



✚ The Winchcombe Meteorite (Part 2) - In the December issue of the ES eNews, I



included an article about a meteorite that crashed in the small Cotswold town of Winchcombe. The meteorite material dates back to the very beginning of our Solar System around 4.6 billion years ago and originated from the asteroid belt between Mars and Jupiter. The [carbonaceous chondrite](#) meteorite is the first collected on impact in Britain. The fact that the meteorite was recovered less than 12 hours after crashing means it had absorbed very little in

the way of contaminants. Analysis has determined that water accounted for up to 11% of the meteorite's weight - and it contained a very similar ratio of different types of hydrogen atoms to the water on Earth. Some scientists say the young Earth was so hot it would have driven off much of its volatile content, including water. Today the Earth's surface is covered by around 70% ocean; suggestions are that much of this water could have been delivered by carbonaceous chondrite meteorites such as the Winchcombe sample. [Winchcombe meteorite bolsters Earth water theory](#)

✚ Australia is the world's largest Lithium supplier – We have had a number of



presentations on clean energy and the problems that raises due to the specialist material requirements and in particular Lithium and Cobalt. Many Australian tin mines have changed to the mining of lithium, driven by a tenfold increase in the price of the lithium rich raw material 'spodumene'. Initially this material was refined for a limited battery market. However, the demand for batteries powering electric vehicles (EV) is driving

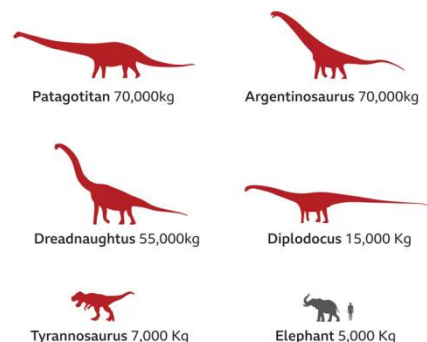
up the lithium price. Although Australia is presently the largest lithium producer, a number of the Australian mines are owned by Chinese companies, with the raw material exported to China to be processed. China presently refines 60% of the world's lithium and 80% of the world's lithium hydroxide. The [Sonora lithium project](#), located in Sonora, Mexico, is estimated to be world's largest lithium deposit with estimated reserves of 243.8 Mt, containing 4.5 Mt of lithium carbonate, again the project is part owned by a Chinese company. [Australia: The World's Largest Lithium Producer](#)

Patagotitan - Colossal dinosaur: When you thought they could not get any bigger! A replica of what could have been the largest animal ever to walk on land will go on show at the Natural History Museum in London at the start of 2023 – if it fits in gallery space. Measuring some 35m (115ft) from nose to tail, the beast could have weighed up to 60 or 70 tonnes in



life and is around 100 million years old. Argentina's Museo Paleontológico Egidio Feruglio (MEF), excavated the animal's giant bones in 2014. A photograph of a searcher lying next to a femur was printed in newspapers around the world. The single leg bone measures 2.4m and weighs over half a tonne. The dinosaur bones appeared in a [video](#) with Sir David Attenborough. This video is 360° and can be dragged around to get different views. [Patagotitan: Colossal dinosaur](#)

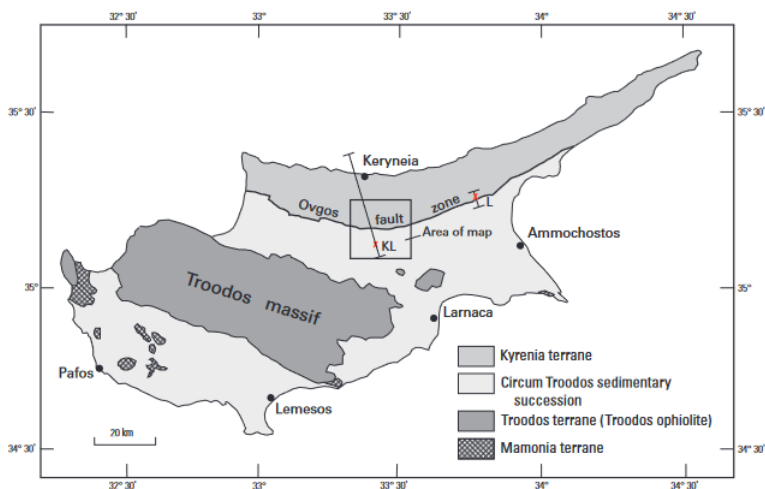
The biggest dinosaurs to walk the Earth



Forgotten Books: Do you need something to read on those cold winter nights? Whilst trawling through the internet, I came across the ‘Forgotten Books’ website. This is a London based book publisher specialising in the restoration of old books, both fiction and non-fiction. They have 1,294,207 books available to read online, download as ebooks or purchase in print. You can read many of these books as a ‘guest’. I spent hours looking through the various subjects. As a sample I have listed some below:

