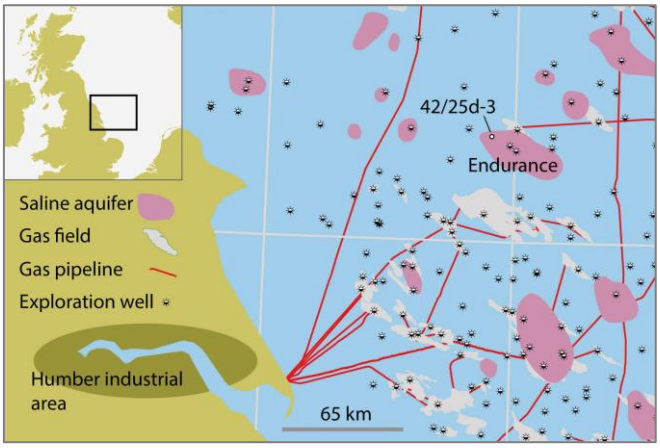


Fig. 1: Southern North Sea map showing field outlines and pipelines.

Why Endurance?

First and foremost, the Humber area is well-positioned when it comes to proximity of offshore aquifers to inject CO_2 in. The Endurance closure is less than 100km away and is also surrounded by other structures already identified through previous studies.

Endurance has been extensively studied in the past. *Expronews* spoke to Steve Furnival, who was the reservoir engineer for National Grid and who now consults through HoBoil Limited. "Endurance is a big closure with likely regional connectivity, has an excellent seal, good reservoir properties and a pressure outlet in the east where the Triassic outcrops at seabed, so the risk of overpressuring the reservoir are slim" Steve says.

Why not use a depleted Rotliegend gas field instead?

The Southern North Sea is best known for its Permian Rotliegend gas reservoirs, of which there are many (Fig. 1). "However, these fields all have multiple well penetrations and it is exactly those holes that pose a risk to the integrity of the seal" Steve adds. "Some of those wells were drilled a long time ago and records about well completions may even have been lost." Endurance only has three penetrations, which is relatively few.

Unique well

The third and most recent well in Endurance is the 42/25d-3 well, drilled in 2013. Steve points out: "This is a unique well in UK offshore drilling history, as it is the only one that was specifically drilled to test reservoir and sealing parameters with the aim

to inject CO_2." There was a need to drill this well because the previous wells did not acquire some key data. However, the porosity/permeability data generated from the extensively cored section turned out very similar to the data that was already available from the offset wells. Porosity varies from 14% to 27% and permeability from 20mD to 2000 mD.

Other initiatives

Another Carbon Capture and Storage (CCS) initiative that runs simultaneously is the Net Zero Teesside project, in which Equinor is a partner too. Although a candidate for CO_2 injection has not been identified yet, there may be opportunities for those projects to collaborate and use the same reservoir for injection.

In February this year, £1.4m was awarded to Heriot-Watt University to further investigate and define a roadmap for storage sites in the Southern North Sea. The project is funded by the Oil and Gas Technology Centre (OGTC) with support from the Oil and Gas Authority (OGA), offshore operators and data owners.

Reference:

https://expronews.com/ccs/triassic-reservoirs-back-on-the-carbon-storage-stage/

EnergyVoice

North Sea job cuts rise to 7,500

by Daniel O'Donoghue

10 July 2020

More than 7,500 oil and gas workers have lost their jobs since the onset of the coronavirus crisis and tens of thousands more could go, industry leaders have warned.

The shocking toll of the virus on the sector was disclosed to MPs by oil and gas bosses at a Commons hearing on Thursday.

Deirdre Michie, chief executive of trade body Oil and Gas UK (OGUK), said as many as 30,000 workers could find themselves without a job if "current conditions continue".

She said: "We have been hit by what we're calling the triple whammy of Covid, the dramatic drop in the oil price and the low, low gas prices. As a result of Covid, we saw industry having to respond by reducing activity levels by about 40% and we saw projects being pushed back and jobs being lost as a result."

