Geological Time Scale

Eons	Era	Period	Epoch	Age / Years Before Present	Life / Major Events
Present		Quaternary	Holocene	0 - 10,000	Modern Man
			Pleistocene	10,000 - 2 million	Homo Sapiens
	Cainozoic (From 65 million years to the present times)	Tertiary	Pliocene	2 - 5 million	Early Human Ancestor
			Miocene	5 - 24 million	Ape: Flowering Plants and Trees
			Oligocene	24 - 37 Ma	Anthropoid Ape
			Eocene	37 - 58 Million	Rabbits and Hare
			Palaeocene	57 - 65 Million	Small Mammals : Rats – Mice
Phanerozoic	Mesozoic 65 - 245 Million Mammals	Cretaceous		65 - 144 Million	Extinction of Dinosaurs
		Jurassic		144 - 208 Million	Age of Dinosaurs
		Triassic		208 - 245 Million	Frogs and turtles
	Palaeozoic 245 - 570 Million	Permian		245 - 286 Million	Reptile dominate-replace amphibians
		Carboniferous		286 - 360 Million	First Reptiles: Vertebrates: Coal beds
		Devonian		360 - 408 Million	Amphibians
		Silurian		408 - 438 Million	First trace of life on land: Plants
		Ordovician		438 - 505 Million	First Fish
		Cambrian		505 - 570 Million	No terrestrial Life : Marine Invertebrate
570 Proterozoic	Pre-Cambrian 570 Million - 4,800 Million			570 - 2,500 Million	Soft-bodied arthropods
2500 Archean				2,500 - 3,800 Million	Blue green Algae: Unicellular bacteria
4000 Hadean				3,800 - 4,800 Million	Oceans and Continents form – Ocean and Atmosphere are rich in Carbon dioxide
4800MYA Origin of Stars	5,000 - 13,700 Million			5,000 Million	Origin of the sun
Supernova				12,000 Million	Origin of the universe
Big Bang				13,700 Million	

Geography Class 08

REVISION OF THE PREVIOUS CLASS (9:20 AM):

- We see eclipses when one heavenly body moves into the shadow of another.
- **Solar Eclipse** happens when the moon blocks the light coming from the sun to the Earth.
- We can have total, partial, and annular solar eclipses.
- **Lunar Eclipse** happens when the earth comes between the sun and the moon blocking the light from the sun which was supposed to be reflected by the moon.
- We can have total, partial, and penumbral lunar eclipses.
- **Super Moon** is a phenomenon of a full moon that coincides with the perigee of the moon.
- The **Blood Moon** is the full moon during the lunar eclipse.
- The **Blue Moon** is the second full moon of the month.

Evolution of the Earth:

- The planet Earth was totally barren and rocky at its origin.
- There was a thin atmosphere of hydrogen and helium.
- The early atmosphere with hydrogen and helium was stripped off due to **solar winds**.

Geological Time Scale of the Earth:

- Features of the earth, as we see it today, were not the same originally- Aravallis were at one point in time higher than the Himalayas.
- The earth is 4800 million years old.
- As animals, we have evolved in the last two million years.
- The cultural evolution(humans residing in community habitations) is around 10,000 years old.
- The survival and eventual dominance of the **Homo Sapiens** is believed to be an accident by many researchers.
- This is because the **Homo Neanderthals** had a bigger brain than us, despite having a shorter size.
- The evolution of our **thumb** was a very major turning point in evolutional history.
- Our thumb helps us in holding objects, which is seen in very few other mammals like **Orang Utans.**
- Dinosaurs ruled the earth for more than 100 million years.

Time Scale divisions:

