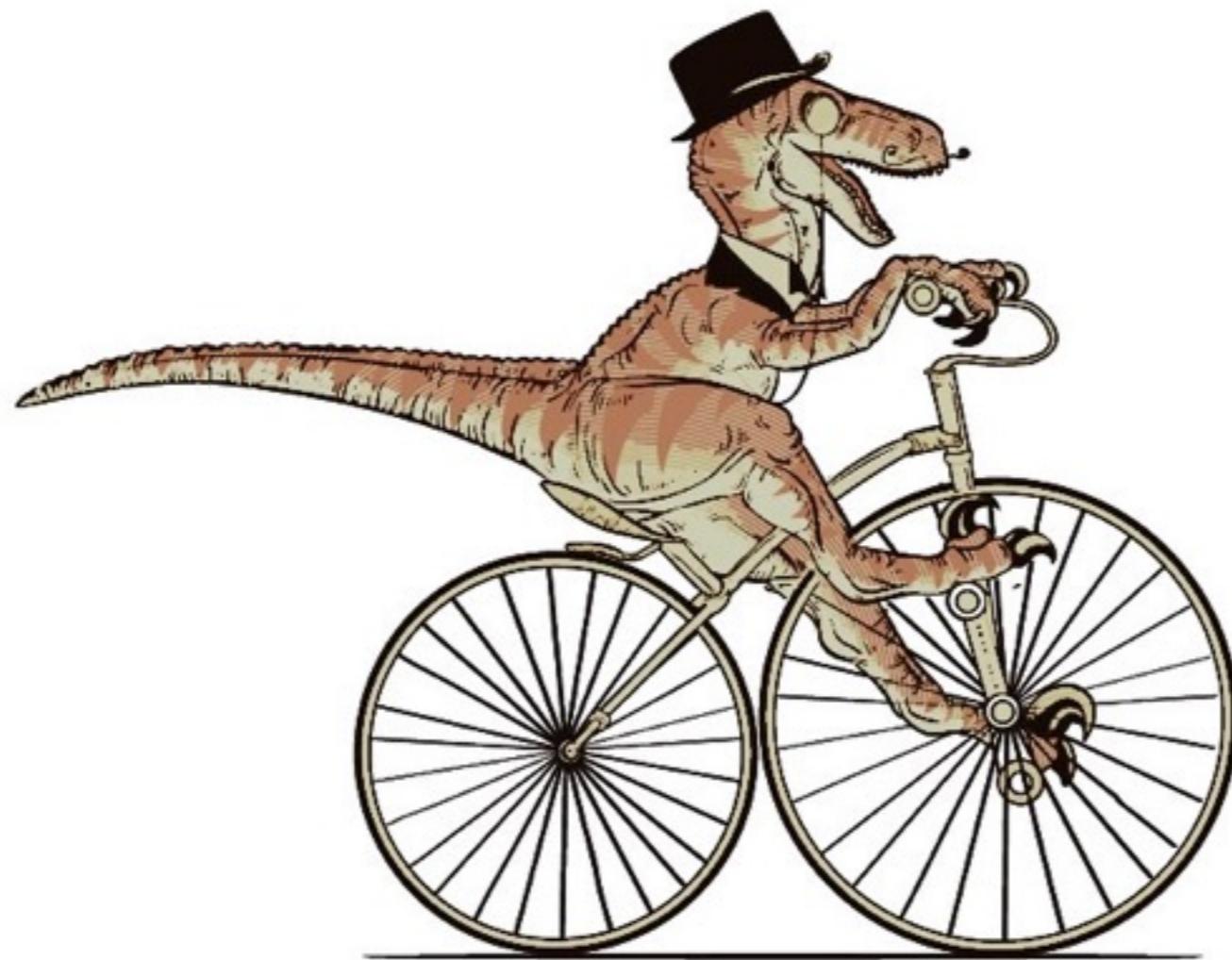


The Natural History of
DINOSAURS

<http://jdyeakel.github.io/teaching/dinos/>



Important information:

Discussion sections:

Monday @ 1:30-2:20 (Paola/Bobby)

Monday @ 2:30-3:20 (Paola/Bobby)

CLSSRM 282

Discussion section starts NEXT week

Make sure you are signed up...

Justin office hours: MW 2-4 (or by appt) SE1 288 (not today)

Paola office hours: W 12:25-1:25 SE1 398

Bobby office hours: WF 10-11 alcove near SE1 281

Important Dates

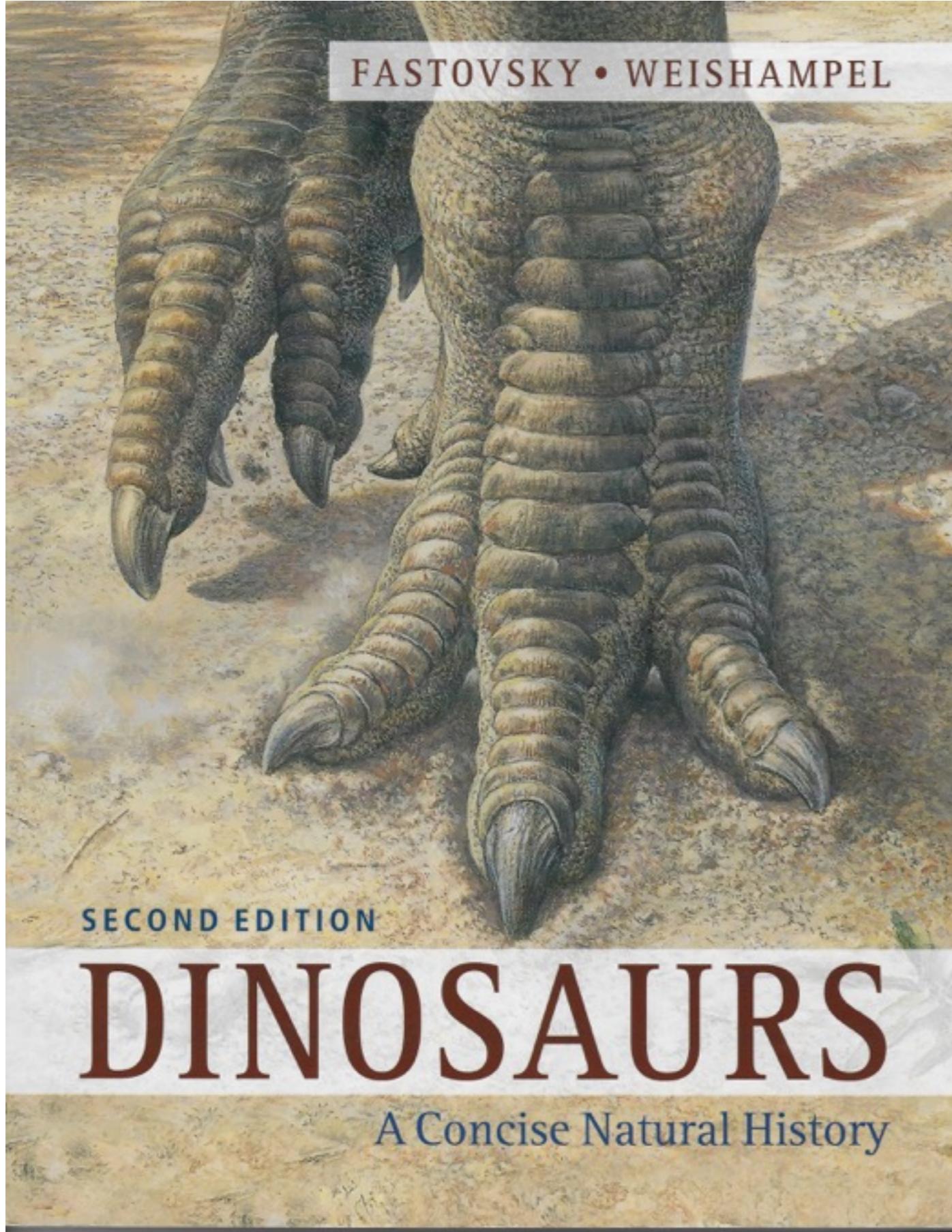
Class add deadline: 2/8

Course drop deadline: 2/8

Course drop (with W): 4/5

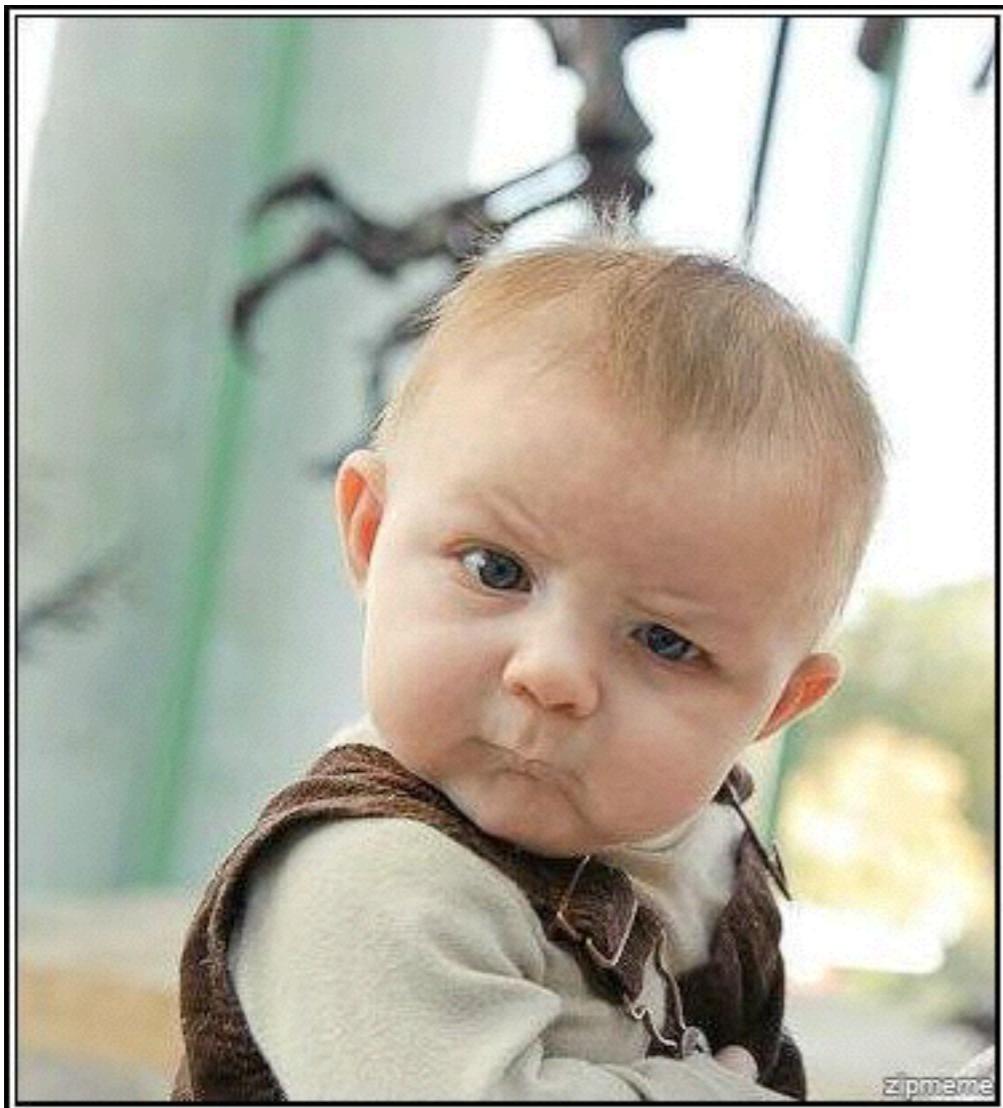


The Textbook



\$68.32 on Amazon
?? UC Merced bookstore

Who are you and why are you here?



Name

Major

Year

What you want from Dinosaurs

Week	Date	Topic	Description	Readings	Assessments
1	1/20	Introduction to paleontology I	Intro, timescales & fossils	Fastovsky Chpt 1	
	1/22	Introduction to paleontology II	Sedimentology & Taphonomy		
S1		None - Organizational			
2	1/25	Evolution and classification I	Introduction to evolution and natural selection	Fastovsky Chpt 2,3	
	1/27	Evolution and classification II	More on natural selection and an introduction to classification		
	1/29	Early life history	Overview of the origin of life leading up to tetrapods		
S2		Cladistics	HW1: Cladogram worksheet		
3	2/1	Tetrapods	Life in the Permian	Fastovsky Chpt 4	
	2/3	An introduction to Dinosauria	Basal dinosaurs		
	2/5	Thyreophorans I	Stegosauria		
S3		Anatomy	HW2: Anatomy worksheet		Homework 1 due
4	2/8	Thyreophorans II	Ankylosauria	Fastovsky Part 2 & Chpt 5	
	2/10	Prepare for Exam I			
	2/12	Exam I	Good Luck!		
S4		Review			Homework 2 due
5	2/15	HOLIDAY - NO CLASS			
	2/17	Pachycephalosaurs	Basal traits and conundrums	Fastovsky Chpt 6	
	2/19	Pachycephalosaurs	Intraspecies competition then and now		
S5		Marginocephalians	HW3: A scientific paper!		
6	2/22	Ceratopsians	Basal traits and relatedness		
	2/24	Ceratopsians	After the frill is gone: diversity and movement over space		
	2/26	Ornithopoda I	Functional morphology and complex dentition	Fastovsky Chpt 7	
S6		Natural History Report	HW4: Writing your Abstract		Homework 3 due
7	2/29	Ornithopoda II	Dinosaur behavioral ecology		
	3/2	Sauropods I	Carnivorous ancestors to gentle giants	Fastovsky Part 3 & Chpt 8	
	3/4	Sauropods II	Troubles: dealing with gigantism and the sauropod hiatus		