Ms Michie said the industry's supply chain was also "under pressure" and cited figures which show revenue down by 33% for firms in the energy sector.

"The current estimates are about 7,500 people have been made redundant to date and we think more are on the way once the furlough scheme comes to an end and if activity doesn't pick up," she told the Scottish affairs committee.

"If current conditions continue to prevail we estimate that about 30,000 jobs could be lost across the industry."

Last month, Skills Development Scotland estimated 4,500 jobs had been lost to date.

Asked what support should be given to the industry, Ms Michie welcomed the announcements in Rishi Sunak's "mini-budget" but said a long-term sector deal would be "key".

She said: "We are looking for the short-term support in terms of jobs and the furlough scheme, but also longer-term support in terms of where industry goes in a net-zero context.

"So, the budget in the autumn will be a key point for us at which we would like to see very positive statements from the Chancellor and from the government about the sector deal and what industry can contribute in that context."

Scottish finance minister Kate Forbes has suggested the sector had been disappointed by the Chancellor's statement, something disputed by Moray MP Douglas Ross, who sits on the committee.

"The SNP put out a press release saying there was nothing for the industry in the statement, but you have welcomed it", he said.

"In direct response to Scotland's finance minister Kate Forbes, we should not be waiting for you to change your opinion?"

"I think you've probably said it for me," Ms Michie responded.

Reference:

https://www.energyvoice.com/oilandgas/north-sea/251447/north-sea-job-cuts-rise-to-7500-oguk/?utm_source=Sailthru&utm_medium=email&utm_campaign=Energy%20Voice%20-%20Daily%20Newsletter%202020-07-10&utm_term=Energy%20Voice%20-%20Newsletter

Newsweek, Tech & Science

Levels of Ocean Biodiversity Have Barely Changed for Hundreds of Millions of Years, Scientists Say

By Rosie McCall

23 April 2020

Levels of biodiversity in the world's oceans have remained virtually unchanged for hundreds of millions of years, according to a new study published in *Science*.

The conclusion that marine biodiversity has stayed stable over time and not mushroomed over the last 200 Ma or so challenges existing assumptions that there has been a steady diversification of species, say the study's authors.

"Our paper rejects past hypotheses that marine diversity today is higher than ever before, due to sustained increases over the last 200 Ma. Rather, we find that levels of diversity today are likely not that different from levels hundreds of millions of years ago," lead author Dr. Richard Close, a paleobiologist at the University of Birmingham in the U.K., told *Newsweek*.

"This may have implications for the way we understand modern biodiversity and conservation."

According to Close, the assumption that biodiversity levels increase at least partially stems from a methodological error - the global fossil record it hinges on is not really global. It is more fractured than the name suggests, varying in geographic reach and continuity, which leads to skewed results.

"The fact that the 'global' fossil record isn't really global hasn't been widely acknowledged before now," said Close. But new computer models able to identify patterns in regional-scale diversity have enabled Close and his team to analyse shifts in biodiversity levels across time and space from the beginning of the Cambrian Explosion, approximately 540 Ma, to the present day.

The results suggest that global biodiversity levels did not increase in a sustained fashion for extended periods of time. Rather it remained stable. However, the team did notice differences in levels on a regional scale, with coral reefs historically displaying some of the greatest variety of species - as they do today.

"When you look at these individual animal groups, you can see fluctuations in diversity that are often substantial. But taken together, these patterns sum to one of constrained diversity," Close said in a statement.

"Some groups might benefit from the misfortune of others, but the overall levels of diversity that we see have remained fairly stable for hundreds of millions of years."

According to Close, understanding how biodiversity came to exist over deep time offers important context for today's biodiversity - as well as how it may change in the future.

This may be particularly relevant today given a number of recent studies suggesting marine biodiversity is under serious threat, from disappearing coral reefs to accelerating rates of species extinction. According to a study recently published in *One Earth*, more than a quarter of the world's oceans must be protected to preserve marine biodiversity.

If current trends continue, would Close expect to see notable declines of biodiversity on the fossil record or does he think it would be followed by a subsequent boom in biodiversity levels?

