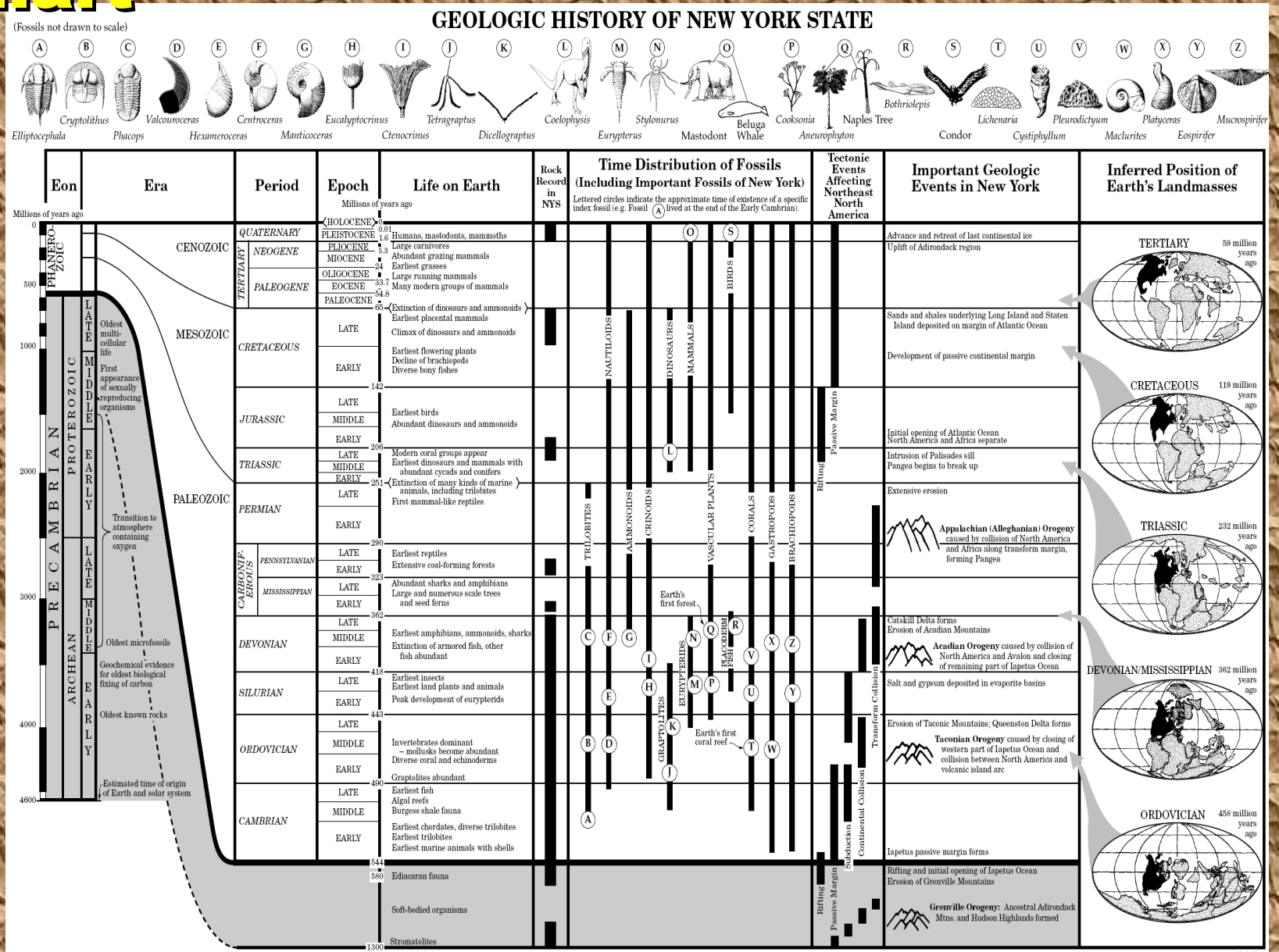
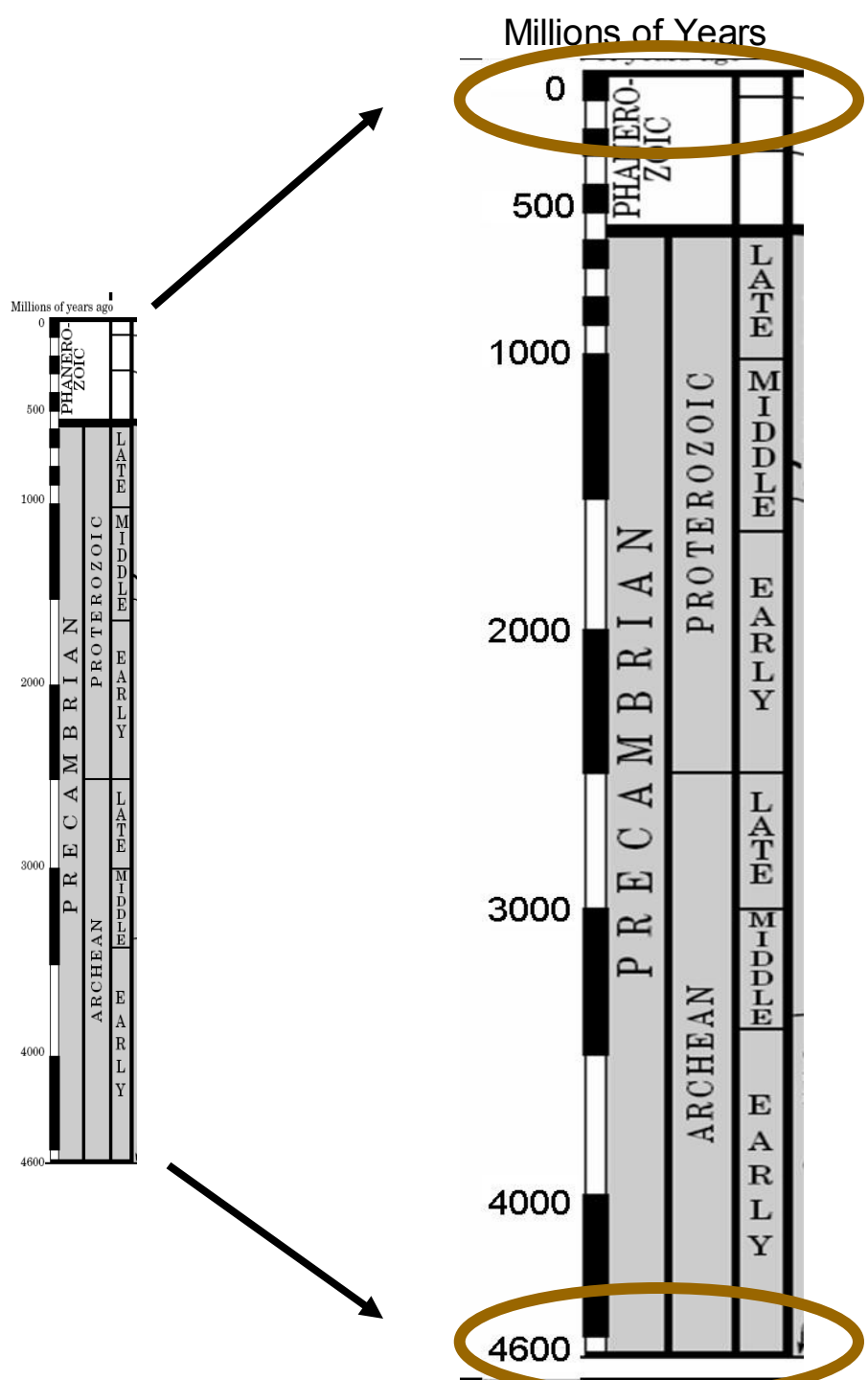
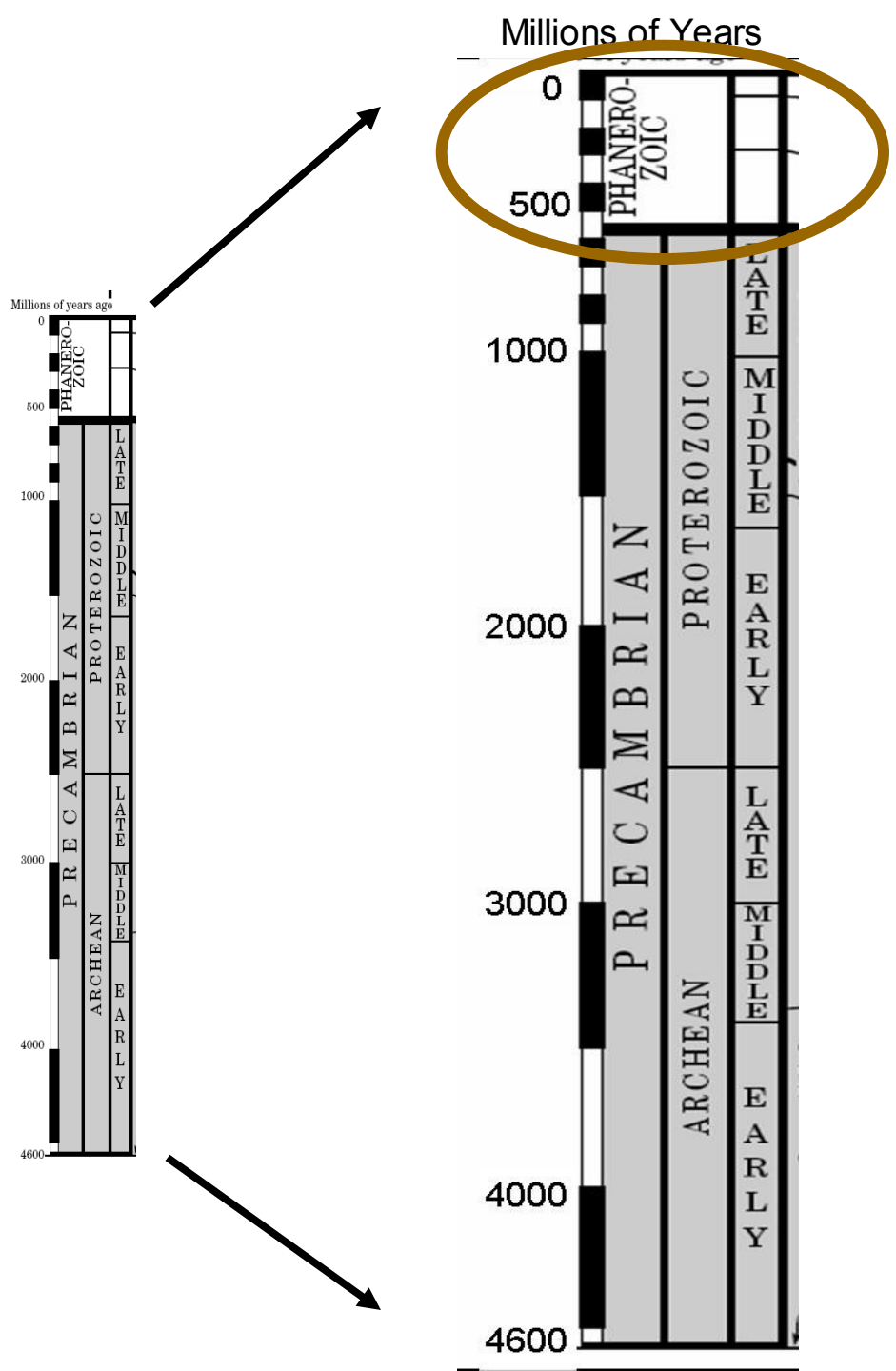
Using the ESRT's Geologic History chart

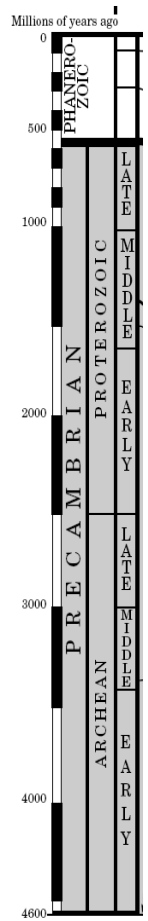


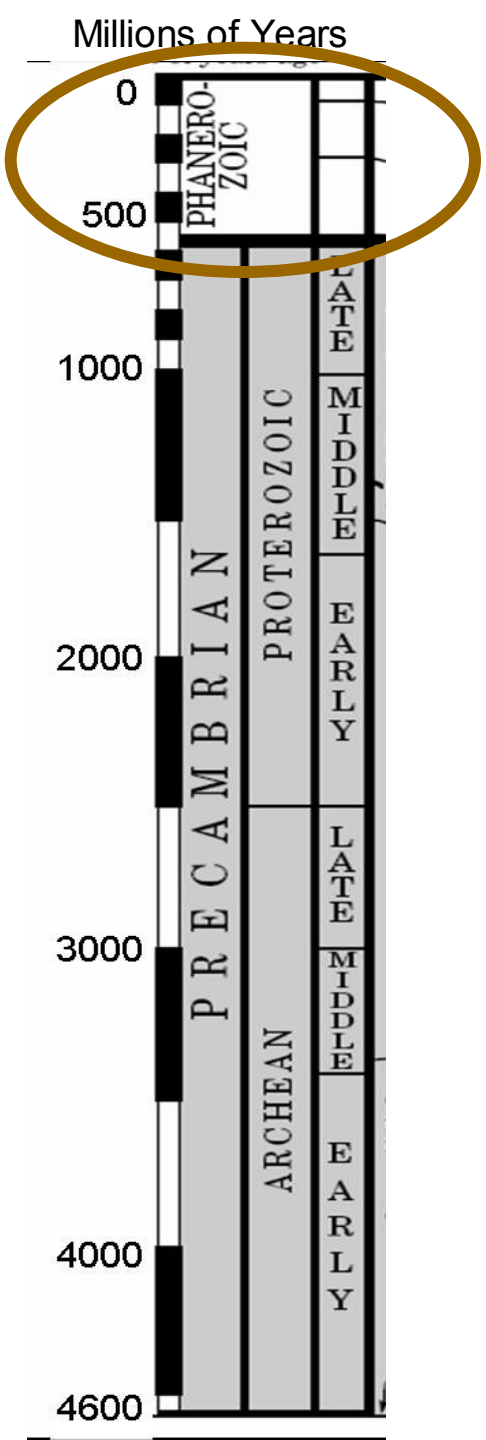


- The left side of the chart is a time-line.
- The scale starts at the present time (0 million years ago)
- and goes back to the Earth's formation, 4600 million years ago (4.6 billion years).



