Geology Matters

The newsletter of Malvern U3A geology group
September 2017

The Leader

As I write, I have just heard that the final outdoor trip of the summer, walking the Hergest ridge has been postponed due to a forecast for rain. I suppose it sums up British weather following such a fantastic bank holiday! The plan is to reschedule for 27th September; those who were going will get first refusal for the new date but there may be places available for others to go. A new calling notice is attached.

The above trip will bring us to the end of our summer programme, so thanks again to all the various leaders and organisers along the way. We now turn our attention to the programme of indoor lectures (see calendar below) and hopefully an influx of new members.

May I draw your attention to the excellent write up by Kay Hughes of our walk on the South Malvern hills in June lead by Dave Bullard. You will find it on our website as usual and I've also attached it to the accompanying email. Thank you, Kay, for such a comprehensive and scholarly write up. Dave is returning to talk to us in December, so this is a very useful introduction to his lecture.

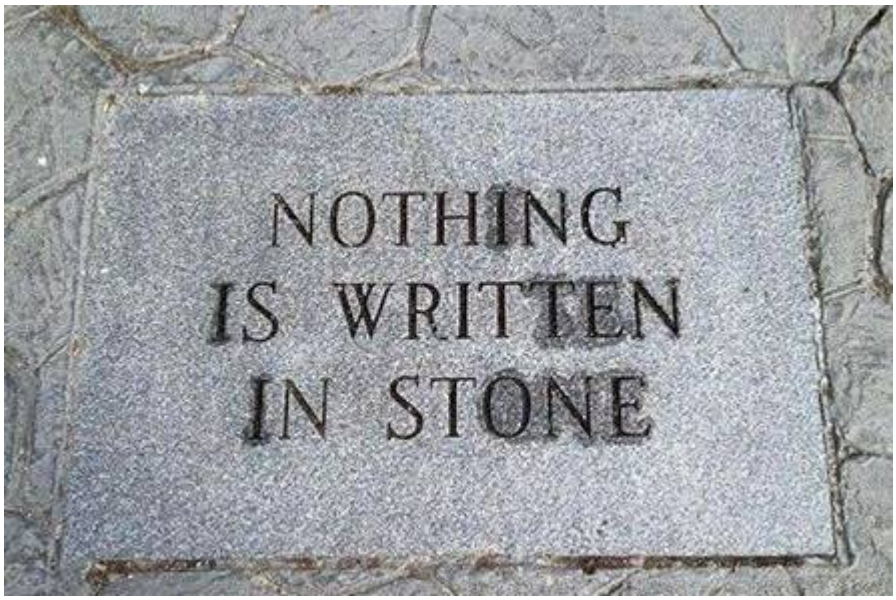
On a more mundane subject, the SC has recently approved an update of the Group's Guiding Principles document. You will find the document on our website (click here) and I urge you to take a moment to read it.

Finally, I wonder how many of you noticed the recent obituary in the press for Dr Alan Smith? He was the eminent Cambridge geologist best known for his part in the 1965 paper "The fit of the Continents around the Atlantic" which laid the groundwork for the revelation, two years later, of the theory of plate tectonics. It was Alfred Wegener who first published a theory of continental drift in 1912, based on evidence of fossil, geological and geographical continuities between the continents. He postulated that they were once joined together in a super continent called Pangea which subsequently broke up and drifted apart. The debate raged for years between Wegener's theory, where the mechanisms involved could not adequately be explained, and the dominant theory of the 'fixists' who contended that the continents formed when the Earth cooled and remained fixed in the same positions ever since. Alan Smith, working as a research assistant in Sir Edward Bullard's team, helped produce results which showed an almost perfect fit between continents at the 500-fathom line. It was clear that they must once have been contiguous

and that the Atlantic Ocean had grown by a few centimetres a year since the early Jurassic period. This work along with the study of magnetic anomalies on the sea floor and the resulting concept of sea floor spreading eventually resulted in the theory of plate tectonics.

Oh, the irony of it.....

Well are you ready for the usual eclectic mixture? This month's edition will be no exception; it ranges widely in subject matter, geological time and geographical location. So, strap in, check the location of the emergency exits and don't forget

