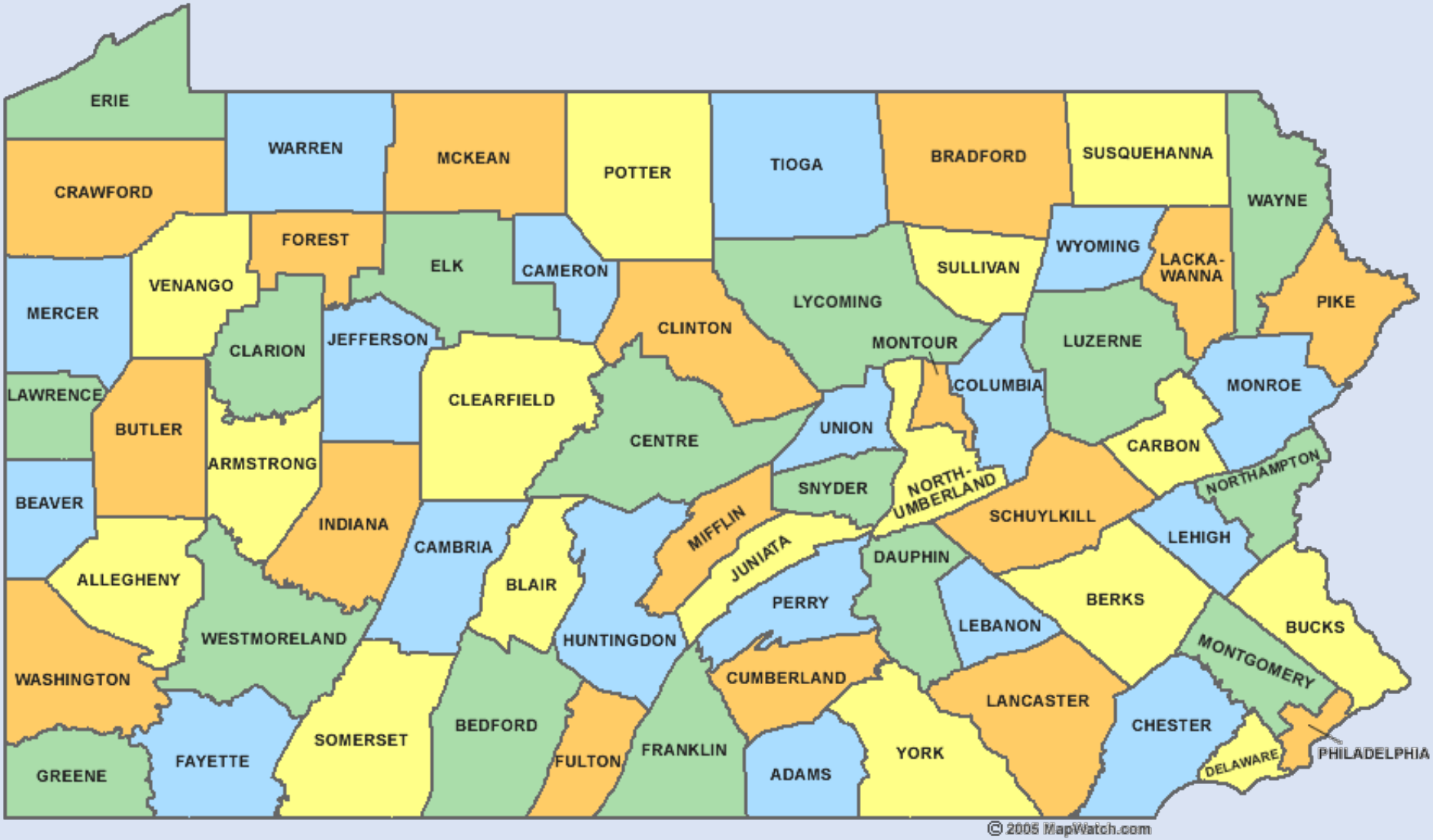
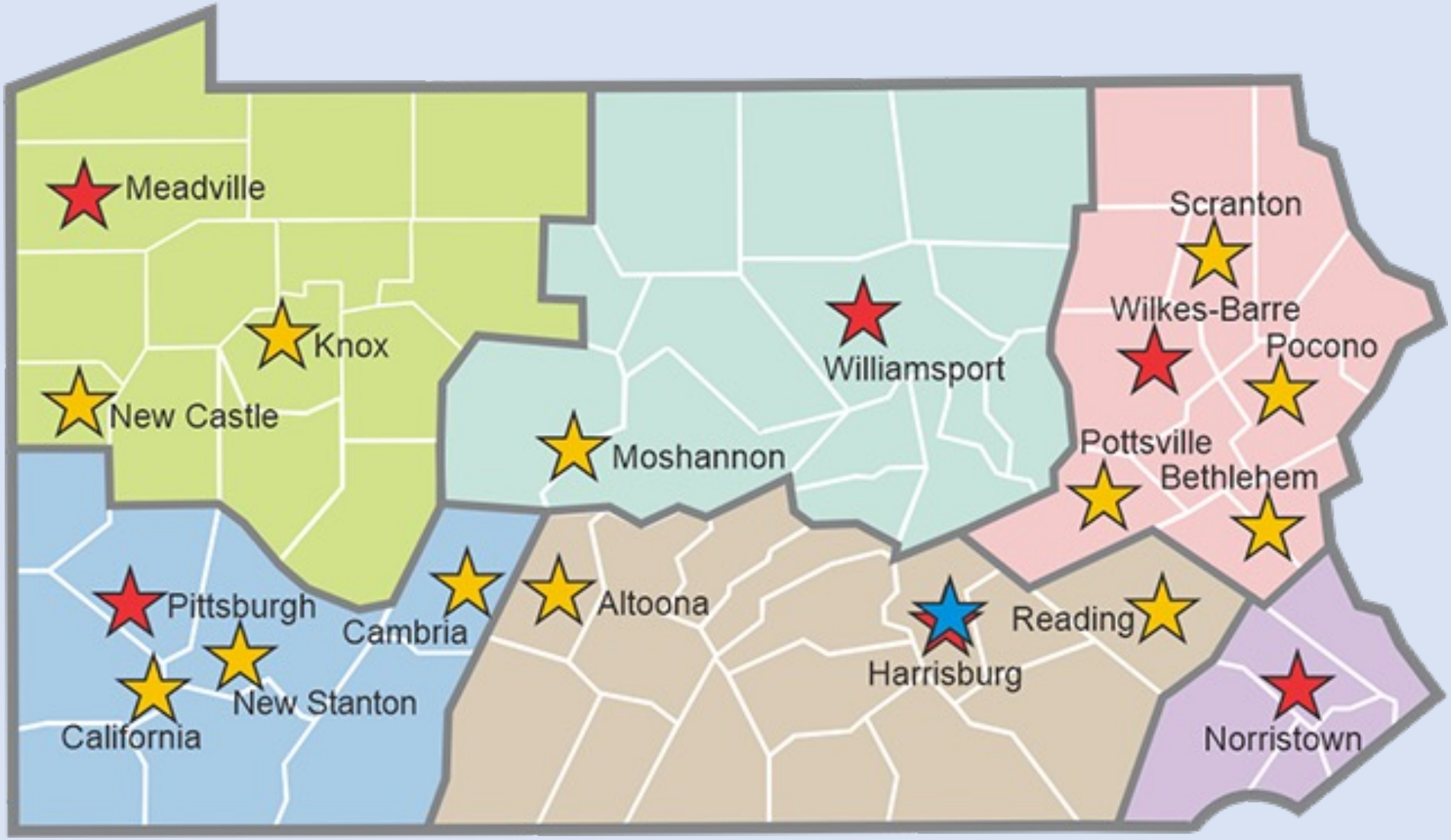
