

Precambrian Eon

Geologic Time Scale

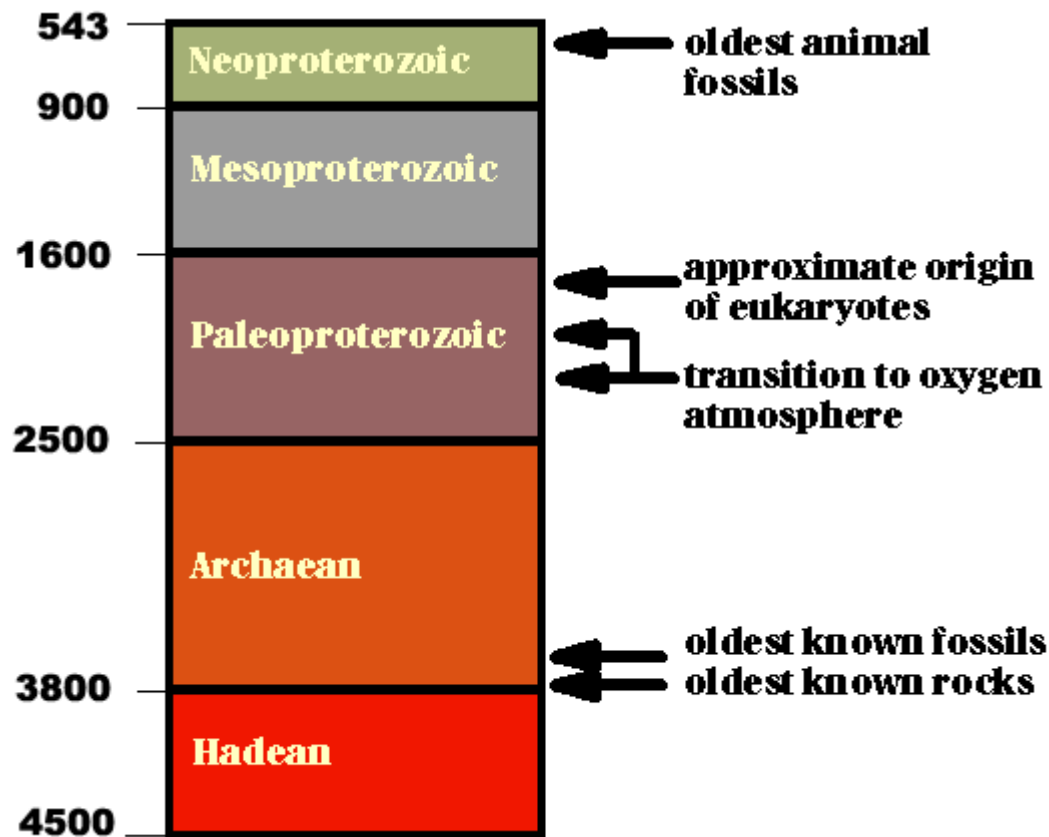
- ❑ The earliest time of the Earth is called the Hadean and refers to a period of time for which we have no rock record.
- ❑ The Archean followed, which corresponds to the ages of the oldest known rocks on earth. These, with the Proterozoic Eon are called the Precambrian Eon. The remainder of geologic time, including present day, belongs to the Phanerozoic Eon.
- ❑ While the units making up the time scale are called geochronologic units.
- ❑ The actual rocks formed during those specific time intervals are called Chrono stratigraphic units.

Precambrian Eon

- The term Precambrian is informal
 - but widely used, referring to both time and rocks
- The Precambrian includes
 - time from Earth's origin 4.6 billion years ago
 - to the beginning of the Phanerozoic Eon
 - 545 million years ago
- It encompasses
 - all rocks older than Cambrian-age rocks
- No rocks are known for the first
 - 640 million years of geologic time
 - The oldest known rocks on Earth
 - are 3.96 billion years old

EON	ERA	PERIOD	MILLIONS OF YEARS AGO	
Phanerozoic	Cenozoic	Quaternary	--- 1.6 ---	
		Tertiary	--- 66 ---	
	Mesozoic	Cretaceous	--- 138 ---	
		Jurassic	--- 205 ---	
		Triassic	--- 240 ---	
		Permian	--- 290 ---	
	Paleozoic	Pennsylvanian	--- 330 ---	
		Mississippian	--- 360 ---	
		Devonian	--- 410 ---	
		Silurian	--- 435 ---	
		Ordovician	--- 500 ---	
		Cambrian	--- 540 ---	
	Proterozoic	Late Proterozoic Middle Proterozoic Early Proterozoic	Ediacaran 635-543 MYA	--- 2500 ---
	Archean	Late Archean Middle Archean Early Archean		--- 3800? ---
Pre-Archean				

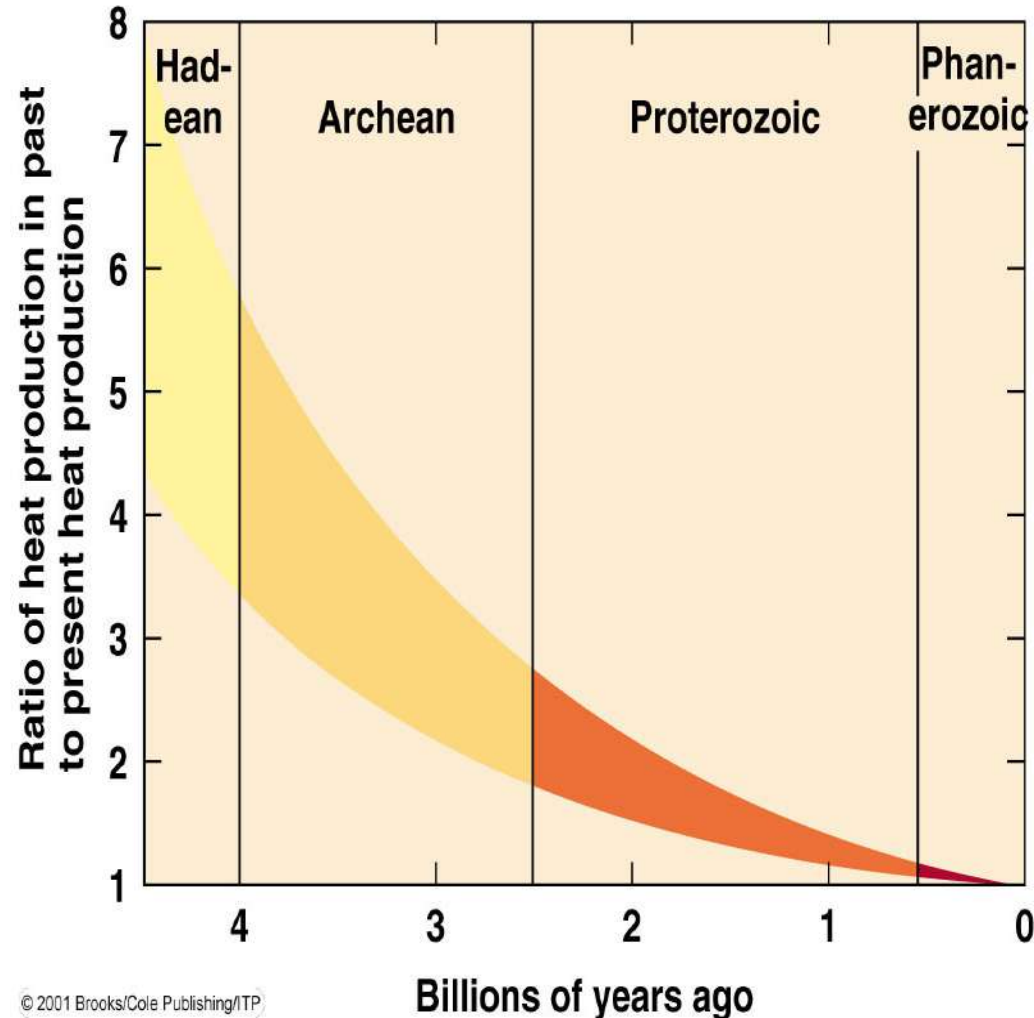
The Precambrian Era actually spans several eras