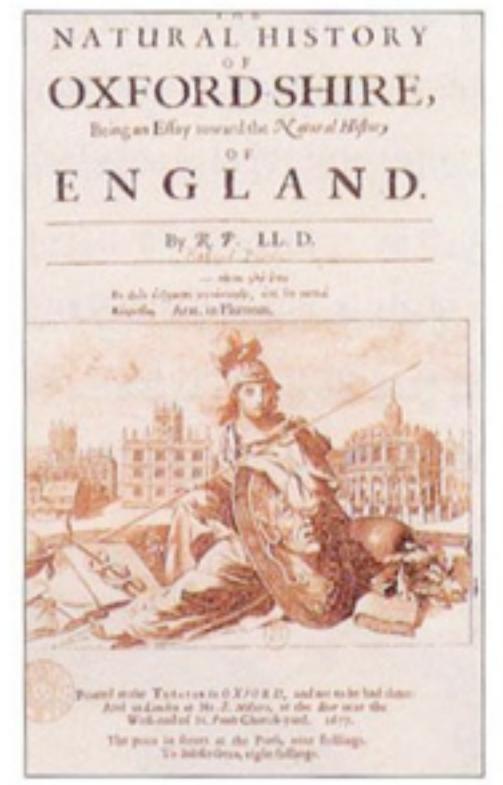
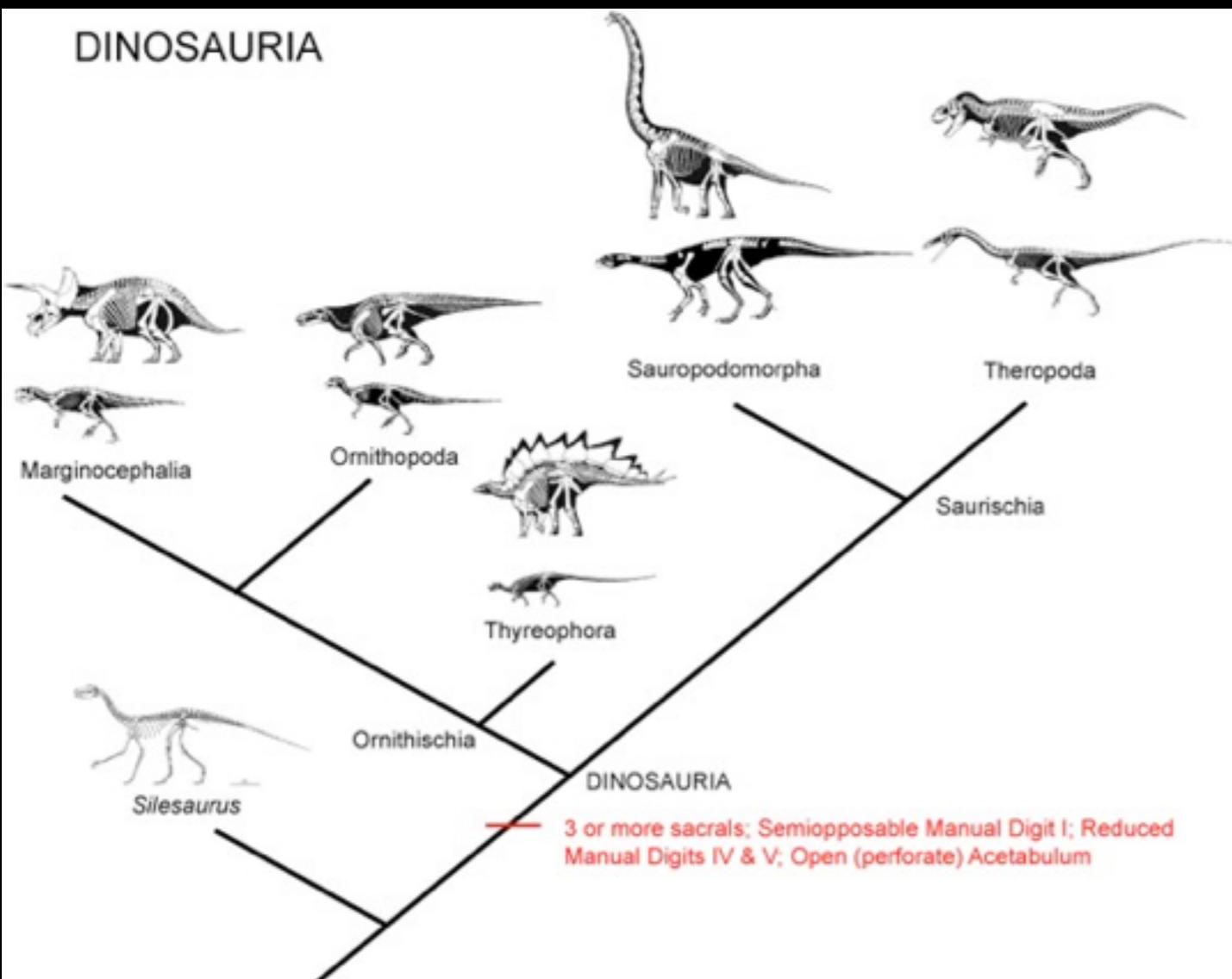
What is a dinosaur???

Scales: Space

Scales: Time

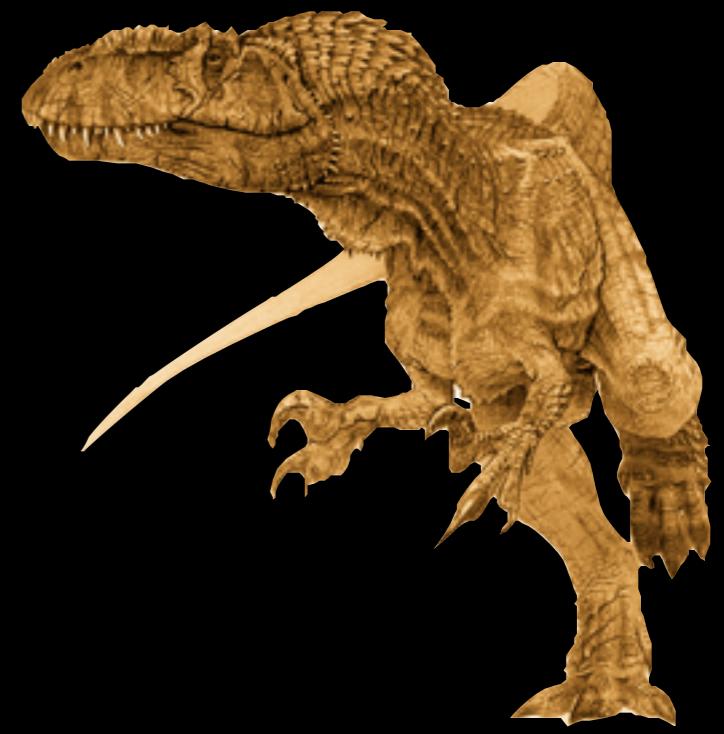
Where do Dinos fit in?

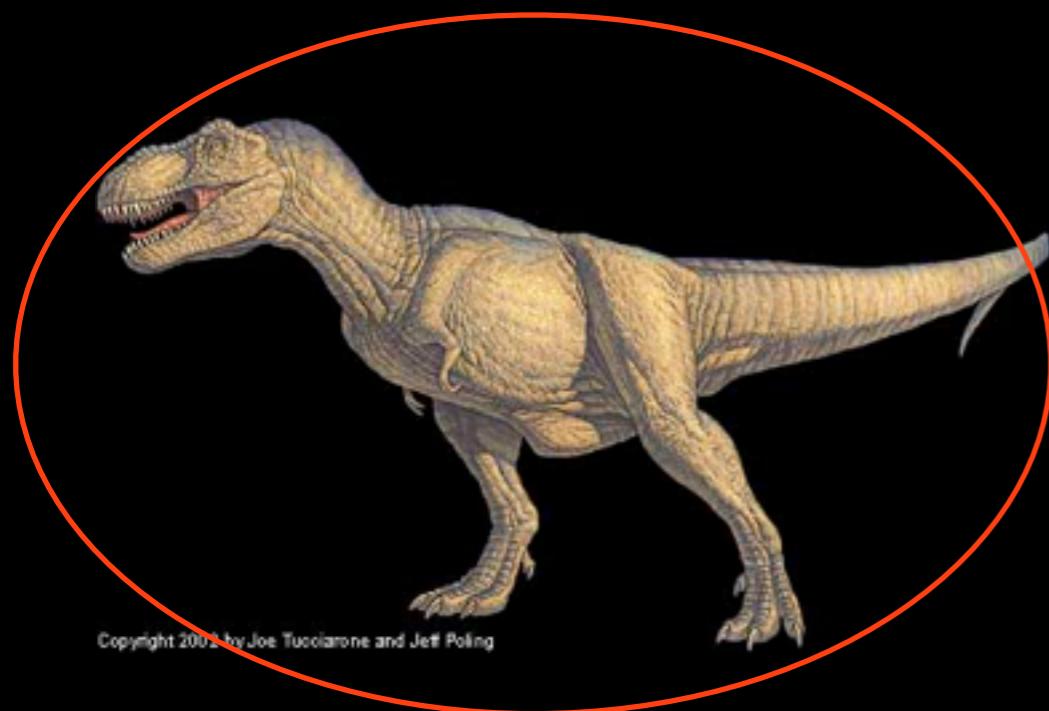
Fossilization and Taphonomy



Scrotum humanum
The distal femur of Megalosaurus

Dinosauria:
A monophyletic clade





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Dinosaur?

What is the age of the Earth?

- a) 6000 years old
- b) 1.8 million years old
- c) 20.2 billion years old
- d) 4.6 billion years old



When did dinosaurs first appear on Earth?

a) 1 million BC

b) 500 million years ago

c) 231 million years ago

d) 251 million years ago



Mesozoic dinosaurs are rare in California because:

- a) they are in rocks that are still buried beneath the surface
- b) California was too cold in the Mesozoic
- c) California was mostly underwater
- d) Dinosaurs don't like hippies



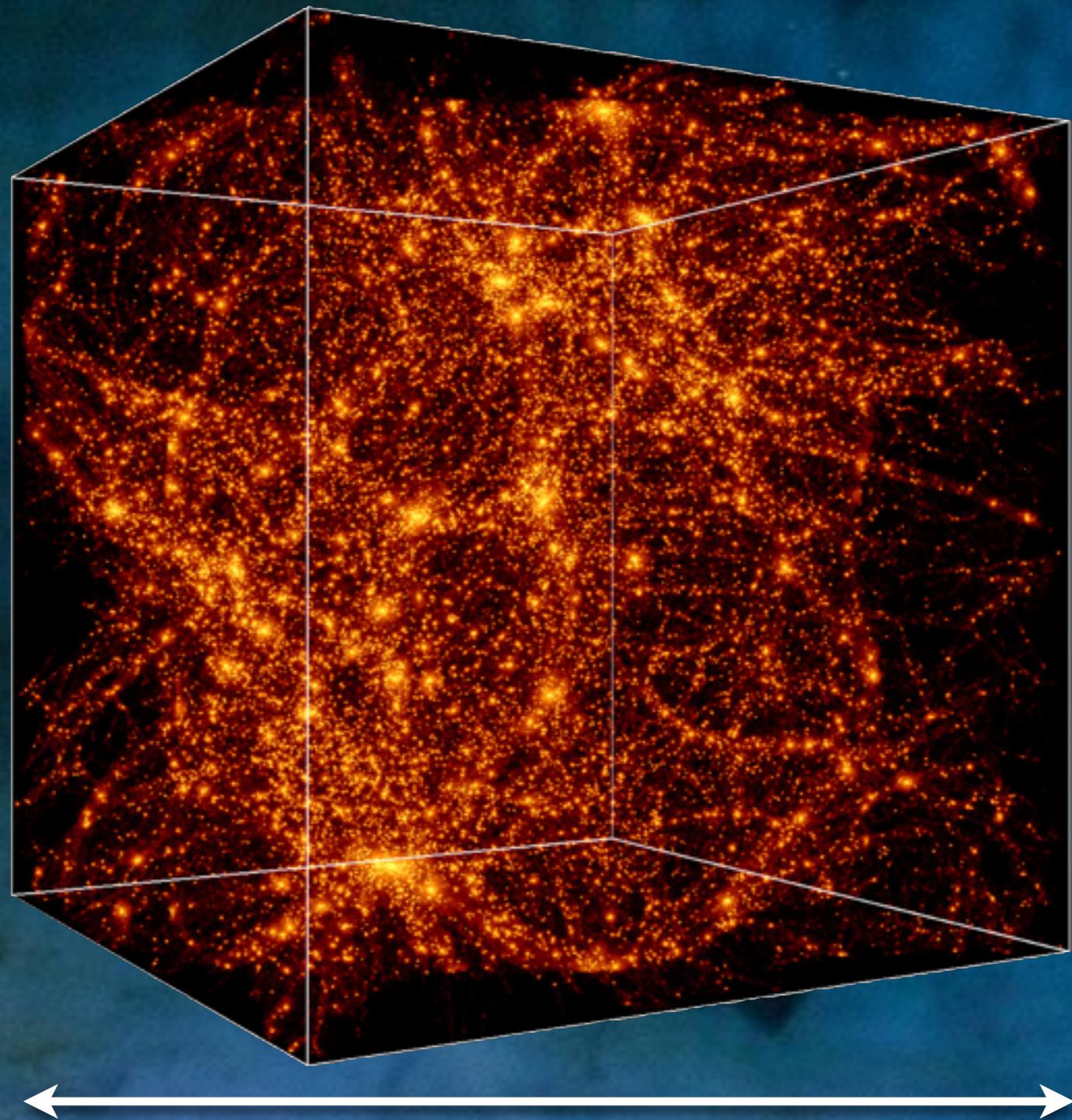
Orders of Magnitude

$$\begin{aligned}10^{10} &= 10000000000 \\&= 10 * 10 * 10 * 10 * 10 * 10 * 10 * 10 * 10\end{aligned}$$

$$\begin{aligned}10^{-10} &= 0.0000000001 \\&= .10 * .10 * .10 * .10 * .10 * .10 * .10 * .10 * .10\end{aligned}$$

