Geology Matters

April 2018

Editorial

On a recent Sunday afternoon I was driven southwards along the A38 from Worcester; in the strong sunlight the silhouetted Malvern hills stood out clearly against the blue sky. It reminded me, as if I needed reminding, about our various motivations for moving to this area – the delightful countryside being high on the list. And it is, of course, the underlying and surface geology that shape and control this beauty. There are some other outstanding landscapes and geosites in the country and in a poll conducted by the Geological Society of London these were the most popular:

1. Landscape: **Assynt** in the Scottish Highlands, where the remarkable Suilven and other peaks were shaped by glaciation.
2. Industrial and economic importance: **Ironbridge Gorge** in Shropshire, site of much early mining and industry, named after the pioneering bridge that spans the Severn River.
3. Historical and scientific importance: **Siccar Point** in Berwickshire, the most famous example of Hutton's Unconformity (a junction between rock strata where the older layers underwent erosion before the younger layers were deposited).
4. Educational: **Rotunda Museum**, Scarborough, built in 1829 in a design suggested by the "father of English geology", William Smith.
5. Adventurous: **Staffa** in the Inner Hebrides, a volcanic island famous for its hexagonal basalt columns.
6. Human habitation: **Stonehenge**, the iconic prehistoric monument in Wiltshire.
7. Coastal: **Hunstanton Cliffs** in Norfolk, noted for their contrasting, colourful layers and many fossils.
8. Outcrops: **Craster**, Northumberland, where the Great Whin Sill can be seen supporting Dunstanburgh Castle, alongside other formations like Greymare Rock.
9. Folding and faulting: **Millook Haven,** part of a section of Cornwall's north coast where spectacularly folded beds of sandstone and shale are exposed.
10. Fire and ice: **Glencoe**, one of Scotland's most famous valleys. Cut by a glacier during the last ice age, it runs between steep mountains left over from an ancient super volcano.

Whilst I think that these are admirable choices, I just find it a bit odd that the Malverns did not feature. Mais tante pis as my French friends would say. So on with this month's geological highlights.

Scouring (again)

Last month's article on the scablands showed the powerful erosive effect of water and so I was interested to find this satellite picture of a similar eroded area in Washington State. This chaotically eroded surface (top of Grande Ronde Basalt) is perched high above, and immediately adjacent to, the Columbia River. Highly turbulent mega floods, up to 220m deep, scoured into this basalt surface, preferentially eroding out areas of weaker rock. The flood(s) responsible for the erosion occurred earlier in the last glacial cycle (~18-19 thousand yrs ago) before the Okanogan Ice Lobe advanced to block the Columbia River upstream. For scale, the white line in the top right hand corner of the image is a 3m wide jeep track.

Meteorites, or rather. their tiny relatives

Micrometeorites are tiny fragments of asteroidal (or occasionally cometary) material that survive the descent through the Earth's atmosphere, and which are collected by planetary scientists from sites where input from terrestrial sedimentary sources is minimal, such as Antarctic ice and snow-fields and oceanic basins. Some micrometeorites survive the journey to the Earth relatively intact, but most are melted by the temperatures caused by friction with the Earths atmosphere (which is greater than that caused by simply falling due to the high relative speeds at which these bodies are travelling before encountering the Earth), often reaching temperatures in excess of 2000°C, which causes them to melt, forming spherical droplets due to surface tension, which recrystallise to form circular bodies called spherules.

These spherules do not retain the same chemistry as their parent bodies; lighter elements, such as sodium, sulphur, phosphorus, chlorine, and manganese tend to evaporate completely, while heavier elements such as iron and nickel separate internally, forming discrete layers.

Micrometeorite < 2 mm diameter

As these liquid spherules descend further they are quench cooled through contact with the denser lower atmosphere, causing dendritic crystals to form. About 95% of such spherules have a silicate dominated composition, while about 4% are iron dominated and about 1% have a mixed composition. They are found in the fossil record, but given their size you will be lucky to find any. This next meteorite was clearly a step up and so rather easier to find.

This photo featuring a local Emeritus Professor of Geology was taken in Thunder Bay, Ontario, Canada. According to witnesses, a bright flash and loud explosion were heard and, following that shaking, this ground debris was located.

Did you notice the word "dendritic"?

Here we have a beautiful cut piece of near transparent chalcedony (microcrystalline silica), also known as agate. In this case crystals of a metallic oxide (probably manganese and/or iron) grew through the stone in a natural fractal tree-like pattern (dendron being the ancient Greek for tree). They grew into the super cooled silica gel as it was congealing, with the crystal growth in effect chasing its component elements through the substrate following the surrounding chemical gradient until it was all used up.

You also see dendrites on a macro scale as the river drainage pattern in this NASA image of Tibet shows. Finally, my thanks to Stuart Robinson whose enthusiasm for this subject led to this article.