Close points to the Cretaceous Period 66 Ma, when an extinction event wiped out roughly half of all plant and animal species (most notably non-avian dinosaurs). The study suggests it was followed by a dramatic shift in biodiversity levels, with an expanding roster of new species - and gastropods in particular - that took advantage of the space left behind.

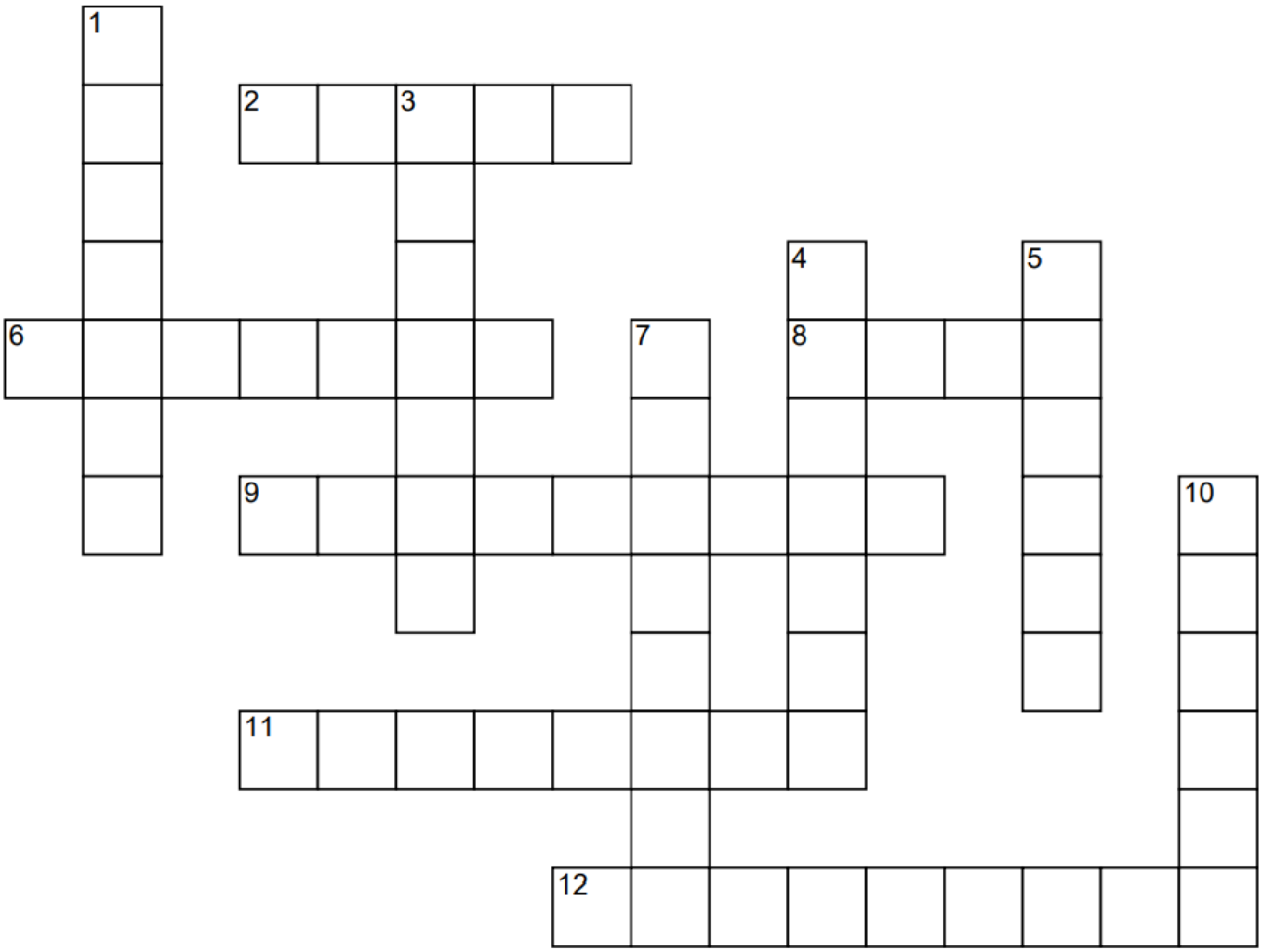
"We find a rapid recovery of diversity levels after the last mass extinction 66 Ma - in fact, to levels even higher than before (although the time resolution of our study is fairly low)," said Close. "Past work has suggested that biodiversity would recover from anthropogenic extinction within a few million years.