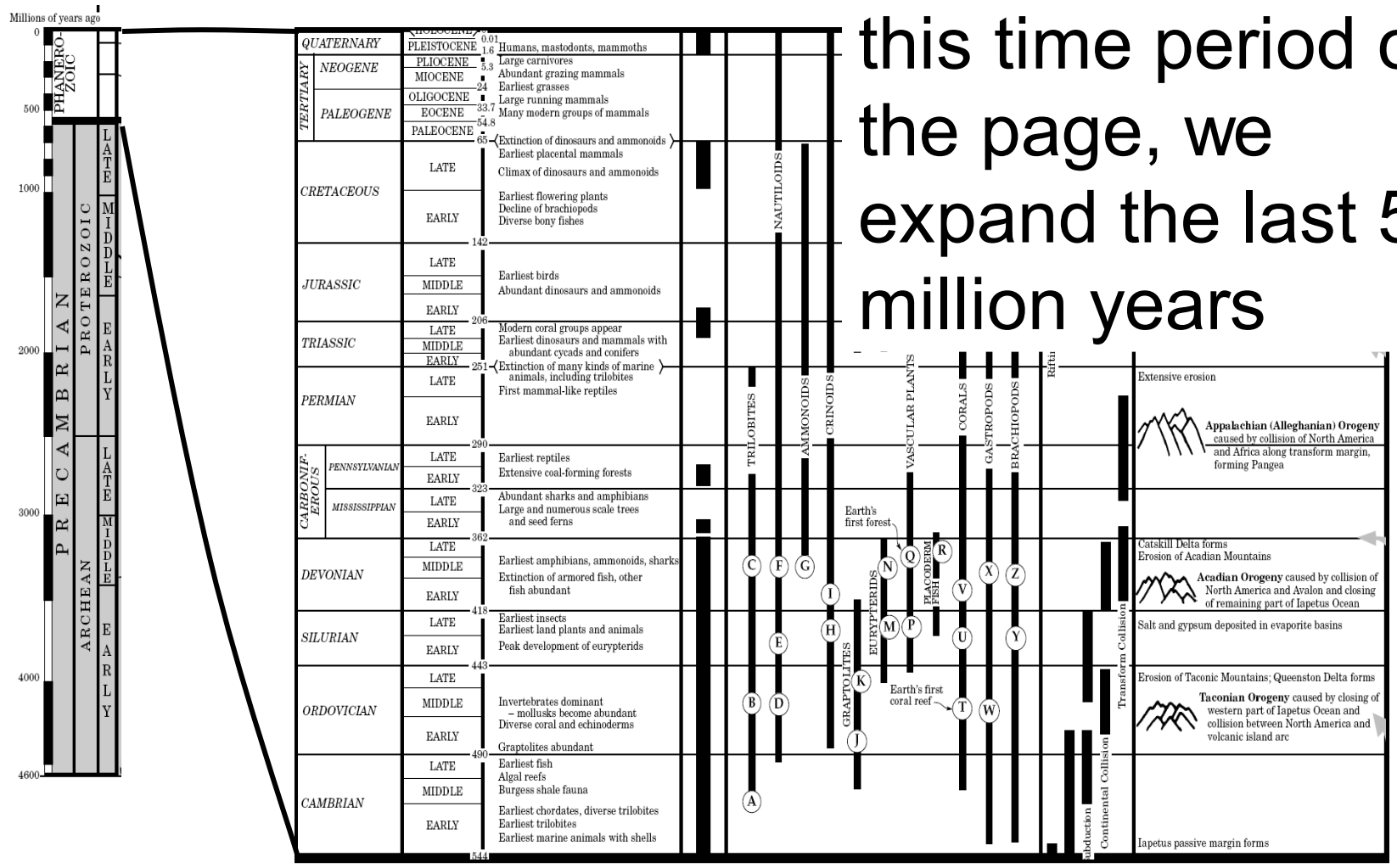
- However, since we have little geologic record and almost no multicellular life from the first 4 billion years, this chart focuses on the past half billion (500 million) years.

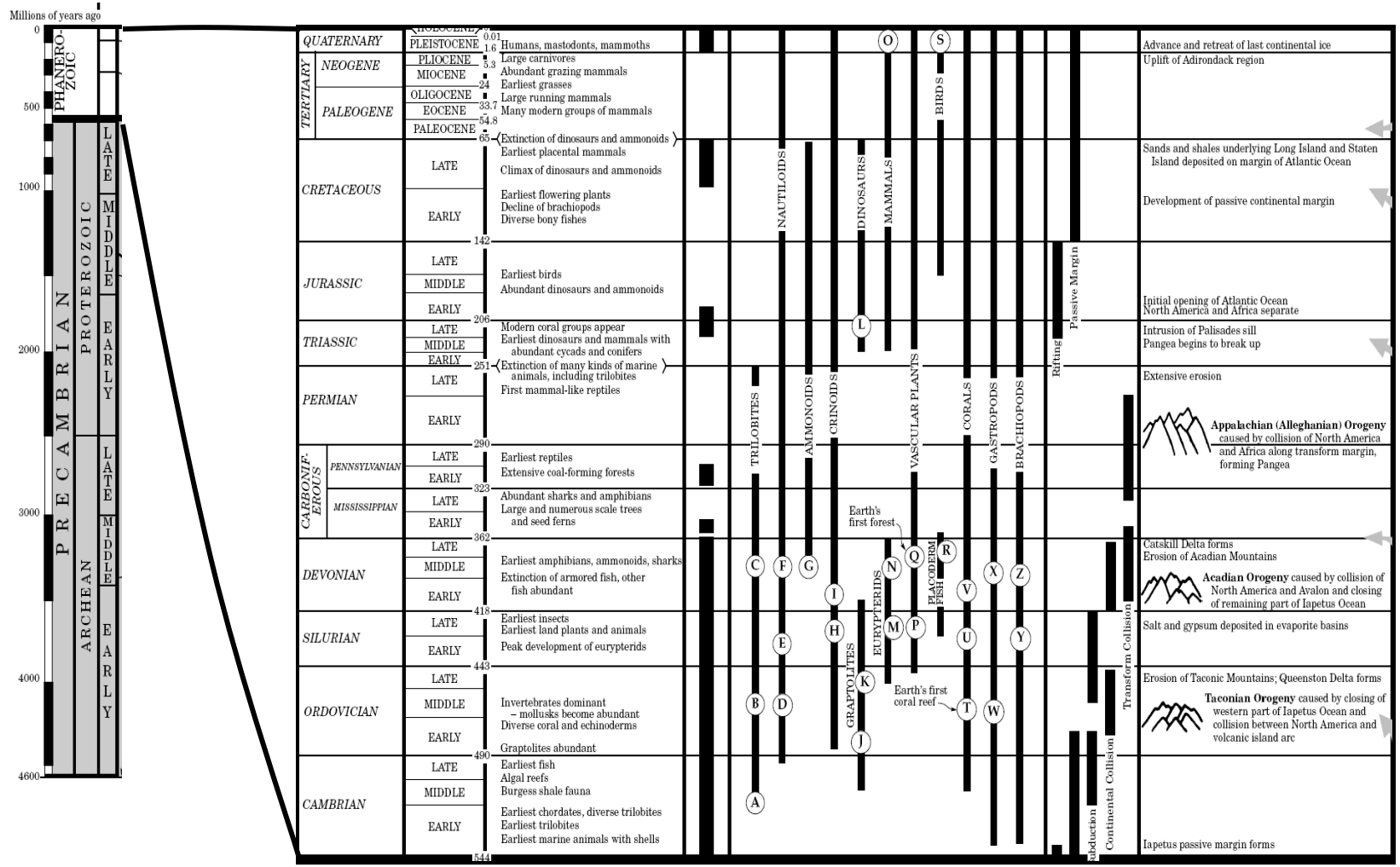




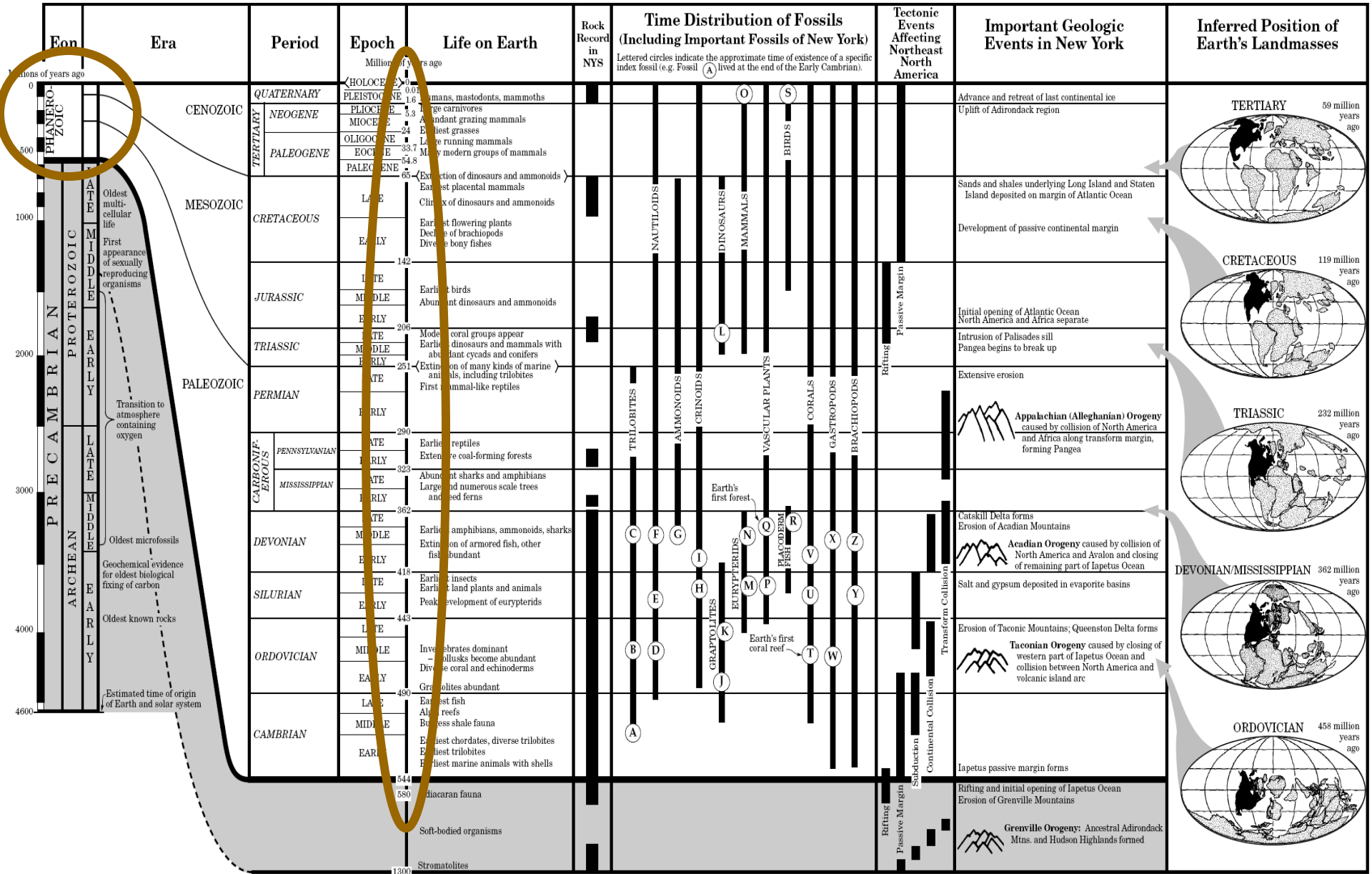
- In order to fit more information about this time period on the page, we expand the last 500 million years.

- In order to fit more information about this time period on the page, we expand the last 500 million years

