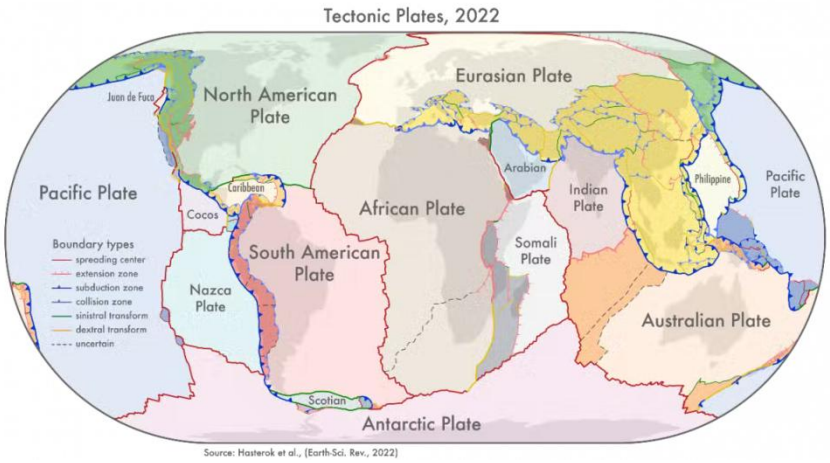
- **Advanced new model of Earth's tectonic plates** - A tectonic plate, is a massive, irregularly shaped slab of solid rock, made up of lithosphere or the earth's top layer. Tectonic plate movements often lead to earthquakes and volcanoes. The new model for tectonic plates better explains the spatial distribution of 90 per cent of earthquakes and 80 per cent of volcanoes from the past two million years whereas existing models only capture 65 per cent of earthquakes. The new model will help in forming a better understanding of natural hazards like earthquakes and volcanoes.

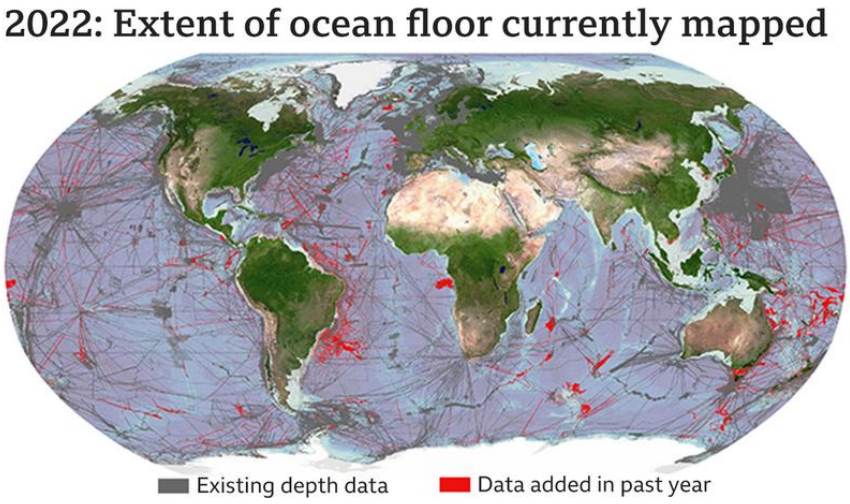



The researchers combined three models to map the new geological provinces and tectonic plates:

- A plate model based on the existing knowledge of tectonic plates.
- A ***province*** (*spatial entity with common geologic attributes*) model based on the geological information of the earth's surface
- An ***orogeny*** (*primary mountain forming mechanism*) model based on the process of mountain formation which is triggered when two tectonic plates collide.

The new model includes fresh micro-plates such as the Macquarie micro-plate that sits south of Tasmania and the Capricorn micro-plate which separates the Indian and Australian plates. The new model will improve the accuracy of tools used to predict earthquakes and volcanoes. ***New Tectonic Plate Model***.

- **Nearly a quarter of Earth's seafloor now mapped** - The proportion of the global ocean floor that's been properly mapped is at 23.4%.