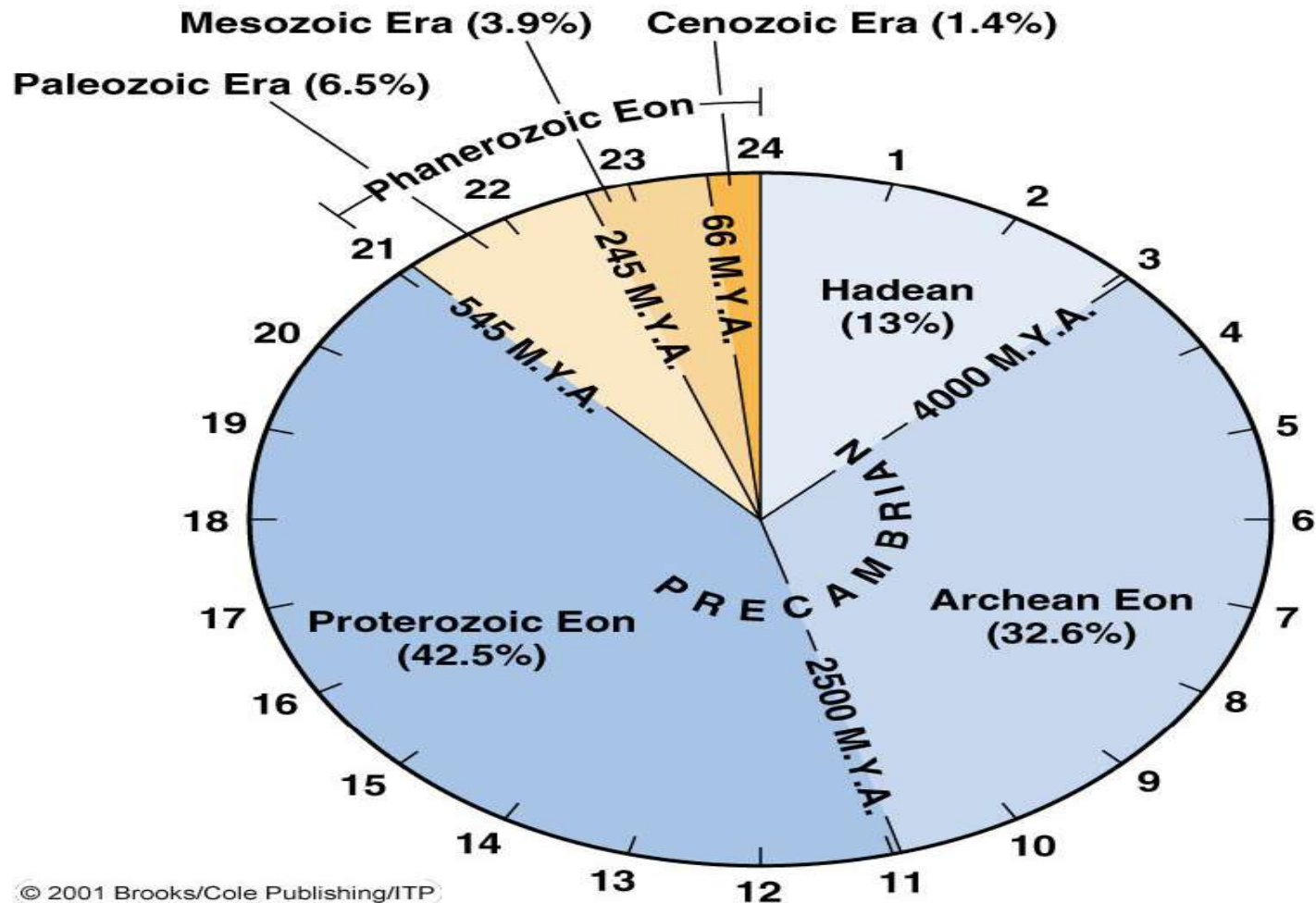
<http://www.palaeos.com/Timescale/Precambrian.htm>

What Happened During the Precambrian Era?

- Earth formed
- Life arose
- First tectonic plates arose and began to move
- Eukaryotic cells evolved (choano-flagellates)
- Atmosphere became enriched in oxygen
- And, just before the end of the Precambrian, complex multicellular organisms, including the first animals, evolved.
- 4-6 times greater heat production



If we represent Earth's history on a 24 hour clock...



Division of Precambrian Eon

- **Hadean:** 4.6 billion years ago to roughly 3.8 billion years ago

- **Archaean:**

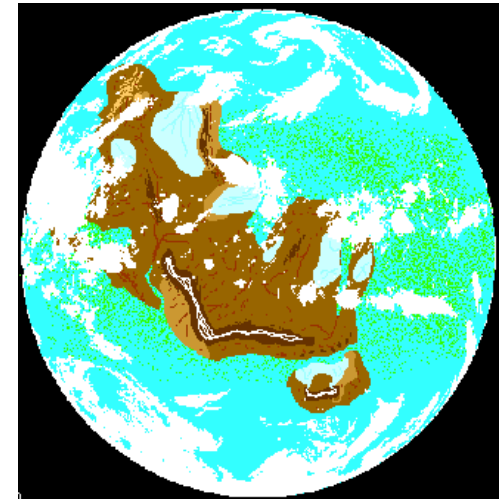
 - 3.8 - 2.5 billion years ago

- **Proterozoic:**

 - 2.5 billion - 542 million years ago



Archaean era



Proterozoic era

Hadean Era



Hadean Era

- This is the period during which the Earth's crust was formed.
- This crust melted and reformed numerous times
- continuously broken up by gigantic magma currents that erupted from the depths of the planet
- tore the thin crust, and then cooled off on the surface before sinking again into the heart of the Earth.

Archean

- Started off very hot
- Lots of volcanic activity—so much geologic activity that there were only *protocontinents* (not large continents that we have today)
- The Archean atmosphere is thought to have lacked free oxygen.
- Temperatures estimated to be near modern levels
- liquid water present
- Life: Stromatalites and bacterial fossils have been found from this era



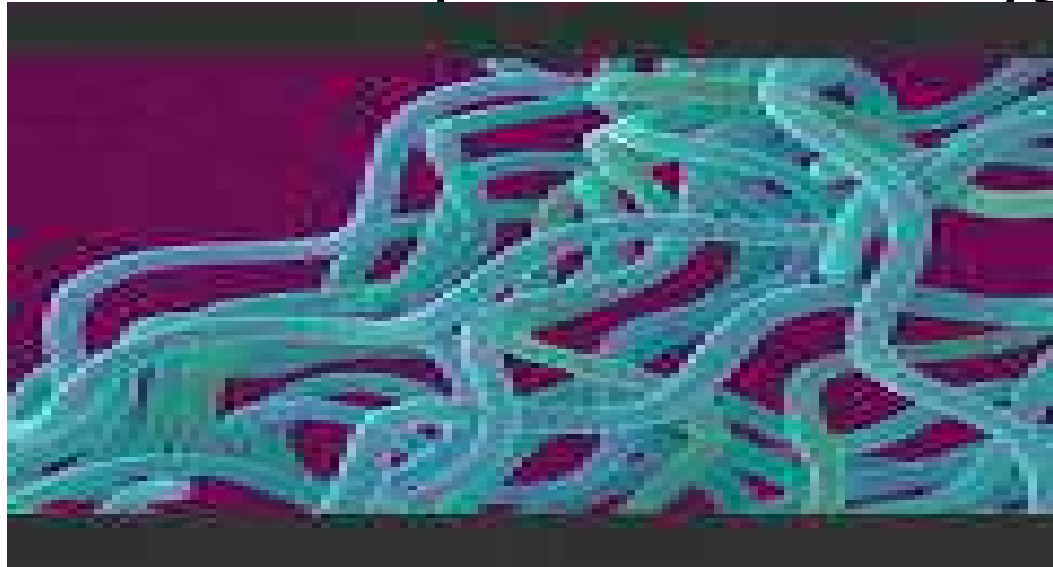
Archean Era



- Archean Earth differed greatly from our modern Earth not only in tectonic activity but also with respect to the atmosphere.
- “Age of Prokaryotes”
- Simple, single-celled organisms
- Reproduce asexually

