Geology Matters

The newsletter of Malvern U3A geology group
December 2017

A sixth mass extinction?

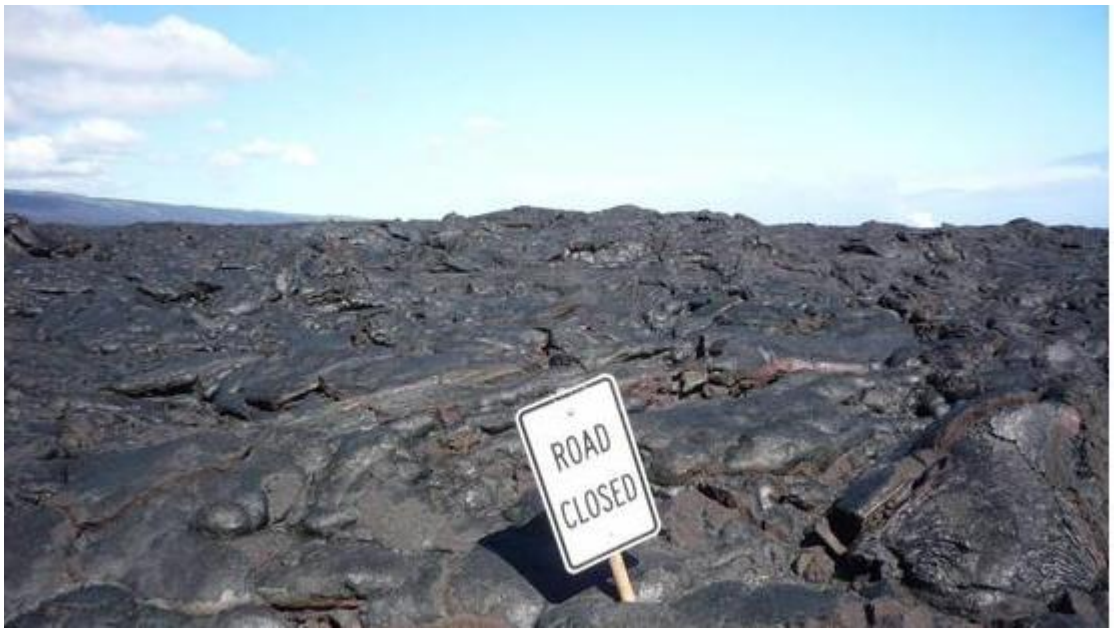
Its always good to start on a cheerful note ! So here we go - during the past 540 million years, the Earth has undergone five mass extinction events, each involving processes that upended the normal cycling of carbon through the atmosphere and oceans. These globally fatal perturbations in carbon each unfolded over thousands to millions of years, and are coincident with the widespread extermination of marine species around the world.
The question for many scientists is whether the carbon cycle is now experiencing a significant jolt that could tip the planet toward a sixth mass extinction. In the modern era, carbon dioxide emissions have risen steadily since the 19th century, but deciphering whether this recent spike in carbon could lead to mass extinction has been challenging. That's mainly because it's difficult to relate ancient carbon anomalies, occurring over thousands to millions of years, to today's disruptions, which have taken place over just a little more than a century.

Now Daniel Rothman, professor of geophysics in the MIT Department of Earth, Atmospheric and Planetary Sciences has analyzed significant changes in the carbon cycle over the last 540 million years, including the five mass extinction events. He has identified "thresholds of catastrophe" in the carbon cycle that, if exceeded, would lead to an unstable environment, and ultimately, mass extinction.

If you would like to read the full article from Scientific American, then follow the hyperlink below:

https://sciencebulletin.org/archives/16164.html

And some truths are self evident



and again.....

You will have heard about (and possibly sampled) the amber nectar

But the sort shown later is no longer liquid**.**

Amber is fossilized tree resin, which has been appreciated for its colour and natural beauty since Neolithic times. Much valued from antiquity to the present as a gemstone, amber is made into a variety of decorative objects. Amber is used in jewellery. It has also been used as a healing agent in folk medicine.