"So long after we are gone, biodiversity will likely bounce back to levels seen for tens to hundreds of millions of years. But it will take hundreds of thousands to millions of years, and it depends how badly we mess up the natural environment."

Reference:

https://www.newsweek.com/levels-ocean-biodiversity-remained-stable-hundred-1499842

Igneous Rocks Crossword



ACROSS

2. The name given to molten rock from volcanoes
6. Vent for extrusive igneous rocks
8. The common name for magma flowing from a volcano
9. Igneous rocks that form from magma that reaches the surface of the earth
11. A light-coloured igneous rock with high silica content and explosive eruptions
12. Igneous rocks that form below the surface of the earth and cool slowly

DOWN

1. Rocks that come from the mantle
3. A common intrusive igneous rock
4. One of the eight basic rock forming minerals
5. An igneous rock with a low silica content that flows easily
7. Volcanic glass with no crystalline structure, breaks with very sharp edges
10. A very light igneous rock, honeycombed volcanic glass

Reference

https://www.rocksandminerals4u.com/support-files/igneous-rocks.pdf

Answers on page 24.

The 'Second Moon' You Didn't Know Earth Had

Cruithne is what's called a quasi-orbital satellite of Earth.

The Crux

By Duncan Forgan

2 March 2015

We all know and love the moon. We're so assured that we only have one that we don't even give it a specific name. It is the brightest object in the night sky, and amateur astronomers take great delight in mapping its craters and seas. To date, it is the only other heavenly body with human footprints.

View of the Earth (Credit: NASA)

What you might not know is that the moon is not the Earth's only natural satellite. As recently as 1997, we discovered that another body, 3753 Cruithne, is what's called a quasi-orbital satellite of Earth. This simply means that Cruithne doesn't loop around the Earth in a nice ellipse in the same way as the moon, or indeed the artificial satellites we loft into orbit. Instead, Cruithne scuttles around the inner solar system in what's called a "horseshoe" orbit.

Cruithne's Orbit

To help understand why it's called a horseshoe orbit, let's imagine we're looking down at the solar system, rotating at the same rate as the Earth goes round the Sun. From our viewpoint, the Earth looks stationary. A body on a simple horseshoe orbit around the Earth moves toward it, then turns round and moves away. Once it's moved so far away it's approaching Earth from the other side, it turns around and moves away again.

Horseshoe orbits are actually quite common for moons in the Solar System. Saturn has a couple of moons in this configuration, for instance.

What's unique about Cruithne is how it wobbles and sways along its horseshoe. If you look at Cruithne's motion in the solar system, it makes a messy ring around Earth's orbit, swinging so wide that it comes into the neighbourhood of both Venus and Mars. Cruithne orbits the Sun about once a year, but it takes nearly 800 years to complete this messy ring shape around the Earth's orbit.

Cruithne Close Up

So, Cruithne is our second moon. What's it like there? Well, we don't really know. It's only about 5km across, which is not dissimilar to the dimensions of the comet 67P/Churyumov-Gerasimenko, which played host to the Rosetta orbiter and the Philae lander.

Artist impression of Cruithne (Credit: unknown)

The surface gravity of 67P is very weak – walking at a spirited pace is probably enough to send you strolling into the wider cosmos. This is why it was so crucial that Philae was able to use its harpoons to tether itself to the surface, and why their failure meant that the lander bounced so far away from its landing site.

Given that Cruithne isn't much more to us at this point than a few blurry pixels on an image, it's safe to say that it sits firmly in the middling size range for non-planetary bodies in the Solar System, and any human or machine explorers would face similar challenges as Rosetta and Philae did on 67P.