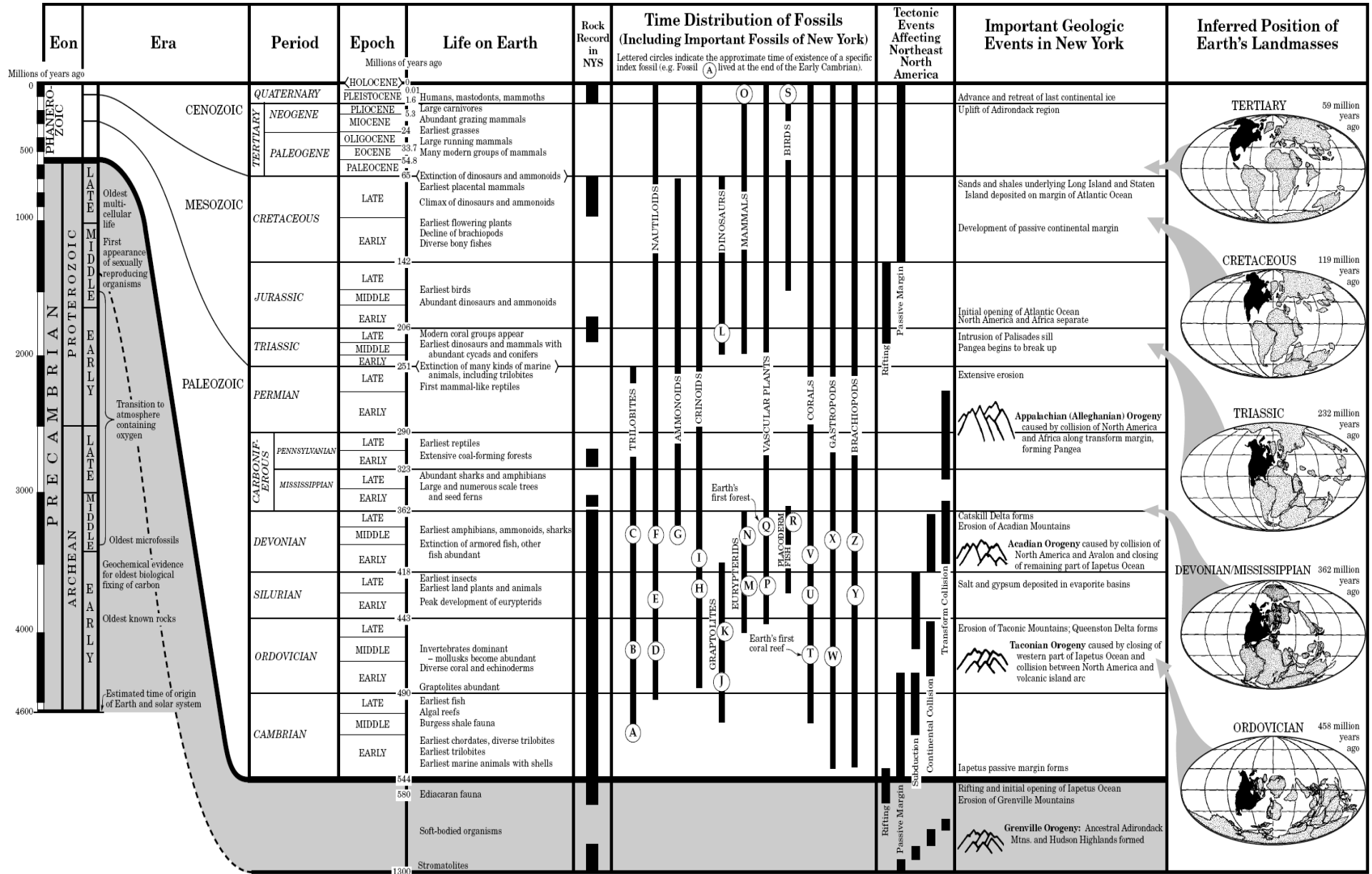



Millions of years ago
0
500
1000
2000
3000
4000
4600
PHANERO-ZOIC
PROTEROZOIC
ARCHEAN
PRECAMBRIAN
LATE
MIDDLE
EARLY
LATE
MIDDLE
EARLY
QUATERNARY
TERTIARY
NEOGENE
PALEOGENE
CRETACEOUS
JURASSIC
TRIASSIC
PERMIAN
CARBONIF-EROUS
PENNSYLVANIAN
MISSISSIPPIAN
DEVONIAN
SILURIAN
ORDOVICIAN
CAMBRIAN
PLEISTOCENE
PLIOCENE
MIOCENE
OLIGOCENE
EOCENE
PALEOCENE
0.01
1.6
5.3
24
33.7
54.8
65
142
206
251
290
323
362
418
443
490
544
Humans, mastodonts, mammoths
Large carnivores
Abundant grazing mammals
Earliest grasses
Large running mammals
Many modern groups of mammals
Extinction of dinosaurs and ammonoids
Earliest placental mammals
Climax of dinosaurs and ammonoids
Earliest flowering plants
Decline of brachiopods
Diverse bony fishes
Earliest birds
Abundant dinosaurs and ammonoids
Modern coral groups appear
Earliest dinosaurs and mammals with abundant cycads and conifers
Extinction of many kinds of marine animals, including trilobites
First mammal-like reptiles
Earliest reptiles
Extensive coal-forming forests
Abundant sharks and amphibians
Large and numerous scale trees and seed ferns
Earliest amphibians, ammonoids, sharks
Extinction of armored fish, other fish abundant
Earliest insects
Earliest land plants and animals
Peak development of eurypterids
Invertebrates dominant – mollusks become abundant
Diverse coral and echinoderms
Graptolites abundant
Earliest fish
Algal reefs
Burgess shale fauna
Earliest chordates, diverse trilobites
Earliest trilobites
Earliest marine animals with shells
TRILOBITES
NAUTILOIDS
AMMONOIDS
CRINOIDS
GRAPTOLITES
EURYPTERIDS
DINOSAURS
MAMMALS
VASCULAR PLANTS
Earth's first forest
PLACODERM FISH
BIRDS
CORALS
GASTROPODS
BRACHIOPODS
Earth's first coral reef
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
Q
R
S
T
U
V
W
X
Y
Z
Rifting
Passive Margin
Transform Collision
Subduction
Continental Collision
Advance and retreat of last continental ice
Uplift of Adirondack region
Sands and shales underlying Long Island and Staten Island deposited on margin of Atlantic Ocean
Development of passive continental margin
Initial opening of Atlantic Ocean
North America and Africa separate
Intrusion of Palisades sill
Pangea begins to break up
Extensive erosion
Appalachian (Alleghanian) Orogeny caused by collision of North America and Africa along transform margin, forming Pangea
Catskill Delta forms
Erosion of Acadian Mountains
Acadian Orogeny caused by collision of North America and Avalon and closing of remaining part of Iapetus Ocean
Salt and gypsum deposited in evaporite basins
Erosion of Taconic Mountains; Queenston Delta forms
Taconian Orogeny caused by closing of western part of Iapetus Ocean and collision between North America and volcanic island arc
Iapetus passive margin forms

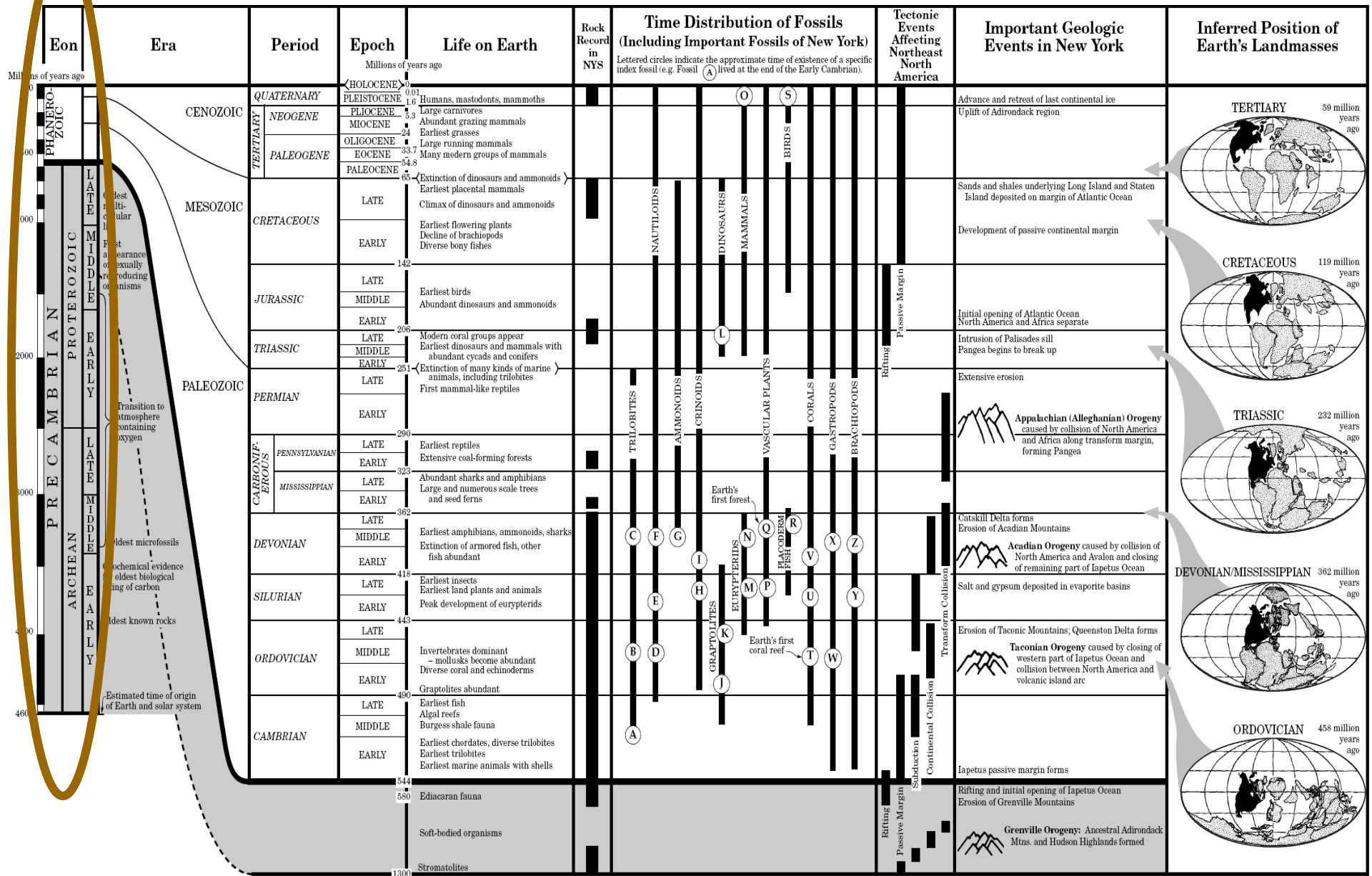
•After you know to look in the first 500 million years, you can use the expanded time scale for more accuracy.



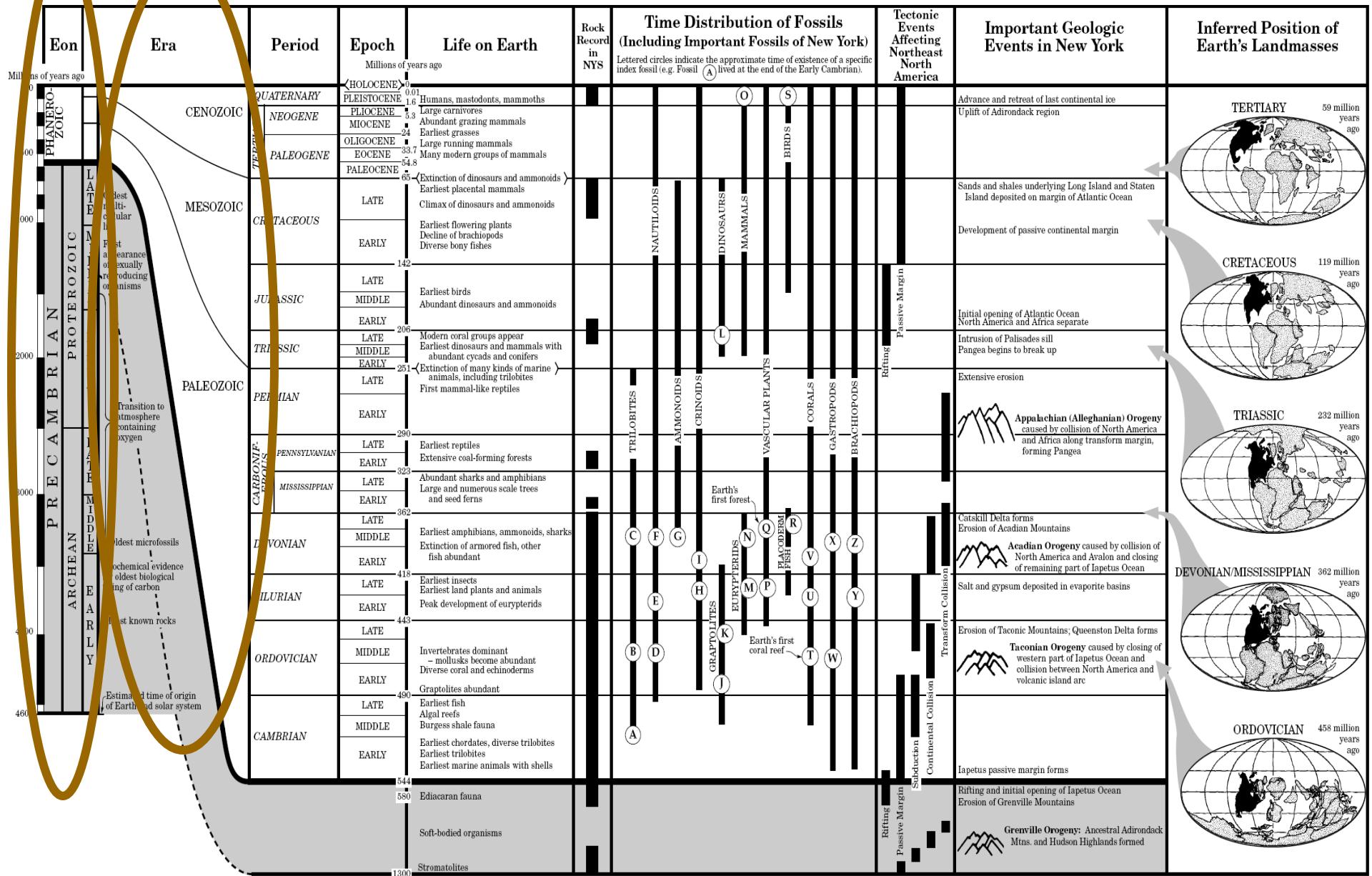
•Geologists have divided Earth's history into time units based upon the fossil record…



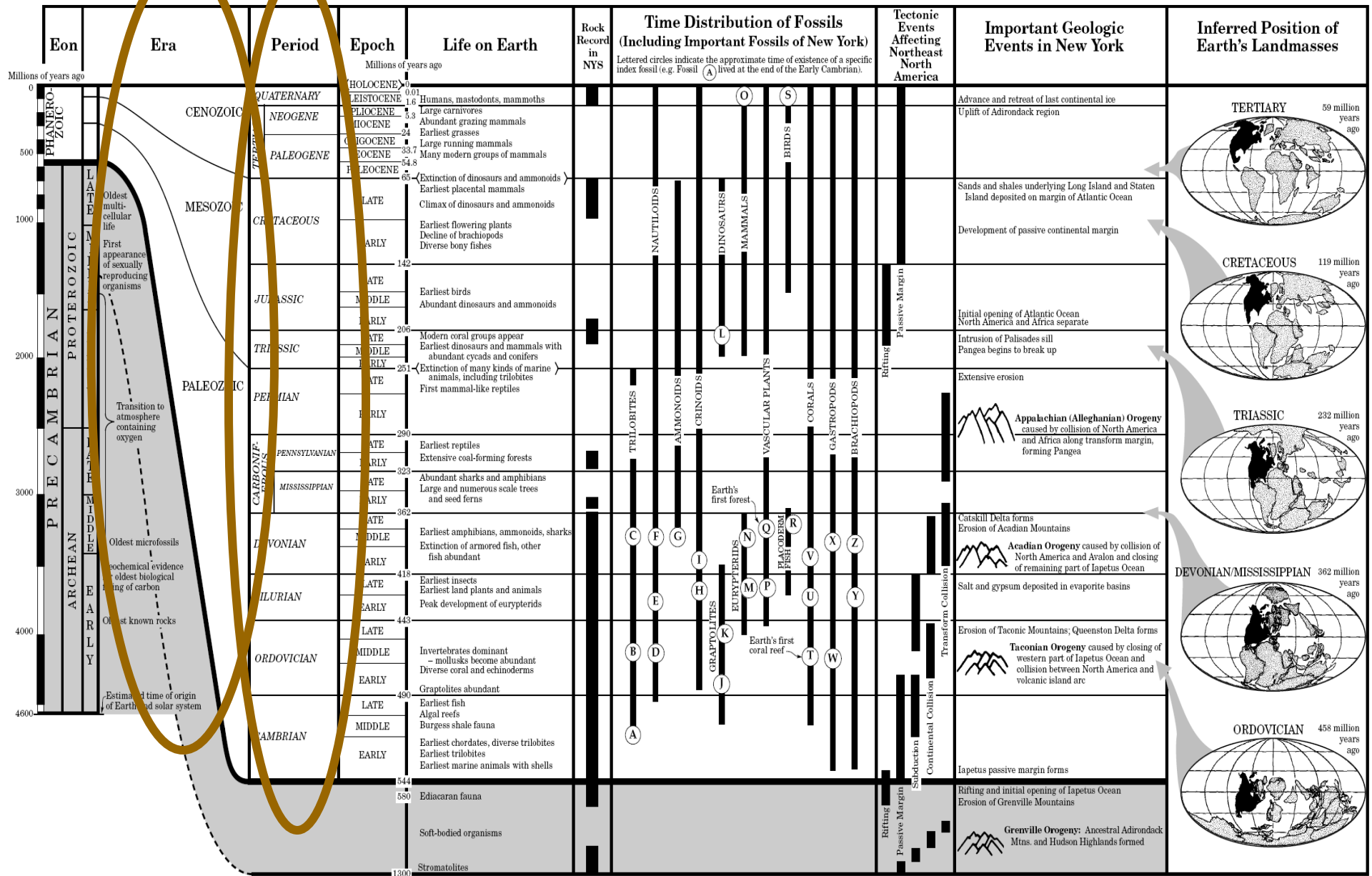
- The geologic history is broken up first into Eons…