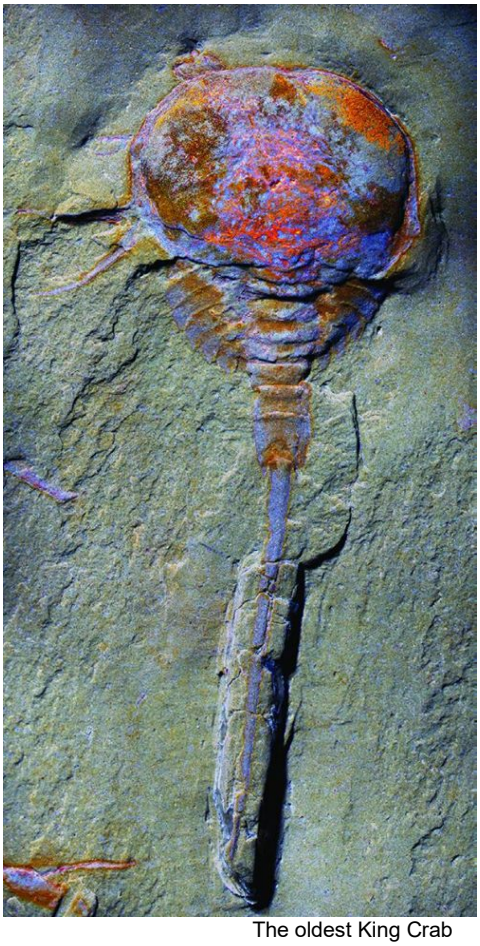


Morocco

I have a lurking suspicion that the Ordovician is the poor relative of the geological sequence. Well think about it for a moment, other than the fact that it sits in between the Cambrian and the Silurian, what do you know about it? Precious little I suspect. In this area we have Cambrian and Silurian rocks in profusion, but what about the Ordo-whatsit rocks? Where are they? Well gone for sure. However, if you care to travel to Morocco, then like going down to the woods, you are in for a big surprise.

And this is where you would need to go. The view is towards the north from Tigzigzaouine Hill, about 25 km north of the town of Zagora. The Lower

Ordovician rock crops out in the hills in the foreground; the low hills in the middle distance are a Cambrian inlier, whereas the mountains on the horizon represent the shales of the Middle Ordovician overlain by the sandstone–shale successions of the Middle to lower Upper Ordovician. And what is the significance of all that you might ask. Well try 1000m thickness of Burgess - type shales. The images below give you some idea of what has been found in this treasure trove.



The oldest King Crab

A cheloniellid arthropod

To cap it all, their soft parts are also preserved. So, if you are feeling adventurous and want to see for yourself then there are organised field trips to the country.

But it all came to an end

The Cambrian period saw a great “explosion” of living things and the Ordovician a great “diversification” but then it all came to a crashing halt and about 85% of oceanic species were wiped out. Some recent research has once again pointed at volcanic action as being the culprit. Examination of rocks laid down towards the end of the period have shown elevated levels of mercury, often characteristic of large scale volcanic euptions forming a province – and there are certainly some of these around. The huge amounts of carbon dioxide emitted during the active phase would have been washed out of the air by rain and leading to a rise in acid levels in the ocean. There would have been an accompanying anti-greenhouse effect which would have

led to a drastic fall in temperature and sea levels as the land slowly became ice covered. Well that's the scenario that has been suggested – all that remains is to identify the guilty province.

But on a different scale

A few hundred kilometres from Morocco takes us to the Canary Islands and the outermost of these is El Hierro. It is quite small and still volcanically active. A 2011 submarine eruption off the coast saw the formation of a very curious floating rock which became known as Restingolite after the village of La Restinga seen in the background of the picture.

When the black shells broke open they were found to have a white hollow interior. The white material is Cretaceous sediment containing marine microfossils.

The Hierro activity was fed by a high-level magma chamber injected at the base of the sediment pile. Fragments of this sediment inevitably found themselves sinking within this basaltic magma. After 10 days of submersion in basaltic melt, these enclaves of sediment had out gassed and vesiculated enough to become buoyant within the chamber and rise to the top, before

being erupted. Hence you get a vesiculated high-temperature metasediment containing microfossils, mingling textures, and surrounded by a basaltic crust. A very odd mixture indeed.

No comment

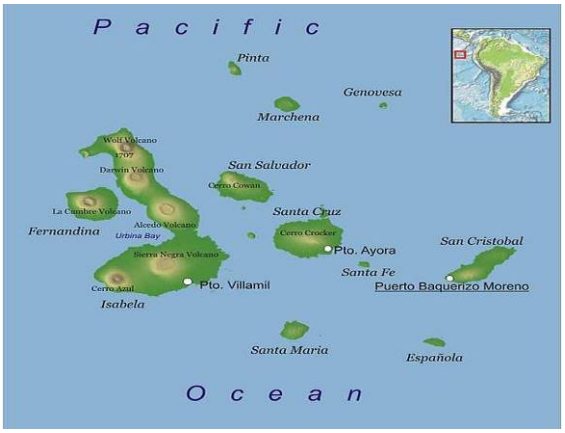
https://www.facebook.com/Geology.Nat/videos/1437900193178134/

Meanwhile 8,500 kilometres away and in another ocean

Charles Darwin visited here in 1831 and was piqued and inspired. Jackie Gribble, the newly appointed secretary of the group's Steering Committee was clearly entranced when she followed in his footsteps. Here is her account. Enjoy! Oh, and apologies for the layout - Jackie's software and mine took an instant dislike to each other and fought viciously throughout the attempted editing.