If Cruithne struck the Earth, though, that would be an extinction-level event, similar to what is believed to have occurred at the end of the Cretaceous Period. Luckily it's not going to hit us anytime soon – its orbit is tilted out of the plane of the Solar System, and astrophysicists have shown using simulations that while it can come quite close, it is extremely unlikely to hit us. The point where it is predicted to get closest is about 2,750 Ka away.

Cruithne is expected to undergo a rather close encounter with Venus in about 8,000 Ka, however. There's a good chance that that will put paid to our

erstwhile spare moon, flinging it out of harm's way, and out of the Terran family.

Other Moons?

The story doesn't end there. Like a good foster home, the Earth plays host to many wayward lumps of rock looking for a gravitational well to hang around near. Astronomers have actually detected several other quasi-orbital satellites that belong to the Earth, all here for a little while before caroming on to pastures new.

So, what can we learn about the Solar System from Cruithne? Quite a lot. Like the many other asteroids and comets, it contains forensic evidence about how the planets were assembled. Its kooky orbit is an ideal testing ground for our understanding of how the Solar System evolves under gravity.

As I said before, it wasn't until the end of the 20th century that we even realized that bodies would enter such weird horseshoe orbits and stay there for such a long time. The fact they do shows us that such interactions will have occurred while the Solar System was forming. Because we think terrestrial planets grow via collisions of bodies of Cruithne-size and above, this is a big new variable.

One day, Cruithne could be a practice site for landing humans on asteroids, and perhaps even mining them for the rare-earth metals our new technologies desperately crave. Most importantly of all, Cruithne teaches us that the Solar System isn't eternal – and by extension, neither are we.

Duncan Forgan is a research fellow at the University of St Andrews. This article was originally published in The Conversation.

Reference

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Perseverance, the newest Mars rover, launches successfully

30 July 2020

Summary by Mick Caulfield

NASA successfully launched its Mars 2020 Perseverance rover (Fig. 1 and 2) on a United Launch Alliance Atlas V541 rocket from Space Launch Complex 41 at Cape Canaveral Air Force Station in Florida at 7:50 am EDT (12:50 pm UK) on Thursday, July 30, 2020.

It was previously delayed from earlier in the month because of technical issues.

Fig. 1: Perseverance launch, July 30, 2020. (Image via NASA)

Fig. 2: Engineers observe the first driving test for NASA's Mars 2020 Perseverance rover in a clean room at NASA's Jet Propulsion Laboratory in Pasadena, California, on December 17, 2019. (Image via NASA/ JPL-Caltech)

Perseverance will land in Jezero Crater (Fig. 3) on the red planet on February 18, 2021. Scientists say the arid Jezero Crater, about 48km wide, was a liquid water lake. That makes it a good spot to search for signs of habitable conditions on Mars in the ancient past and for signs of past microbial life itself.

NASA chose Jezero crater as the landing site for the Perseverance rover because the area was once flooded with water and was home to an ancient river delta.

Jezero crater tells a story of the on-again, off-again nature of the wet past of Mars. More than 3.5 Ga, river channels spilled over the crater wall and created a lake. Scientists see evidence that water carried clay minerals from the surrounding area