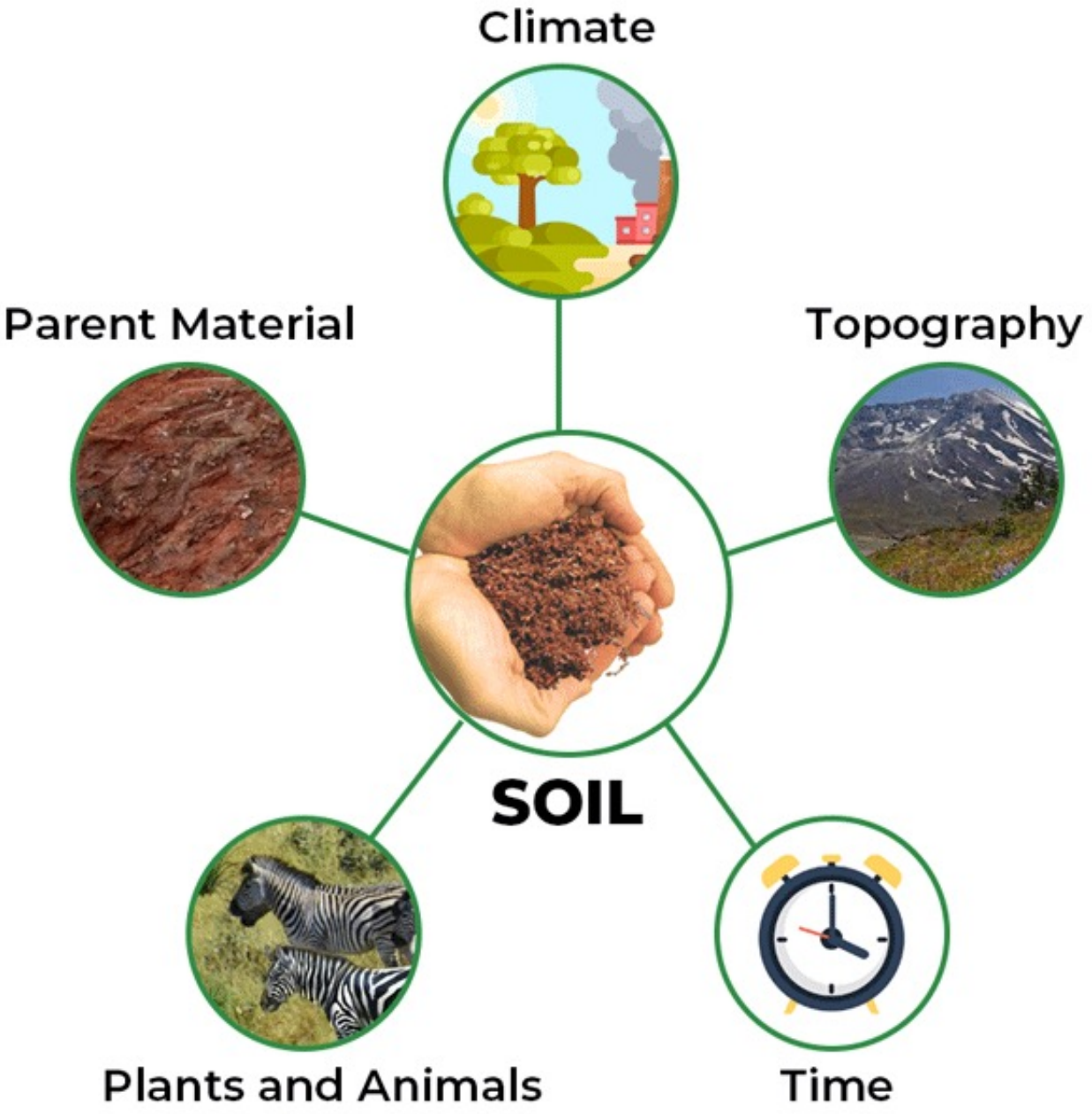
What Makes Pennsylvania's Soil so Difficult?