- Eon-Era-Period-Epoch-Age.
- Every Eon is made up of around one billion years.
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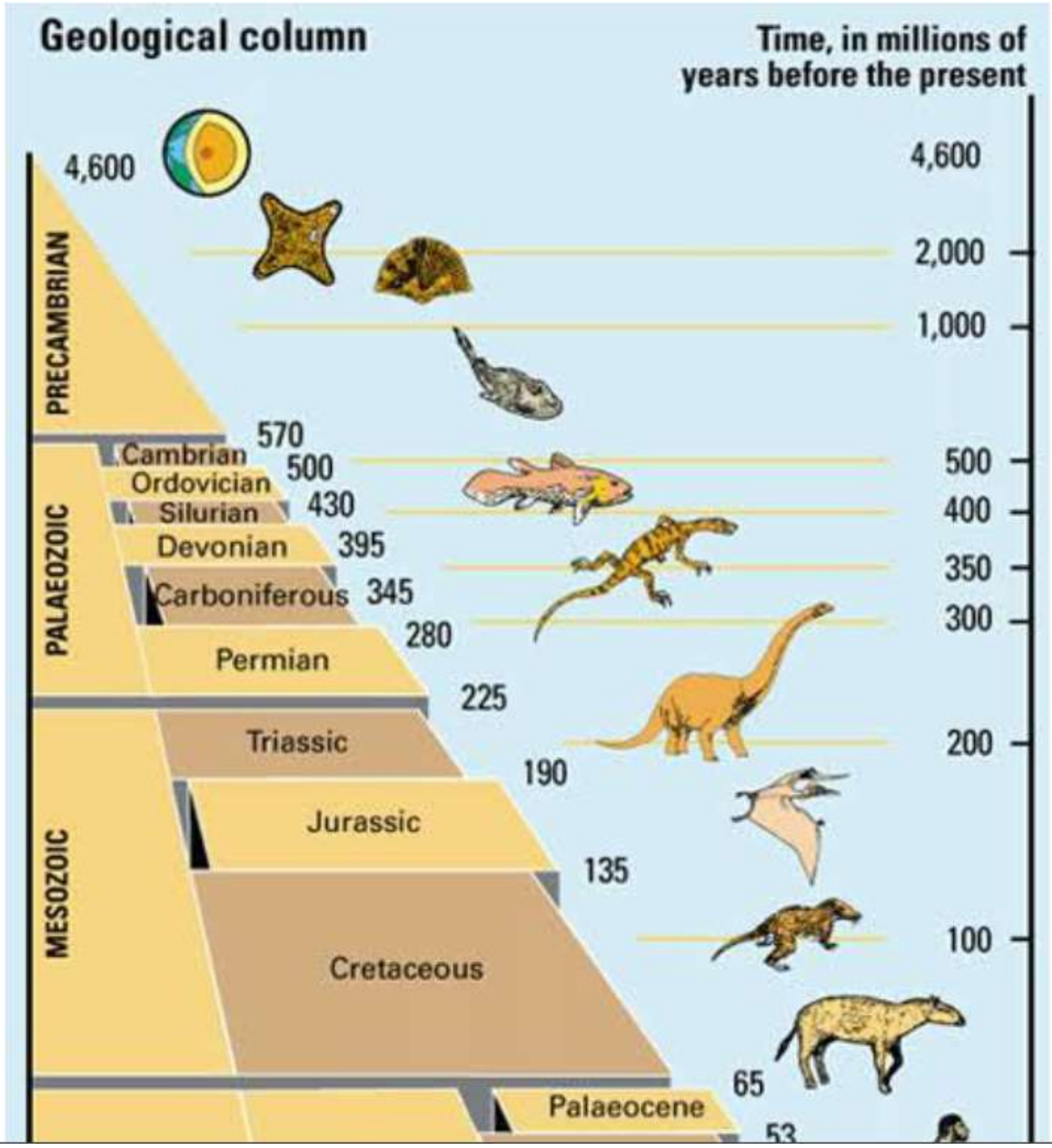
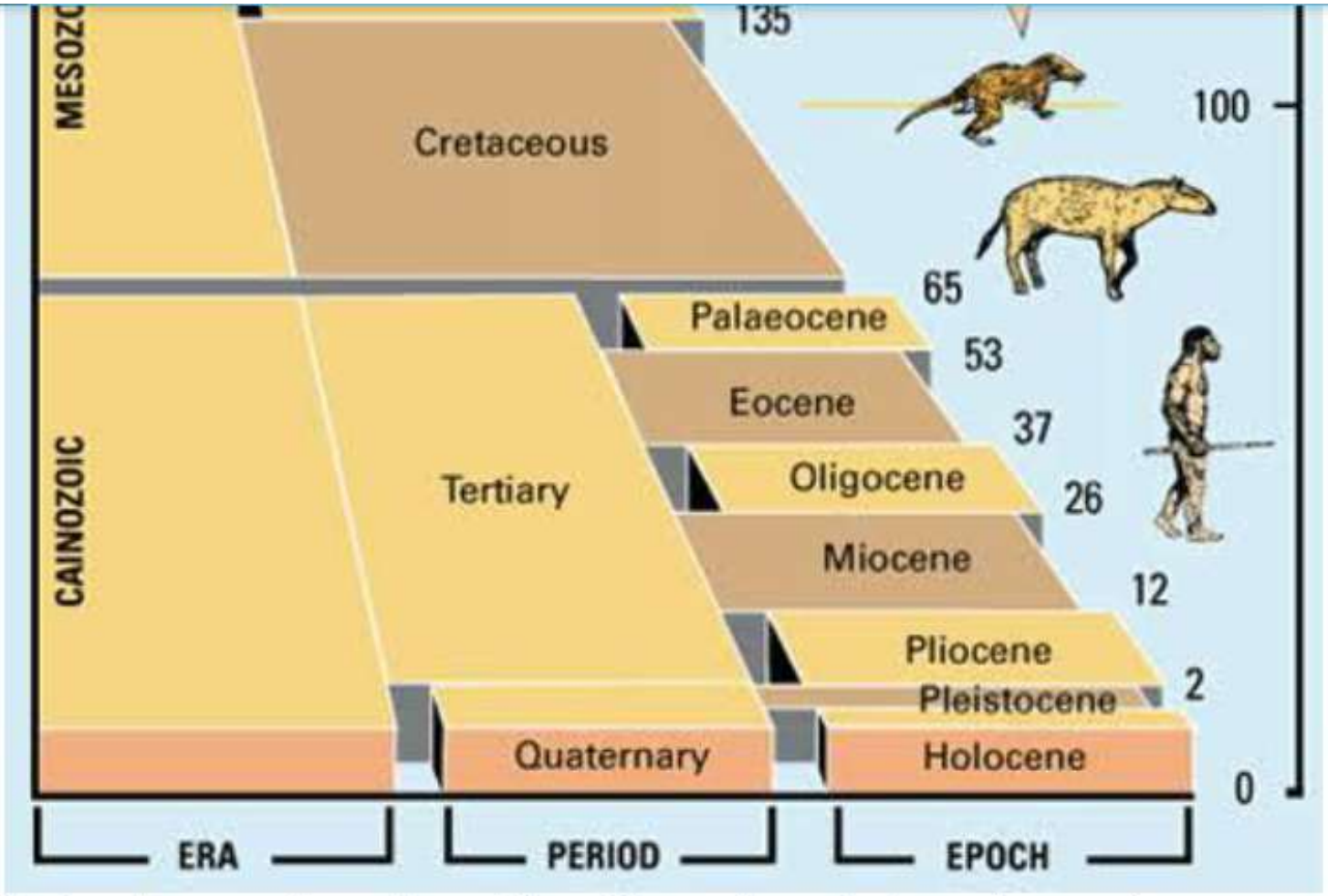