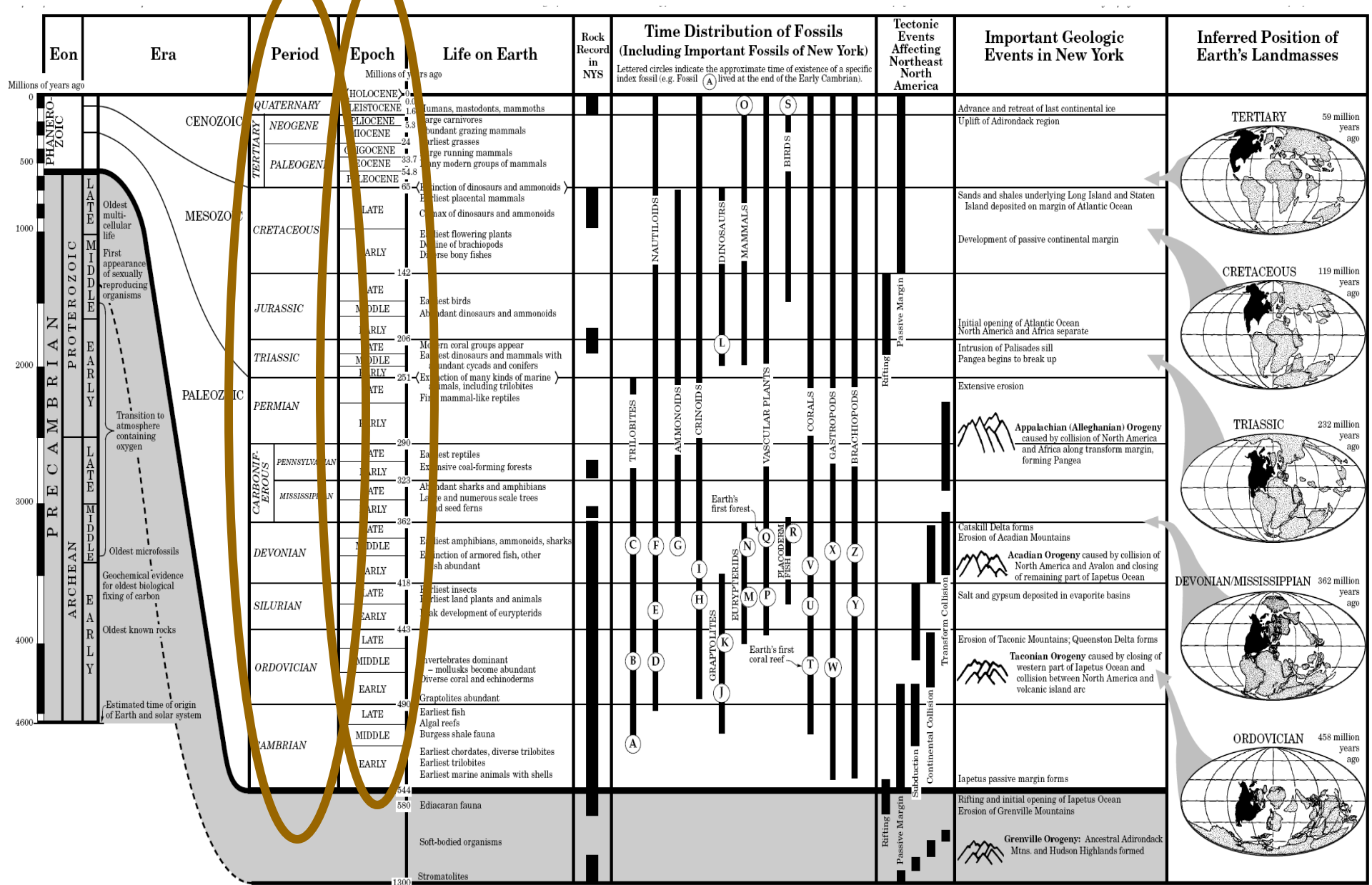
- The Eons are broken into Eras…

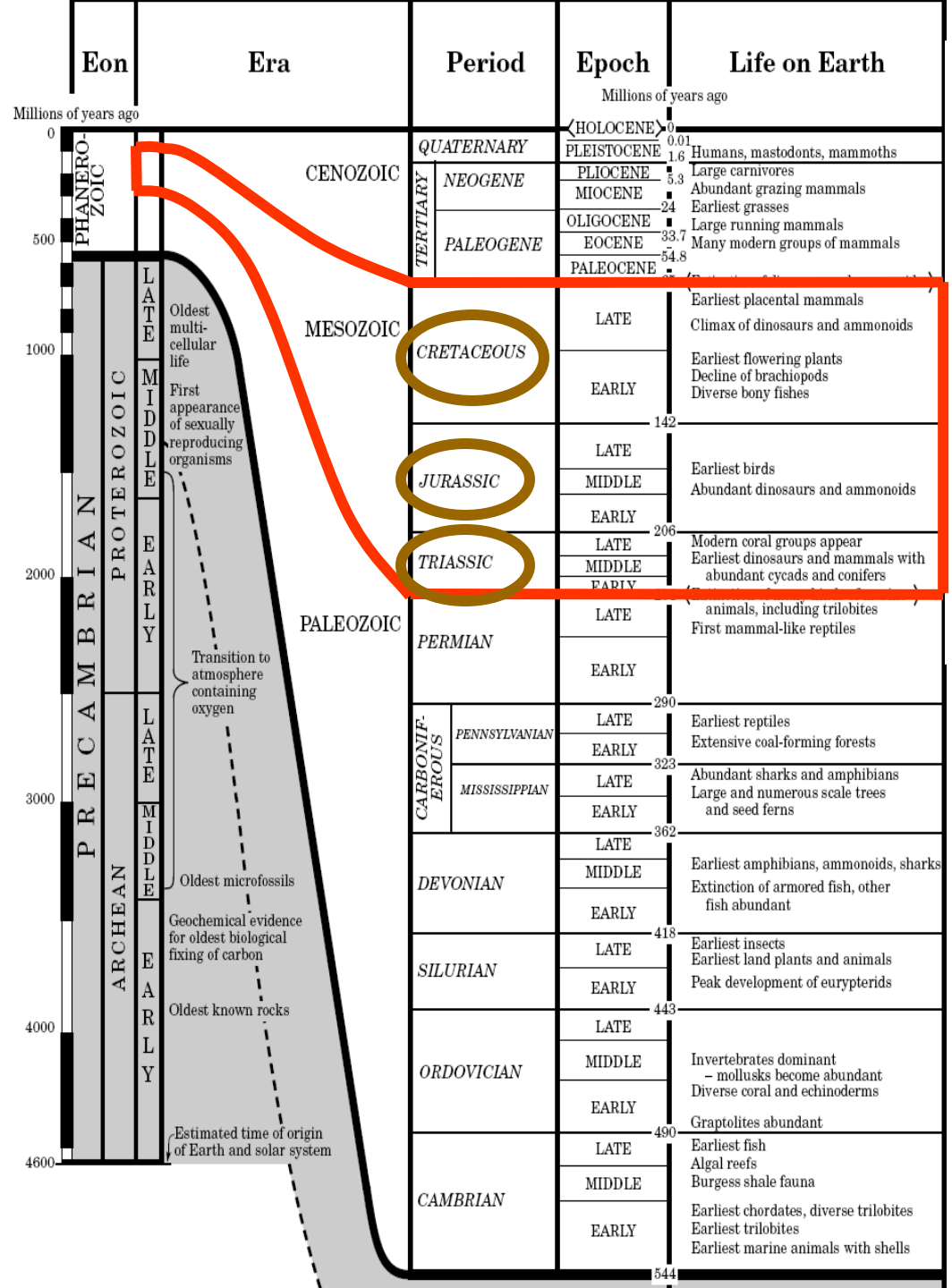


- The Eras are broken into Periods…

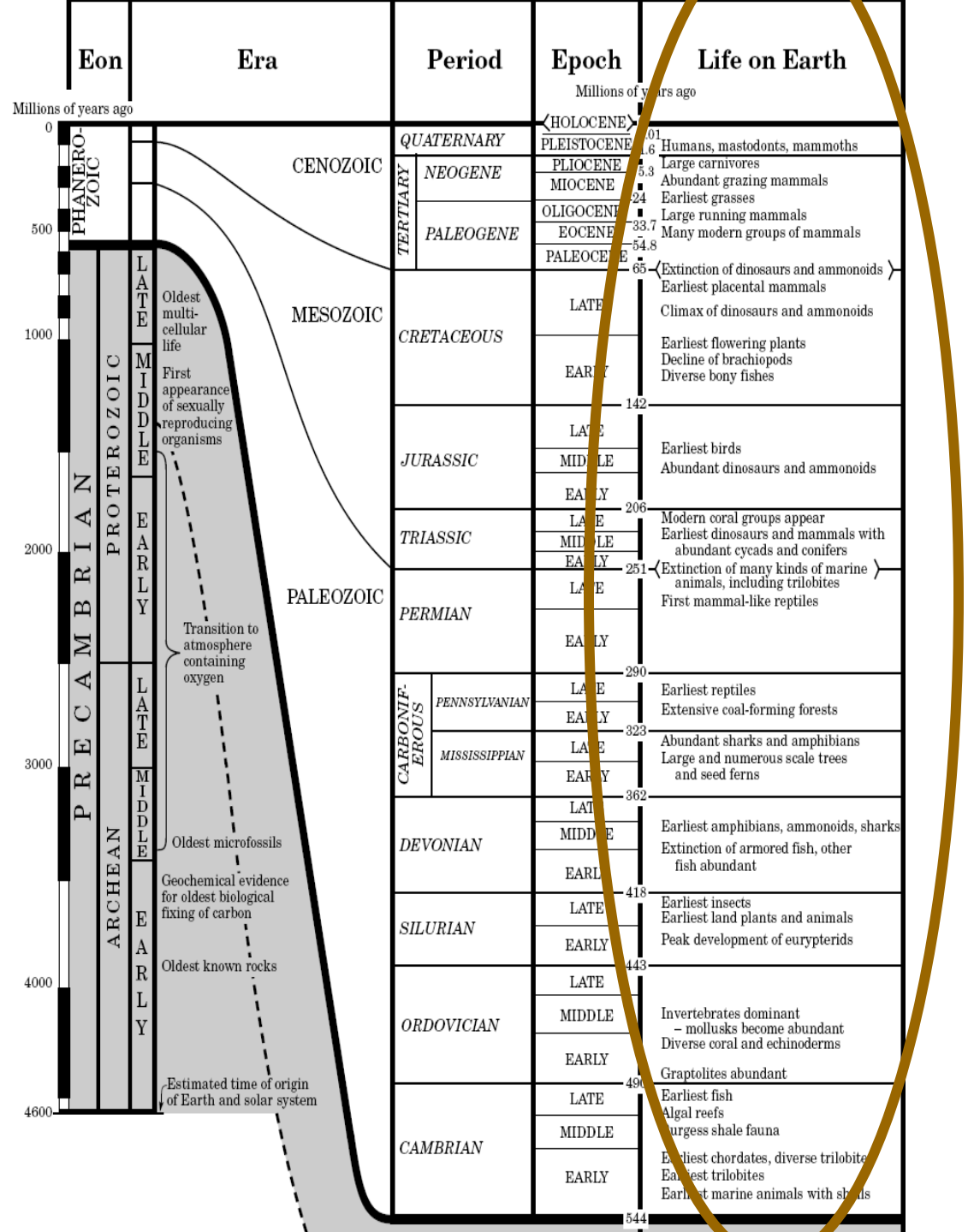


- And the Periods are broken into Epochs…

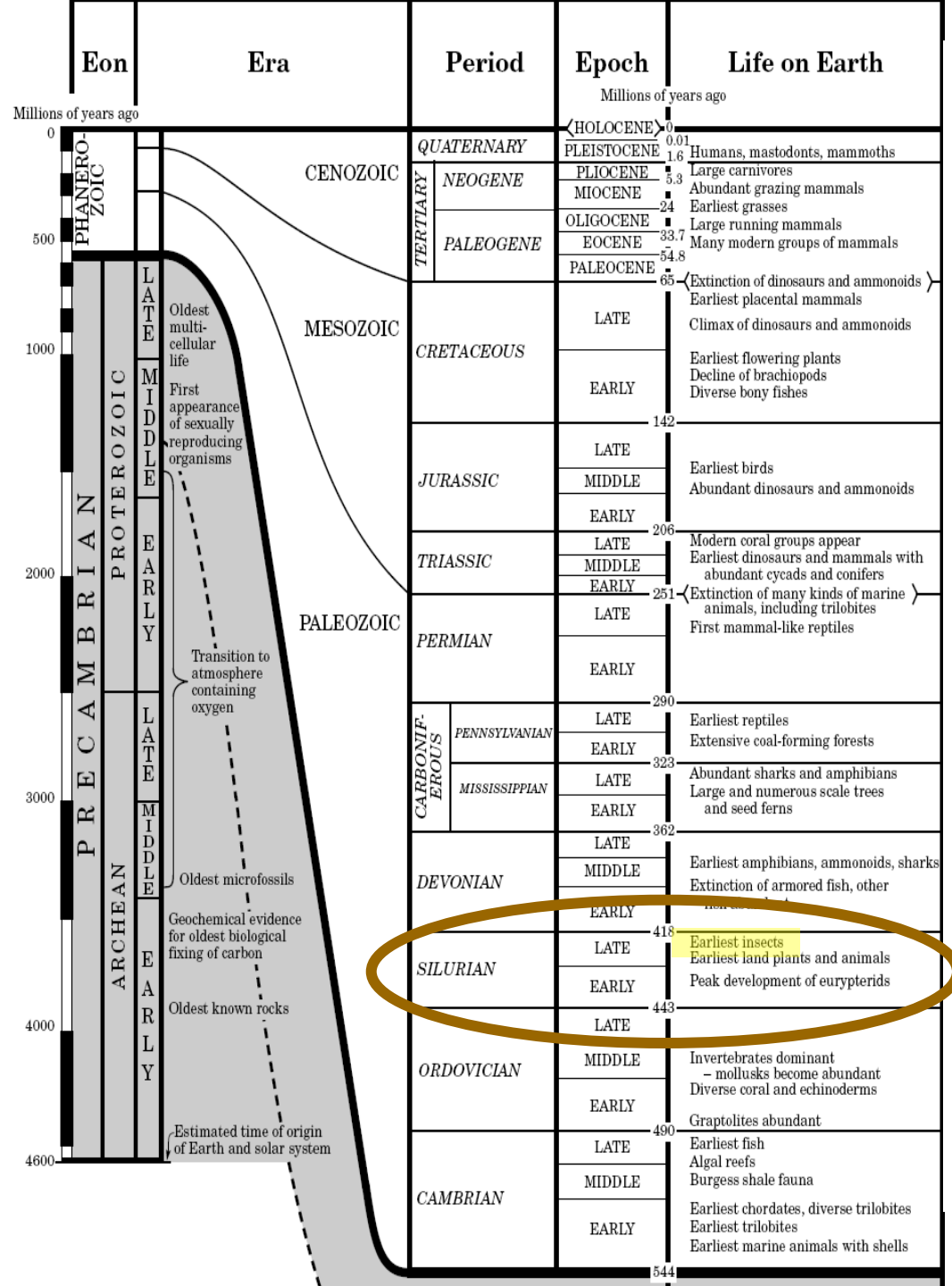




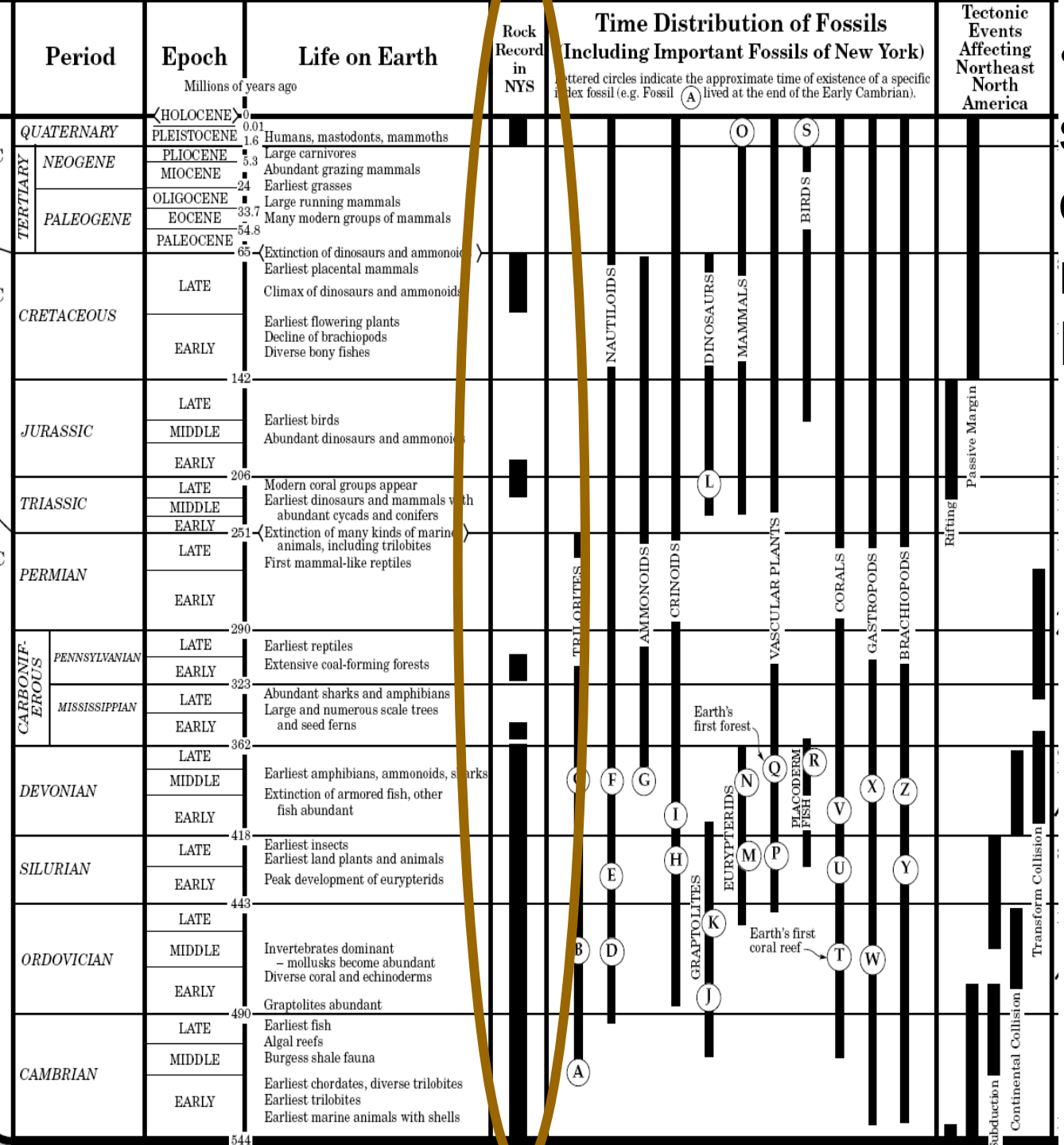
- The Mesozoic Era is made up of what three Periods?
- Cretaceous
- Jurassic
- Triassic



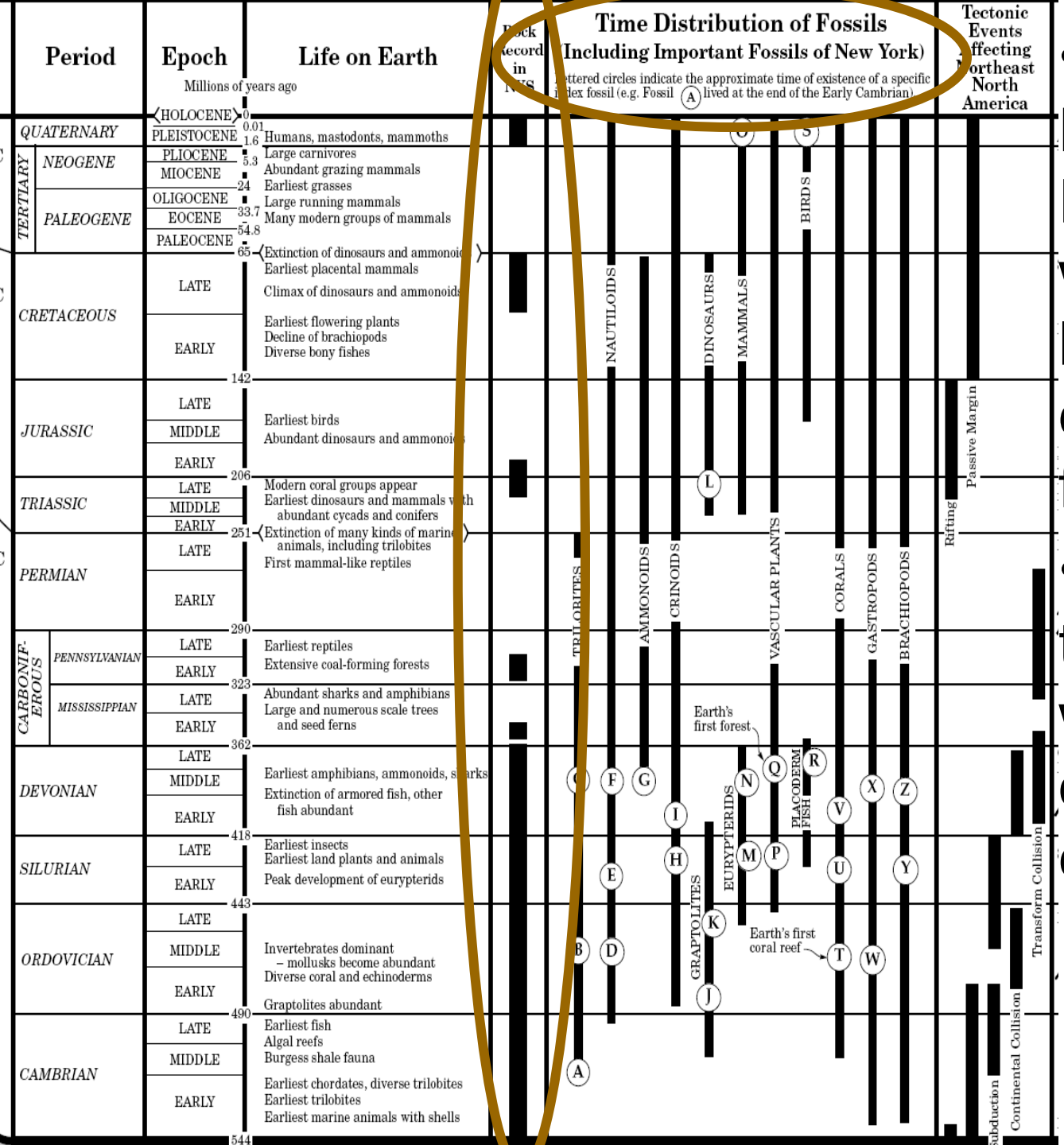