Russell Losco, PG, CPSS, SEO
Lanchester Soil Consultants, Inc.
West Chester University
Delaware County Community College


Meadville
Knox
New Castle
Williamsport
Moshannon
Scranton
Wilkes-Barre
Pocono
Pottsville
Bethlehem
Pittsburgh
Cambria
Altoona
Harrisburg
Reading
New Stanton
California
Norristown

https://www.freeworldmaps.net/united-states/pennsylvania/map.html


Climate
Parent Material
Topography
SOIL
Plants and Animals
Time

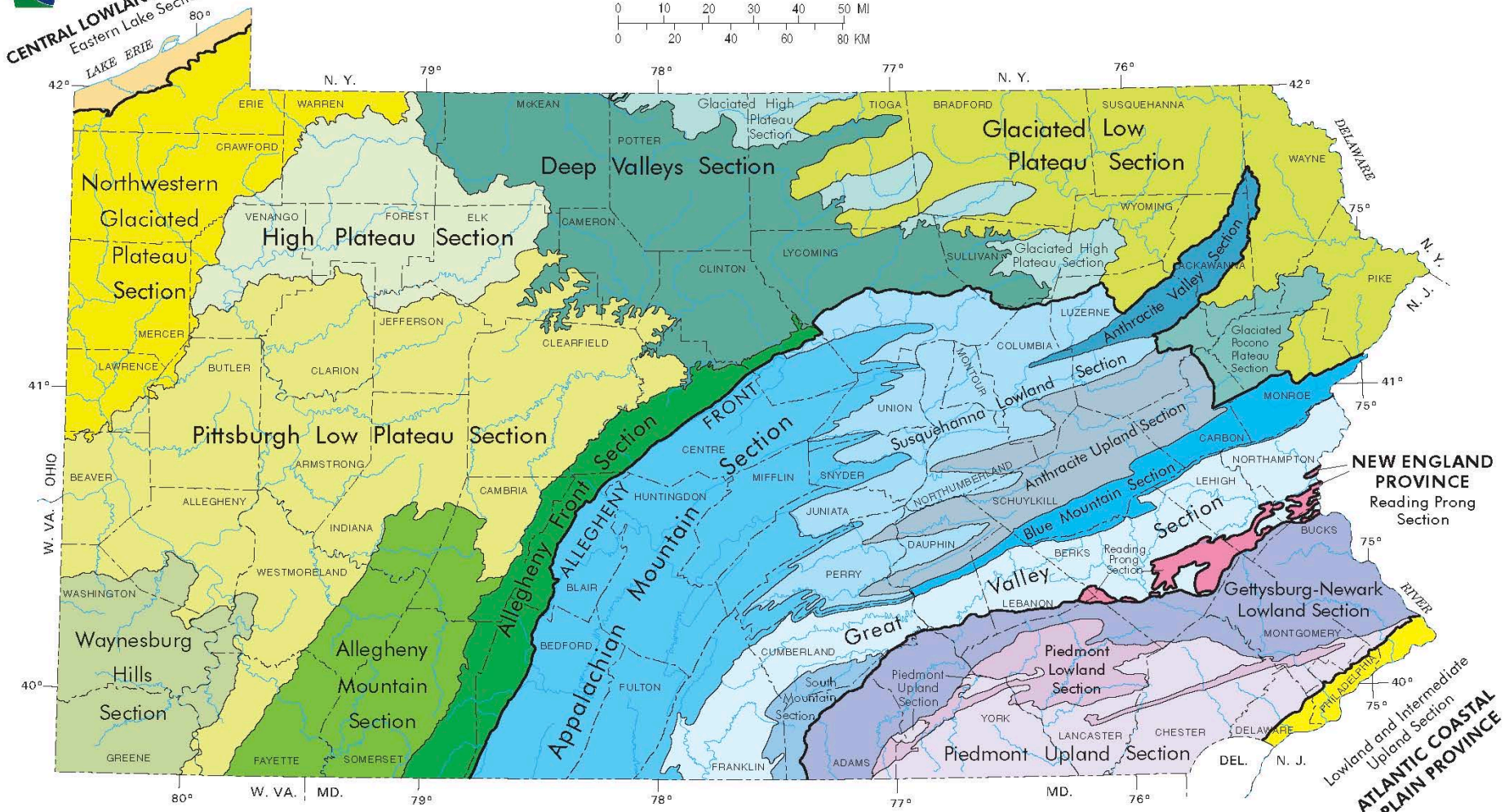
MAP 13

PHYSIOGRAPHIC PROVINCES OF PENNSYLVANIA

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF
CONSERVATION AND NATURAL RESOURCES
BUREAU OF TOPOGRAPHIC AND GEOLOGIC SURVEY
www.dcnr.pa.gov/Geology