Geological column
Time, in millions of years before the present
4,600
PRECAMBRIAN
570
Cambrian
500
Ordovician
430
Silurian
395
Devonian
345
Carboniferous
280
Permian
PALAEOZOIC
225
Triassic
190
Jurassic
135
Cretaceous
MESOZOIC
65
Palaeocene
53
4,600
2,000
1,000
500
400
350
300
200
100



- **Hadean Eon** saw the early evolution of the earth- early atmosphere, and hydrosphere.
- **Archaean Eon** saw the evolution of life as blue-green algae
- **Proterozoic Eon** saw changes in the earth as per the changes in oxygen levels.
- This eon saw the coming up of soft-bodied marine multicellular organisms.

Paleozoic Era:

- The **Paleozoic Era** is a sub-division of the **Phanerozoic eon**

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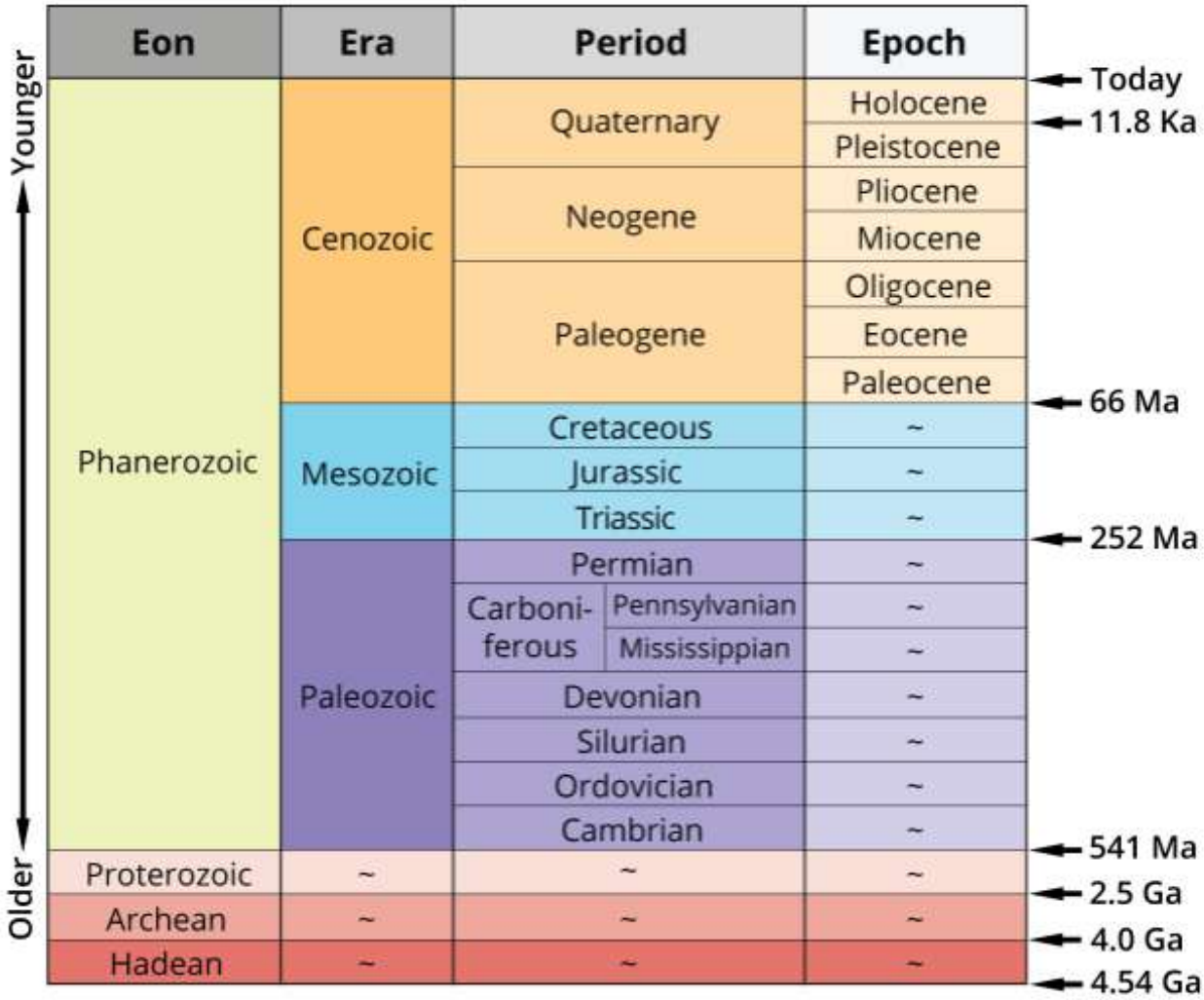