Spatial Scales

Orders of Magnitude



Orders of Magnitude



10^{15}



Orders of Magnitude

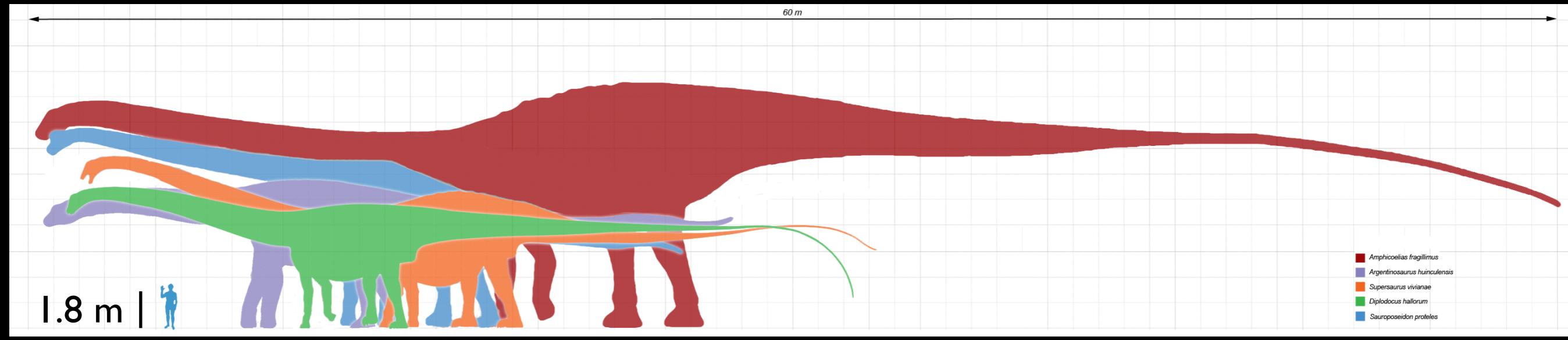


10^{10}

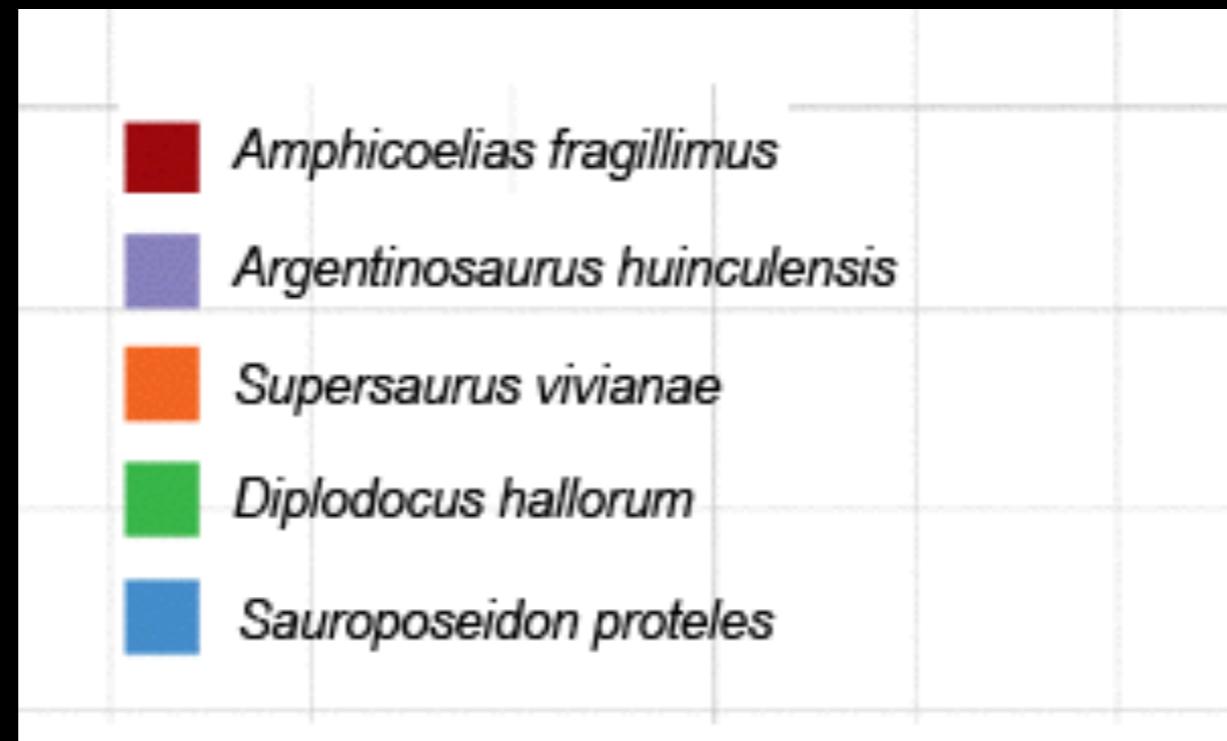
Orders of Magnitude



10^6



60 m

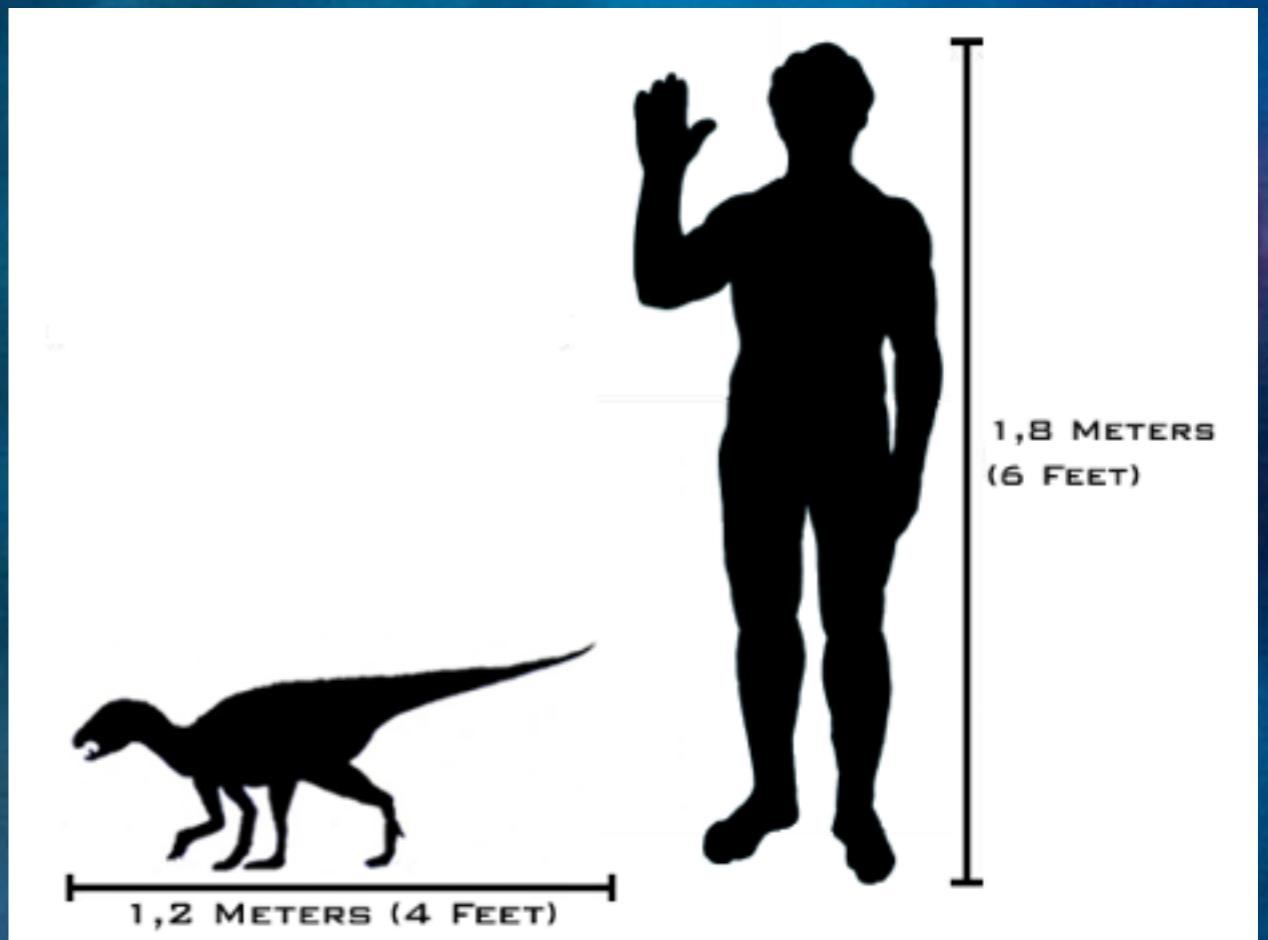




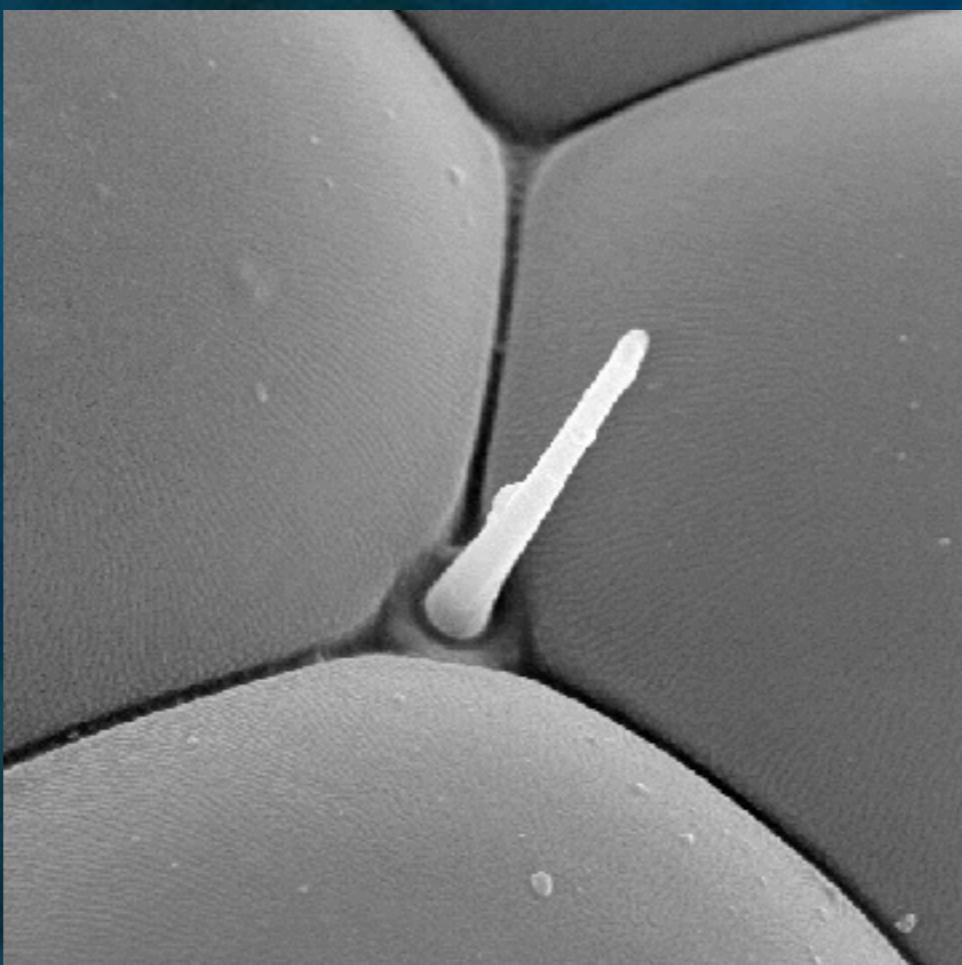
Orders of Magnitude



10^0

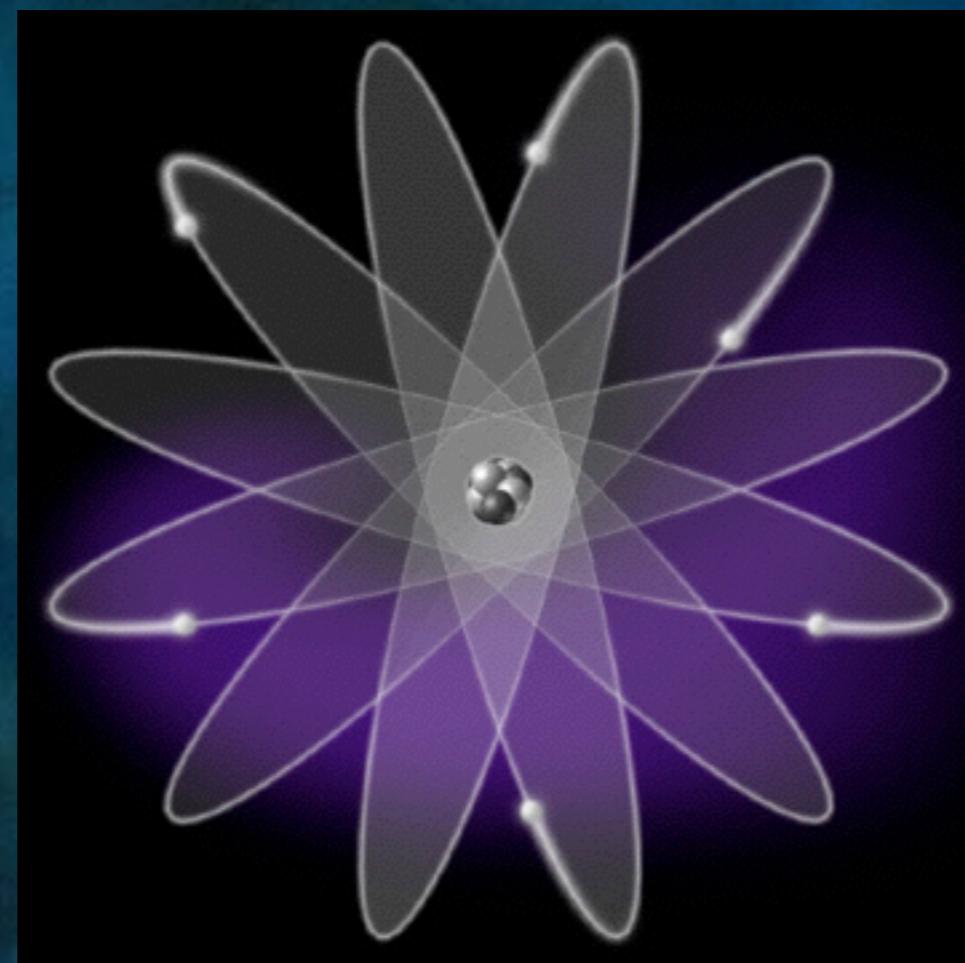


Orders of Magnitude



| 10⁻⁵

Orders of Magnitude



10^{-10}

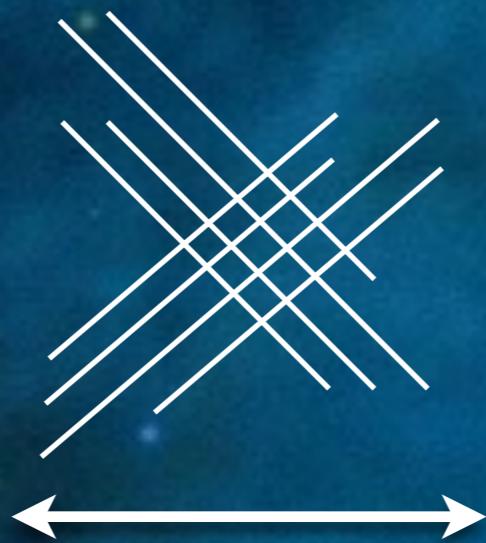
Orders of Magnitude

10^{-15}



Orders of Magnitude

10^{-34}



Plank's Constant
 $h = 6.63 \times 10^{-34}$

Temporal Scales

13.3-13.9 Ga

0

THE BIG BANG

INFLATION

COSMIC MICROWAVE
BACKGROUND
400,000 YEARS AFTER
BIG BANG

GALAXY EVOLUTION
CONTINUES...

FIRST STARS
400,000,000 YEARS
AFTER BIG BANG

THE DARK AGES

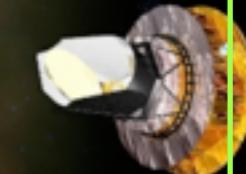
FIRST GALAXIES
1000,000,000 YEARS
AFTER BIG BANG

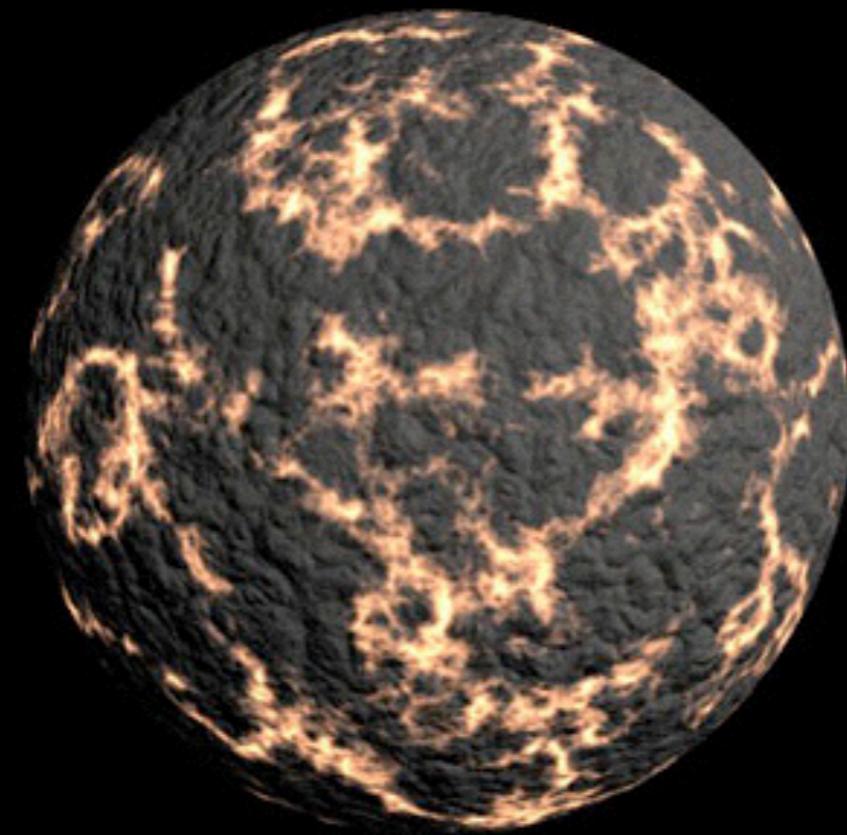
FORMATION OF
THE SOLAR SYSTEM
8,700,000,000 YEARS
AFTER BIG BANG

DARK ENERGY?