SCALE 1:2,000,000

0 10 20 30 40 50 MI
0 20 40 60 80 KM



EXPLANATION

CENTRAL LOWLANDS PROVINCE
- Eastern Lake Section

APPALACHIAN PLATEAUS PROVINCE
- Northwestern Glaciated Plateau Section
- High Plateau Section
- Pittsburgh Low Plateau Section
- Waynesburg Hills Section
- Allegheny Mountain Section
- Allegheny Front Section
- Deep Valleys Section
- Glaciated High Plateau Section
- Glaciated Low Plateau Section
- Glaciated Pocono Plateau Section

RIDGE AND VALLEY PROVINCE
- Appalachian Mountain Section
- Susquehanna Lowland Section
- Anthracite Valley Section
- Anthracite Upland Section
- Blue Mountain Section
- Great Valley Section
- South Mountain Section

NEW ENGLAND PROVINCE
- Reading Prong Section

PIEDMONT PROVINCE
- Gettysburg-Newark Lowland Section
- Piedmont Lowland Section
- Piedmont Upland Section

ATLANTIC COASTAL PLAIN PROVINCE
- Lowland and Intermediate Upland Section

SYMBOLS
- Approximate boundary between physiographic provinces
- Approximate boundary between physiographic sections

Compiled by W. D. Sevon. Fourth Edition, 2000; Second Printing, 2018.