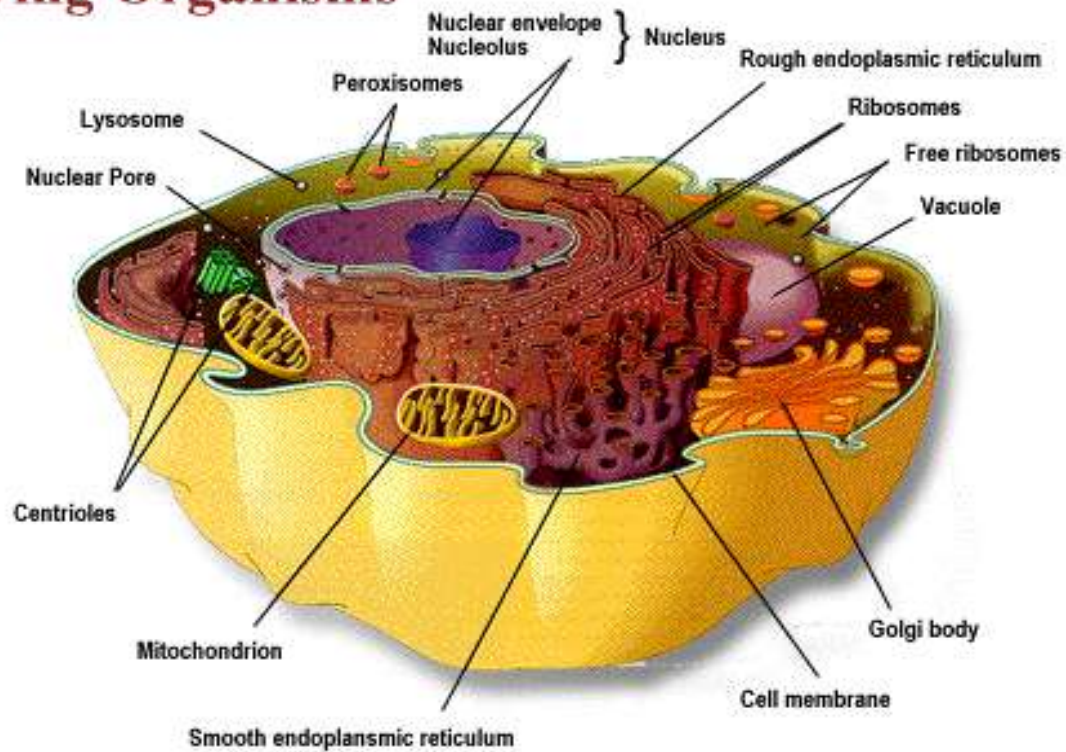
Cyanobacteria

- Through photosynthetic activity, cyanobacteria fundamentally altered the Archean atmosphere through the production of a valuable waste product--free oxygen.



Proterozoic Era

Living Organisms



Animal Cell (eukaryote)

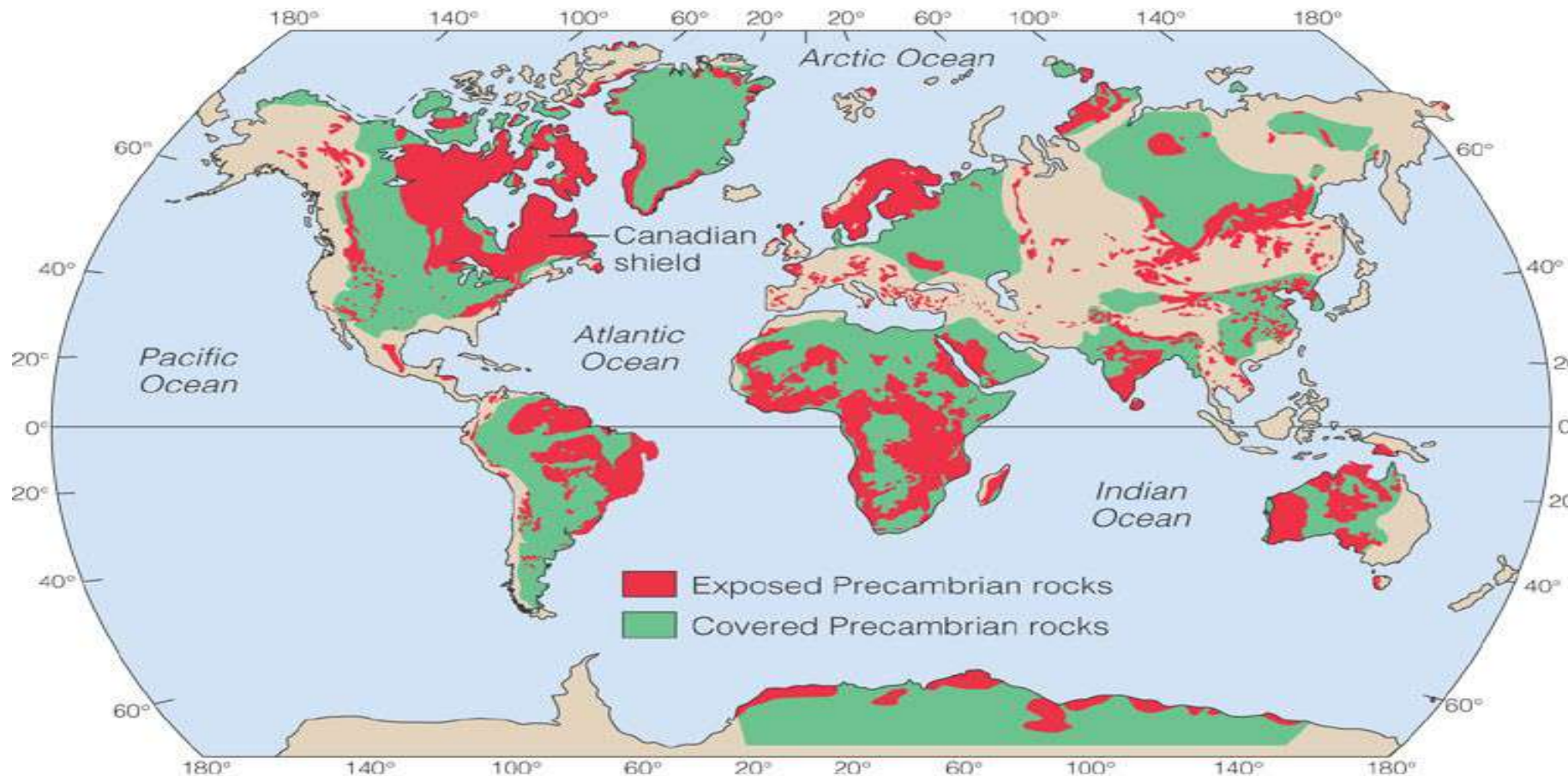
Proterozoic Era

- **Period before the first abundant complex life on Earth**
- **Fossil record**
- **Featured massive, rapid continental accretion**
- **Large increase in atmospheric oxygen**
- **Life: herbivorous eukaryotes (algae)**
- **First glaciation**