life

NOW
13,700,000,000 YEARS
AFTER BIG BANG





4.56 gyr



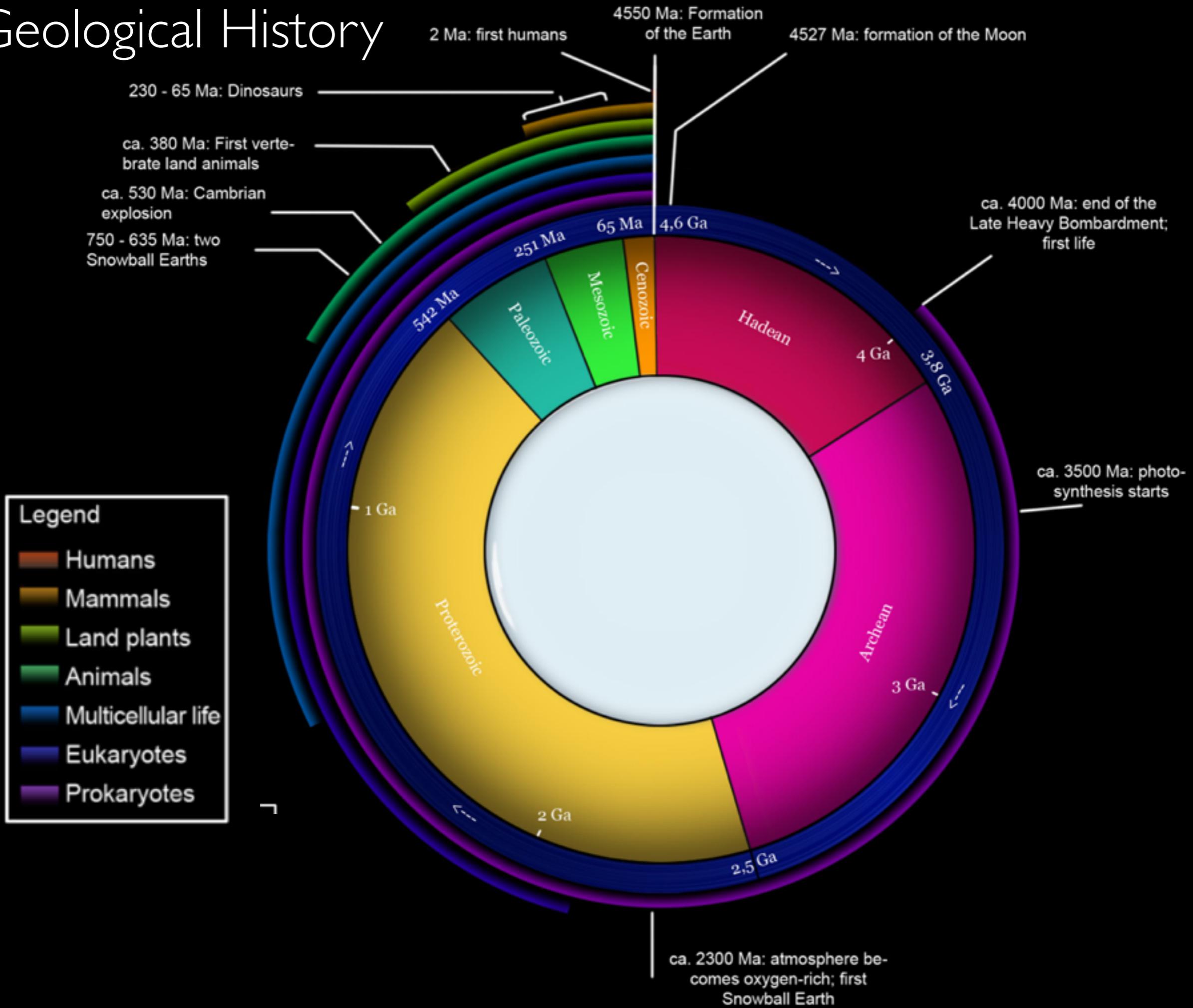
4.527 gyr



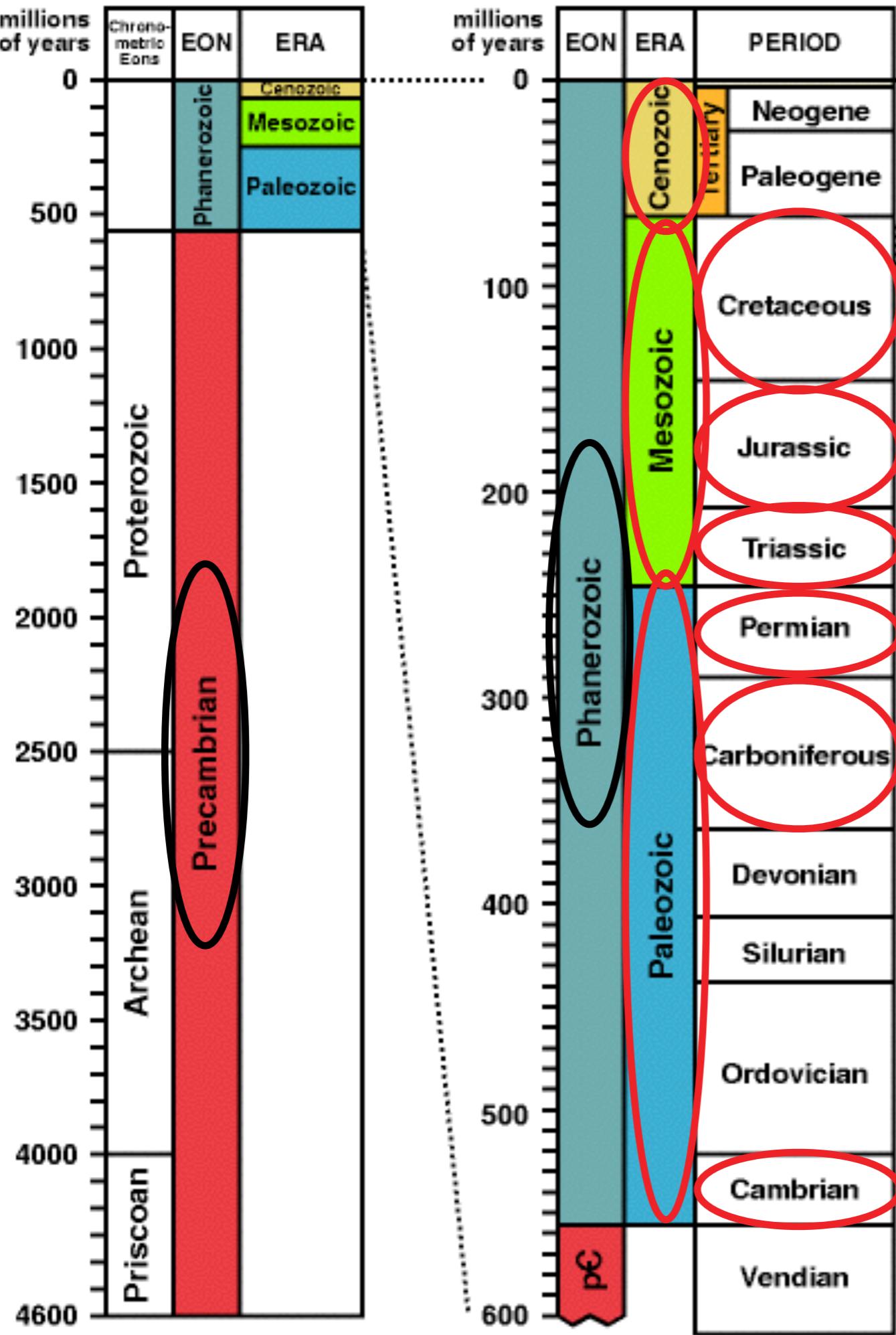
© Mark A. Garlick
space-art.co.uk

$> 4.527 \text{ gyr}$

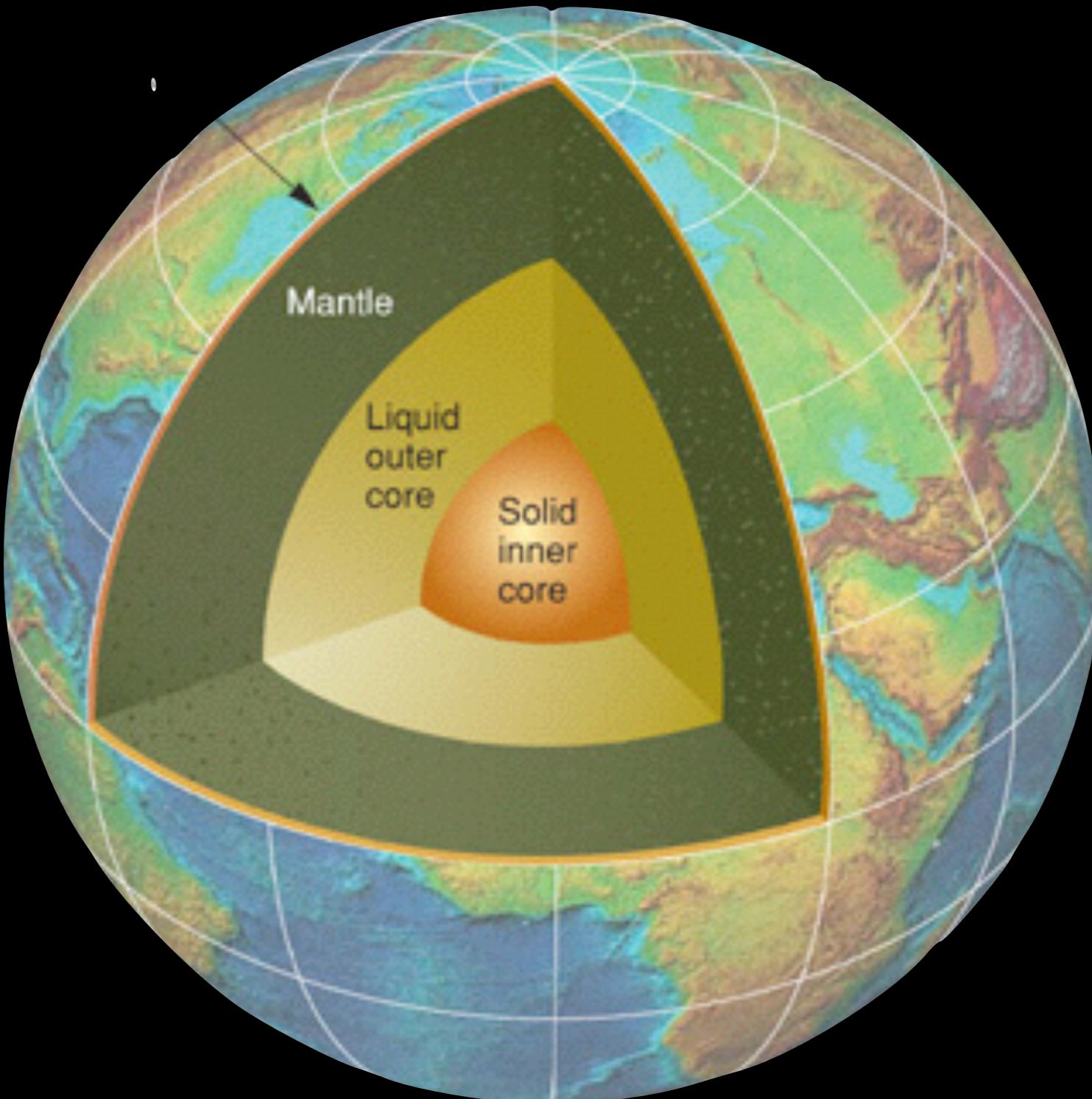
Geological History



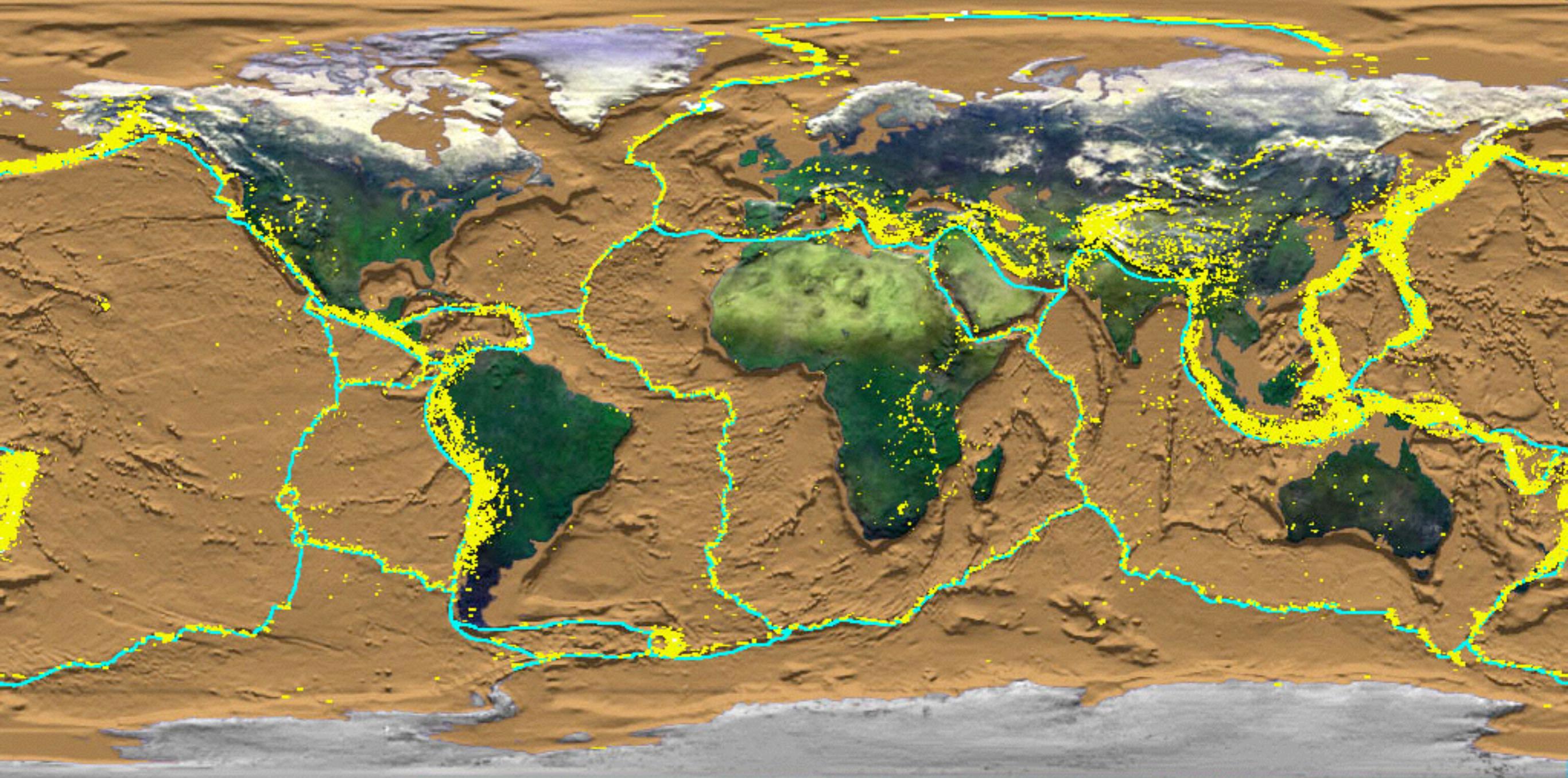
Be Familiar Know



- Precambrian Eon
- Phanerozoic Eon
- Paleozoic
 - Cambrian (542:488 Ma)
 - Carboniferous (360:299 Ma)
 - Permian (299:251 Ma)
- Mesozoic
 - Triassic (251:200 Ma)
 - Jurassic (200:146 Ma)
 - Cretaceous (146:65.5)
- Cenozoic (65.5:now)