- The **Paleozoic Era** is divided into **six periods:**
- **I.** We see sudden explosion of life during the **Cambrian Period.**
- **II. Ordovician Period** saw the evolution of the first vertebrates which were primitive fish.
- Life was still in water only and the land was still barren.
- This period saw the first mass extinction.

- **III. Silurian Period** saw the evolution of life on the surface of the land.
- Plants were the first life on the land.
- These plants were non-flowering plants.
- **IV. Devonian Period** saw the rise of amphibians.
- The Devonian period ended with another mass extinction which was driven by global climatic changes.
- **V. Carboniferous Period** saw the rise of the first reptiles.
- **VI. Permian Period** saw the reptiles dominate and replace the amphibians.
- The Permian period ended with another mass extinction.
- **Corals** are some remnants of the Paleozoic era.

MESOZOIC ERA (10:15 AM):

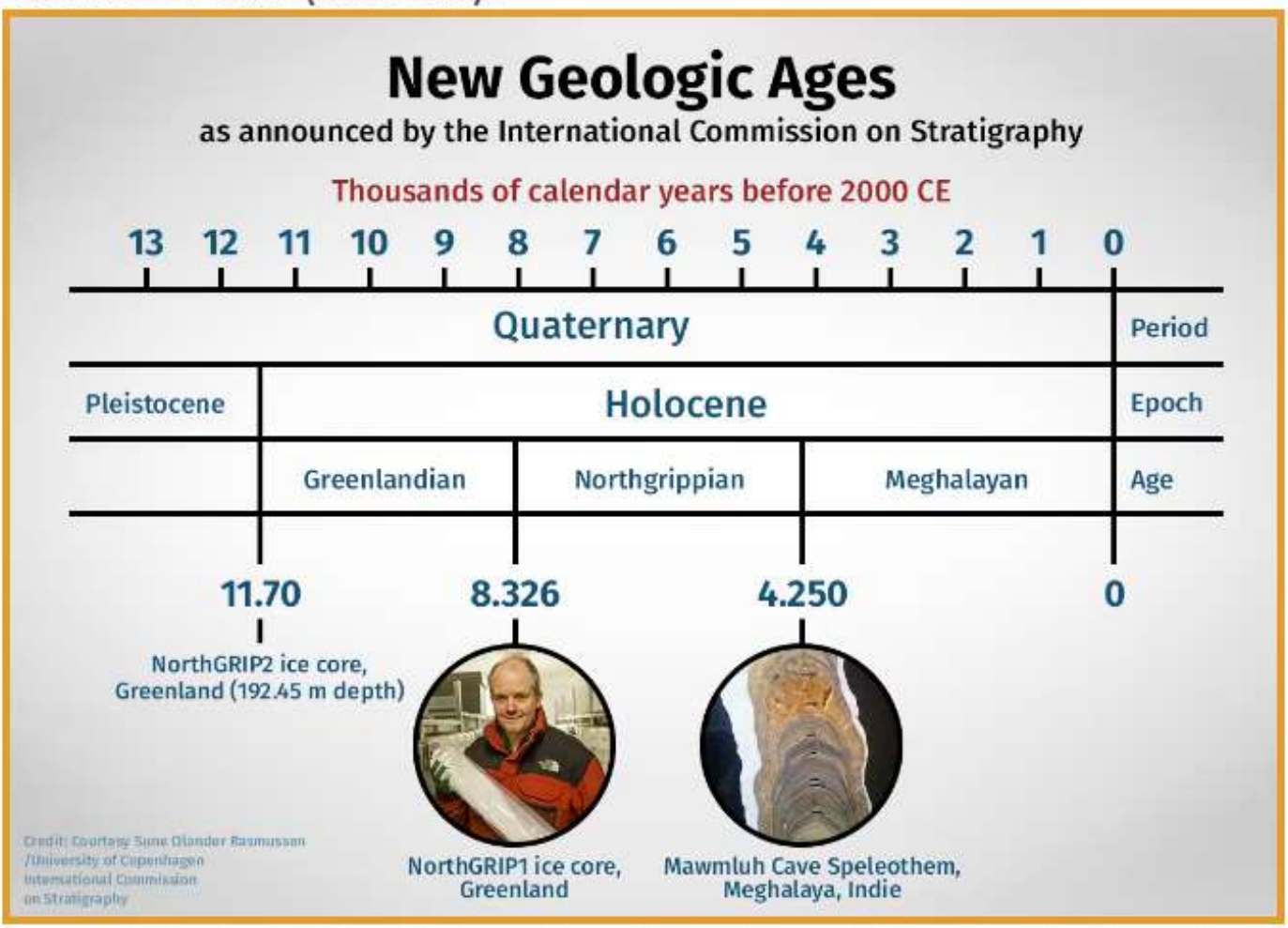
- This era is divided into **three periods:**
- **I. Triassic period** saw the diversification of reptiles.
- This period also ended with a mass extinction.
- **II. Jurassic period(** 200 million years ago) is named after the **Jura** mountains of Europe(Switzerland, France, etc.) where pieces of evidence of the period were found.
- The age saw the evolution of **dinosaurs** which were the most dominant creatures on the earth.
- The age also had some mammals.
- Jabalpur, Jaisalmer, etc are some places in India where dinosaur pieces of evidence have been found.
- **III. Cretaceous period** saw dinosaurs rising to their peak.
- This period also ended with a mass extinction.
- Global warming had also reached its peak.
- As per most of the evidence, this mass extinction was caused due to an impact of a huge meteorite that happened near the **Yucatan Peninsula** near the **Gulf of Mexico.**