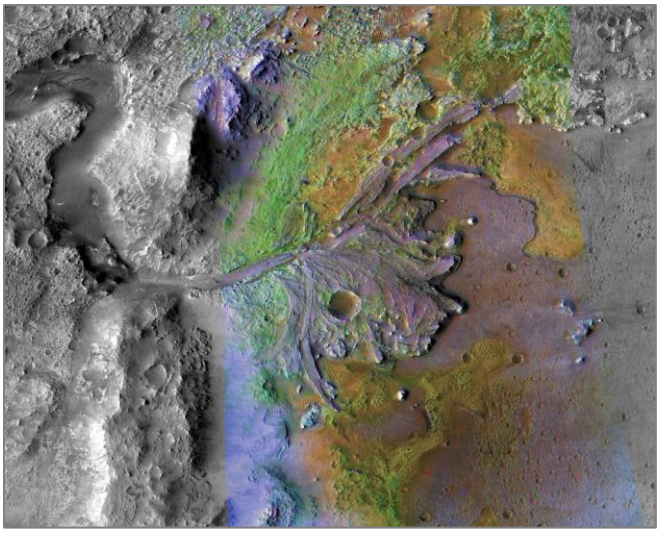


Fig. 3: This image of Jezero Crater, the landing site for the Mars Perseverance Rover, was taken by instruments on NASA's Mars Reconnaissance Orbiter, which regularly takes images of potential landing sites for future missions. (Image Credit: NASA/JPL-Caltech/MSSS/JHU-APL)

Fig. 4: Artist's concept of Mars helicopter Ingenuity. (Image via DLR/ NASA)

into the crater lake. Conceivably, microbial life could have lived in Jezero during one or more of these wet times. If so, signs of their remains might be found in lakebed or shoreline sediments.

On July 22, NASA announced that the mission had passed its flight readiness review, which includes a preparedness assessment of the spacecraft, rocket, procedures, and personnel.

About the size of a car, Perseverance weighs just under 1,043kg, with dimensions similar to the Mars Curiosity rover. The mission will carry seven different scientific instruments.

According to a NASA statement: "The mission is designed to better understand the geology and climate of Mars and seek signs of ancient life on the red planet. It will use the robotic scientist to collect and store a set of rock and soil samples that could be returned to Earth by future Mars sample return missions. It will also test new technologies to benefit future robotic and human exploration of Mars".

Perseverance will also ferry a separate technology experiment to the surface of Mars: a helicopter weighing less than 2kg, named **Ingenuity** (Fig. 4), which will be the first aircraft to fly on another planet.

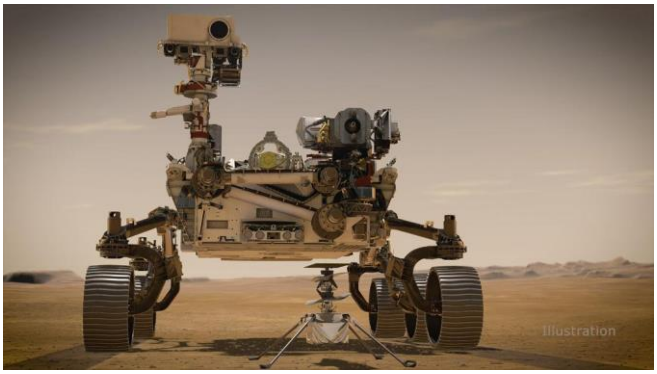
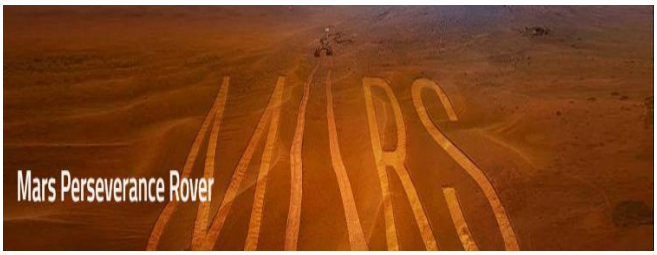


Fig. 5: Artist's impression of the Mars Perseverance Rover on the surface of the "Red Planet". (Image Credit: NASA).

References

1. https://www.nasa.gov/perseverance
2. https://earthsky.org/space/watch-launch-newest-mars-rover-perseverance-july30-2020?utm_source=EarthSky+News&utm_campaign=ac022d77b4-EMAIL_CAMPAIGN_2018_02_02_COPY_01&utm_medium=email&utm_term=0_c643945d79-ac022d77b4-395201289



Crossword Solution

ACROSS		DOWN	
2.	Magma	1.	Igneous
6.	Volcano	3.	Granite
8.	Lava	4.	Olivine
9.	Extrusive	5.	Basalt
11.	Rhyolite	7.	Obsidian
12.	Intrusive	10.	Pumice