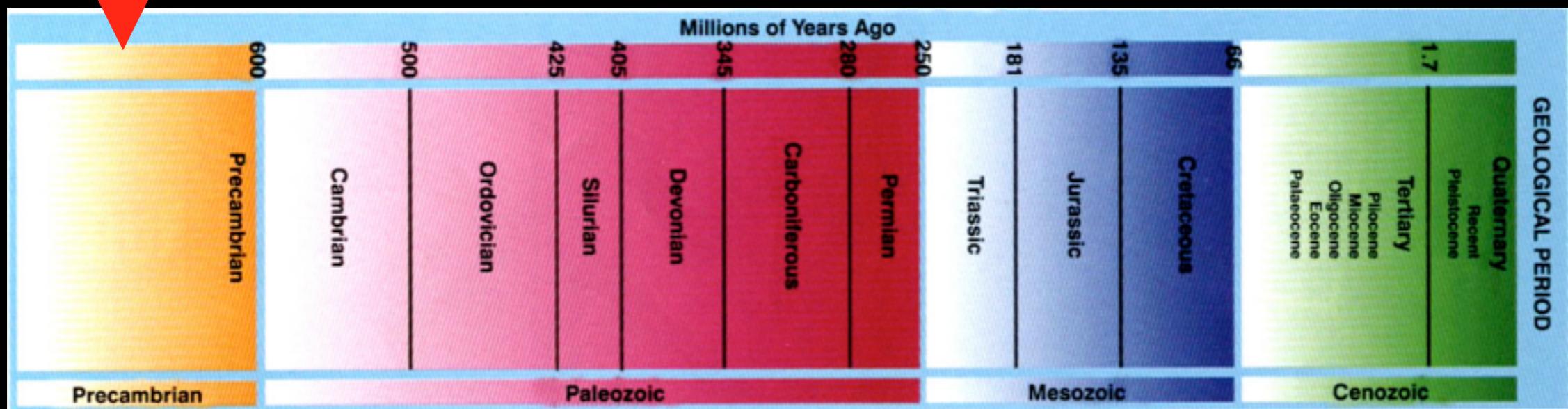
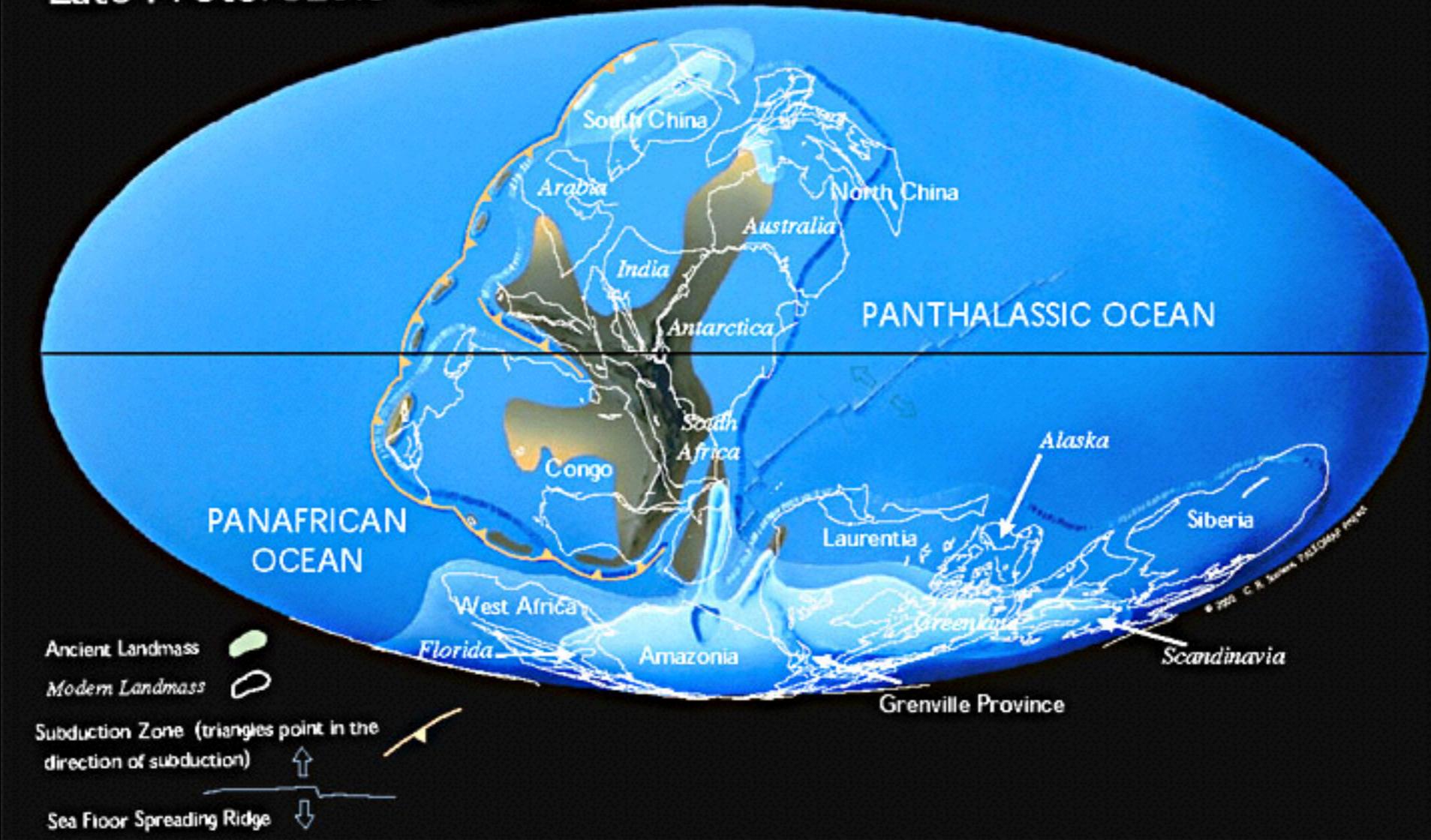


Continental Plates

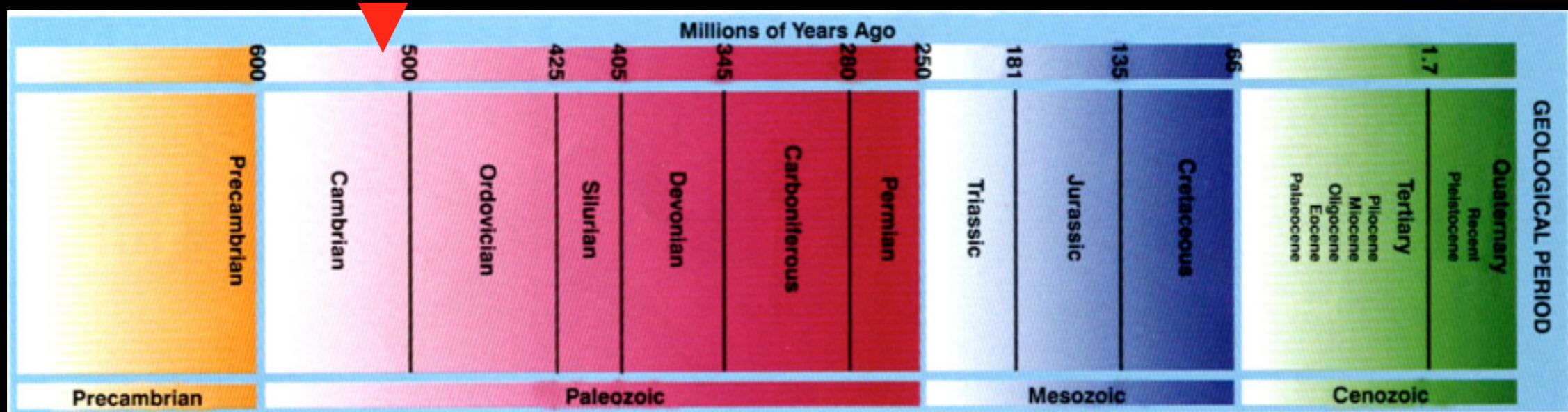
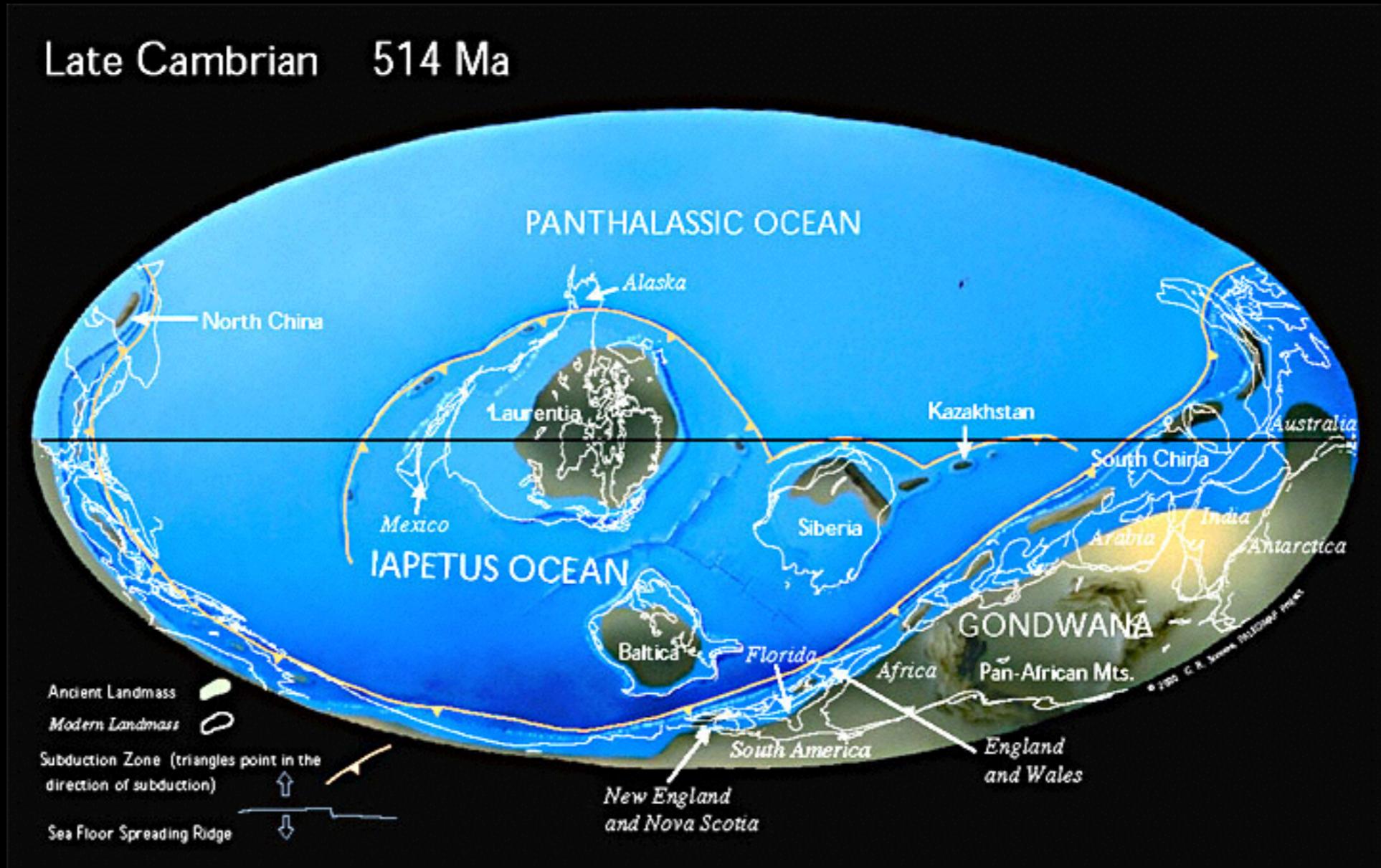


- = earthquakes

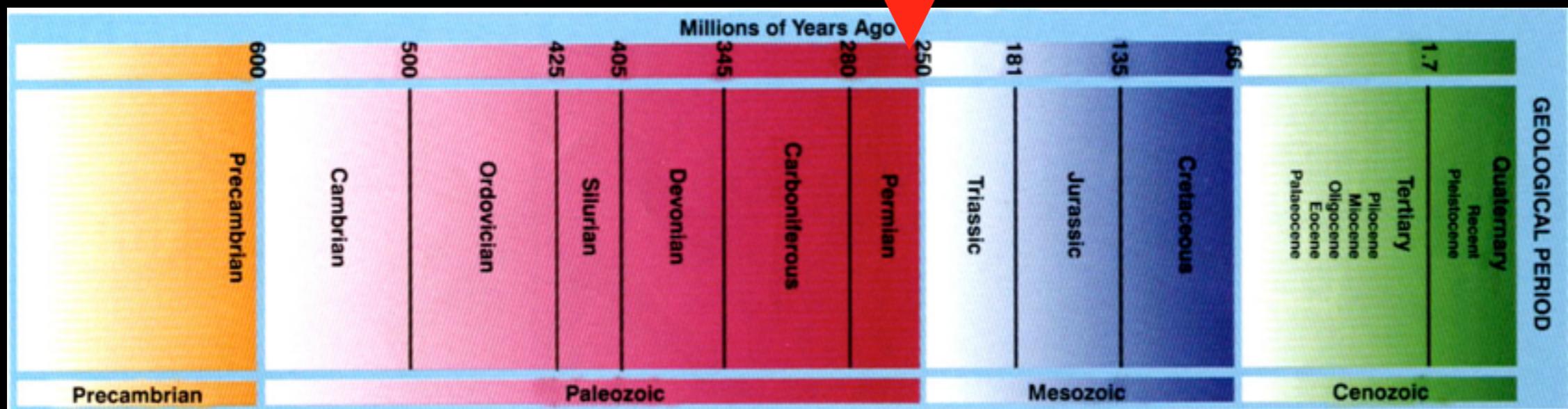
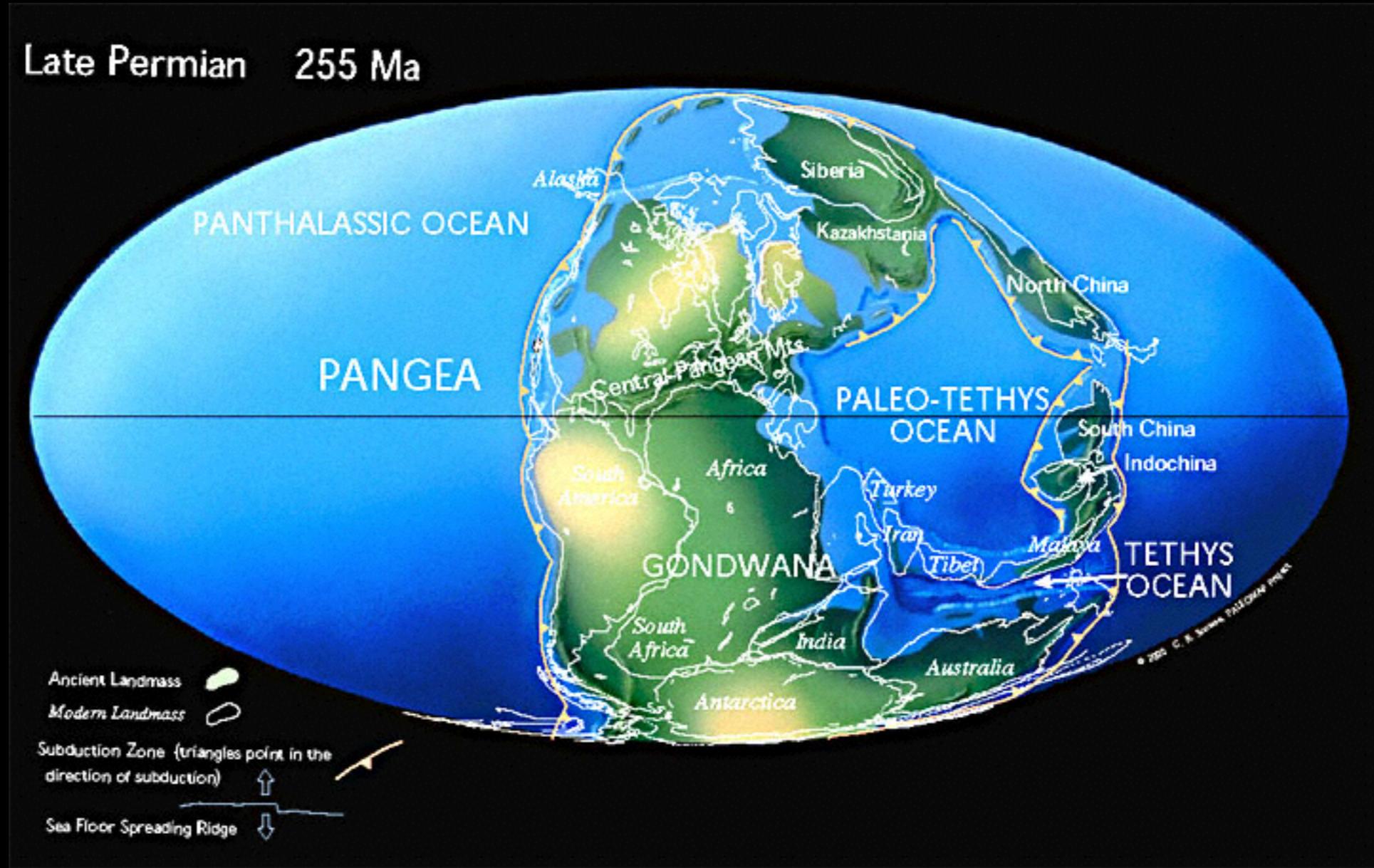
Late Proterozoic 650 Ma