- The impact resulted in large tsunamis and volcanic eruptions all over the earth.
- Around 95% of the dinosaurs were wiped out.
- Some dinosaurs that were capable of flying, live in water were able to survive.
- Some mammals also survived this event.

Cenozoic Era:

- The Mesozoic era was followed by the **Cenozoic era.**
- 65-2 million years- T**ertiary Cenozoic era:**
- Major events were an evolution of flowering plants, and alpine mountains(Himalayas, Rockies, etc).
- The most important event was the evolution of apes which eventually saw the rise of Homo Sapiens
- 2 million years to present- **Quaternary Cenozoic era:**
- Humans evolved along with lions and cheetahs from the Savannah grasslands of Africa.
- The **Pleistocene epoch** saw the biological evolution of humans.
- The **Holocene epoch** saw the social evolution of humans.

HOLOCENE EPOCH (10:45 AM):

- 

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- Time analysis of different layers can point to droughts for specific time periods.
- It might also help in discovering if long droughts had wiped out civilizations.
- Stalagmite analysis in 2017 from **Mawmluh caves of Meghalaya** gave us information about what is now known as the **Meghalayan age.**

SOURCES OF INFORMATION ON THE INTERIOR OF THE EARTH (11:15 AM):

Direct Sources:

- Direct sources provide limited observation as we lack the technology to reach the deep interiors of the earth.
- Two sources of direct information are mining and volcanism.

Stalagmite analysis refers to the study of stalagmites (rock formations rising from the floor of caves) to understand past environmental and climatic conditions. Stalagmites form when mineral-rich water drips from a cave ceiling and deposits minerals like calcium carbonate over time. By analyzing the chemical and physical properties of these formations, scientists can extract valuable information about Earth's history.

1 degree rise as we go 32m deeper.

Mining:

- The deep mine and drilling projects have provided a good amount of information such as the increase in pressure, density, and temperature with the depth.
- The maximum depth achieved through mining is about 4 km - **Mponeng gold mine in South Africa**.

Kola Deep Ocean drilling mission:

- The project in 1970 attempted to drill as deeply as possible into the earth's crust.
- It could reach up to 12 km (6300km is the earth's radius).
-

- The **Kolar** Gold Mines was the deepest gold mine in India (3 km deep) and one of the deepest in the world.
- Mining provides us with limited information through the materials extracted.