Dickinsonia

Distribution of Pre-cambrian rocks



<http://www.ucmp.berkeley.edu/precambrian/precambrian.html>

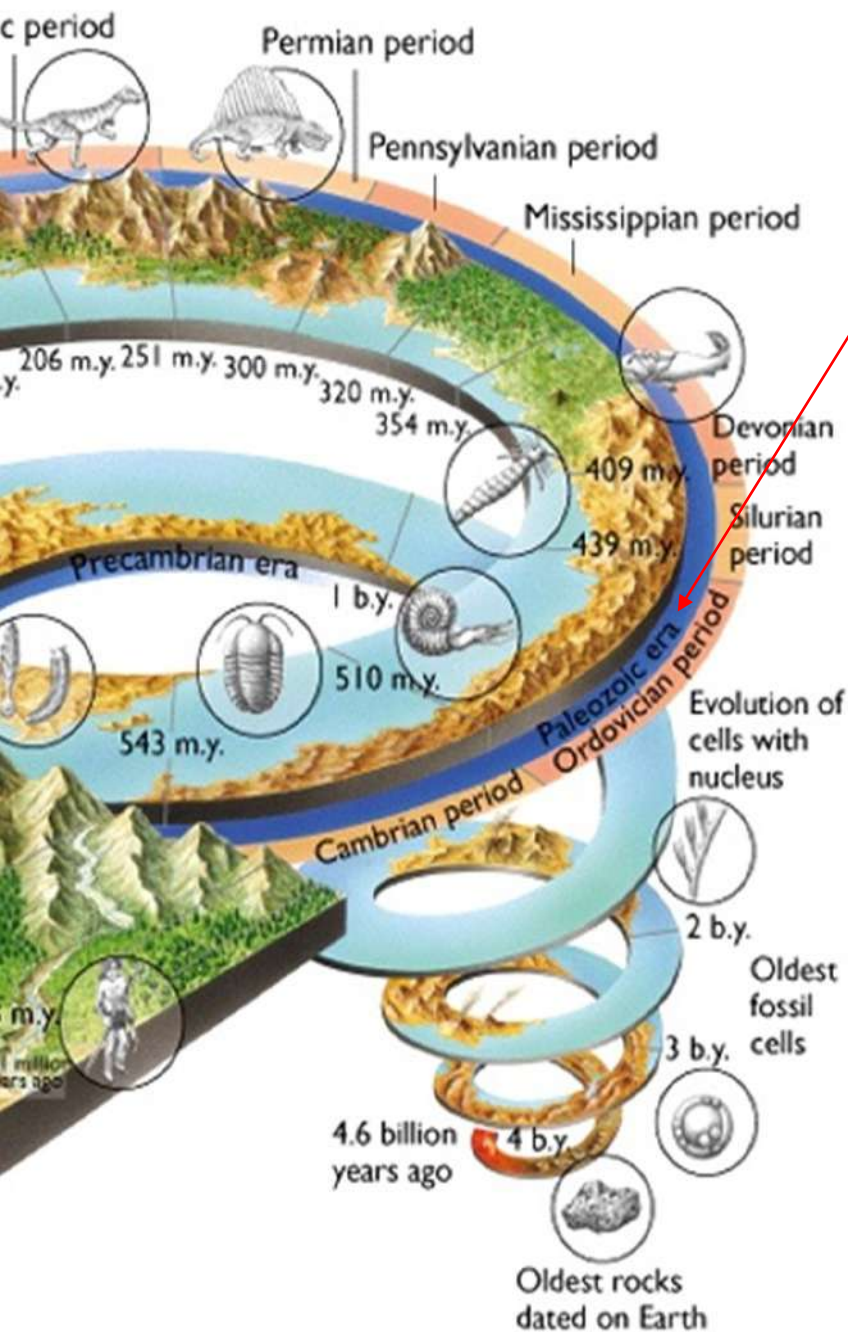
Events

- The Hadean was a time when the Earth was just starting to form.
- Archean was the time when the first life forms that could trap energy from the sun and they could also reproduce themselves.
- The Proterozoic produced the first multicellular organism that could be easily fossilized.

Post-cambrian Eon

MYA	ERA	PERIOD	EPOCH	PLATE TECTONICS	LIFE
0.01	Cenozoic "Age of Mammals"	Quaternary	Holocene	Beaches and barrier islands form	-Mastadons become extinct -Human culture flourishes -Accelerating extinction of many species
1.8			Pleistocene	Ice sheets form	-Modern humans develop -Asians arrive and settle the Americas
5.3		Tertiary	Pliocene	-Volcanic activity in North America and Africa -Grand Canyon forms	Hominids develop
23.8			Miocene	Sand hills form in S.C.	Horses, mastodons, tigers, and camels live in South Carolina
33.7			Oligocene	Appalachians uplift; erosion increases	Cats, dogs, and apes appear
54.8			Eocene	Sea levels rise; deposits of marine sediments – limestone in S.C.; land bridges form	-Grass spreads widely -Diverse array of animals develop, including whales, rhinos, and elephants
65.0			Paleocene	Earthquakes common; Georgia Embayment, Cape Fear Arch forms in Southeast	-First horses appear (size of a cat) -Tropical plants dominate
144	Mesozoic "Age of Reptiles"	Cretaceous		Mass extinction occurs at the end of the period caused by a meteorite impact (Dinosaurs, ammonites and 25% of marine life become extinct)	-T-Rex develops but number of dinosaur species decline -Snakes appear and first primates appear -Angiosperms appear
206		Jurassic		Western US: orogeny of Rockies; North America continues to rotate away from Africa	-First birds appear -Golden age of dinosaurs
248		Triassic		-Pangea begins to break apart -Rocky Mountains and Sierra	First dinosaurs, mammals, crinoids, and modern echinoids

320	Carboniferous	Pennsylvanian	Great swamps develop (future coal deposits)	-Reptiles develop from amphibians -Flying insects appear
354		Mississippian	Much of North America is under water	-First seed plants appear -Sea life flourishes including coral, brachiopods, blastoids, and bryozoa
417		Devonian	Acadian Orogeny – SC metamorphism	-Dominant animals: fish -Amphibians, evergreens and ferns appear
443		Silurian	Extensive erosion	First land plants appear and land animals follow
490		Ordovician	-Beginning of the construction of South Carolina -Great extinction due to growth of ice caps including in what is now northern Africa	-First animals with bones appear -Dominant animals: marine invertebrates including corals and trilobites
540		Cambrian	S.C. near the equator; island arc continues to move toward North America	-Explosion of life -All existing phyla came into being here -Life forms in warm seas as oxygen levels rose enough to support life -Dominant animals: trilobites and brachiopods
4600		Precambrian (Hadean, Archean, and Proterozoic Ages) http://www.enchantedlearning.com/subjects/Geologictime.html		Earth takes 10 million years to cool: initial atmosphere escapes into space (H&He) and the core forms (Fe&Ni) Volcanic outgassing of water and carbon dioxide occurred for millions of years, helping to build atmosphere and then oceans At 3 billion years ago, handed



Paleozoic Era

Divided into 6 periods:

Cambrian period -

Sponges, snails, clams and worms evolve

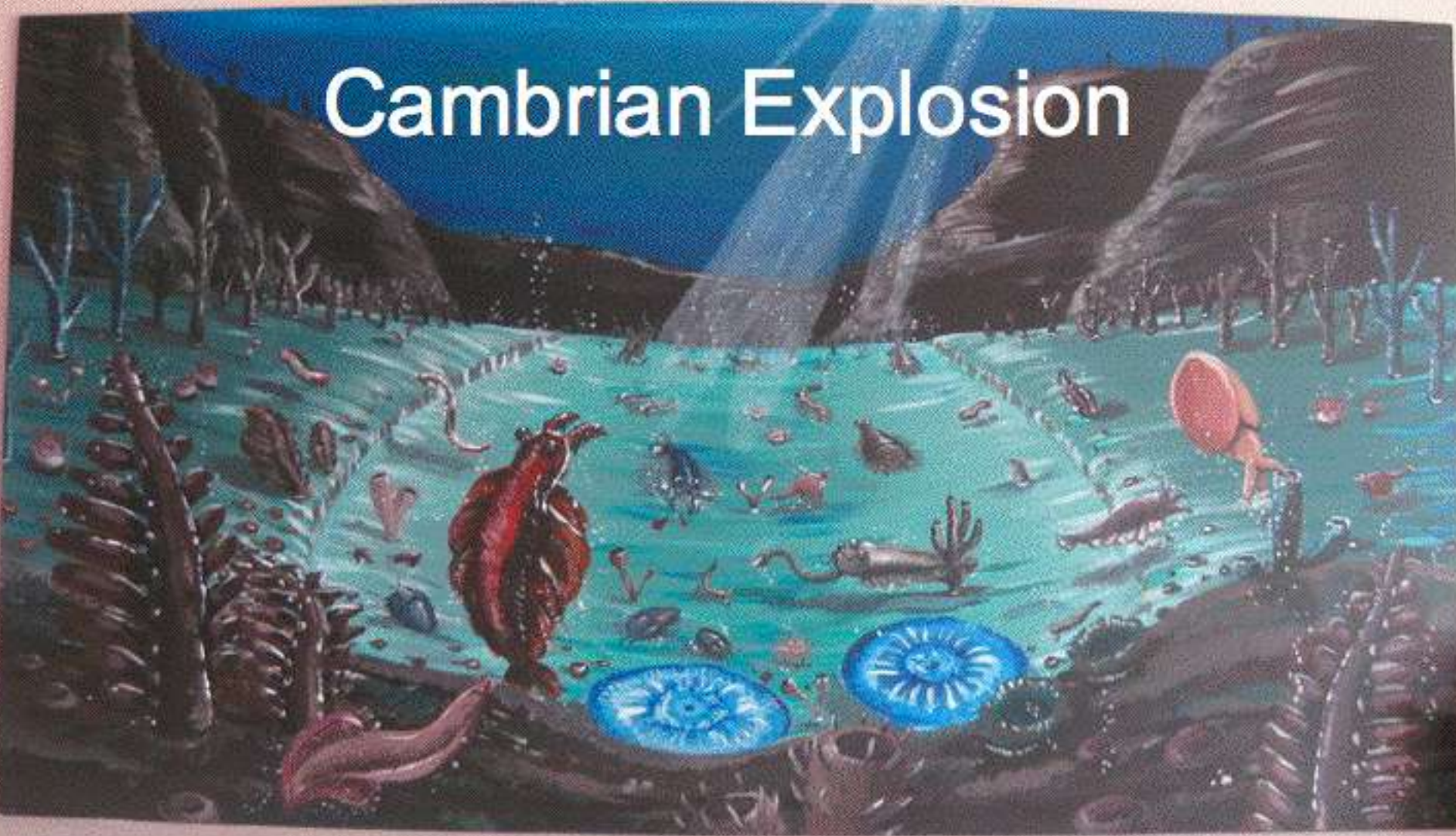
Ordovician period -

First fishes evolved and other species become extinct

Silurian period -

Land plants, insects and spiders appear

Cambrian Explosion



- Many different invertebrate critters evolve

The First Vertebrates

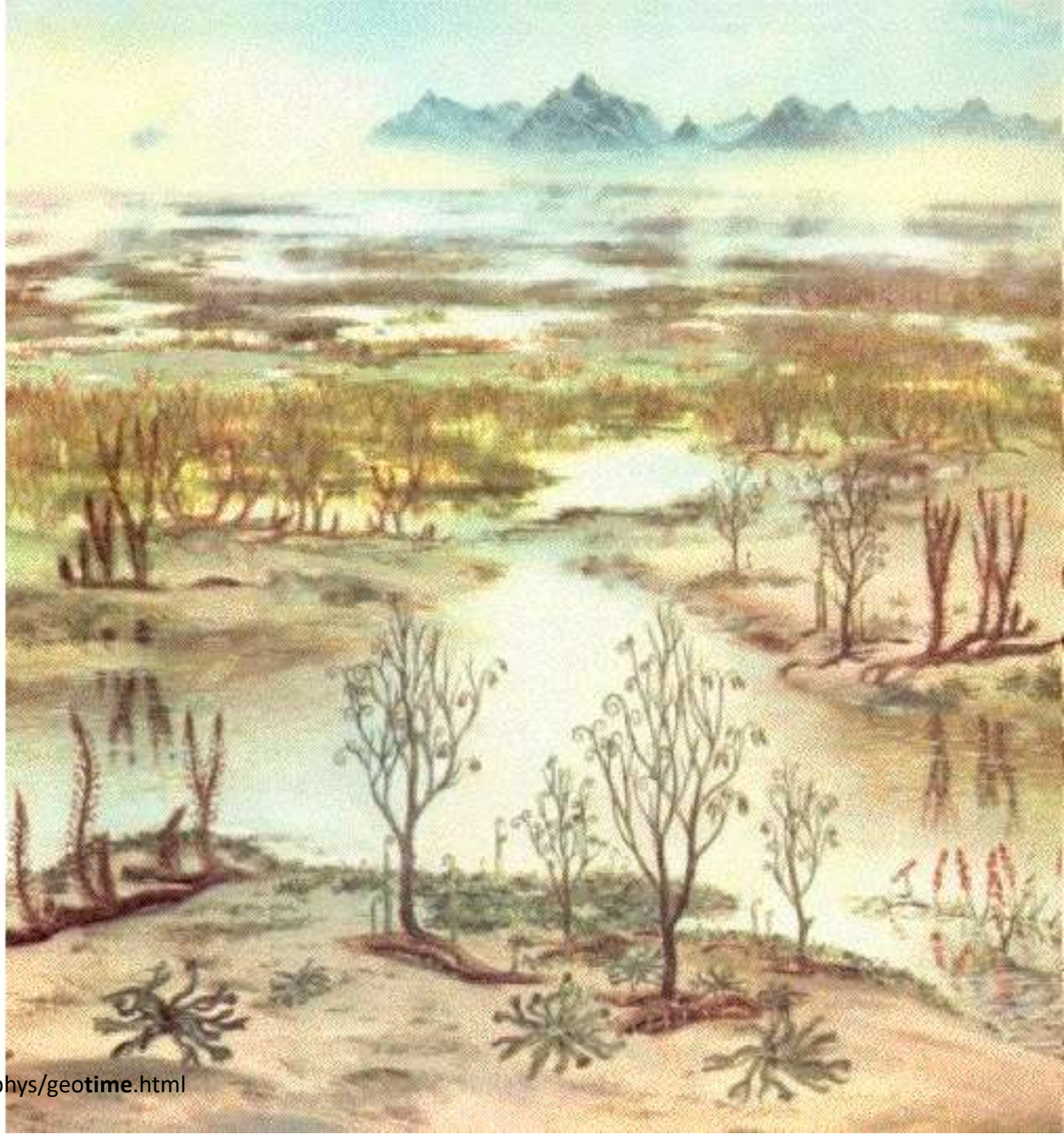


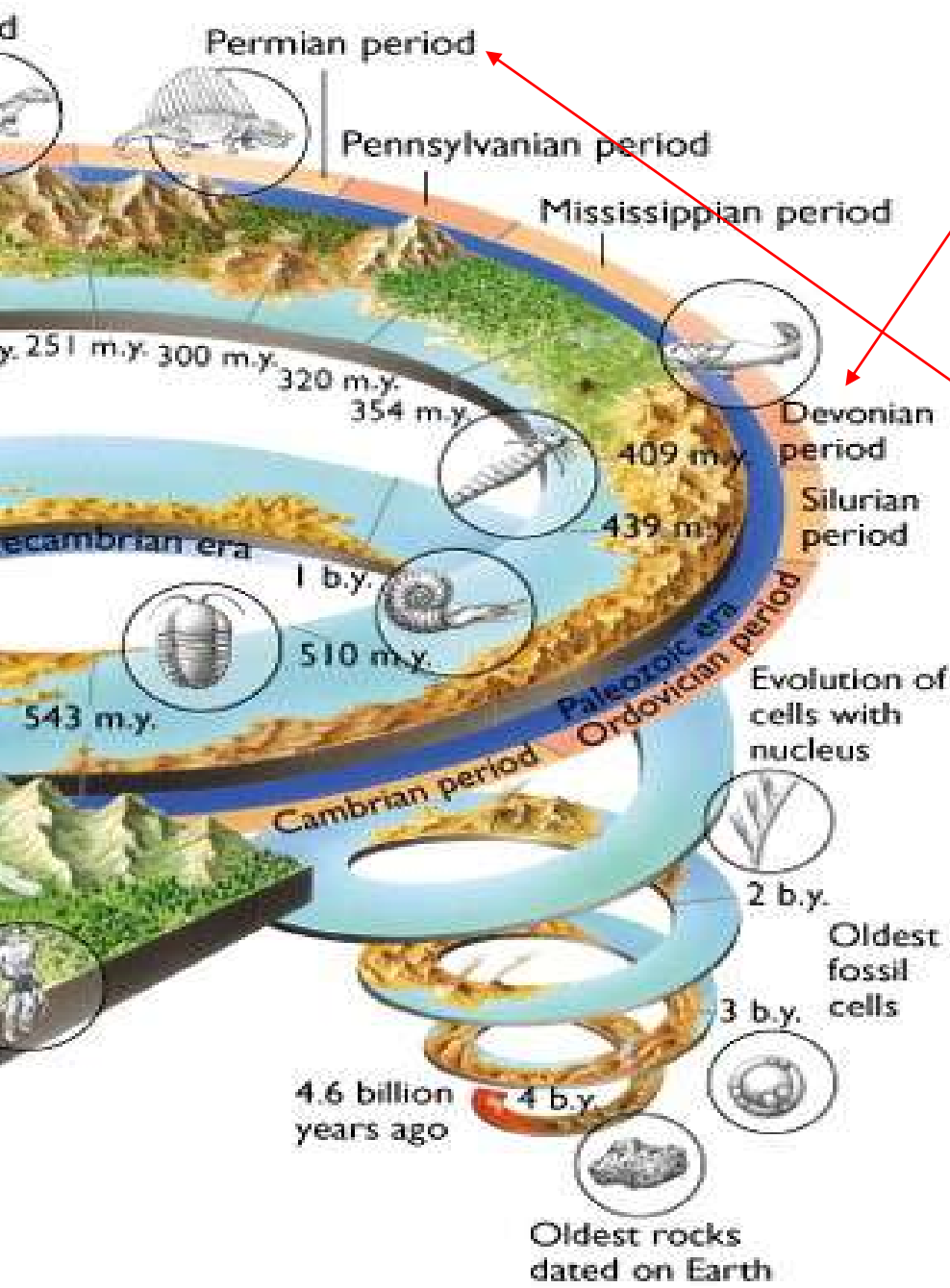
Jawless fish appear
Ordovician period



Silurian Period