How long ago? Really?

Recently there seems to have been a rash of scientific papers about the origin of life. Now I wouldn't normally expect to find serious scientific reporting in the Daily Mail, but the online edition recently featured an article suggesting that plant life began in the mid Cambrian, some 100 million years earlier than previously reported. The technique used is indirect but is none the less based on well established science. If you would like to read the article then follow the link:
http://www.dailymail.co.uk/sciencetech/article-5410161/New-research-pushes- history-land-plants-100-million-years.html

Shortly afterwards, this picture was published - it shows 1.6 billion years old fossilized oxygen bubbles, created by tiny microbes in what was once a shallow sea somewhere on young Earth.

Microbes are of special interest; they were not only the first life forms on Earth, they also turned our planet into a tolerable environment for plants and animals and thus their activity paved the way for life as we know it today.

Some of these early microbes were cyanobacteria that thrived in early shallow waters. They produced oxygen by photosynthesis, and sometimes the oxygen got trapped as bubbles within sticky microbial mats.

These fossilized bubbles and cyanobacterial come from 1.6 billion-year-old phosphatized microbial mats found in the Vindhyan Super group of central India. The bubbles in the photo were preserved, and they can be seen as a signature for life.

Cyanobacteria changed the face of the Earth irreversibly since they were responsible for oxygenating the atmosphere. Simultaneously they constructed sedimentary structures called stromatolites, which still exist on Earth today.

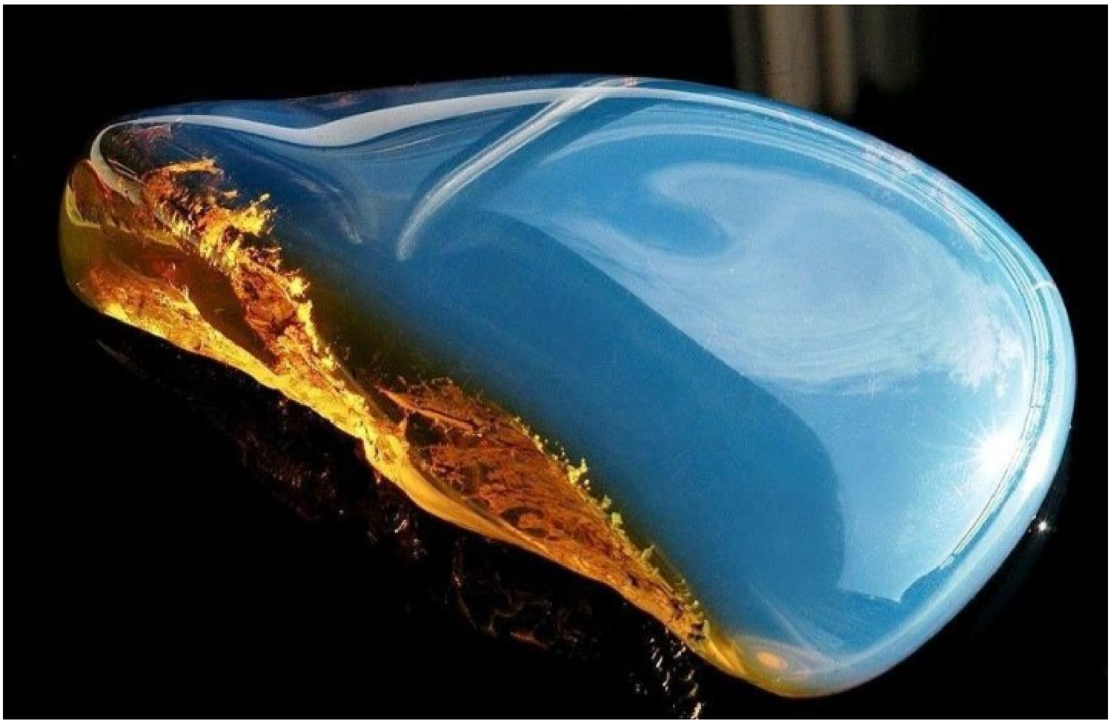
The researchers now think that cyanobacteria played a larger role than previously believed in creating phosphorites in shallow waters, thereby allowing today's scientists a unique window into ancient ecosystems.

Rock of the month

Baltic amber is a fascinating and fairly familiar material:

but what about this equally fascinating, but very unusual material?

It is the rare Dominican blue amber.



Although there are several theories about the origin of Dominican blue amber, there is a strong probability that it owes its existence to ingredients such as anthracene produced by 'incomplete combustion' occurring during forest fires among the extinct species Hymenaea_protera trees about 25 to 40 million years ago

Stop press

Malvern Hills District Council is considering an application for planning permission to mount a plaque on the wall of the HSBC building in Church Street. It is part of the “Route to the Hills” project.