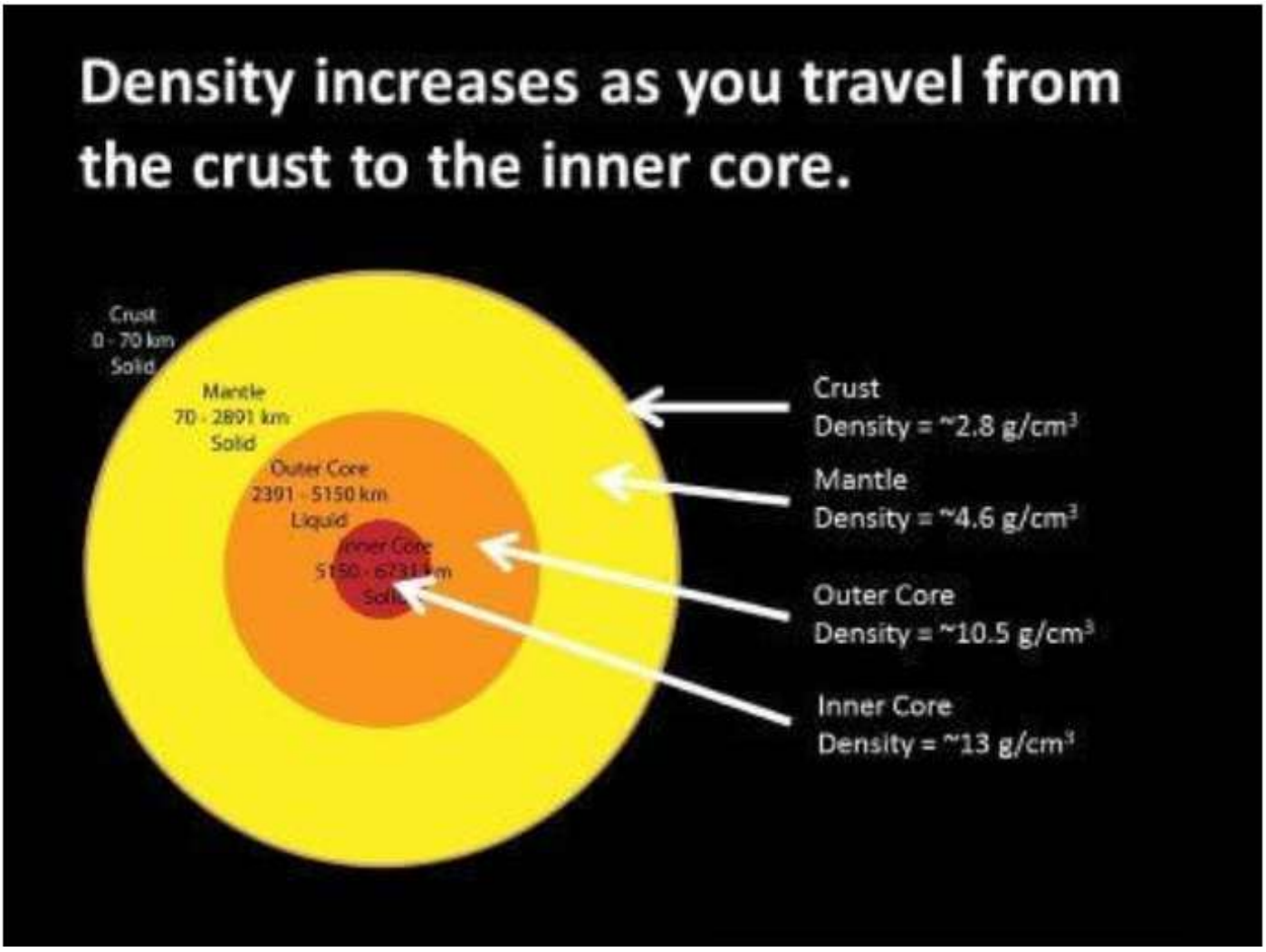
Volcanism:

- The cooling of magma after eruptions and other materials released provide information regarding the earth's interior.
- This is one of the major sources of direct information.
- Eruptions give a clear picture of the constituents, temperature, and density.
- So the need for indirect sources rose.

Indirect sources:

Density study:

- The average density of the earth is 5.5gm/cm^3.
- But the surface continental crust exhibits an average density of 2.7 gm/cm^3 which is almost half of the total average.
- So to attain the average, it is evident that there is an increase in the density with the depth.
- The density is a maximum of 13gm/cm^3 at the center.
- We could also conclude that the crust is lighter and the core is heavier.


Density increases as you travel from the crust to the inner core.
Crust
0 - 70 km
Solid
Mantle
70 - 2891 km
Solid
Outer Core
2891 - 5150 km
Liquid
Crust
Density = ~2.8 g/cm³
Mantle
Density = ~4.6 g/cm³
Outer Core
Density = ~10.5 g/cm³
Inner Core
Density = ~13 g/cm³

As we go deeper into the Earth, the rate of increase in temperature (known as the geothermal gradient) is influenced not only by the flow of heat from the Earth's interior but also by the pressure.
Although pressure increases with depth, which causes some adiabatic heating, it also limits the core's ability to generate excessive temperatures. The compression of materials makes heat transfer more efficient under certain conditions.