- Life reaches land during the Silurian period. Plants become abundant





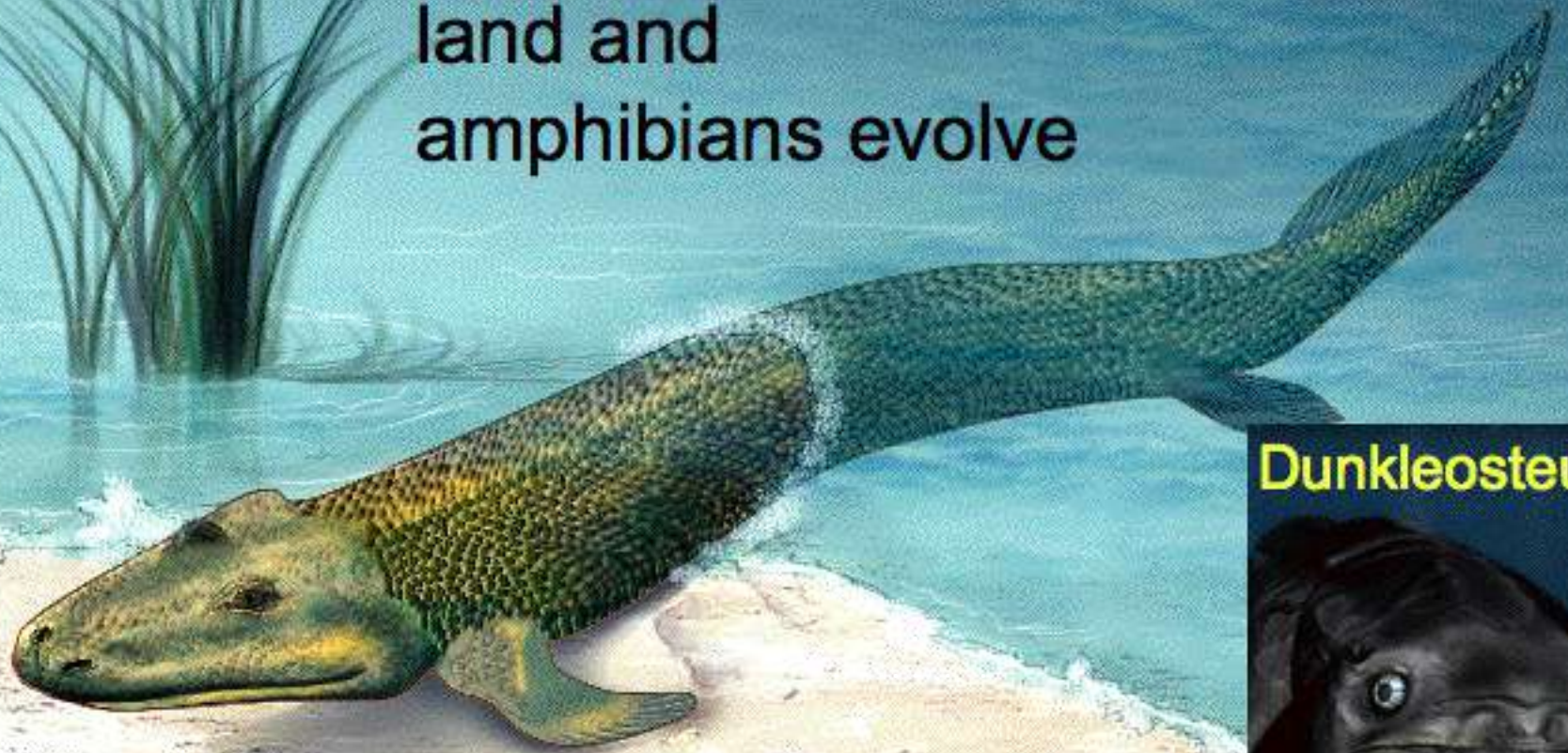
Devonian period - Amphibians evolve and cone-bearing plants start to appear.

Permian period - Seed plants become common and insects and reptiles become widespread. Sea animals and some amphibians begin to disappear.

Carboniferous period - Tropical forests appear and

Devonian Period

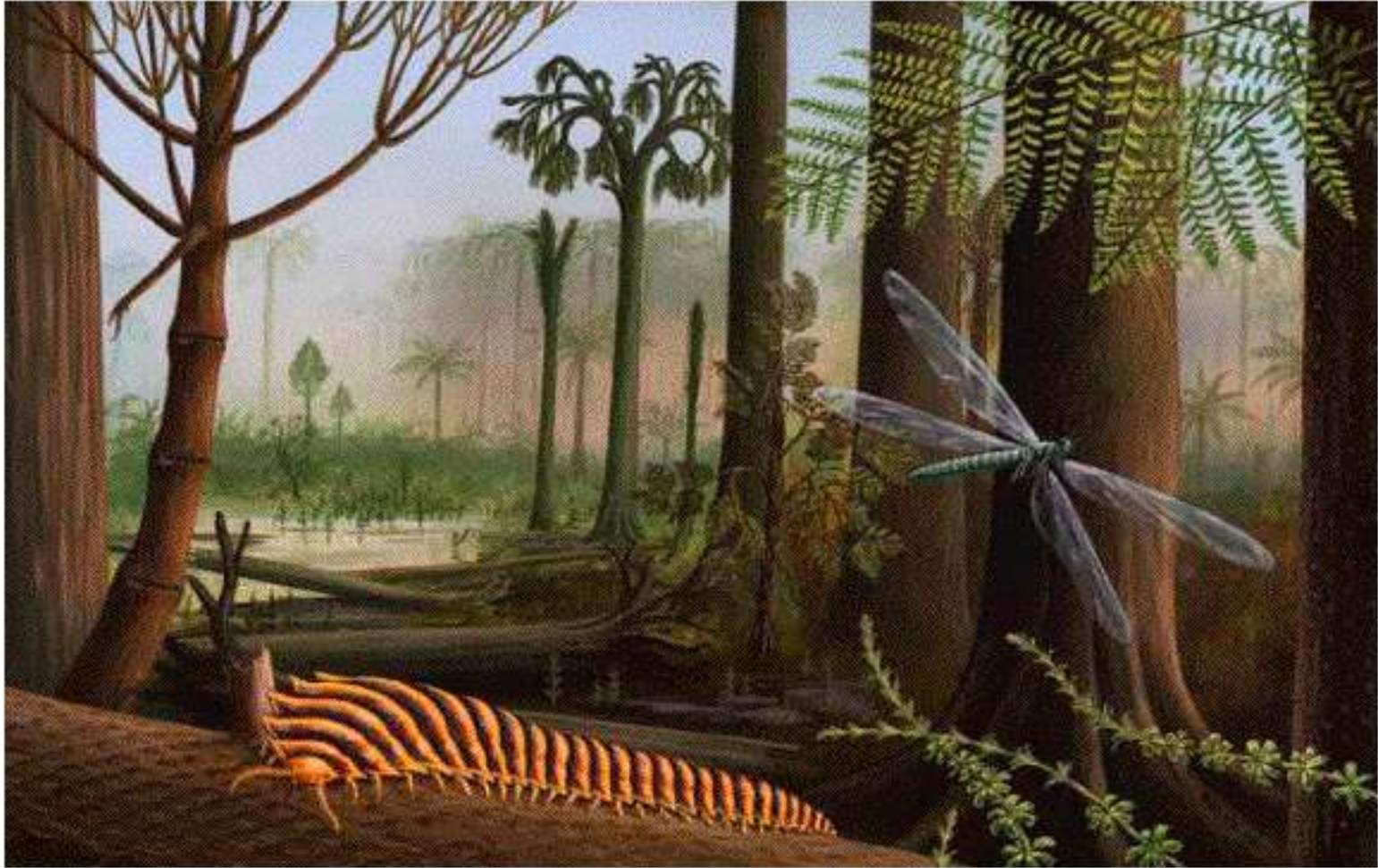
Animals invade the
land and
amphibians evolve