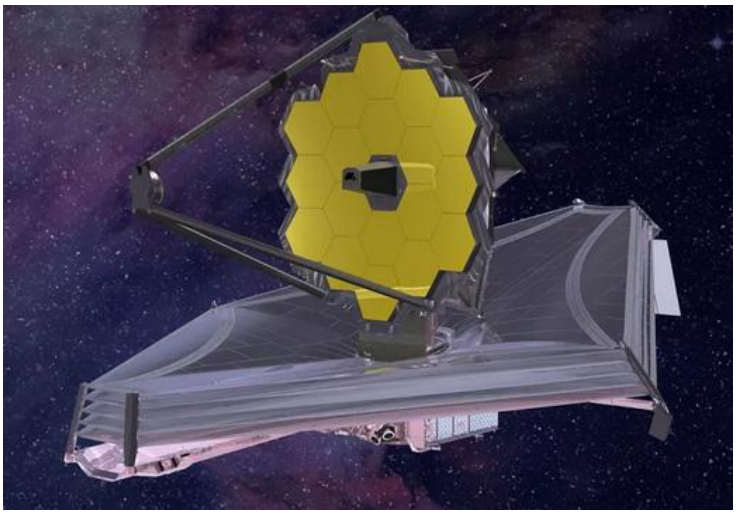



Some 10 million sq km (3.8 million sq miles) of new bathymetric (depth) data was added in the past year. This is an area broadly equivalent to the land surface of Europe. Much of the recently added data is not from new surveys but from the sharing of information in existing databases. Sea maps are essential for not only for safe navigation but also for fisheries management and conservation. In addition, the rugged seafloor influences the behaviour

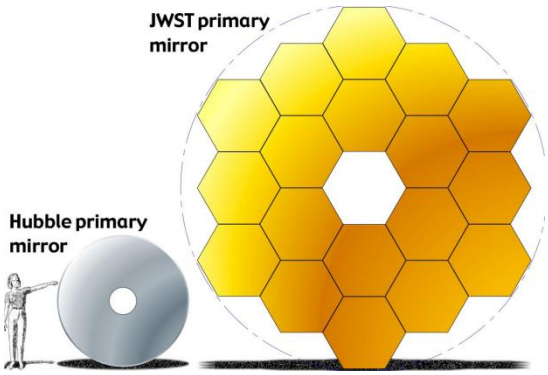

of ocean currents and the vertical mixing of water. This is information required to improve the models that forecast future climate change - because it is the oceans that play a pivotal role in moving heat around the planet. Some of the new data was collected by the autonomous, 22 m long *Saildrone Surveyor*, which mapped 22,000 sq km of seafloor on a cruise between San Francisco and Honolulu last year. A marine robotics company is presently building a fleet of 78m long autonomous ships for ocean floor mapping.

***Ocean Floor Mapping***

- **James Web Telescope** – Even far from the light pollution of our cities, the view of the sky from Earth telescopes is attenuated and distorted by moisture and dust in the atmosphere and absorption of the ultraviolet and infrared parts of the spectrum. As long ago as 1923 the German rocket scientist Herman Oberth suggested a space bound telescope to overcome these problems. The Hubble telescope, named after Edwin Hubble, who had discovered the expansion of the Universe, was finally launched in 1990 and gave us astounding views of the planets, stars and galaxies. In the main Hubble views in the visible part of the spectrum and has limited capabilities in the invisible ultraviolet and infrared wavelengths.



The proposed successor to the Hubble telescope was the James Webb Space Telescope (JWST). The $1 billion observatory to be launched in 2007 became a $10 billion project that launched in 2021. The JWST mirror is more than twice the size of the Hubble optics. The primary goals of the Webb telescope are to study galaxy, star and planet formation in the early Universe. A simple explanation of how the light detected by space telescopes allows us to look back in time is to consider our Sun. The Sun is, on average, only 150 million kilometres away from the Earth. The sunlight travels to Earth at the speed of light 300,000 km/s and therefore takes about 8 minutes and 20 seconds to reach Earth, so we see the sun as it was 8min 20secs ago. Polaris (The North Star), is 433 light years away. When we look at Polaris, we see the star as it was 433 years ago. Due to the expansion of the universe, light from very distant objects shifts to longer wavelengths at the redder end of the spectrum (red-shifted). The JWST will observe this infrared light in great detail and shed light on some of the oldest stars and galaxies that formed billions of years ago,



in the early days of the universe. The more red-shifted the light JWST observes the further back in time it is observing.

The heart of the JWST is its mirror also called the Optical Telescope Element (OTE). At


21.3 feet (6.5 meters) across, it's the largest mirror to ever go into space. JWST's mirror, is made from 18 hexagonal segments of beryllium coated with gold. More than 100 motors manipulate the segments to focus the individual images to a single point. The motors can move in steps that are a fraction of the wavelength of light (1/10,000$^{th}$ the width of a human hair)
On Feb. 11, NASA announced that the James Webb Space Telescope had captured its first images of starlight. The first image taken by Webb was of a star called HD 84406. Light from HD84406 was captured by Webb's 18 mirror segments located on the primary mirror, resulting in a mosaic of 18 scattered bright dots. The 100+ motors then realigned each of the 18 mirror segments to produce a single, clear image of the star.
The onboard instruments need to operate at a very low temperature of -266$^{o}$C (7$^{o}$Kelvin). To achieve this they are shielded by five layers of a polymer called Kaplon E, sandwiched between aluminium and silicon to reflect sunlight and heat away from the observatory. While JWST orbits, the sunshield always stands between its mirror and the direction of the sun.
JWST does not orbit the Earth itself, but rather in a point where the gravitational pulls of the Earth and the sun equalize each other, called a Lagrange point. There are 5 Lagrange points around the Earth (L1 to L5) and the JWST is 'parked' around L2.
JWST Unfurls Video (1m 7secs)