- We can also see approximately when different forms of life evolved on Earth.



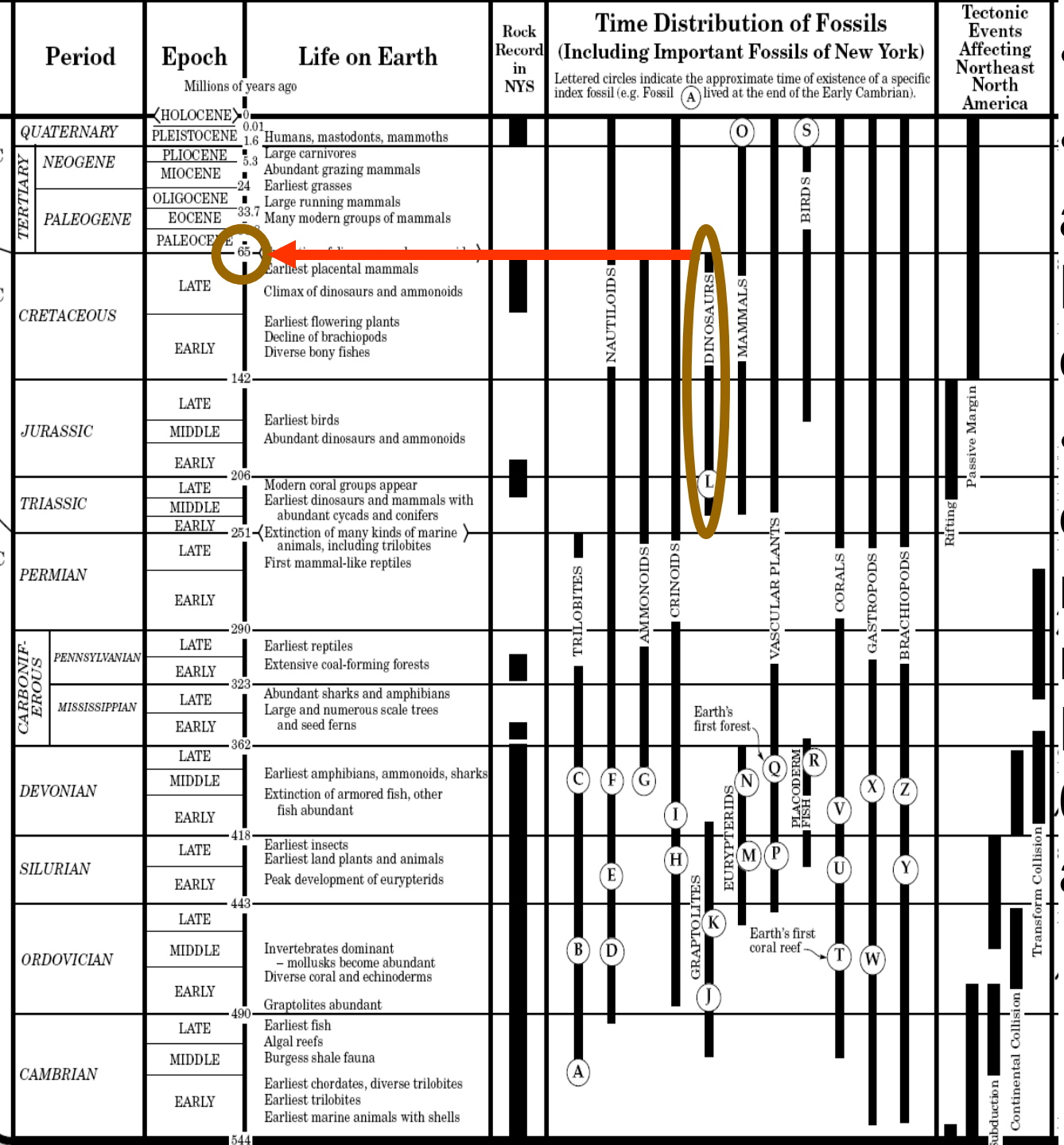
- Approximately how many years ago did the earliest insects appear?
- In the Silurian Period, between 418 and 443 million years ago…
- But closer to 418…
- So we can estimate 420 million years ago.



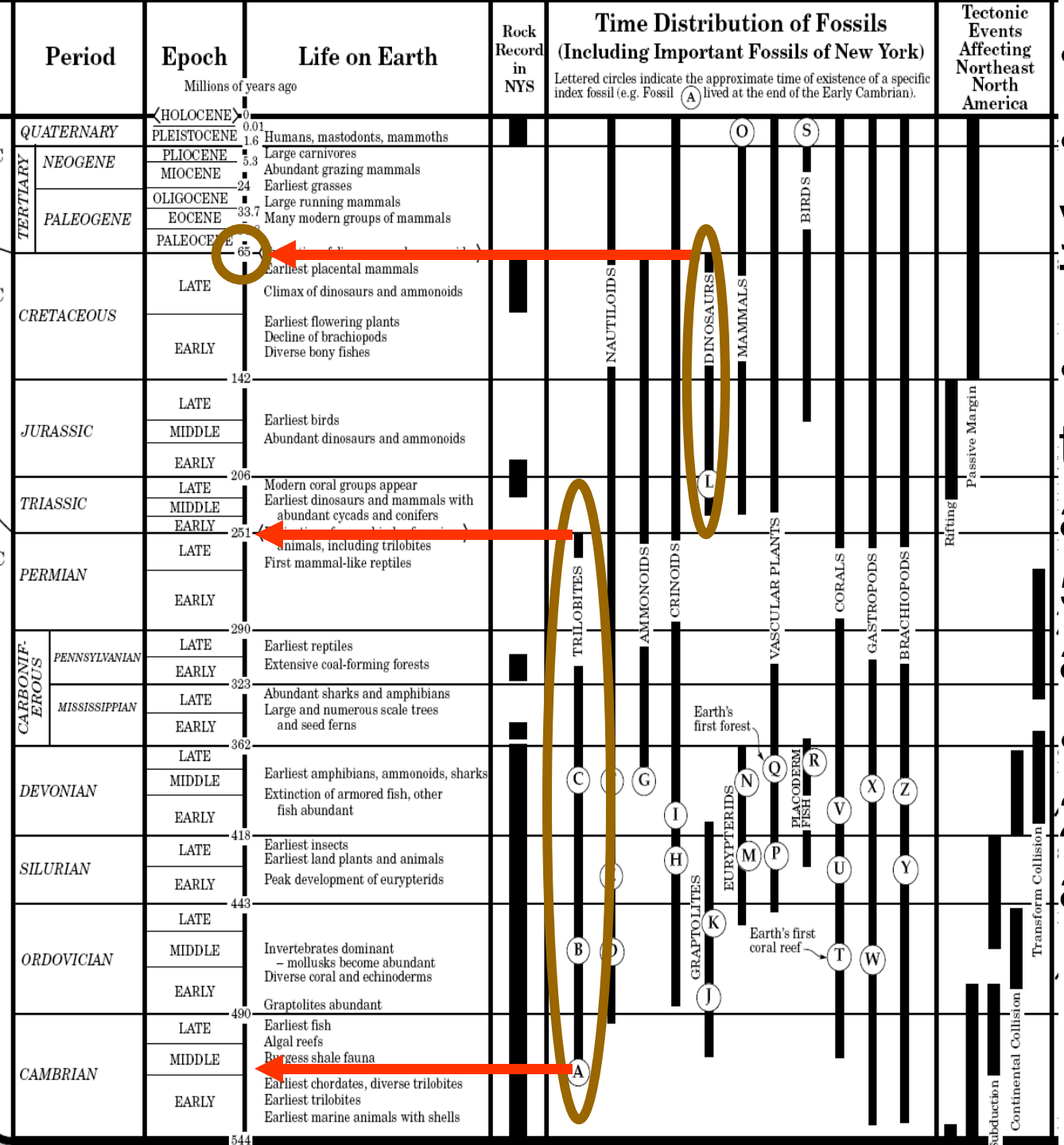
- The next column shows what parts of the rock record exist in New York State.