Where to start?
BIG TASK
SMALL TASK
Marijke

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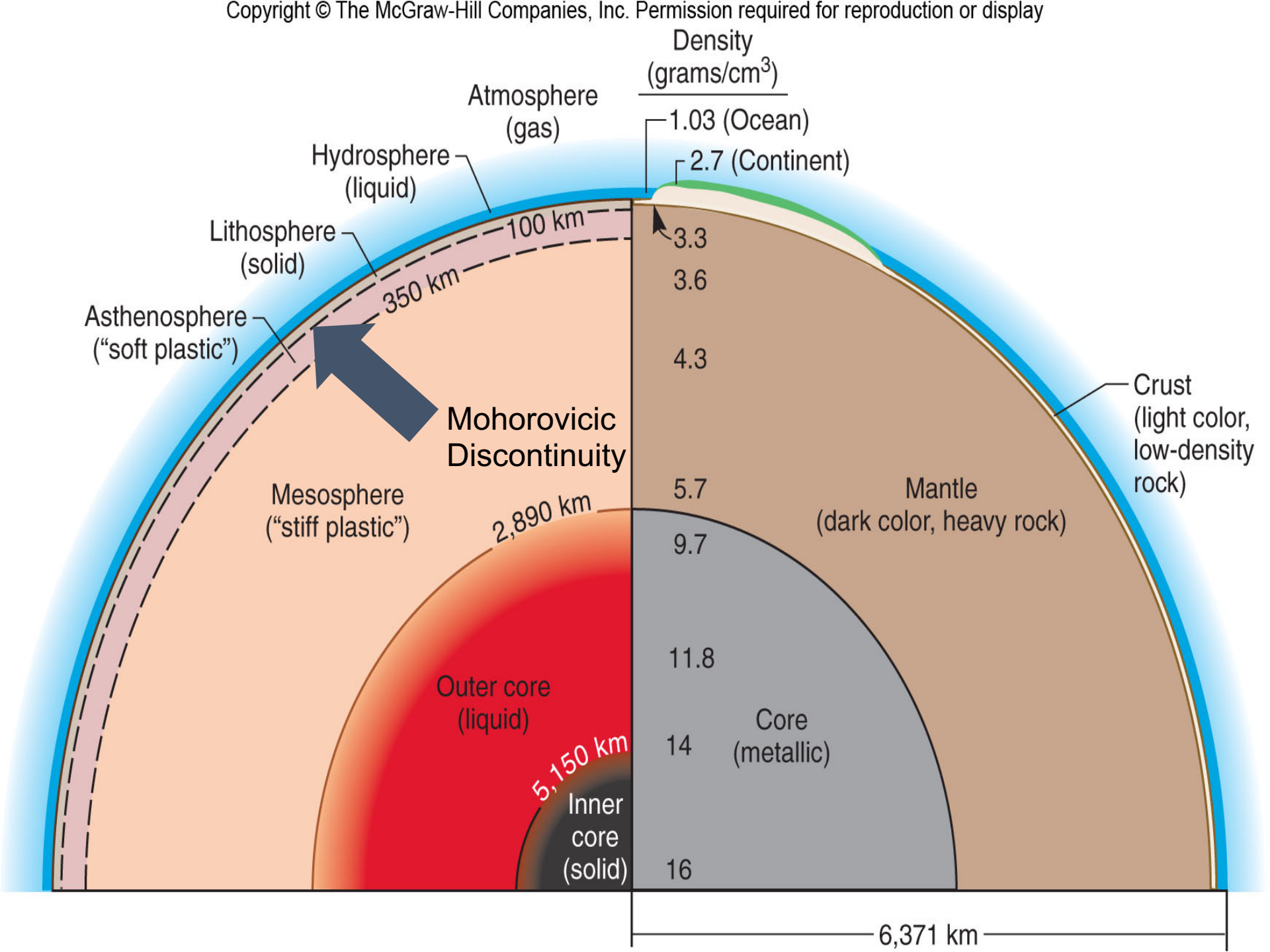
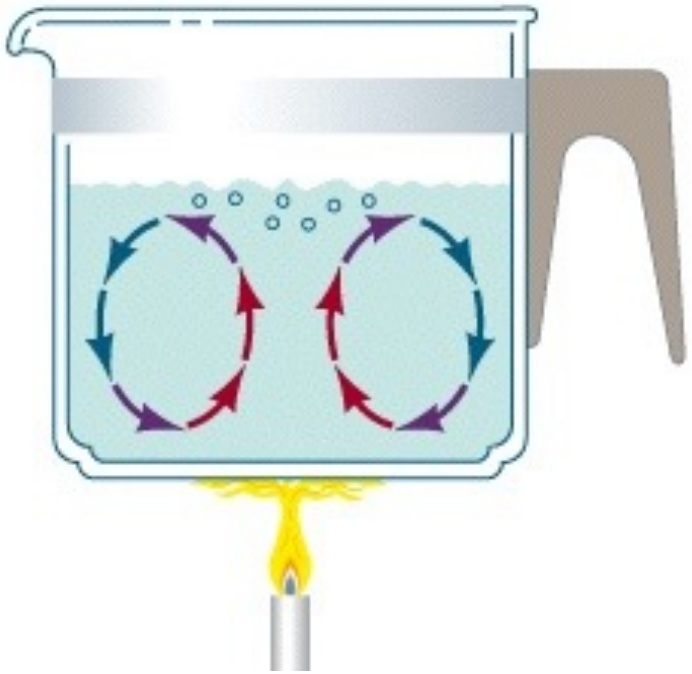
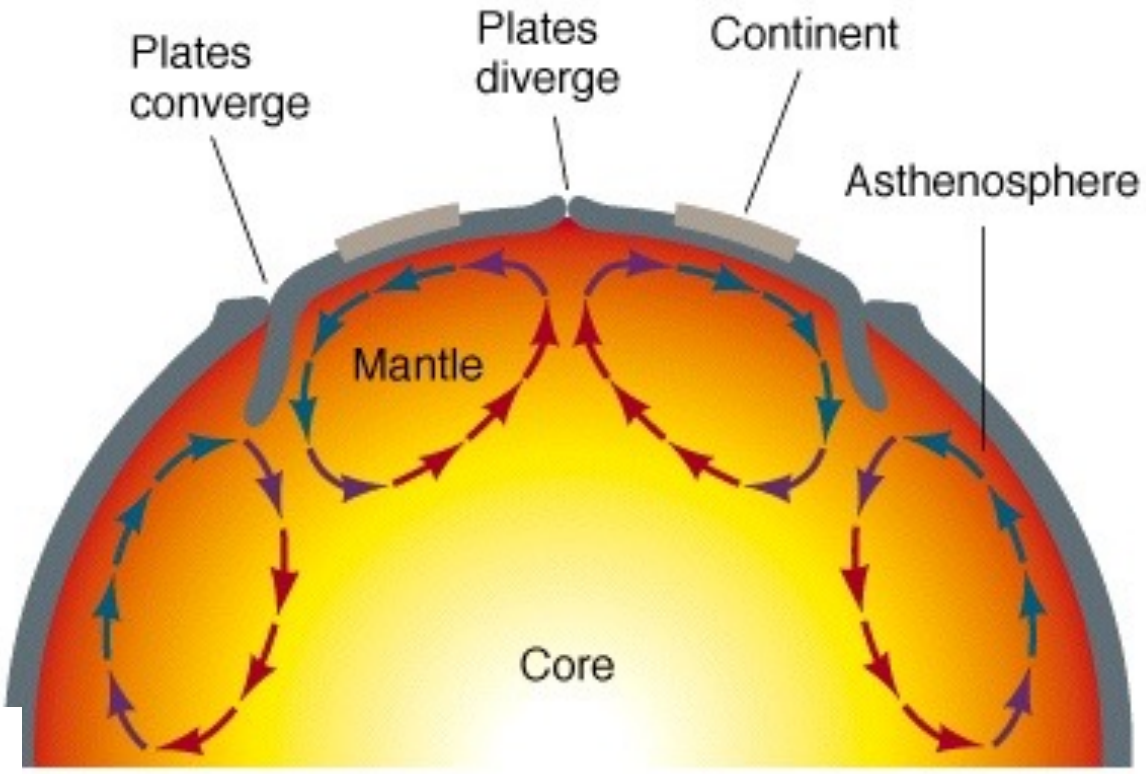