Seismic Studies

- Through the analysis of different types of earthquake waves, their speed and direction while passing through the earth's interior.
- These are the waves generated during the earthquake that results in the shaking of the lithosphere which is primarily due to the energy released in the form of waves.
- This energy gets transformed into the following types of waves:
- **Body waves:**
- A body wave is a seismic wave that moves through the interior of the earth, as opposed to surface waves that travel near the earth's surface.
- **Surface waves:**
- They move across the surface of the earth.

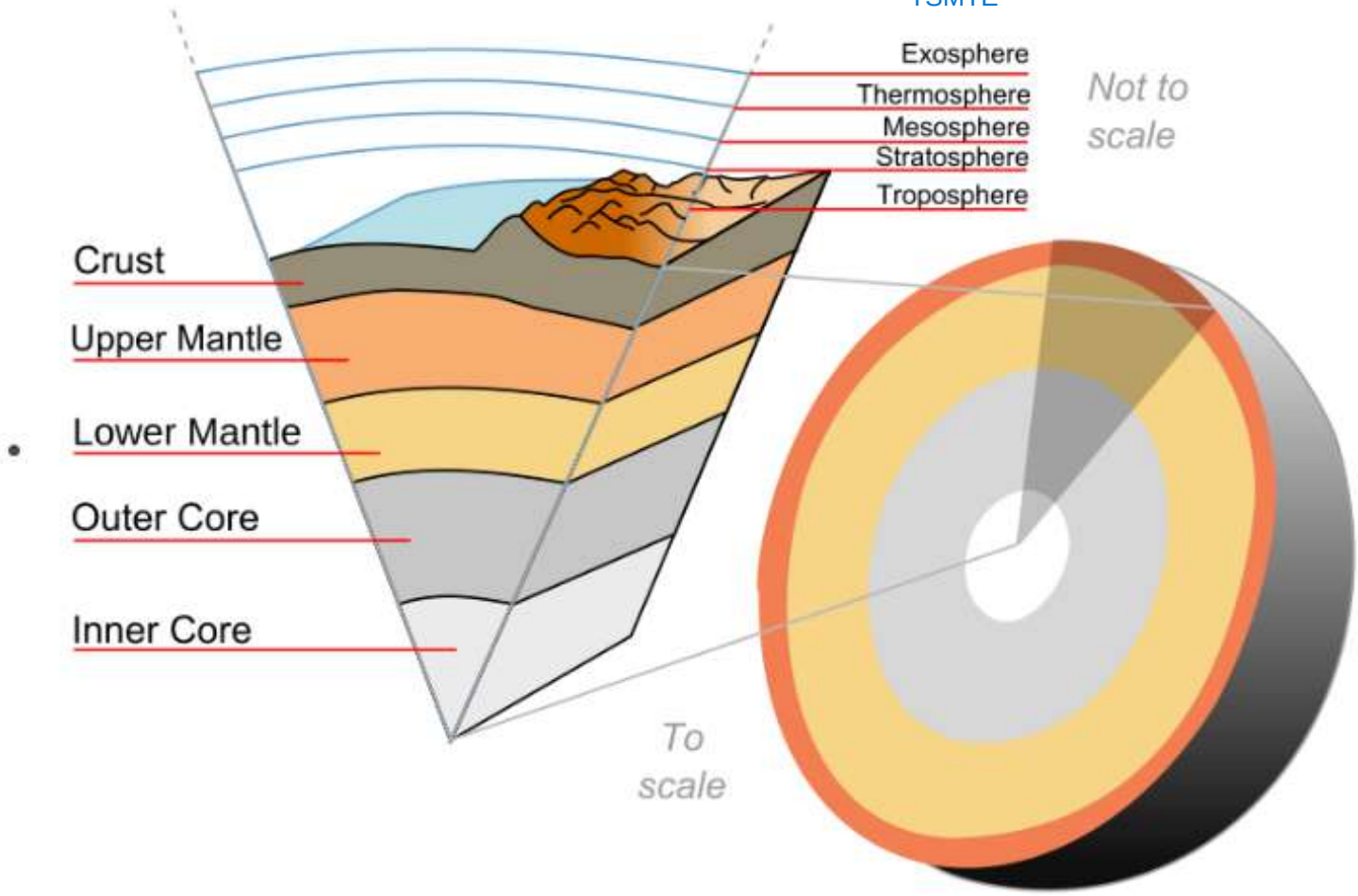
TEMPERATURE & PRESSURE STUDIES (11:45 AM):

- The temperature increases by 1 degree Celsius for every 32 meters as we go deep into the earth.
- However, with the increase in depth, higher pressure increases the melting point of tricks causing variations in the rate of change of temperature.
- Also if we go by the same rate(1 degree/32 meters), the temperature of Earth's center must have been more than Sun's temperature, which is not the case