The James Webb Space Telescope image of the Carina Nebula is a composed of data from both the telescopes near and mid-infrared instruments

Unfortunately it has not all been plain sailing for the JWST. As the mirrors are not enclosed they are subjected to impacts from micrometeoroid which was expected at a rate of approximately one per month. However, one such strike in July was larger than the pre-launch modelling and has resulted in damage to a mirror segment that cannot be fully corrected by mirror realignment. Fortunately, the overall effect on the JWST image quality is small.

Stellar Images from the *James Webb Space Telescope*

**Videos**

Aligning the Primary Mirror Segments of the James Webb Space Telescope (2m 24secs)

Seeing The Universe Like We've Never Seen It Before (39mins) – worth watching

- **James Ephraim Lovelock** died in July 2022 at the age of 103. He is best known for proposing the Gaia hypothesis, named after the ancient Greek goddess of Earth. The hypothesis postulates that living organisms interact with their inorganic surroundings on Earth to form a synergistic and self-regulating, complex system that helps to maintain and perpetuate the conditions for life on the planet. Many new age authors have written books which mix New Age teachings with Gaia philosophy. In Lovelock's 2006 book, *The Revenge of Gaia*, he argued that the lack of respect humans have had for Gaia, through the damage done to rainforests and the reduction in planetary biodiversity, is testing Gaia's capacity to minimise the effects of the addition of greenhouse gases to the atmosphere. This eliminates the planet's negative feedbacks and increases the likelihood of homeostatic positive feedback potential associated with runaway global warming.

    - **homeostasis**, any self-regulating process by which biological systems tend to maintain stability while adjusting to conditions that are optimal for survival. If homeostasis is successful, life continues; if unsuccessful, disaster or death ensues. The stability attained is actually a dynamic equilibrium, in which continuous change occurs yet relatively uniform conditions prevail.

- **Space Telescope Image of distant star** – On July 31, French scientist Étienne Klein

tweeted an image of a glowing red circle with a caption saying - *"Picture of Proxima Centauri, the nearest star to the Sun, located 4.2 light years away from us. It was taken by the James Webb Space Telescope,"* said Klein, a physicist and director at France's Alternative Energies and Atomic Energy Commission, in the translated tweet. *"This level of detail... A new world is unveiled every day,"* he added. However, Klein later admitted the picture was not of Proxima Centauri or of anything found in space. In fact, it was simply a picture of a slice of chorizo, a type of smoked sausage!! (Brilliant!!)

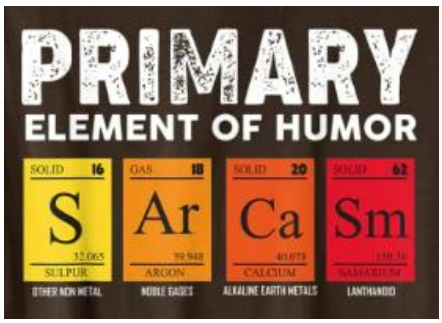
- **Scientists find fossil of dinosaur 'killed on day of asteroid strike –** Scientists have

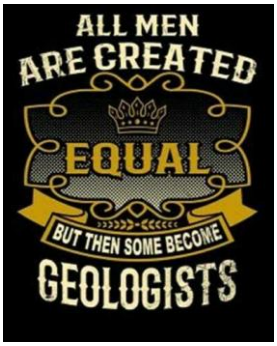
found the remains of a perfectly preserved dinosaur leg, including the remnants of skin, that contains the debris from the asteroid that brought about the extinction of the dinosaurs 66mya. Several incredibly well-preserved dinosaur fossils were uncovered at Tanis, a site in North Dakota. Scientists believe the dinosaurs died the day a giant asteroid hit the earth 66 million years ago. The Tanis site is rich in well-preserved fossils, including fish, a turtle, and even the embryo of a flying pterosaur encased in an egg. Scientists believe that tiny glass-like particles of molten rock lodged in the gills of fish fossils found at the site were kicked up by the asteroid's explosive impact. The dig has been filmed for a **BBC documentary Dinosaurs: The Final Day with Sir David Attenborough**

- 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.

# 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)*




**Acknowledgements**

DownToEarth | डाउन टू अर्थ
Samachar Central
BBC NEWS
SPACE.com
hubble
NASA
WIKIPEDIA The Free Encyclopedia
DAILY BEAST
enquiries@wonderdome.co.uk
Britannica
The Guardian
EarthSky