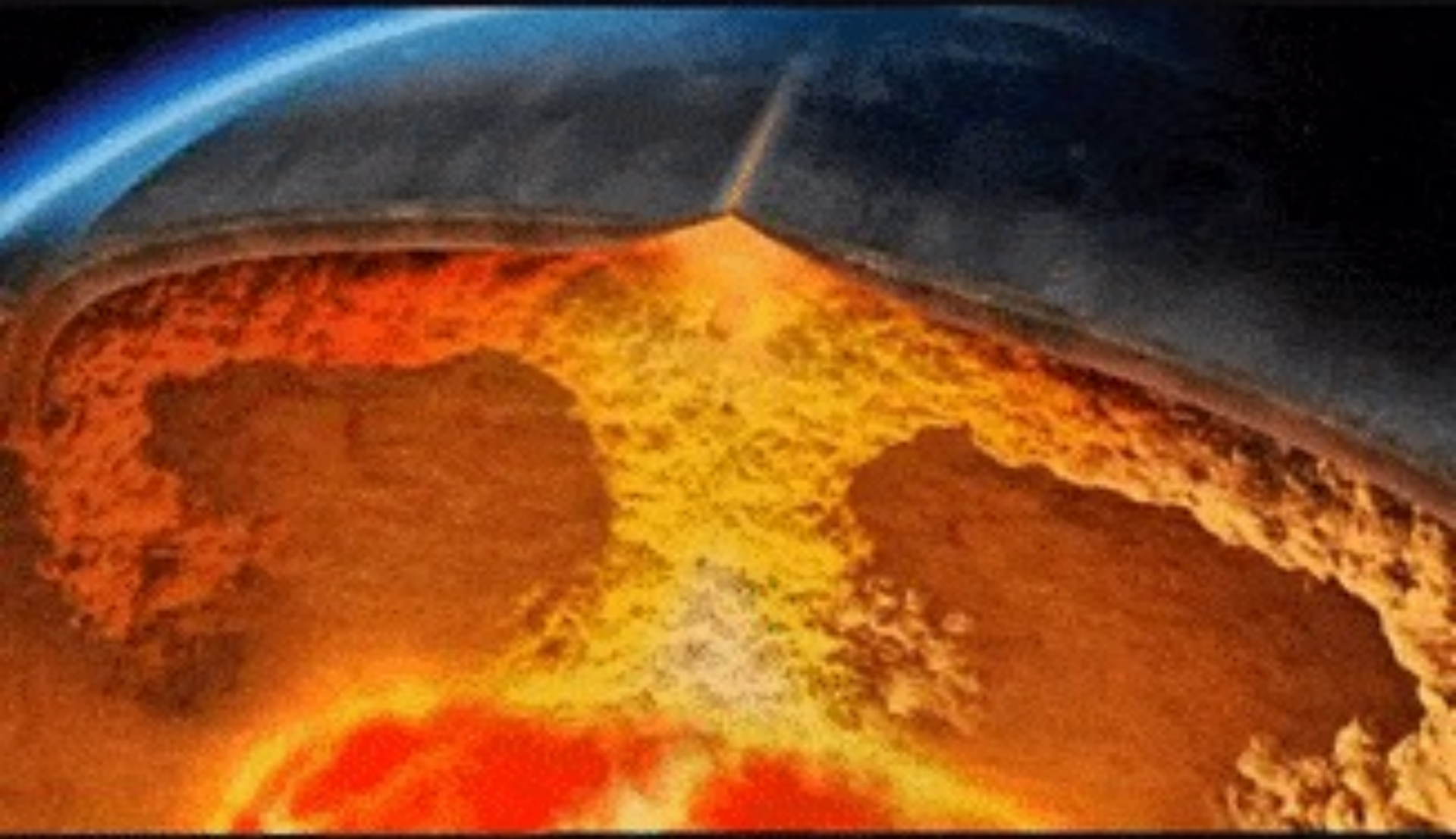
Plate tectonics : the theory that couples th
plate movement with a mechanism for mo
One mechanism: convection in the mantl
Another mechanism: ridge push/slab pull