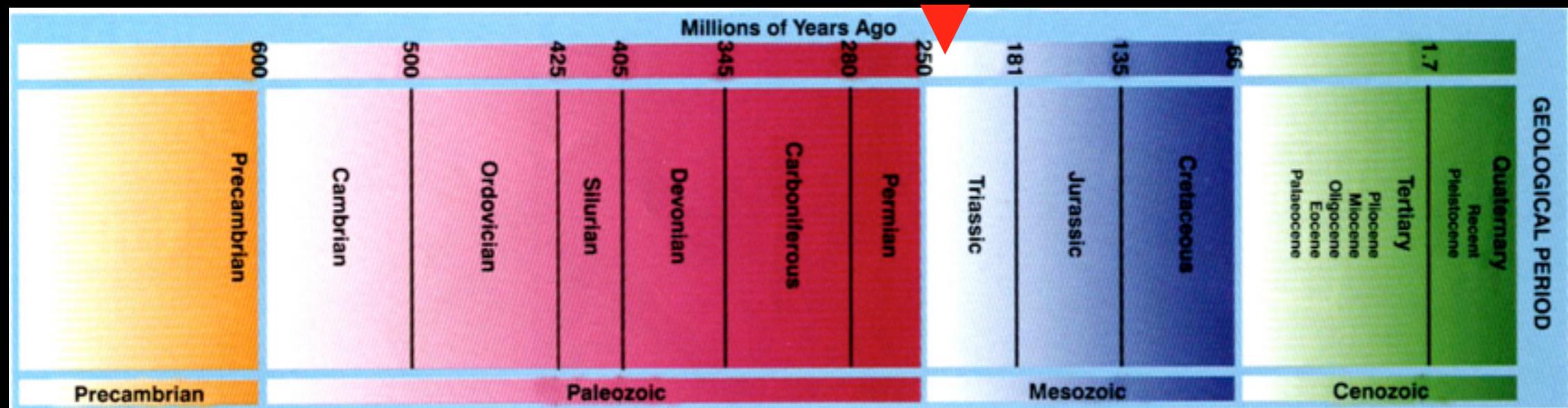
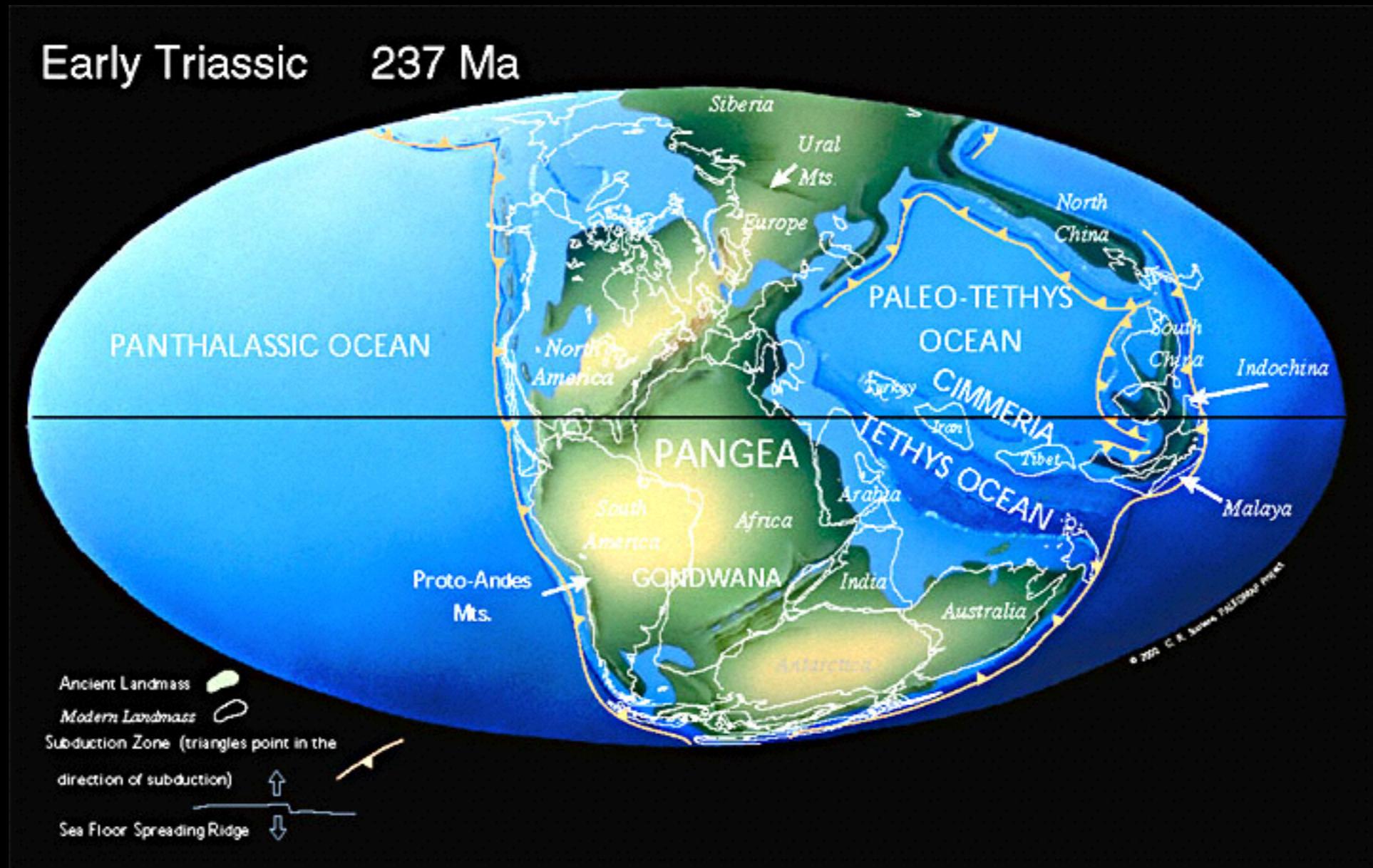
Late Cambrian 514 Ma



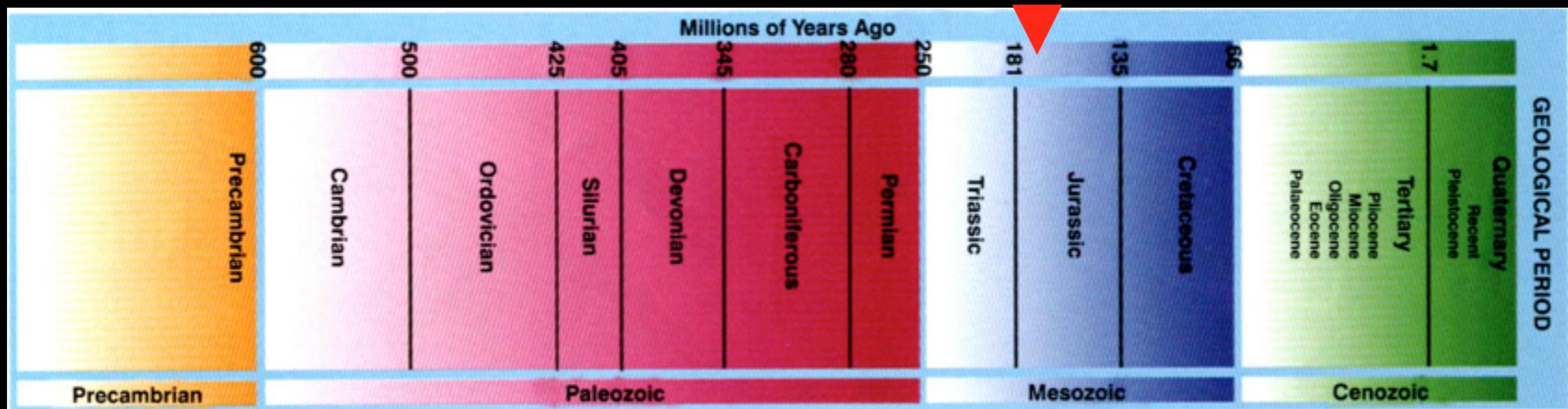
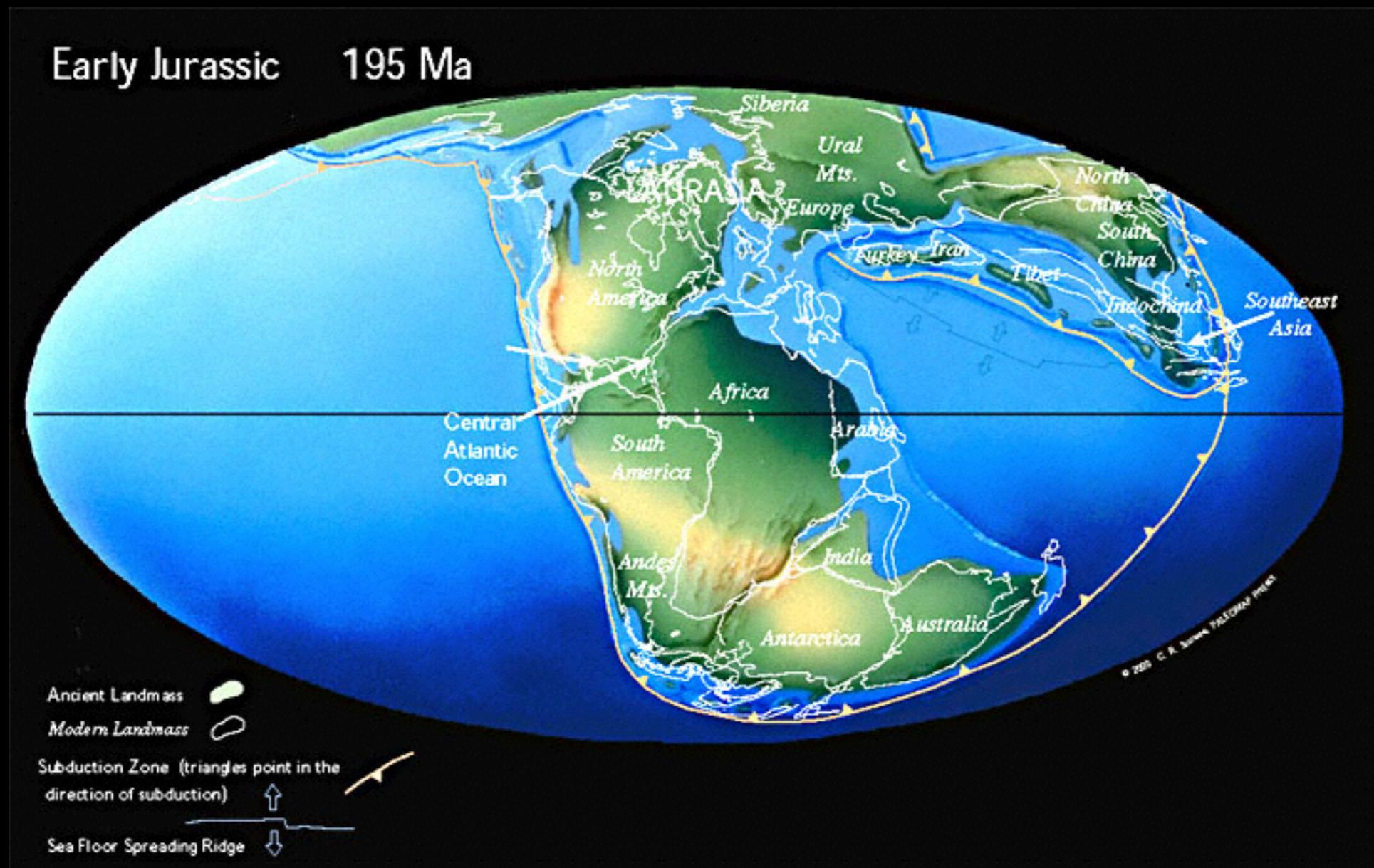
Late Permian 255 Ma