- "Time Distribution of Fossils" shows when and for how long different types of fossils are found.
- The lines span the time periods when each type of organism existed.



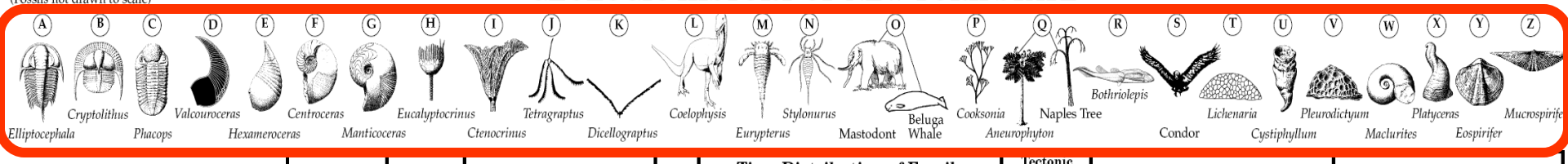
- For example,
- How many years ago did the Dinosaurs go extinct?
- Since the line ends at 65 million, this means the last Dinosaurs lived 65 million years ago.



- For example,
- Between what years did Trilobites exist?
- We can see that the first trilobites are found about 520 million years ago…
- And went extinct 251 million years ago.

(Fossils not drawn to scale)

GEOLOGIC HISTORY OF NEW YORK STATE



- The pictures at the top of the screen represent index fossils

Period	Epoch	Millions of years ago	Life on Earth	Rock Record in NYS	Time Distribution of Fossils (Including Important Fossils of New York)	Tectonic Events Affecting Northeast North America	Important Geologic Events in New York
	HOLOCENE	0					
QUATERNARY	PLEISTOCENE	0.01 / 1.6	Humans, mastodonts, mammoths				Advance and retreat of last continental ice
TERTIARY NEOGENE	PLIOCENE	5.3	Large carnivores				Uplift of Adirondack region
	MIOCENE	24	Abundant grazing mammals Earliest grasses				
TERTIARY PALEOGENE	OLIGOCENE	33.7	Large running mammals				
	EOCENE	54.8	Many modern groups of mammals				
	PALEOCENE	65	Extinction of dinosaurs and ammonoids				
CRETACEOUS	LATE		Earliest placental mammals Climax of dinosaurs and ammonoids				Sands and shales underlying Long Island and Staten Island deposited on margin of Atlantic Ocean
	EARLY		Earliest flowering plants Decline of brachiopods Diverse bony fishes				Development of passive continental margin
		142					
JURASSIC	LATE		Earliest birds				
	MIDDLE		Abundant dinosaurs and ammonoids				
	EARLY	206					Initial opening of Atlantic Ocean North America and Africa separate
TRIASSIC	LATE		Modern coral groups appear				
	MIDDLE		Earliest dinosaurs and mammals with abundant cycads and conifers				Intrusion of Palisades sill Pangea begins to break up
	EARLY	251	Extinction of many kinds of marine animals, including trilobites				
PERMIAN	LATE		First mammal-like reptiles				Extensive erosion
	EARLY	290					**Appalachian (Alleghanian) Orogeny** caused by collision of North America and Africa along transform margin, forming Pangea
CARBONIFEROUS PENNSYLVANIAN	LATE		Earliest reptiles				
	EARLY	323	Extensive coal-forming forests				
CARBONIFEROUS MISSISSIPPIAN	LATE		Abundant sharks and amphibians Large and numerous scale trees and seed ferns				
	EARLY	362					
DEVONIAN	LATE		Earliest amphibians, ammonoids, sharks				Catskill Delta forms Erosion of Acadian Mountains
	MIDDLE		Extinction of armored fish, other fish abundant				**Acadian Orogeny** caused by collision of North America and Avalon and closing of remaining part of Iapetus Ocean
	EARLY	418					
SILURIAN	LATE		Earliest insects Earliest land plants and animals				Salt and gypsum deposited in evaporite basins
	EARLY	443	Peak development of eurypterids				
ORDOVICIAN	LATE						Erosion of Taconic Mountains; Queenston Delta forms
	MIDDLE		Invertebrates dominant – mollusks become abundant Diverse coral and echinoderms				**Taconian Orogeny** caused by closing of western part of Iapetus Ocean and collision between North America and volcanic island arc
	EARLY	490	Graptolites abundant				
CAMBRIAN	LATE		Earliest fish Algal reefs				
	MIDDLE		Burgess shale fauna				
	EARLY		Earliest chordates, diverse trilobites Earliest trilobites Earliest marine animals with shells				Iapetus passive margin forms
		544					
		580	Ediacaran fauna				Rifting and initial opening of Iapetus Ocean Erosion of Grenville Mountains
			Soft-bodied organisms				**Grenville Orogeny:** Ancestral Adirondack Mtns. and Hudson Highlands formed
		1300	Stromatolites				

Time Distribution of Fossils (Including Important Fossils of New York)

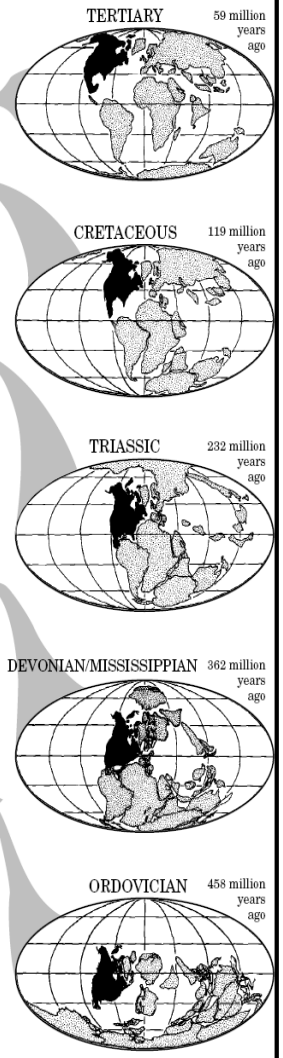
Lettered circles indicate the approximate time of existence of a specific index fossil (e.g. Fossil (A) lived at the end of the Early Cambrian).

TRILOBITES (A, B, C) · NAUTILOIDS (D, E, F) · AMMONOIDS (G) · CRINOIDS (H, I) · GRAPTOLITES (J, K) · DINOSAURS (L) · MAMMALS (L) · EURYPTERIDS (M) · Earth's first coral reef (M) · Earth's first forest (N) · VASCULAR PLANTS (N, O) · PLACODERM FISH (P, Q, R) · BIRDS (S) · CORALS (T, U, V) · GASTROPODS (W, X) · BRACHIOPODS (Y, Z)

Tectonic Events Affecting Northeast North America

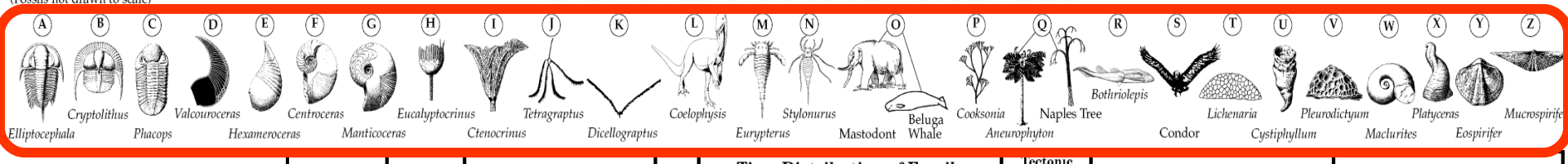
Rifting · Passive Margin · Rifting · Transform Collision · Subduction · Continental Collision · Passive Margin

Inferred Position of Earth's Landmasses



GEOLOGIC HISTORY OF NEW YORK STATE

(Fossils not drawn to scale)



- Each existed for a short period of time and can be dated using the chart.

Period	Epoch	Millions of years ago	Life on Earth	Important Geologic Events in New York
QUATERNARY	HOLOCENE	0		
	PLEISTOCENE	0.01 / 1.6	Humans, mastodonts, mammoths	Advance and retreat of last continental ice
TERTIARY – NEOGENE	PLIOCENE	5.3	Large carnivores	Uplift of Adirondack region
	MIOCENE	24	Abundant grazing mammals Earliest grasses	
TERTIARY – PALEOGENE	OLIGOCENE	33.7	Large running mammals	
	EOCENE	54.8	Many modern groups of mammals	
	PALEOCENE	65	Extinction of dinosaurs and ammonoids	
CRETACEOUS	LATE		Earliest placental mammals Climax of dinosaurs and ammonoids	Sands and shales underlying Long Island and Staten Island deposited on margin of Atlantic Ocean
	EARLY		Earliest flowering plants Decline of brachiopods Diverse bony fishes	Development of passive continental margin
		142		
JURASSIC	LATE			
	MIDDLE		Earliest birds Abundant dinosaurs and ammonoids	
	EARLY	206		Initial opening of Atlantic Ocean North America and Africa separate
TRIASSIC	LATE		Modern coral groups appear	
	MIDDLE		Earliest dinosaurs and mammals with abundant cycads and conifers	Intrusion of Palisades sill Pangea begins to break up
	EARLY	251	Extinction of many kinds of marine animals, including trilobites	
PERMIAN	LATE		First mammal-like reptiles	Extensive erosion
	EARLY			**Appalachian (Alleghanian) Orogeny** caused by collision of North America and Africa along transform margin, forming Pangea
		290		
CARBONIFEROUS – PENNSYLVANIAN	LATE		Earliest reptiles	
	EARLY	323	Extensive coal-forming forests	
CARBONIFEROUS – MISSISSIPPIAN	LATE		Abundant sharks and amphibians Large and numerous scale trees and seed ferns	
	EARLY	362		
DEVONIAN	LATE			Catskill Delta forms Erosion of Acadian Mountains
	MIDDLE		Earliest amphibians, ammonoids, sharks	
	EARLY	418	Extinction of armored fish, other fish abundant	**Acadian Orogeny** caused by collision of North America and Avalon and closing of remaining part of Iapetus Ocean
SILURIAN	LATE		Earliest insects Earliest land plants and animals	Salt and gypsum deposited in evaporite basins
	EARLY	443	Peak development of eurypterids	
ORDOVICIAN	LATE			Erosion of Taconic Mountains; Queenston Delta forms
	MIDDLE		Invertebrates dominant – mollusks become abundant Diverse coral and echinoderms	**Taconian Orogeny** caused by closing of western part of Iapetus Ocean and collision between North America and volcanic island arc
	EARLY	490	Graptolites abundant	
CAMBRIAN	LATE		Earliest fish Algal reefs Burgess shale fauna	
	MIDDLE			
	EARLY		Earliest chordates, diverse trilobites Earliest trilobites Earliest marine animals with shells	Iapetus passive margin forms
		544		
		580	Ediacaran fauna	Rifting and initial opening of Iapetus Ocean Erosion of Grenville Mountains
			Soft-bodied organisms	**Grenville Orogeny:** Ancestral Adirondack Mtns. and Hudson Highlands formed
		1300	Stromatolites	

Time Distribution of Fossils (Including Important Fossils of New York)

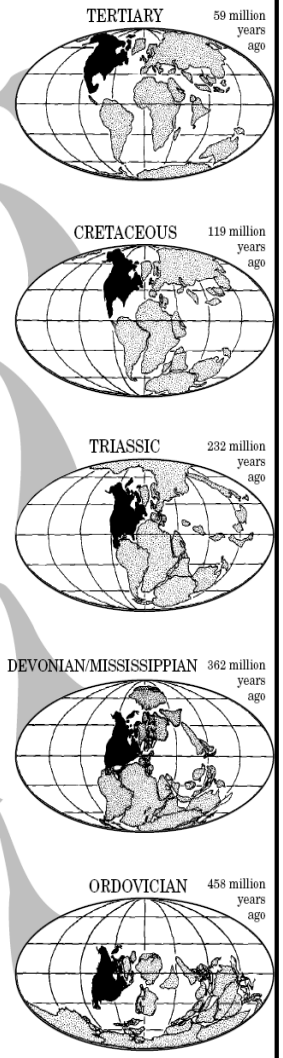
Lettered circles indicate the approximate time of existence of a specific index fossil (e.g. Fossil A lived at the end of the Early Cambrian).

Fossil ranges: TRILOBITES, NAUTILOIDS, AMMONOIDS, CRINOIDS, DINOSAURS, MAMMALS, BIRDS, VASCULAR PLANTS, CORALS, GASTROPODS, BRACHIOPODS, GRAPTOLITES, EURYPTERIDS, PLACODERM FISH, Earth's first forest, Earth's first coral reef

Tectonic Events Affecting Northeast North America

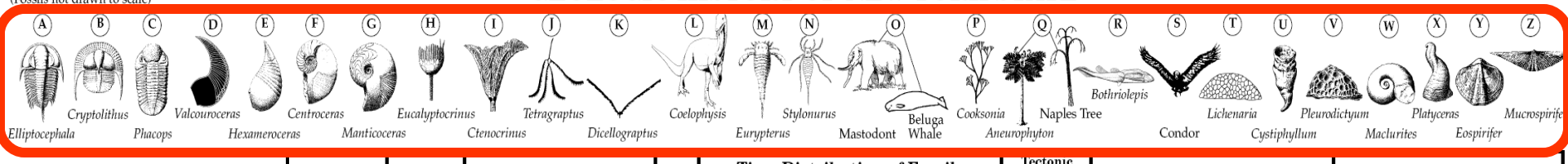
Rifting, Passive Margin, Transform Collision, Subduction, Continental Collision, Rifting, Passive Margin

Inferred Position of Earth's Landmasses



GEOLOGIC HISTORY OF NEW YORK STATE

(Fossils not drawn to scale)



- Just find where the fossil's letter is on the chart and estimate the age.