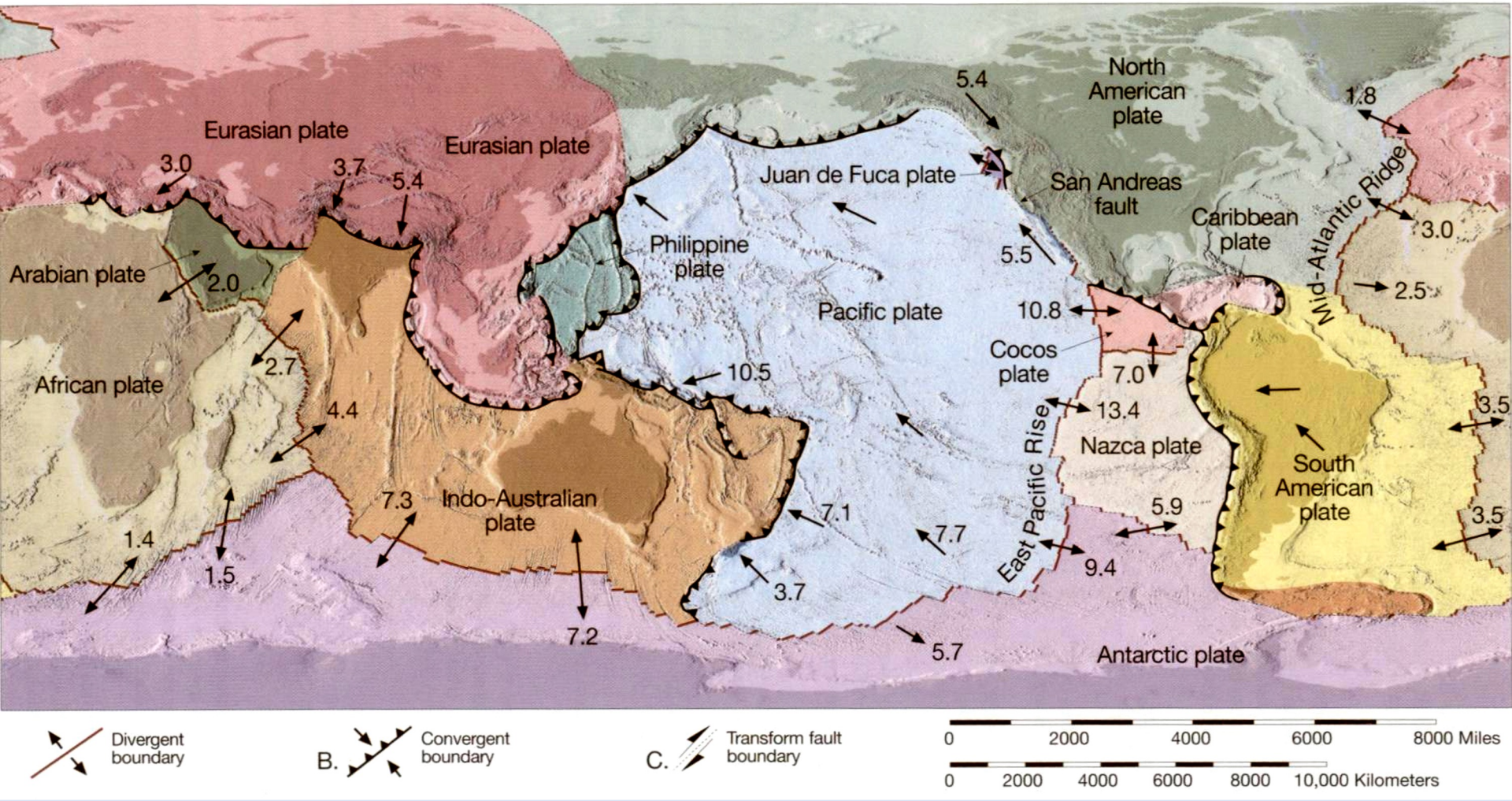


b)