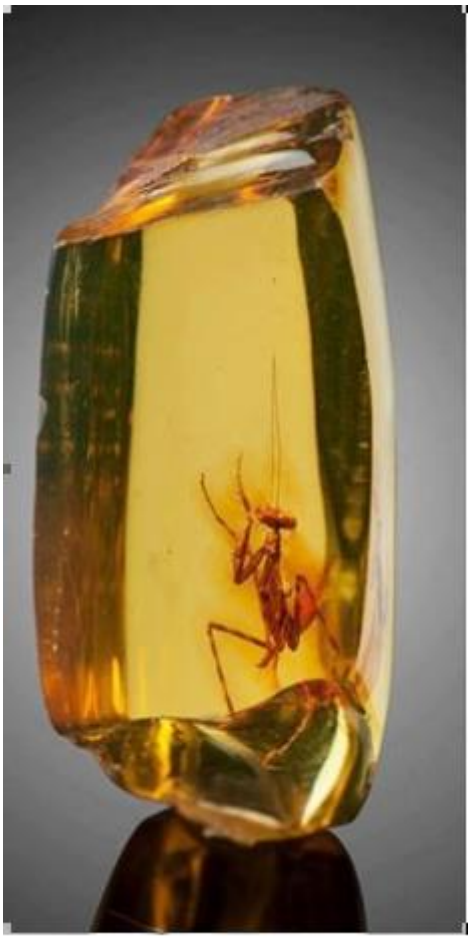
There are five classes of amber, defined on the basis of their chemical constituents. Because it originates as a soft, sticky tree resin, amber

sometimes contains animal and plant material as inclusions. Amber occurring in coal seams is also called resinite

The oldest amber recovered dates to the Upper Carboniferous period (320 million years ago). Its chemical composition makes it difficult to match the amber to its producers – it is most similar to the resins produced by flowering plants; however, there are no flowering plant fossils until the Cretaceous, and they were not common until the Upper Cretaceous. Amber becomes abundant long after the Carboniferous, in the Early Cretaceous, 150 million years ago, when it is found in association with insects. The oldest amber with arthropod inclusions comes from the Lebanon and Jordan. This amber, roughly 125–135 million years old, is considered of high scientific value, providing evidence of some of the oldest sampled ecosystems.

Below are some examples, which illustrate nicely the attractiveness of amber to insects, and of course, the terminal consequences.

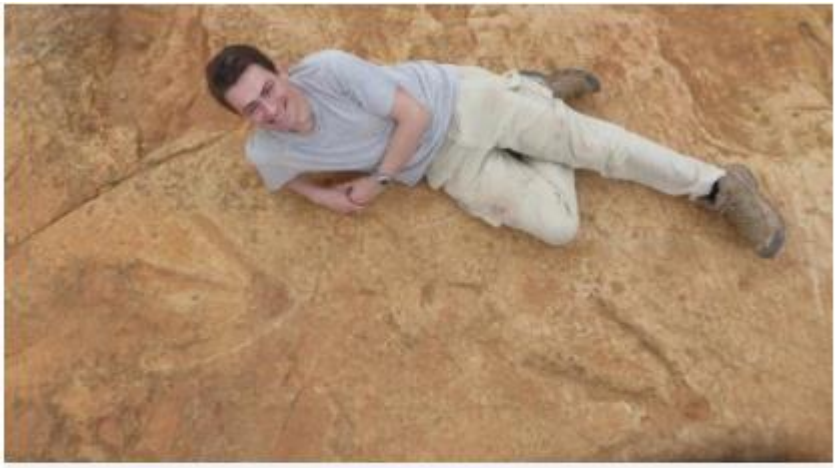
A praying mantis
A dragonfly plus plant fragments



'Mega-carnivore' dinosaur roamed southern Africa 200 million years ago

Now to change the scale completely - an international team of scientists has discovered the first evidence that a huge carnivorous dinosaur roamed southern Africa 200 million year ago. The team, which includes researchers from The Universities of Manchester, Cape Town, and São Paulo, have found several three-toed footprints measuring 57cm long and 50cm wide. This means the dinosaur would have had an estimated body length of around nine metres and be a little less than three metres tall at the hip. That's four times the size of a lion, which is currently the largest carnivore in southern Africa**.**
The footprints belong to a new species, named *Kayentapus ambrokholohali*, which is part of the group of dinosaurs called "Megatheropods." The term Megatheropods describes the giant two-legged carnivorous dinosaurs, such as the iconic *Tyrannosaurus rex* which fossil evidence shows was around 12 metres long.