Dunkleosteus



Carboniferous



Carboniferous forests expand over the Earth. Reptiles evolve. Later these forest form coal deposits.

Mass Extinction



- The Permian Extinction marks the end of the Paleozoic

THE MESOZOIC ERA

245 - 66 mya



Age of the dinosaurs

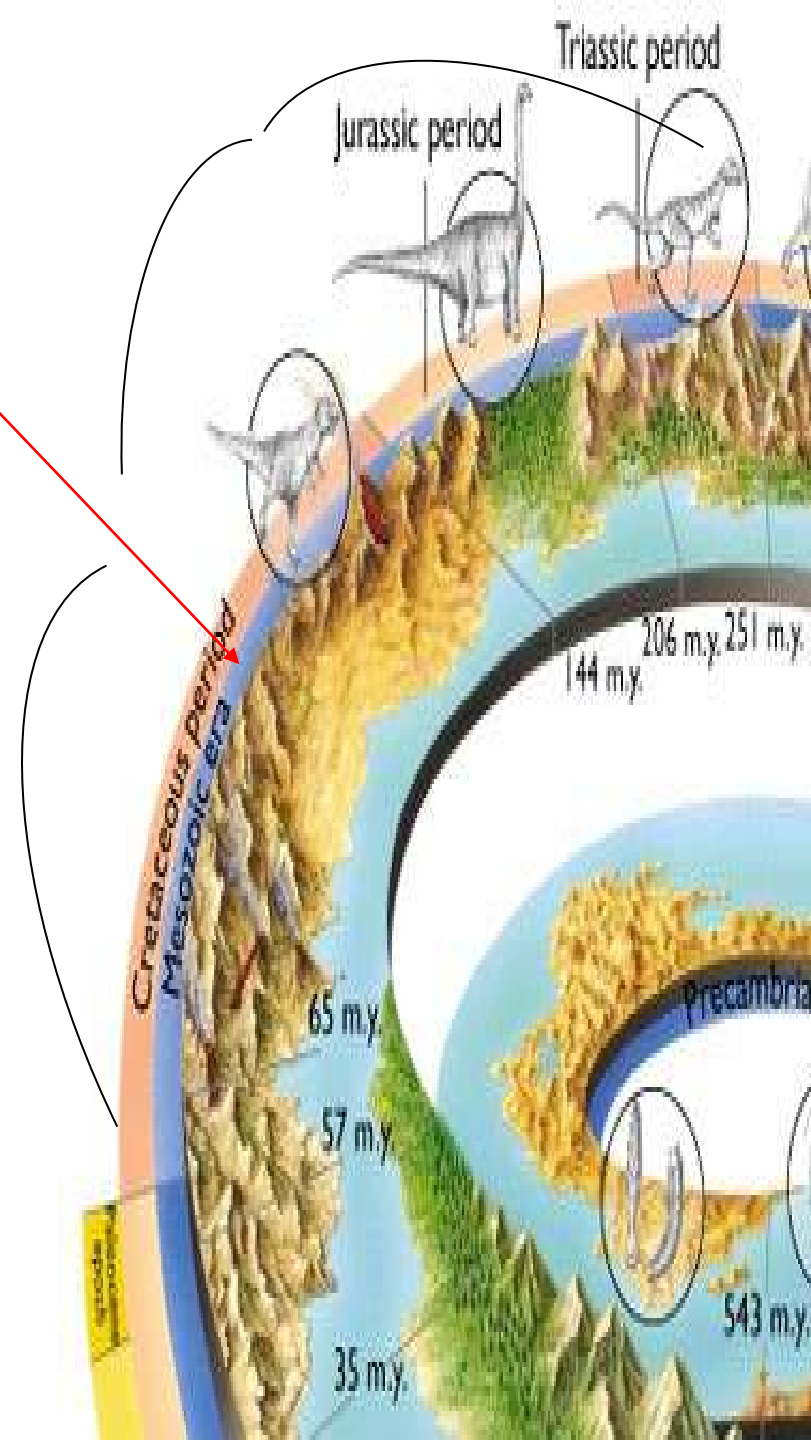
Mesozoic Era

Divided into 3 periods:

Triassic period - Turtles and crocodiles evolve and dinosaurs appear.

Jurassic period - Large dinosaurs roam the world. First mammals and birds appear.

Cretaceous period - Flowering plants appear,



- Plants and animals that survive the 1st mass extinction include insects, fish, reptiles, mammals, cone bearing trees



Jurassic



- **Dinosaurs become the dominant animals.**

Cretaceous



Flying reptiles and birds compete for places in the sky.