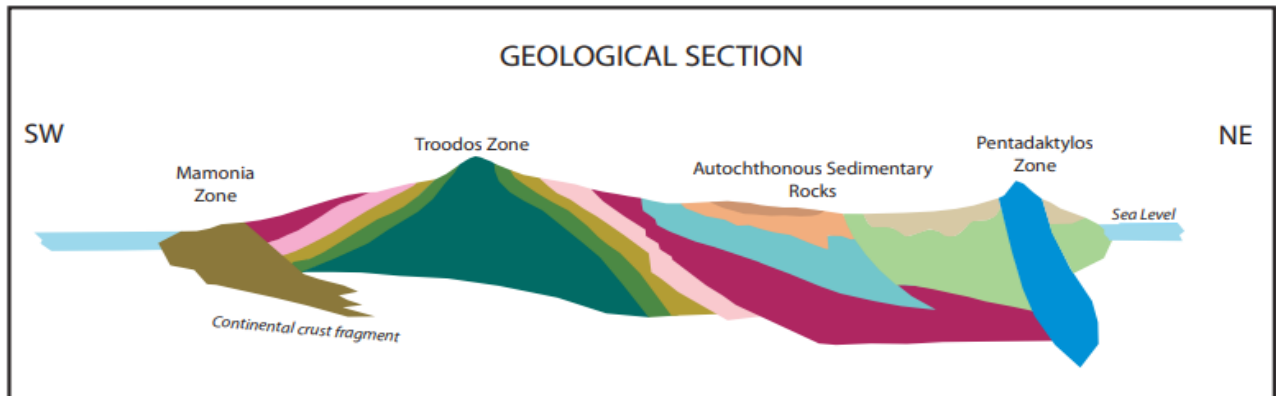
- [First Lessons in Geology](#), A. S. Packard, Jnr, 1882
- [The Geology of Cyprus](#), C. V. Bellamy & A. J. Jukes-Brown, 1905
- [A handbook of Cyprus](#), Sir J. T. Hutchinson & Claude Delaval Cobham 1907
- [Geology of Today](#) (A Popular Introduction in Simple Language), J. W Gregory 1915

Cyprus Geology (Basics): About 90 million years ago, Cyprus was part of the bottom of a deep ocean, called **Tethys**. Tectonic movements at that time resulted in the collision of the African tectonic plate with the Eurasian plate, ultimately giving birth to the island. The Troodos Massif itself first rose above the ocean around 20 million years ago, along with its smaller sister in the north of the island, the Pentadactylos range. Today's high point, **Mount Olympus** (Chionistra) at 1952m or 6400 ft, is



actually a slice of a 90 million year old crust of the ocean consisting of [plutonic](#), intrusive and volcanic rocks and chemical sediments. Cyprus consists of four named bedrock units, known as the Keryneia Terrane, Troodos Ophiolite, Circum Troodos

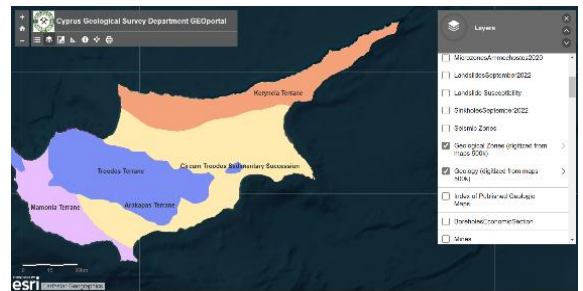
Sedimentary Succession and Mamonia Terrane (see map). The complex geological processes which took place to form the island can be clearly seen in the rock formations in the Troodos massif area. The Troodos Mountain Range is made up of serpentine-rock, diabase, gabbro and pillow lava. It is also rich in mineral deposits including asbestos, chromite, iron and copper which probably gave the island its name.