Period	Epoch	Millions of years ago	Life on Earth
QUATERNARY	HOLOCENE	0	
	PLEISTOCENE	0.01	Humans, mastodonts, mammoths
TERTIARY – NEOGENE	PLIOCENE	1.6	Large carnivores
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TERTIARY – PALEOGENE	OLIGOCENE	24	Earliest grasses
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	EARLY		Earliest flowering plants Decline of brachiopods Diverse bony fishes
JURASSIC	LATE	142	Earliest birds
	MIDDLE		Abundant dinosaurs and ammonoids
	EARLY	206	
TRIASSIC	LATE		Modern coral groups appear
	MIDDLE		Earliest dinosaurs and mammals with abundant cycads and conifers
	EARLY	251	Extinction of many kinds of marine animals, including trilobites
PERMIAN	LATE		First mammal-like reptiles
	EARLY	290	
CARBONIFEROUS – PENNSYLVANIAN	LATE		Earliest reptiles
	EARLY	323	Extensive coal-forming forests
CARBONIFEROUS – MISSISSIPPIAN	LATE		Abundant sharks and amphibians
	EARLY	362	Large and numerous scale trees and seed ferns
DEVONIAN	LATE		
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	EARLY	544	Earliest chordates, diverse trilobites Earliest trilobites Earliest marine animals with shells
		580	Ediacaran fauna
			Soft-bodied organisms
		1300	Stromatolites

Time Distribution of Fossils (Including Important Fossils of New York)

Lettered circles indicate the approximate time of existence of a specific index fossil (e.g. Fossil A lived at the end of the Early Cambrian).

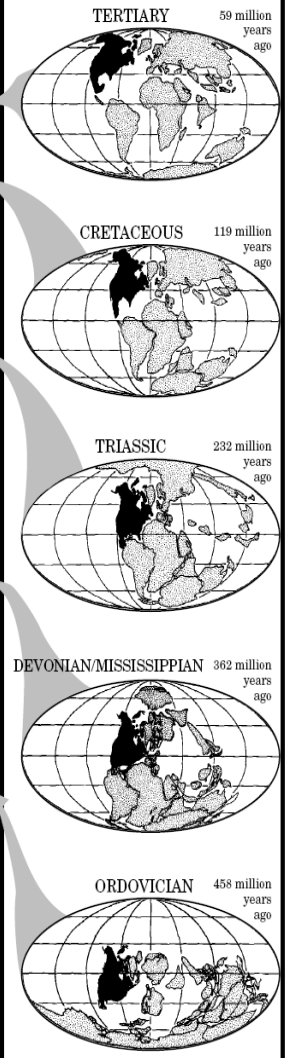
Rock Record in NYS

Tectonic Events Affecting Northeast North America

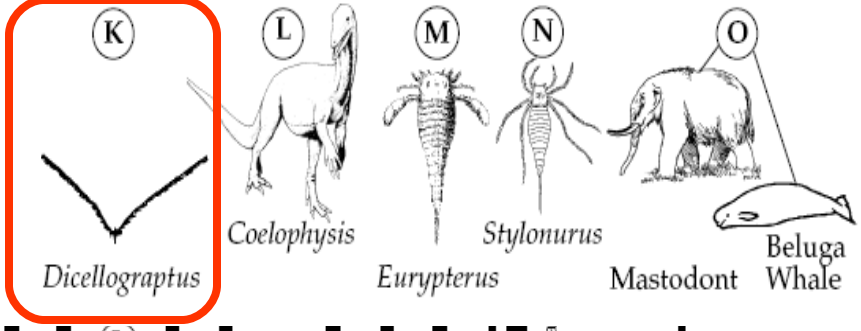
Important Geologic Events in New York

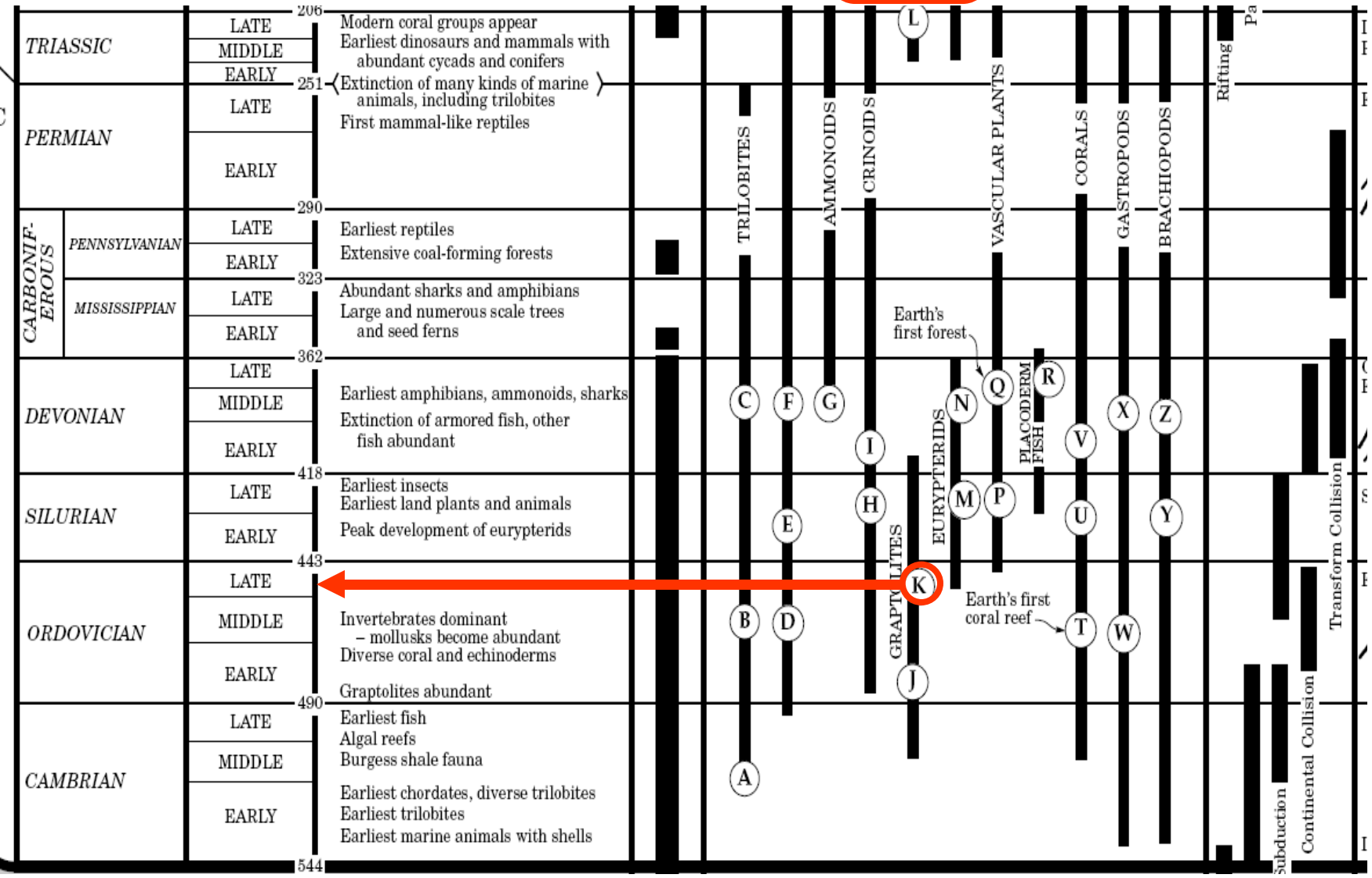
- Advance and retreat of last continental ice
- Uplift of Adirondack region
- Sands and shales underlying Long Island and Staten Island deposited on margin of Atlantic Ocean
- Development of passive continental margin
- Initial opening of Atlantic Ocean North America and Africa separate
- Intrusion of Palisades sill
- Pangea begins to break up
- Extensive erosion
- **Appalachian (Alleghanian) Orogeny** caused by collision of North America and Africa along transform margin, forming Pangea
- Catskill Delta forms
- Erosion of Acadian Mountains
- **Acadian Orogeny** caused by collision of North America and Avalon and closing of remaining part of Iapetus Ocean
- Salt and gypsum deposited in evaporite basins
- Erosion of Taconic Mountains; Queenston Delta forms
- **Taconian Orogeny** caused by closing of western part of Iapetus Ocean and collision between North America and volcanic island arc
- Iapetus passive margin forms
- Rifting and initial opening of Iapetus Ocean
- Erosion of Grenville Mountains
- **Grenville Orogeny:** Ancestral Adirondack Mtns. and Hudson Highlands formed

Inferred Position of Earth's Landmasses

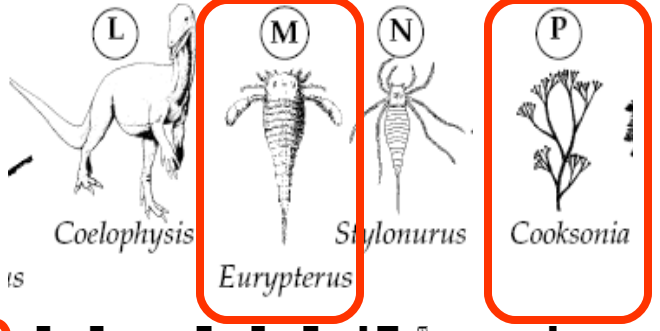


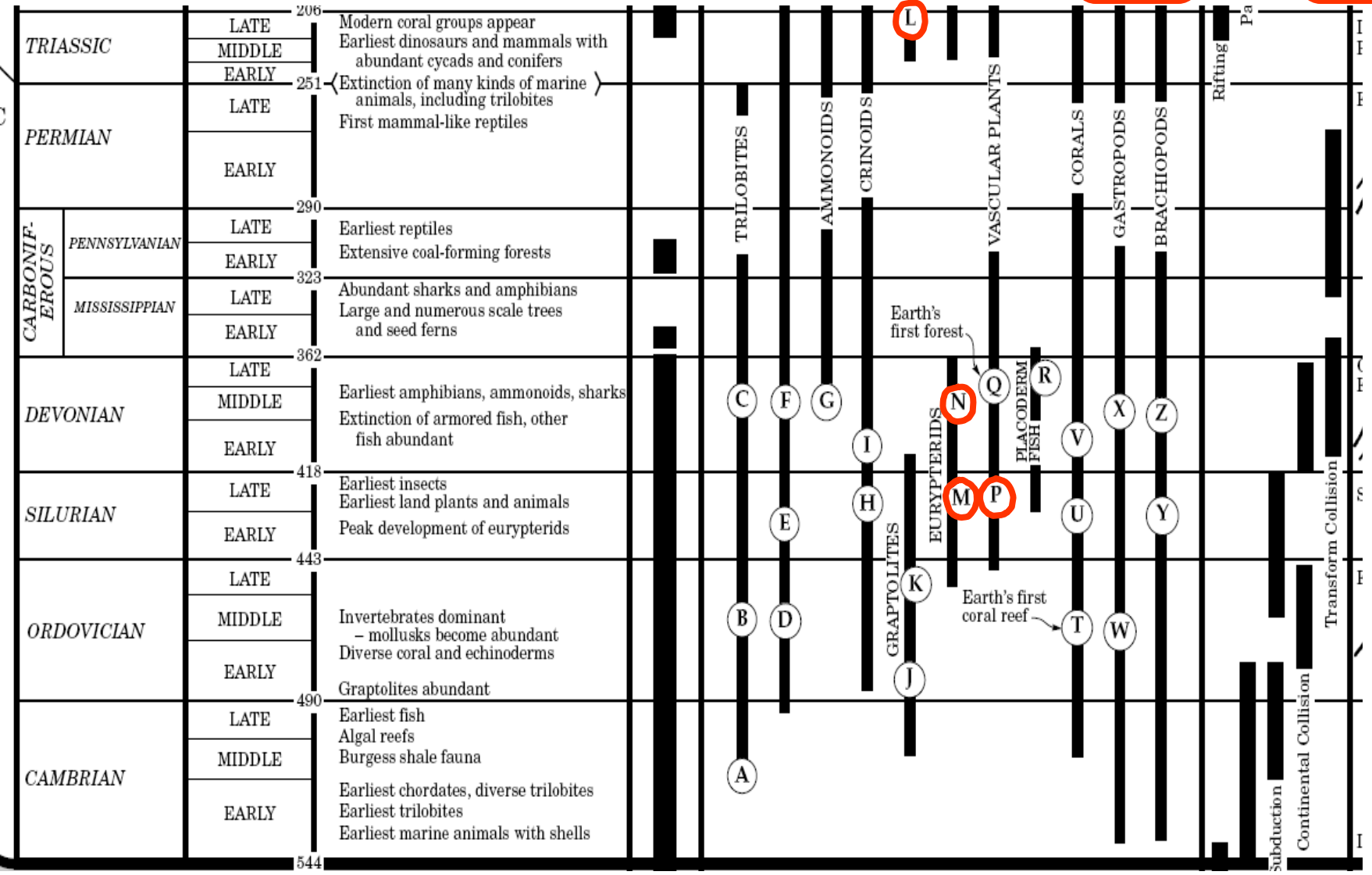
- For Example:
- When did Dicellograptus live?
- Answer: 450 million years ago