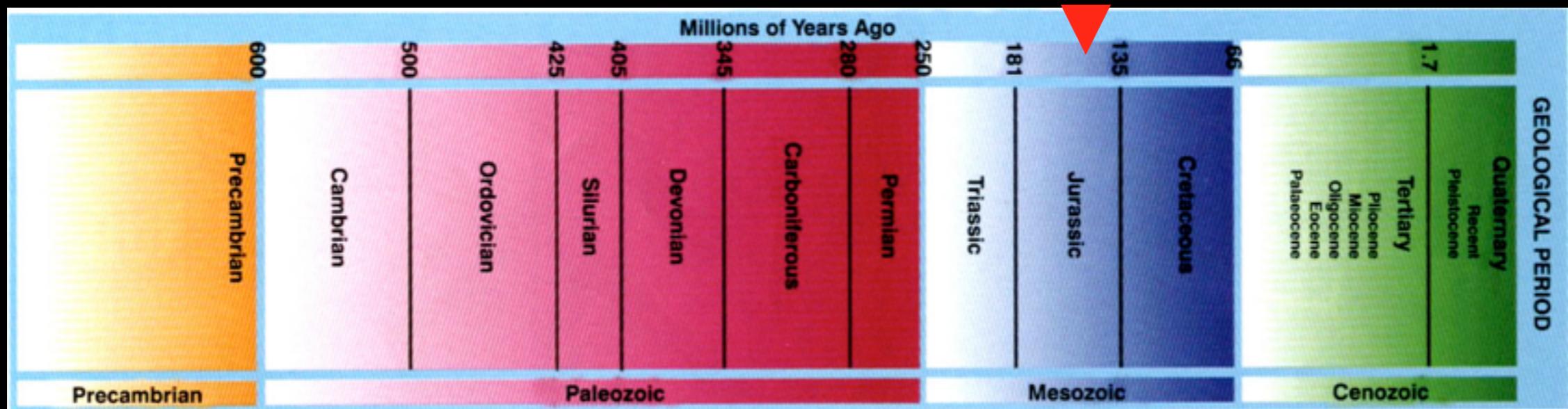
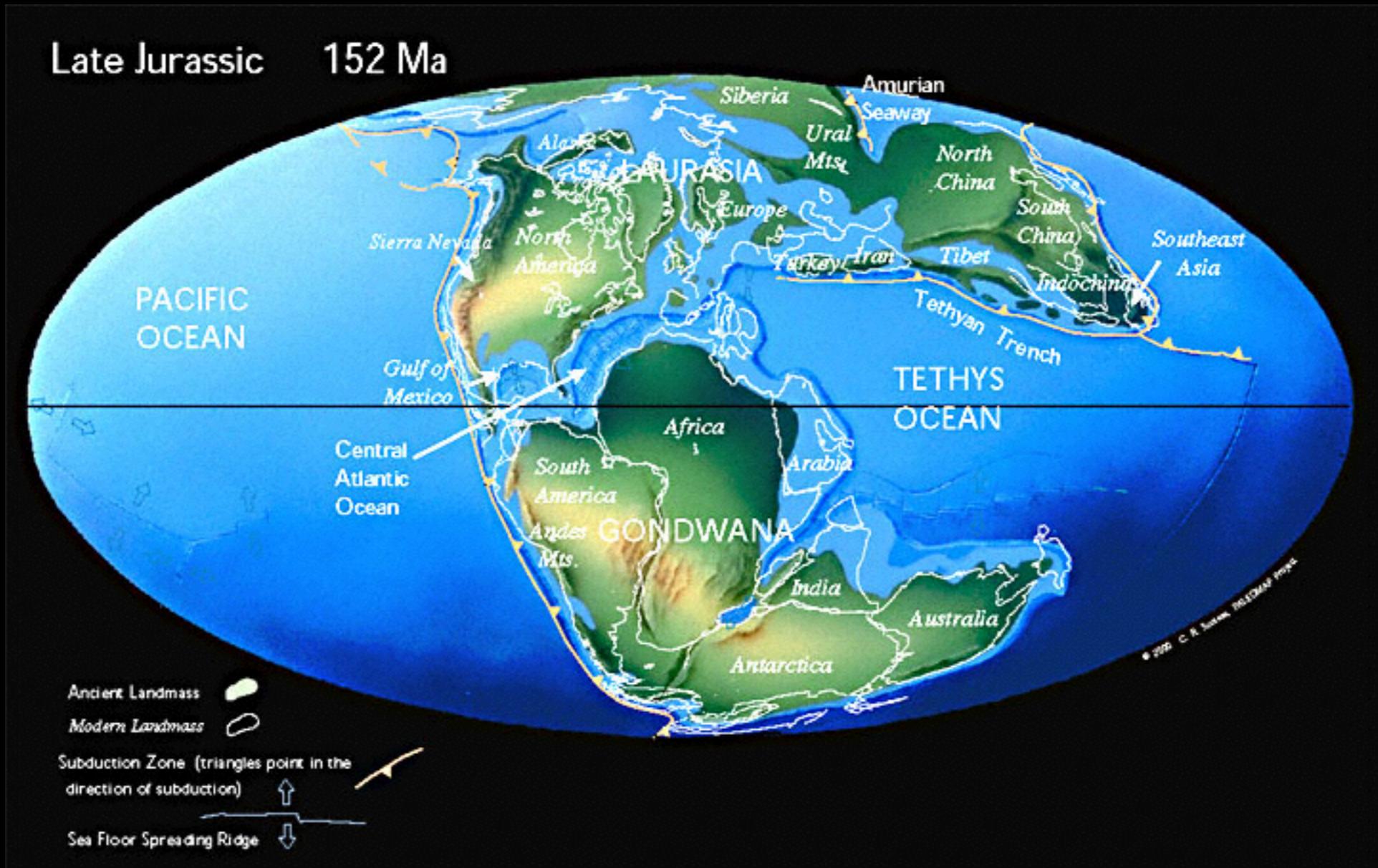


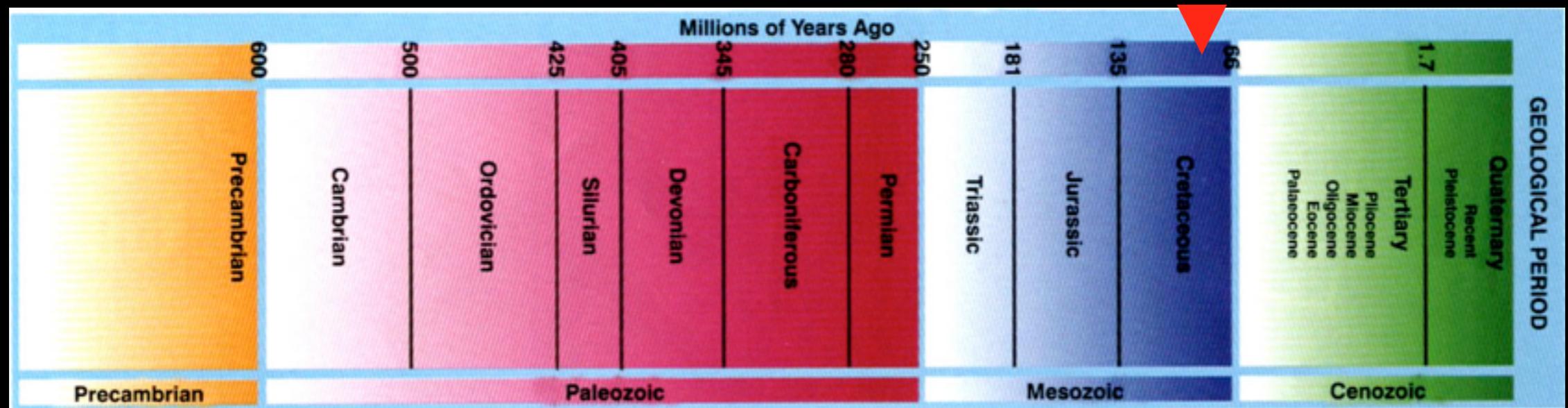
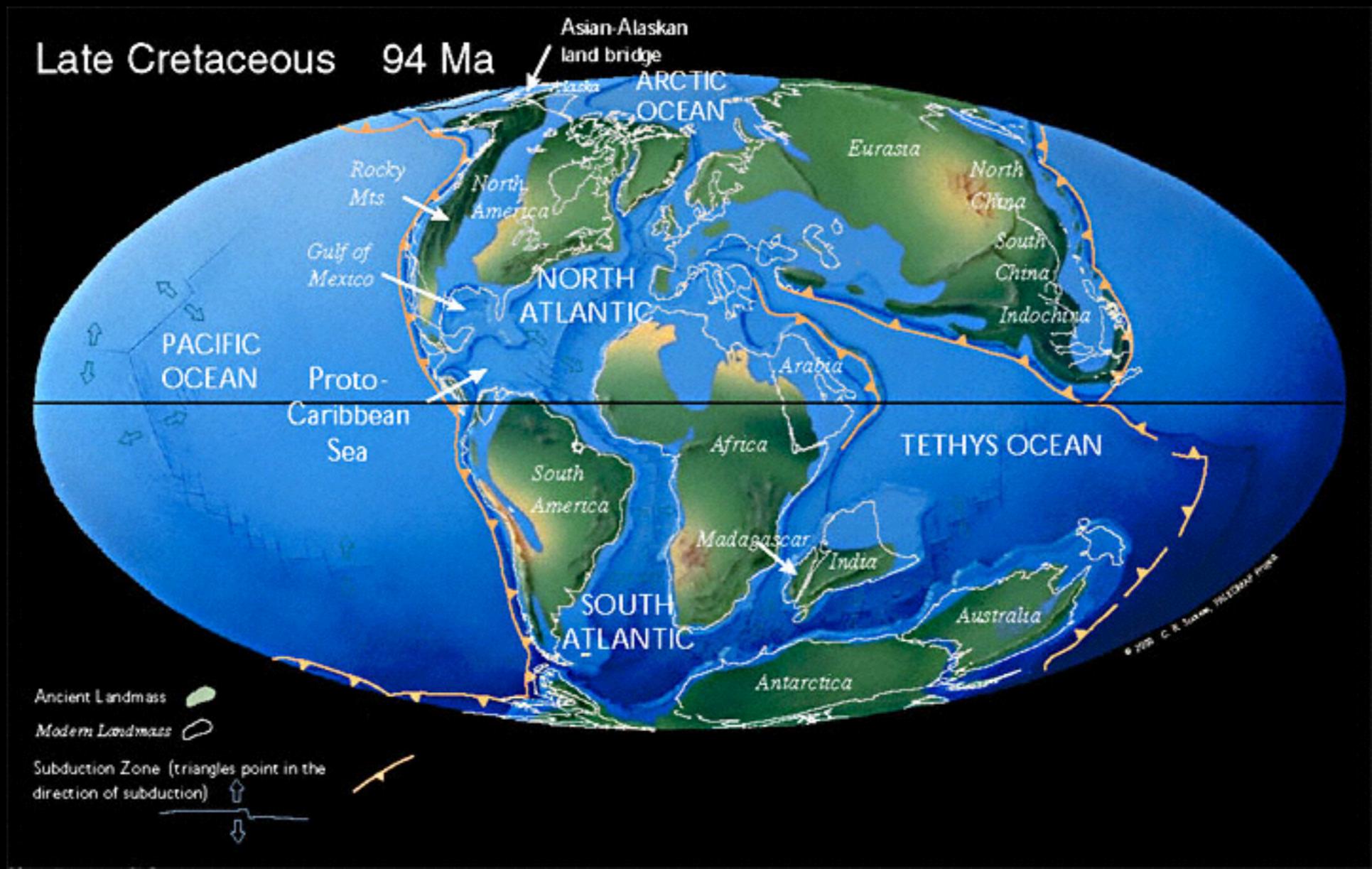
Early Triassic 237 Ma

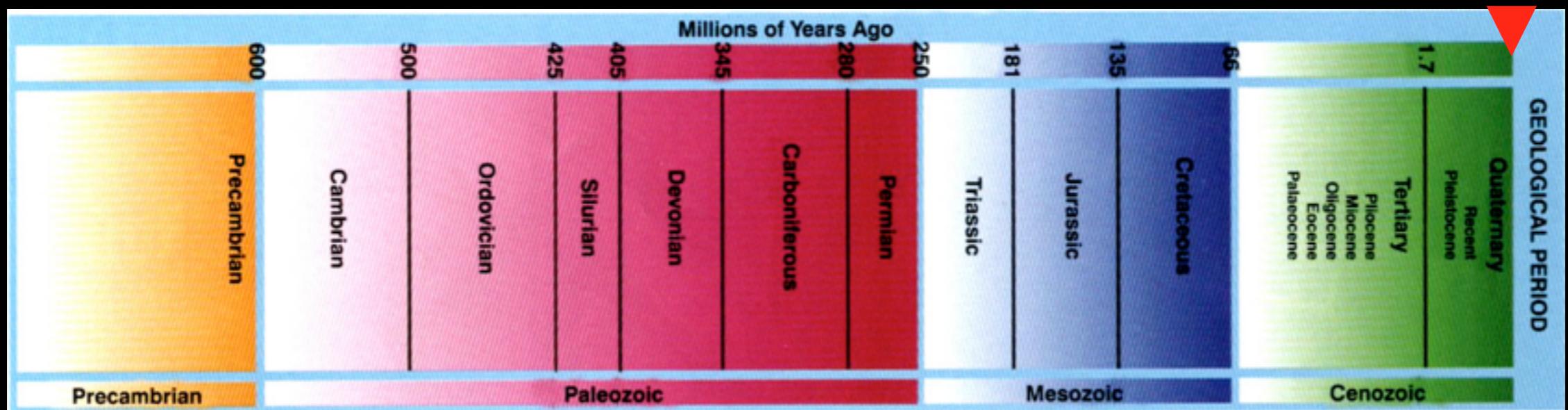
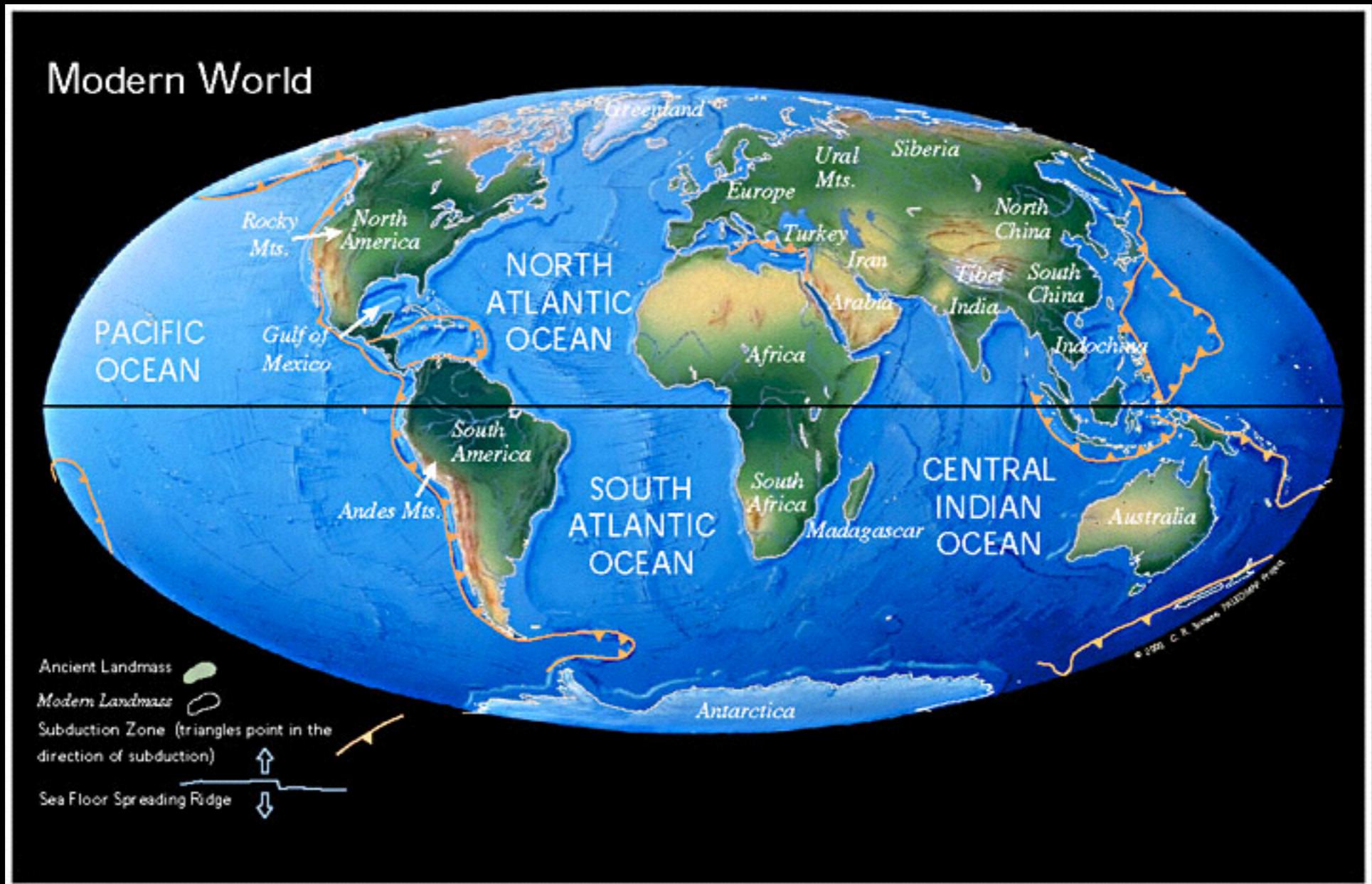