Mass Extinction #2



End of the 65 million year
dinosaur age

THE CENOZOIC ERA

66mya -present



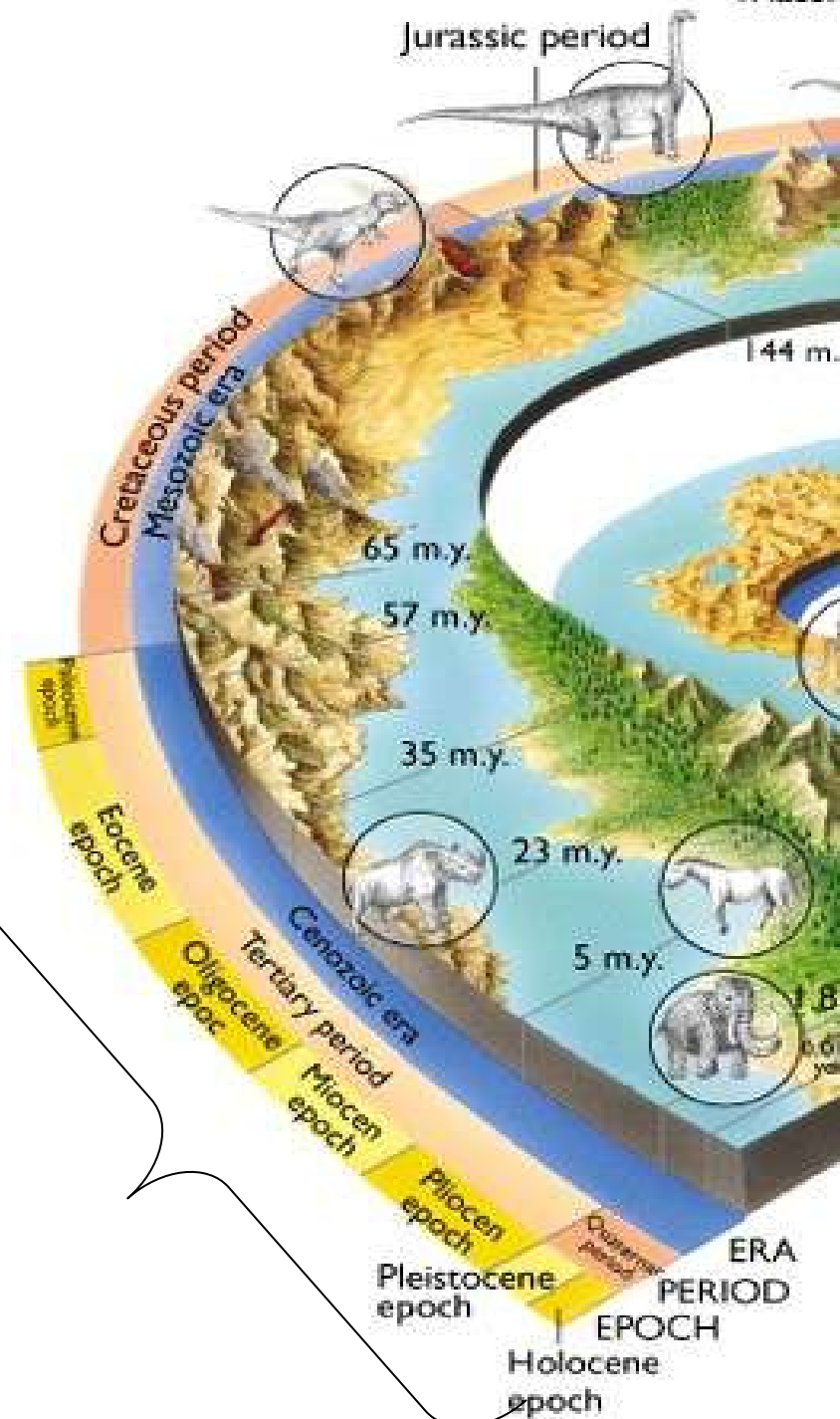
Age of the mammals

Cenozoic Era

Divided into 2 periods:

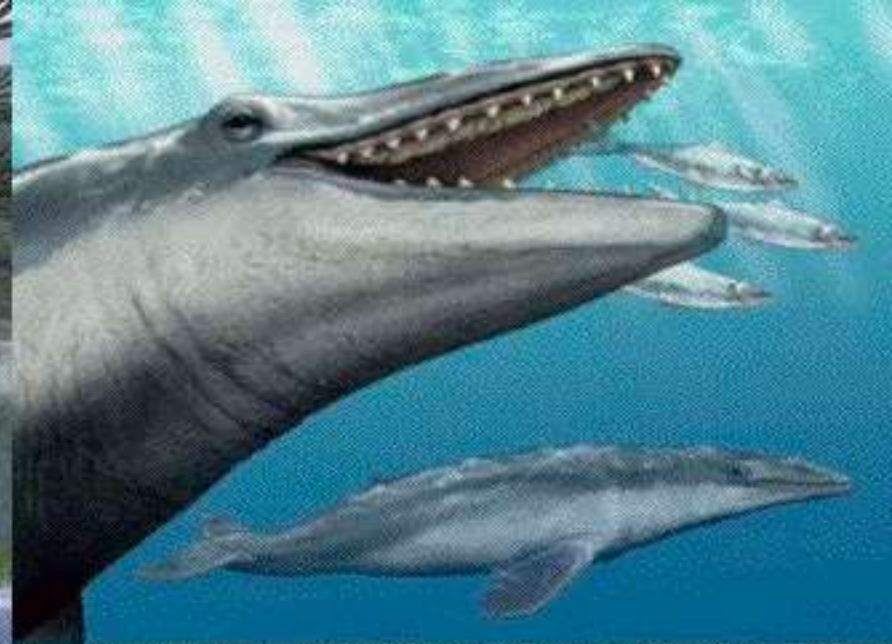
Tertiary period - First primates appear and flowering plants become the most common.

Quaternary period - Humans evolve and large mammals like woolly mammoths become extinct.

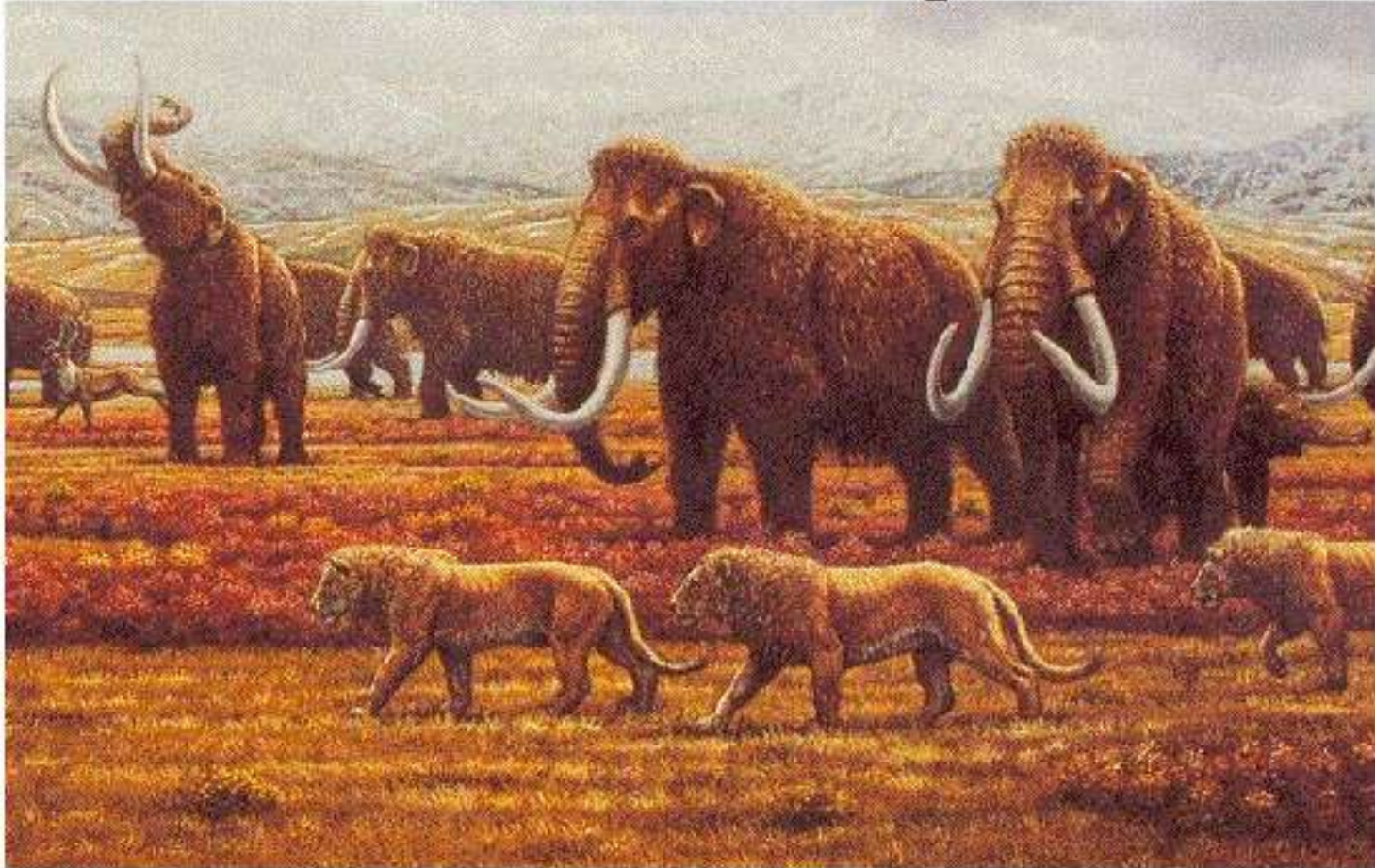


Tertiary

- Warm climates, evolving marine mammals, flowering plants



Quaternary



- **Changing environment, large mammals, ice ages, Homo sapiens**