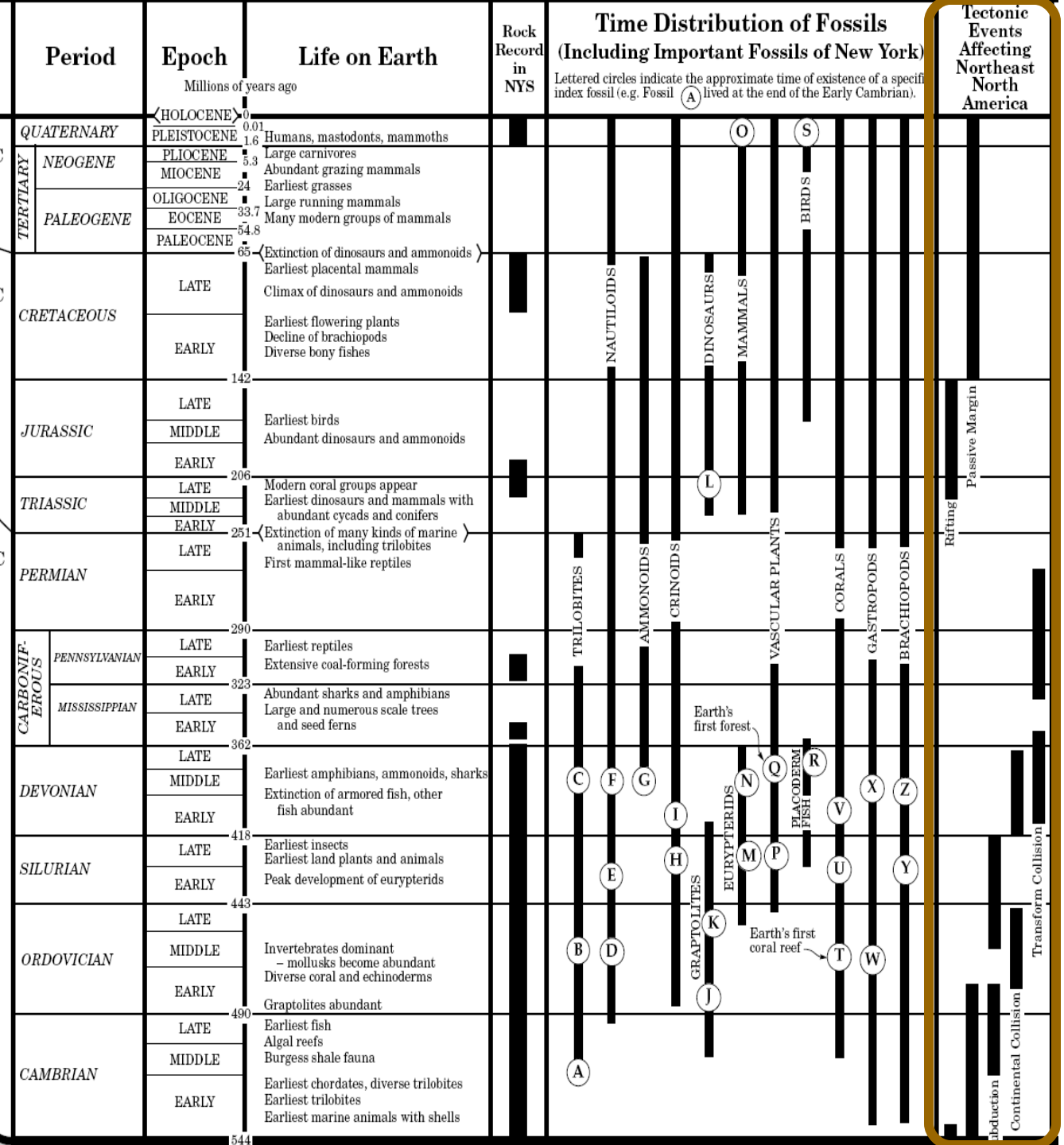




- Which of these fossils lived at the same time?
- Eurypterus & Cooksonia

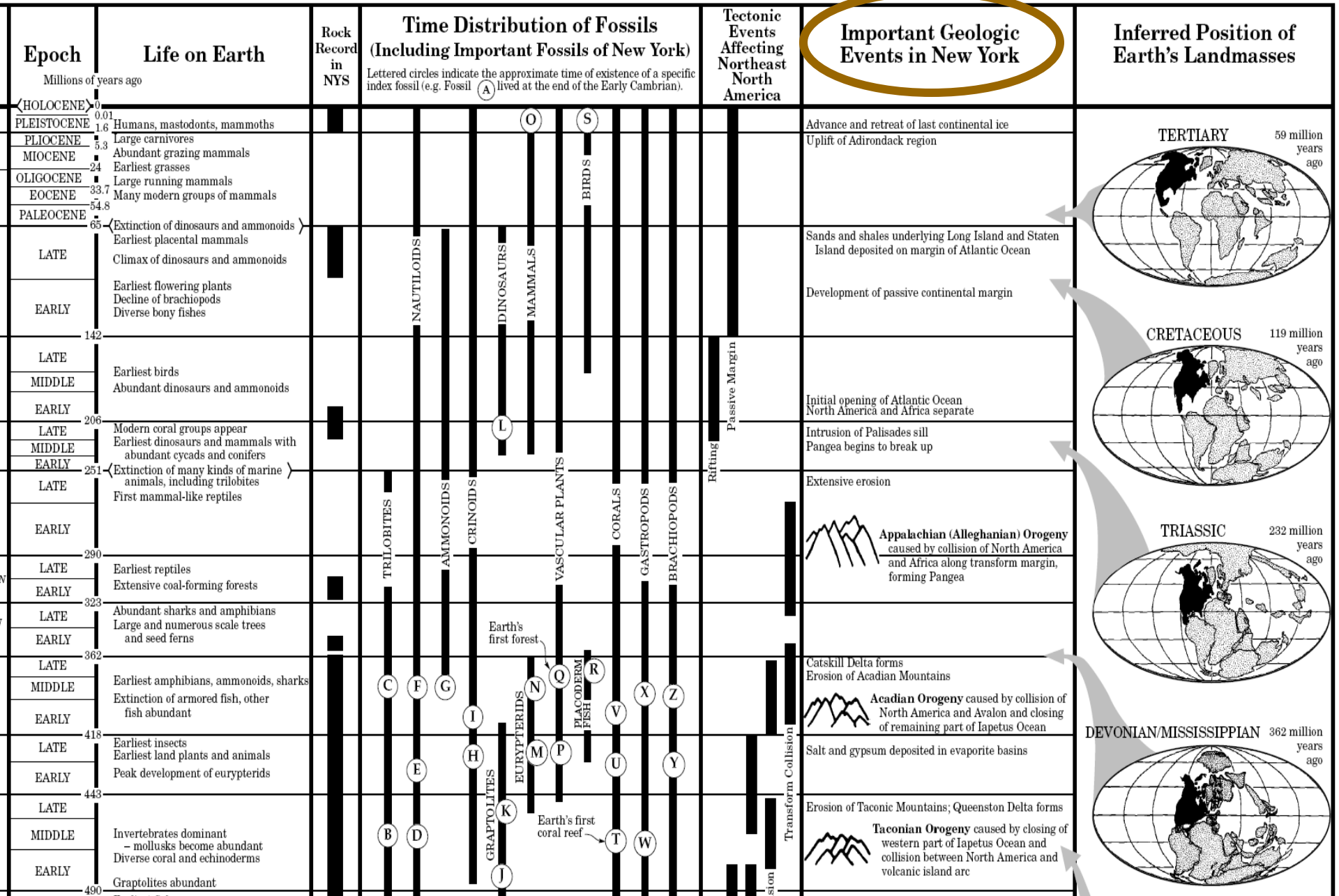




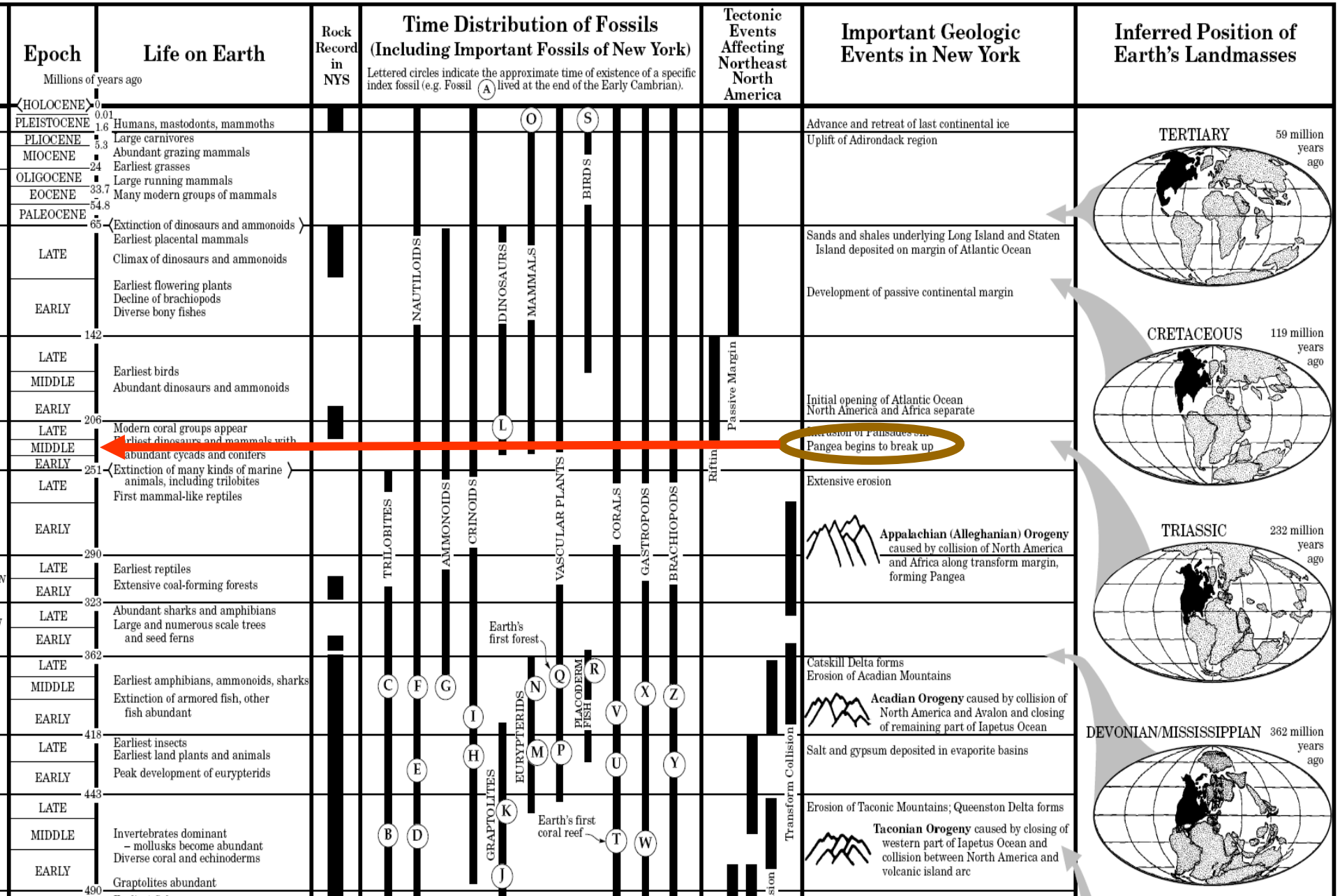


- The next column shows the time periods when different tectonic events impacted our area.

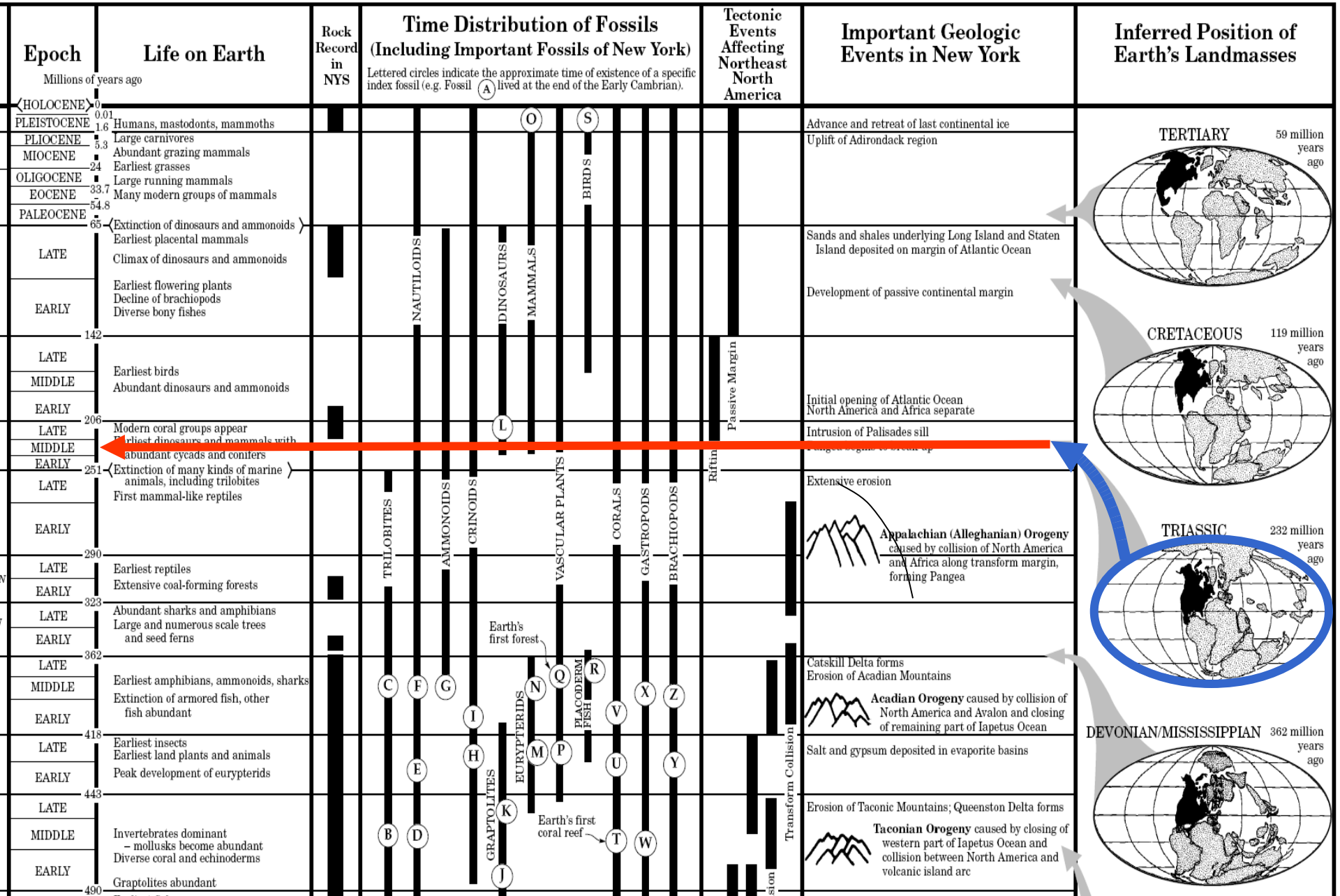
•This column shows Geologic events that occurred in the New York area…



•Example: When did Pangea begin to break up?
•230 million years ago.



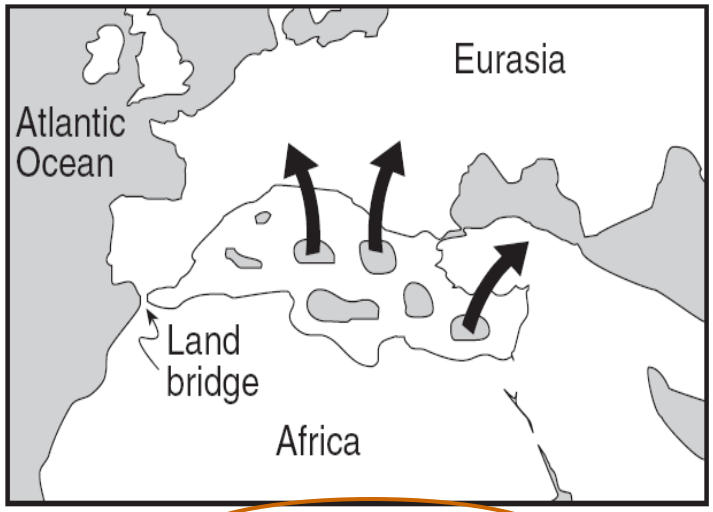
- You can also look at the maps to determine ages…
- But remember to follow the arrows!




THE END

Geologic History of NY State

About 10 Million Years Ago



About 8 to 5.5 Million Years Ago
Evaporation from Mediterranean Sea

During which geologic time period did the changes shown in the maps take place?

(1) Cambrian
(2) Cretaceous
(3) Permian
(4) Neogene

- Just look at the dates
  - Between 5.5 and 10 million years ago

Geologic History of NY State

During which geologic time period did the changes shown in the maps take place?

(1) Cambrian
(2) Cretaceous
(3) Permian
(4) Neogene