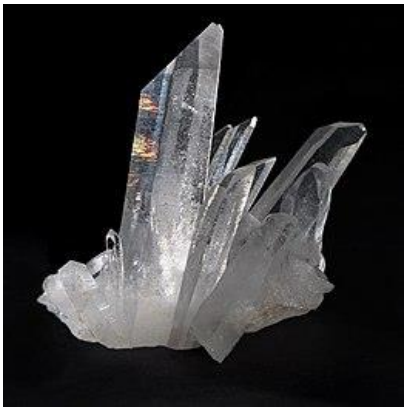
This study also reveals that these footprints make up the largest theropod tracks in Africa. They tracks were found on an ancient land surface, known as a palaeosurface, in the Maseru District of Lesotho. The surface is covered in 200 million year old 'current-ripple marks' and 'desiccation cracks' which are signs of a prehistoric watering hole or river bank.



Fabien Knoll, Honorary Senior Research Fellow at the University of Manchester, lies next to the new exceptionally large carnivorous dinosaur footprints found in Lesotho.

Rock of the month

Quartz is the second most common mineral on the planet's continental crust (after feldspar) but it is also one of great variety and versatility. It is a mineral composed of silicon and oxygen atoms in a continuous framework of SiO_4 silicon–oxygen tetrahedra, with each oxygen being shared between two tetrahedra, giving an overall chemical formula of SiO_2.



It seems to combine effortlessly with a wide range of other minerals and so produce variants such as rose quartz, chalcedony and agate, to name but a few. The rather beautiful sample below is called Rutilated Quartz, which contains the mineral Rutile, which is largely Titanium Dioxide.

Sand is a naturally occurring granular material composed of finely divided rock and mineral particles. It is defined by size, being finer than gravel and coarser than silt The composition of sand varies, depending on the local rock sources and conditions, but the most common constituent of sand in inland continental settings and non-tropical coastal settings is silica (silicon dioxide, or SiO_2), usually in the form of quartz But even then it can be very variable in composition as this 250X image shows.

Mobile geology

Well, you might reasonably ask, is there any other sort? Since we last featured a geology app for smart phones, there has been a recent offering to add to the BGS's well regarded app **igeology**; it is known as **Rockd.**

Igeology caters extremely well for the geology of the United Kingdom, but that is it. **Rockd** goes for world wide coverage – including Antarctica, so when on your holidays, you want information about local geology it can be there in your pocket. Like the BGS version, it is available in both the major formats and is also free At the time of writing, it is still clearly a 'work in progress', but it certainly shows promise.

http://www.bgs.ac.uk/igeology/
and
https://rockd.org/

No comment

CO_2 is by far the most important anthropogenic long-lived greenhouse gas. Globally averaged concentrations for CO_2 reached 403.3 parts per million in 2016, up from 400.00 ppm in 2015. This record annual increase of 3.3 ppm was partly due to the strong 2015/2016 El Niño, which triggered droughts in tropical regions and reduced the capacity of "sinks" like forests, vegetation and the oceans to absorb CO_2. Concentrations of CO_2 are now 145% of pre-industrial (before 1750) levels.

The rate of increase of atmospheric CO_2 over the past 70 years is nearly 100 times larger than that at the end of the last ice age. As far as direct and proxy observations can tell, such abrupt changes in the atmospheric levels of CO_2 have never before been seen.

Over the last 800,000 years, pre-industrial atmospheric CO_2 content remained below 280 ppm, but it has now risen to the 2016 global average of 403.3 ppm.

From the most-recent high-resolution reconstructions from ice cores, it is possible to observe that changes in CO_2 have never been as fast as in the past 150 years. The natural ice-age changes in CO_2 have always preceded corresponding temperature changes. Geological records show that the current levels of CO_2 correspond to an "equilibrium" climate last observed in the mid-Pliocene (3-5 million years ago), a climate

that was 2-3 °C warmer, where the Greenland and West Antarctic ice sheets melted and even some of the East Antarctic ice was lost, leading to sea levels that were 10-20 m higher than those today.

Source: World Meteorological Organization

And finally , and on an entirely more cheerful note

The members of the steering committee look forward to the continuing pleasure of your company in 2018 !