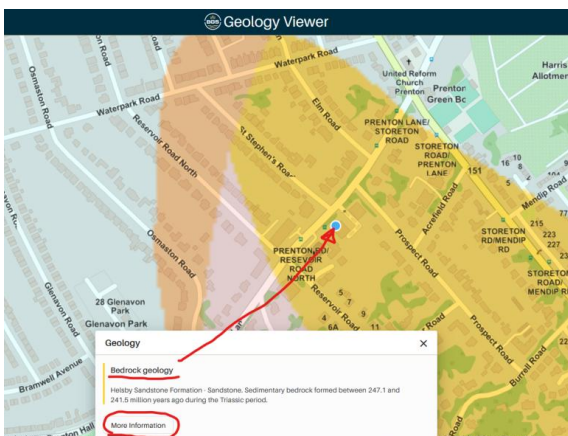
✚ **High quality Cyprus Geological maps** are available for viewing online. Details are also provided for where these maps can be purchased. [Geological Survey Department | Map Publications \(moa.gov.cy\)](http://www.moa.gov.cy/Geological%20Survey%20Department/Map%20Publications)

✚ **Cyprus Interactive map** [Cyprus Geological Survey Department GEOportal \(arcgis.com\)](http://www.moa.gov.cy/Geological%20Survey%20Department/GEOportal). This application was designed by the Cyprus Geological Survey Department for the dissemination of

geological knowledge. The interactive map of Cyprus has a number of selectable features including the ability to measure distance and area. The 'Layers' tab (LHS Menu) displays a selectable legend of over 60 items e.g Borehole Information, Landslide Susceptibility, Landslides September 2022, Seismic Zones, Geology, Mines, Quarries, Geological Zones, Gossan Areas and much more.

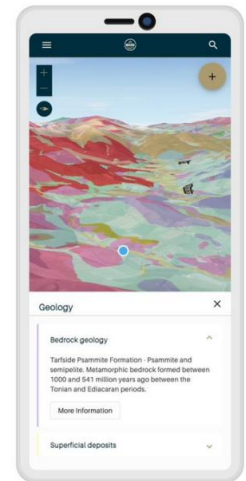


✚ **BGS Geology Viewer:** If and when you are next in the UK, download the [BGS Geology Viewer](https://www.bgs.gov.uk/geology-viewer). This is a free mobile phone app available on all browsers that lets you access detailed information about the geology all around you. The BGS Geology viewer can also be used from your tablet or desktop. Tapping the map reveals the bedrock and superficial geology as well as explaining how certain features were formed. As can be seen from the sample map, the detail is down to road and house number.



The basic geological bedrock information is displayed with the option for 'More Detail'. The app has the following features:

- **3D Visualisation** – View BGS Geology data draped over a 3D terrain model to get a new perspective on the geology of Great Britain.
- **Multiple base maps** – View the BGS Geology data over a choice of base map, including satellite imagery.
- **Geolocation** – Use your device's GPS to track your position on the map while you explore.
- **Dynamic geology legend** – Pan around the map and you can see the geology legend update to show all visible formations. To view, open the sidebar and tap 'View the layer legend' button. Clicking a legend item will take you to the BGS Lexicon for the full details.