I'd wanted to go to the Galapagos for decades. I'd been in Ecuador in the early 80s and been very tempted, but had decided the cost was just too high. It became my dream holiday and topped my wish list for years. Finally, last November, I went. The trip was everything I'd hoped for and so much more. I loved the approachable birds and animals; I was awed by the scenery; I found the people really friendly and welcoming; the accommodation and food were superb; transport was thrilling; the snorkelling was like swimming in a well-stocked aquarium - just amazing – I can't fault it. On my return, I ran out of

superlatives to describe how good the trip had been. It was a privilege to go there.



The Galapagos Islands are a volcanic archipelago which lie 1000 km west of mainland South America, either side of the equator. Most of the western islands are tips of huge submarine volcanoes. Most of the eastern islands are uplifted submarine lava. (Sea level has varied considerably over the millennia.) Those in the east of the archipelago were formed several million years ago, while the oldest rocks from the western islands are less than 700,000 years old. The tectonic situation around the Galapagos is complicated as there are three plates in close proximity: the Pacific, the Nazca and the Cocos. The Galapagos Islands are on the Nazca plate, close to its junction with the Cocos plate. As a result of the spreading of the sea floor along the Galapagos Rift and the East Pacific Rise, the islands are moving south and east at more than 7 cm per year.

Crater edge with successive basalt deposits

Close up of crater edge

This area, the Galapagos Hot Spot, is one of the most active, oceanic volcanic regions on earth. The bulk of the volcanic material comes out gently to form large lava flows rather than explosions as it is basaltic. The result is that the major Galapagos volcanoes tend to have smooth shield-shaped outlines with rounded tops. Volcanoes have been formed by successive lava flows.

Lava from 1890 eruptions, still virtually uneroded, at Sullivan Bay on Santiago

Two major types of lava are found: rough-surfaced “aa” (after the Hawaiian for “hurt”) and smooth, ropy-surfaced “Pahoehoe” (from the Hawaiian for “rope”). The smooth type of lava has a thin skin. When it slows down & comes to rest, the molten material underneath buckles the surface & causes curved rope shapes.

Aa lava

Pahoehoe lava

In both types of flow, a solid exterior often surrounds a molten interior. When the supply of lava decreases an empty space forms, which is called a “lava tube”, and can vary in diameter from 1m to over 10m.

Inside a Santa Cruz lava tube

Sometimes there are cones of glassy lava, “hornitos”, in the middle of lava flows caused by pockets of gas escaping from the flow.

Hornitos

Some other outstanding geological features are tuff cones, formed from compacted volcanic ash, generally seen near the coast. Further inland, on the sides of volcanoes, cinder cones are found.

Pinnacle Rock, an eroded tuff cone, on Bartolome

Kicker rock – a great place to snorkel

Antarctica – the greatest volcanic province on the planet?

The West Antarctic Ice Sheet overlies the West Antarctic Rift System about which, due to the comprehensive ice cover, we have only limited and sporadic knowledge of volcanic activity and its extent. Improving our understanding of sub glacial volcanic activity across the province is important both for helping to constrain how volcanism and rifting may have influenced ice-sheet growth and decay over previous glacial cycles, and in light of concerns over whether enhanced geothermal heat fluxes and sub glacial melting may contribute to instability of the West Antarctic Ice Sheet. The overall result of investigations constitutes a first inventory of West Antarctica's sub glacial volcanism. The survey team from Edinburgh University identified 138 volcanoes, 91 of which have not previously been identified, and which are widely distributed throughout the deep basins of West Antarctica, but are especially concentrated and orientated along the >3000 km central axis of the West Antarctic Rift System. The identified volcanoes extend in height from 100 metres (328 feet) to 3,850 metres (12,631 feet), and while the researchers don't yet know if any of them are active, it's important to find out.

Because these volcanoes are buried under kilometres of ice, it's unlikely they could pose a direct immediate threat to anything on the Antarctic surface, but if one were to erupt, it could heat and melt the ice above it, potentially raising sea level.

Rock of the month

No not a giant pair of ears, but a geode of amethyst. This one was discovered in Uruguay. A fist sized example would cost around £30…….

The mineral itself is one of the many forms of silica, given its distinctive colour by trace elements such as iron and more exotic elements, which have been subjected to low levels of radioactivity.

Your summer travels

So where did you get to this summer? I've heard of Iceland, Norway and the Balearic Islands. Given that you're an adventurous group of individuals then I'm sure that there are other even more exotic destinations. Please send us a few geology/landscape snaps to our Group Photographic Resource – details below.

The Calendar

September	4	Group's Fair; 10.00 – 12.00am
October	11	Monthly Talk: Metal Mines of Spain
November	8	Monthly Talk: Glaciology
December	13	Monthly Talk: Malvern Hills Geology
January	10	Monthly Talk: Effects of Meteorites, Asteroids and Comets
February	14	Monthly Talk: Speleothems
March	14	Monthly Talk: Turbidite Flows
April	11	Monthly Talk: The Devonian System

Who's who?

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