Early Jurassic 195 Ma

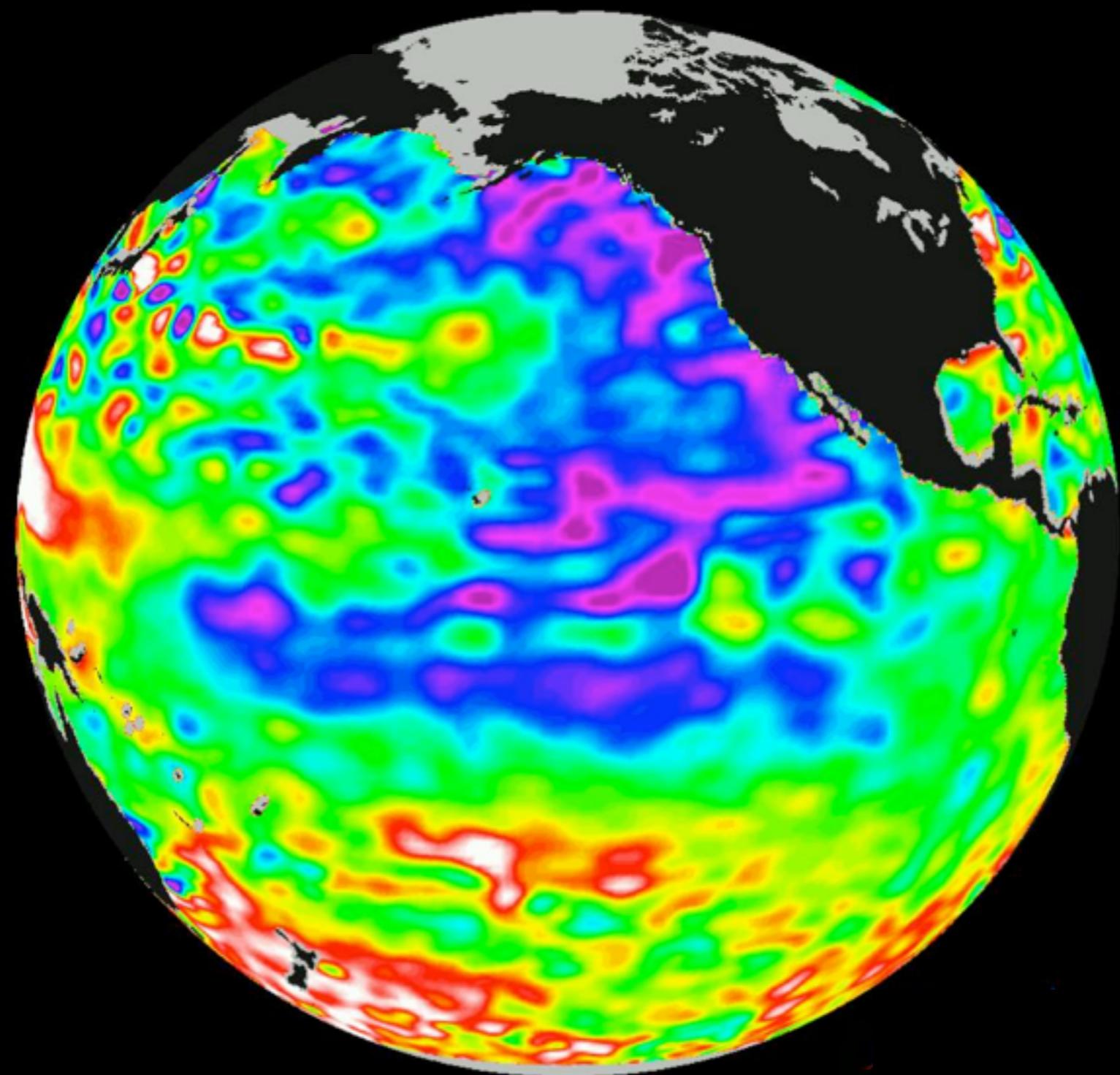








Why do we care?





“Being a paleontologist is like being a coroner except that all the witnesses are dead and all the evidence has been left out in the rain for 65 million years.”

Mike Brett-Surman, 1994



Herrerasaurus

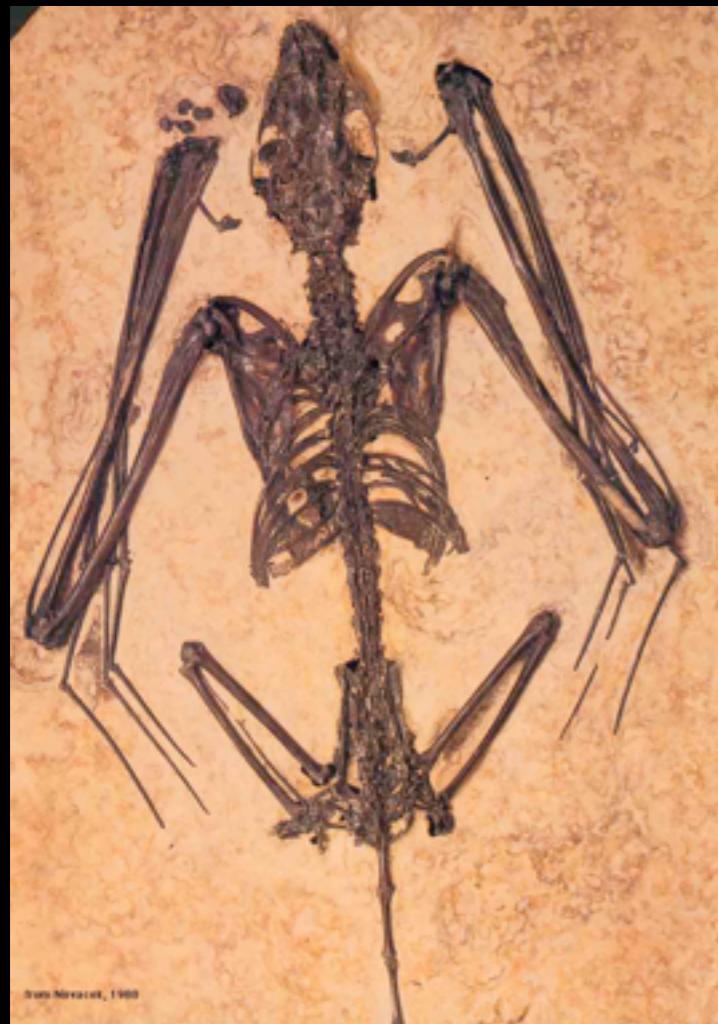


There is a lot that we don't know about dinosaurs...

Science is dynamic



Fossils and Preservation:



Many meanings... types of fossils

Trace Fossils
Poo (Coprolites)
Gastroliths
Trackways



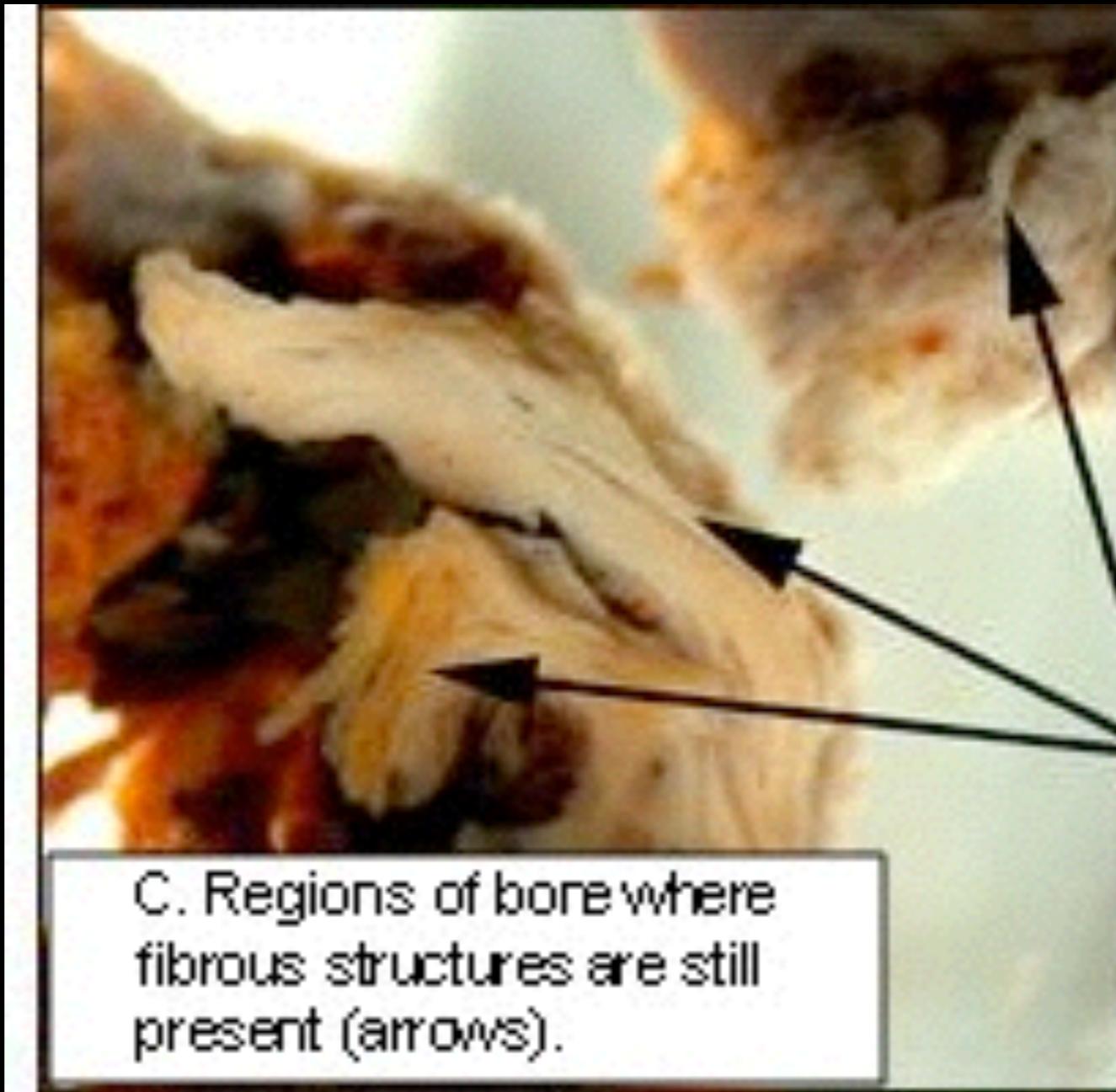
Soft Parts:
Impressions
Amber
Protein???



Hadrosaur skin



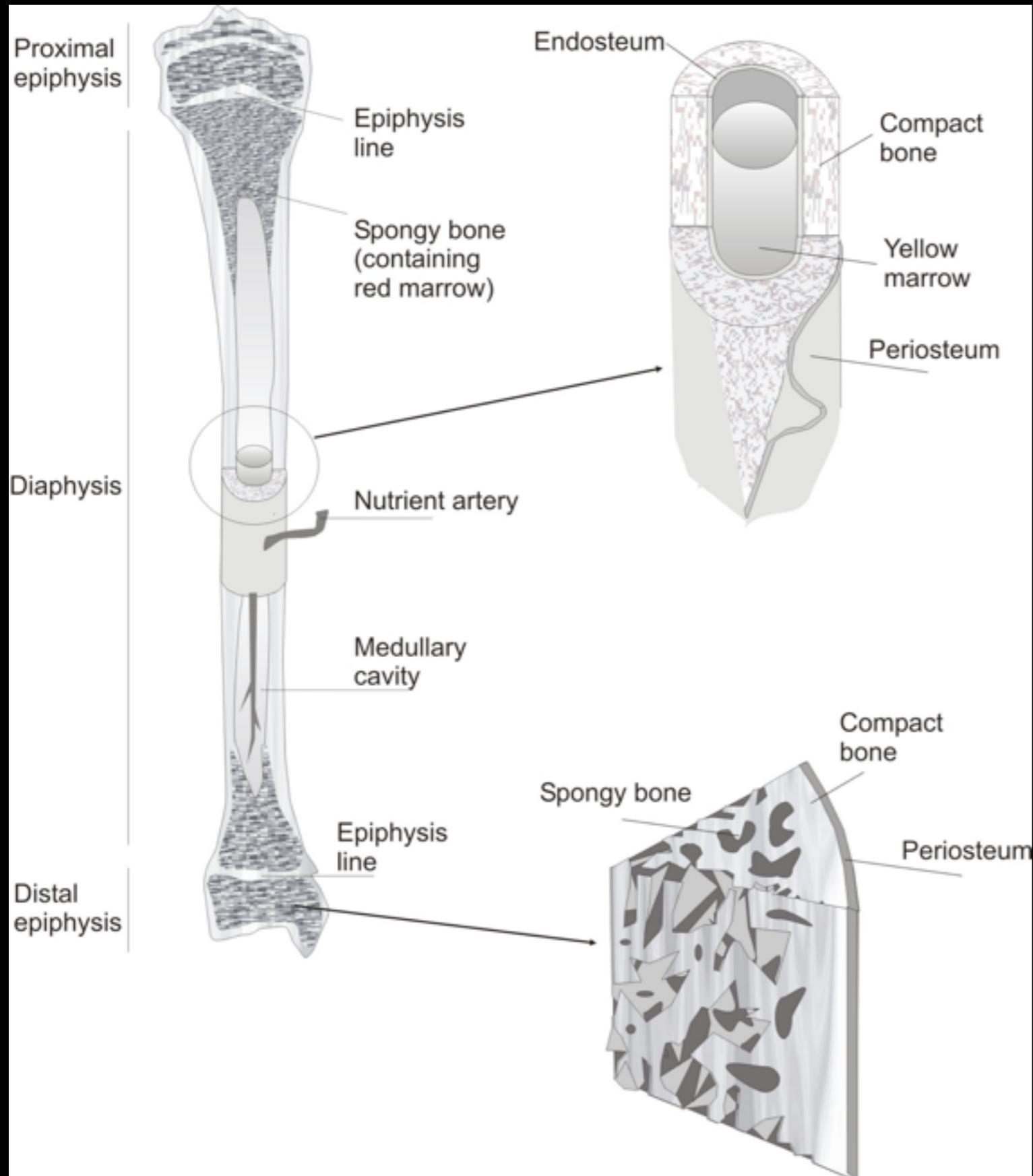
T. rex collagen?



68 Ma

Hard Parts: Living vs. Fossilized





Living Bone

Bone Matrix

- Organic
- Collagen**
- Nonorganic
- Hydroxyapatite

Structure of Bone

Diagram illustrating the structure of skeletal long bones comprising solid outer cortical (compact) bone and inner trabecular (spongy) bone in which the bone marrow is housed. Redrawn and adapted from Baron, 1996. Copyright BTR©

Fossil Bone

$\text{Ca}_{10}(\text{PO}_4)_6(\text{F}, \text{OH}, \text{Cl})_2$



Apatite Mineral Francolite
No longer biological- it's a rock.

Unaltered remains



Bogs



- Acidic peat bogs, tar pits
- Pickling