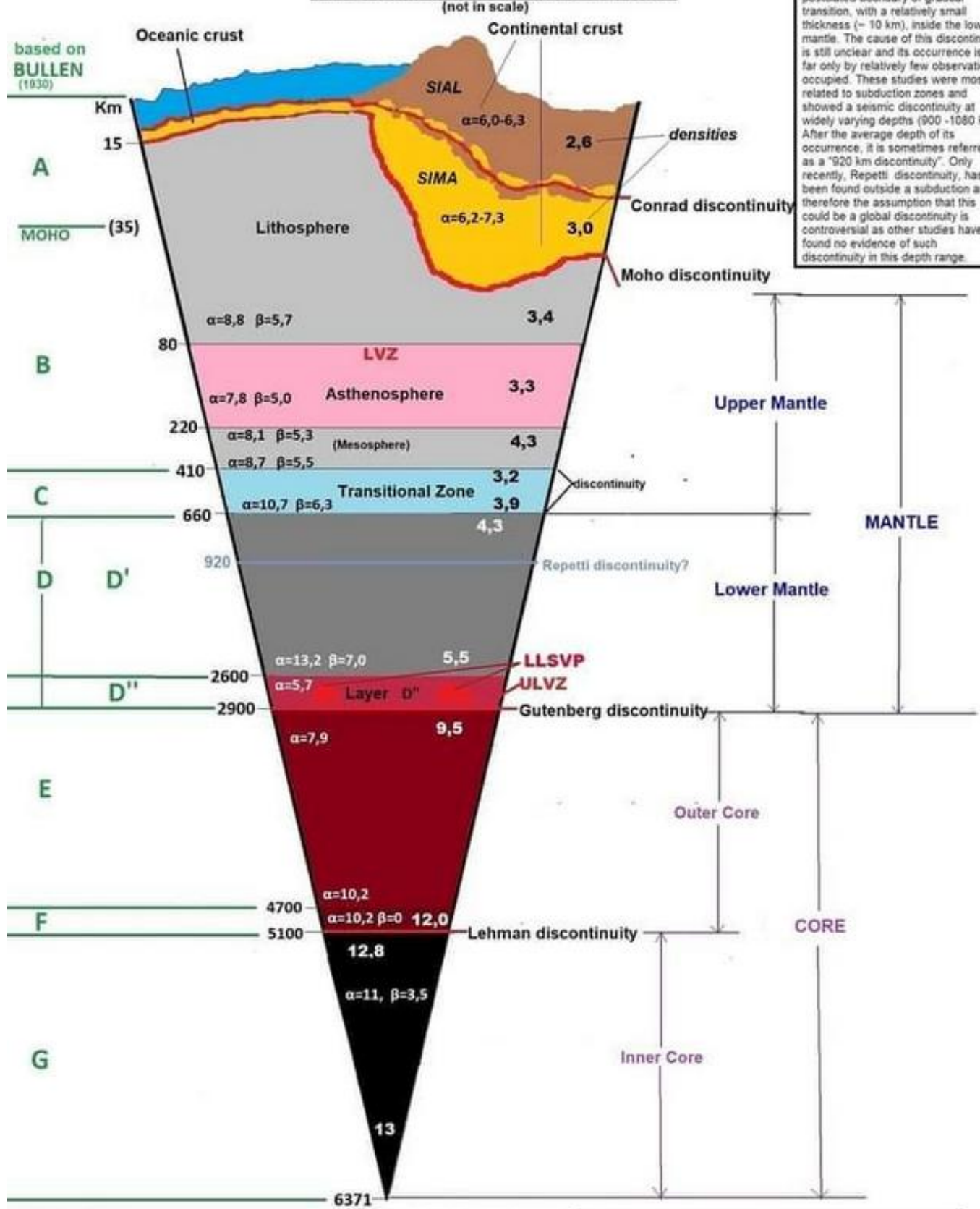
The Internal Structure of the Earth: The earth is made up of several layers and each has unique properties, characteristics, composition and affects the inner processes of the earth differently. The Earth can be divided into one of two ways – mechanically or chemically. Mechanically - it can be divided into the lithosphere, asthenosphere, mesospheric mantle, outer core and the inner core. Chemically, which is the more popular of the two; it can be divided into the crust, the mantle (which can be subdivided into the upper and lower mantle) and the core – which can also be subdivided into the outer core, and inner core. With increasing depth, Earth's interior is characterized by gradual increases in temperature, pressure, and density. Depending on the temperature and depth, a particular Earth material may behave like a brittle solid, deform in a plastic-like manner or melt and become liquid. How do we know the structure of the Earth? Rock samples can be taken, up to a limited depth. After that indirect geophysical methods are used such as:

- **Magnetic Measurements** using magnetometers
- **Gravity Measurements** using gravimeters or satellites
- **Seismic waves** from earthquakes or large explosions using seismometers

The most common method used and easiest to understand (for me at least) is seismology, this is the study of vibrations within the Earth. These vibrations are caused by events such as earthquakes, extraterrestrial impacts, explosions (natural or manmade), storm waves hitting the shore etc. Seismology is applied to the detection and study of earthquakes, but seismic waves also provide important information about Earth's interior.

Seismic waves travel through different materials at different speeds and we can apply knowledge of how they interact with different materials to understand Earth's layers and internal structures. Where a wave encounters a layer with a different composition, it will change direction and/or velocity. Seismometers measure how long it takes for seismic waves to travel from their source to a recording station. Seismic waves can be simply divided into P-waves and S-waves. P-waves can travel rapidly though both liquids and solids but S-waves can only travel though solids and are slower than P-waves. Observing where P-waves travel and S-waves do not, allows us to identify regions within Earth where the rock is molten.