Meteorites:

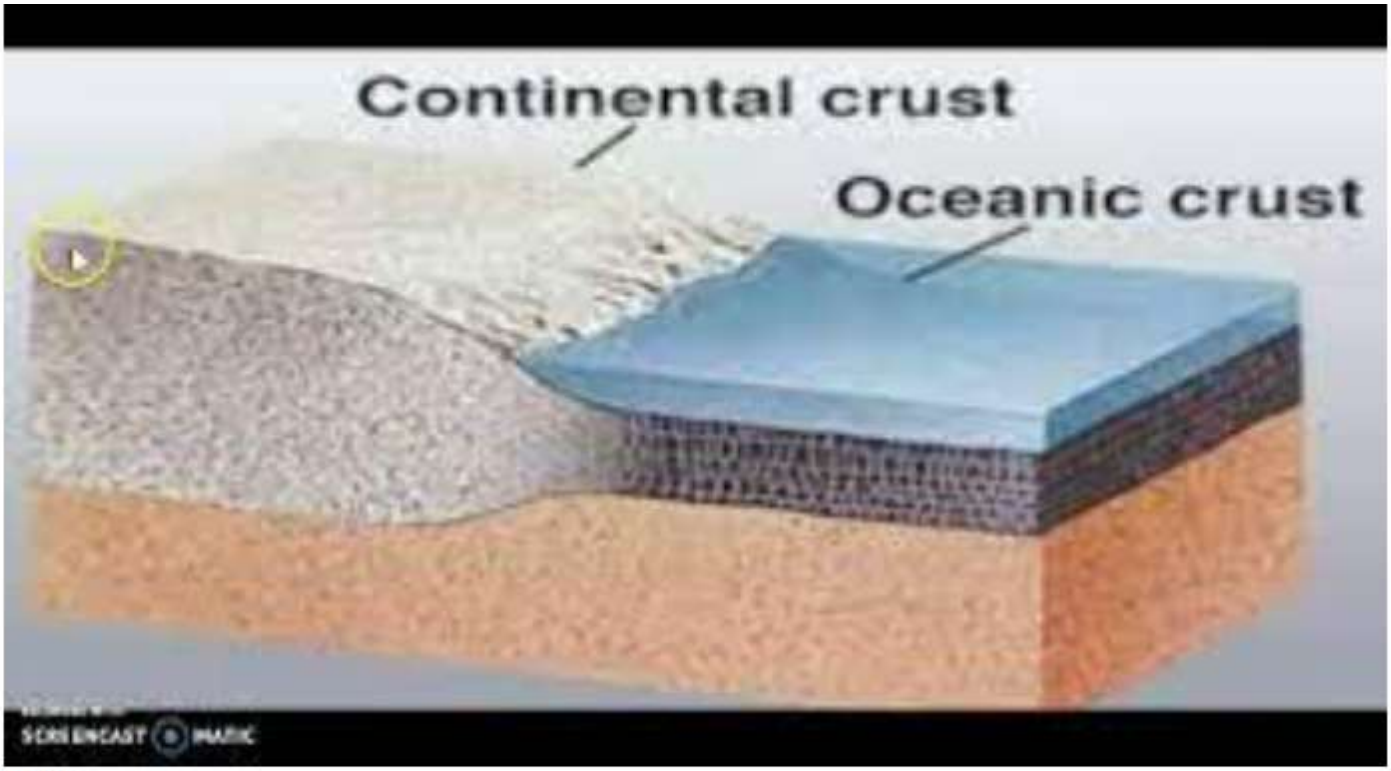
- By analyzing the structure, mineralogy, etc. we can conclude about the earth's interior as meteorites are the remnants of the planets.

Layers of the Earth:



Crust:

- It is the uppermost layer of the earth.
- It is divided into **continental and oceanic crusts.**
- The crust is the lightest and thinnest layer.
- The crust is majorly made up of Silica, Aluminium, Sodium, Magnesium, etc.
- The continental crust has continents over it & the Oceanic crust has oceans above it.
- Continental Crust and Oceanic crust are next to each other, and no one floats above the other.

- 

Mantle:

- This is the thickest layer of the earth.
- It covers 83% of the Earth's volume and 63 % of the Earth's mass.
- It is denser than the crust and lighter than the core.
- it is divided into upper & lower mantle.
- As we go from crust to mantle, the amount of silica & aluminum decreases, and iron & magnesium increase.

Core:

- This is the innermost and densest layer.
- It is almost twice as dense as the mantle.
- It is mainly composed of nickel and iron.
- So it is also called the **Nife** layer.
- it is divided into outer cores & inner core.
- The outer core is liquid (molten rocks)and the inner core is solid.
- As the pressure increases, even the melting point increases.
- The pressure at the inner core is very high and hence, the melting point of the rocks there gets too high.

The topics for the next class are a continuation of the earth's interior, types of discontinuities, types of rocks, etc.