INTERIOR STRUCTURE OF EARTH



The Repetti discontinuity is a postulated boundary of gradual transition, with a relatively small thickness (~ 10 km), inside the lower mantle. The cause of this discontinuity is still unclear and its occurrence is so far only by relatively few observations occupied. These studies were mostly related to subduction zones and showed a seismic discontinuity at widely varying depths (900 -1080 km). After the average depth of its occurrence, it is sometimes referred as a "920 km discontinuity". Only recently, Repetti discontinuity, has been found outside a subduction area, therefore the assumption that this could be a global discontinuity is controversial as other studies have found no evidence of such discontinuity in this depth range.

α : Primary seismic waves
 β : Secondary seismic waves
LVZ: Low Velocity Zone
ULVZ: Ultra-Low Velocity Zone
LLSVP: Large Low Shear-wave Velocity Provinces: *Pacific (Jason) and Africa (Tuzo)*

Layer D'' or Core-Mantle Boundary (CMB): It's compose with post-perovskite (MgSiO₃). It has the ability to absorb Fe from the liquid outer core and is the most anisotropic segment. Seismic tomography studies have shown significant irregularities within the boundary zone and appear to be dominated by the LLSVPs.

Basil Andronis

Christmas Geology Jokes (I did not want to spoil your Christmas sending these in December)

Q: Why didn't the geologist want his Christmas dinner?

A: He lost his apatite.

Q: Who did Santa bring along to perform at the Earth Sciences Christmas party?

A: Elf-is Presley!

Q: What is Father Christmas's favourite element?

A: Holmium (Ho Ho Ho!)

Q: What happened to Rudolph when he accidentally ate clay?

A: He got illite.

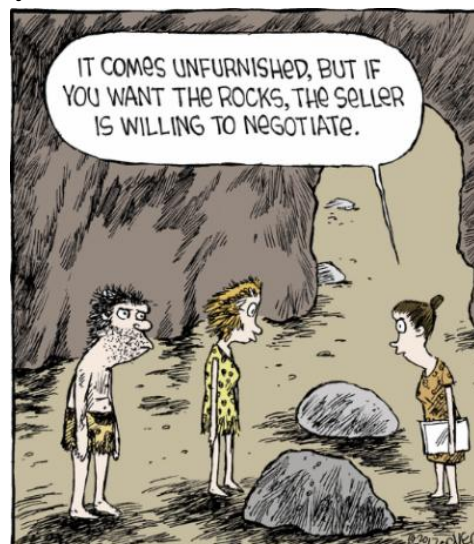
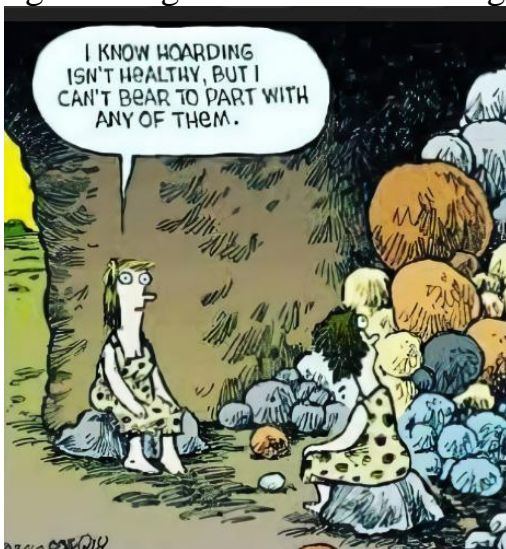
Q: Why are advent calendars like the dinosaurs?

A: Because their days were numbered!

Q: Why aren't there any single geologists at Christmas parties?

A: They will date anything!

Stone Age Geologists – not much changed? (sorry John & Rob)



Quiz

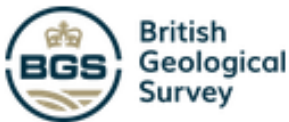
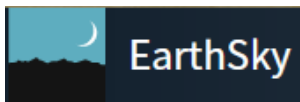
+ [Earthquakes – Fact or Fiction](#)

+ [True or False: All About the Earth](#)

+ [The Solid Earth Quiz](#) (*With a 'bit' of guessing I did better than I expected on this quiz*)

+ A reminder that the *P3A Earth Sciences Group* website can be found [here](#). Contact details can be found for the Group Leaders and copies of previously issued 'Geology Newsletters', which preceded the current 'ES eNews'. There is also a link to an [Earth Science Glossary](#) with terms that are more specifically related to Cyprus geology.

Acknowledgements



Geological Survey Department