The source of heat inside the Earth is radioactive decay



Earth's Plates – Plate Tectonics

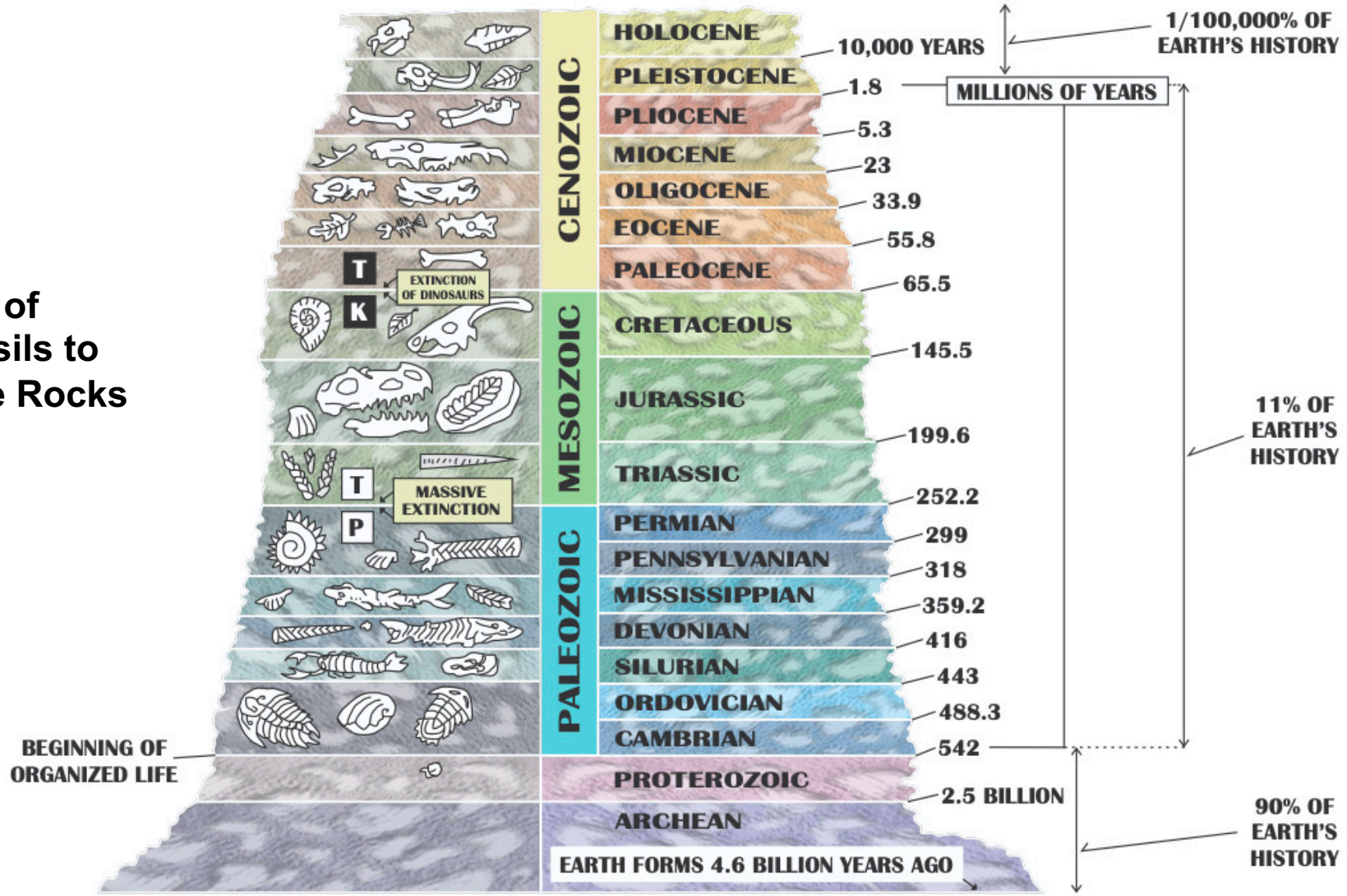


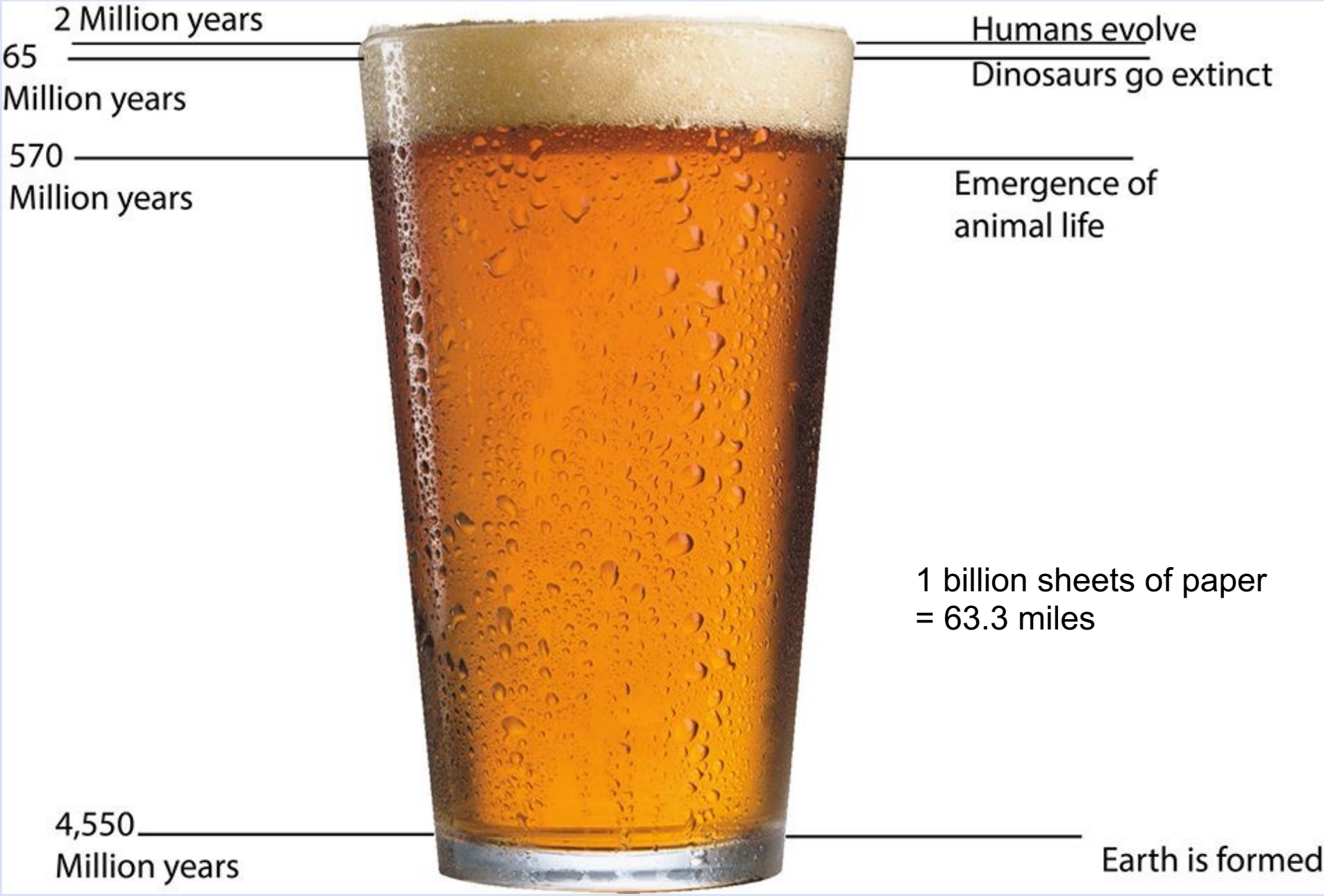
Busch et al.

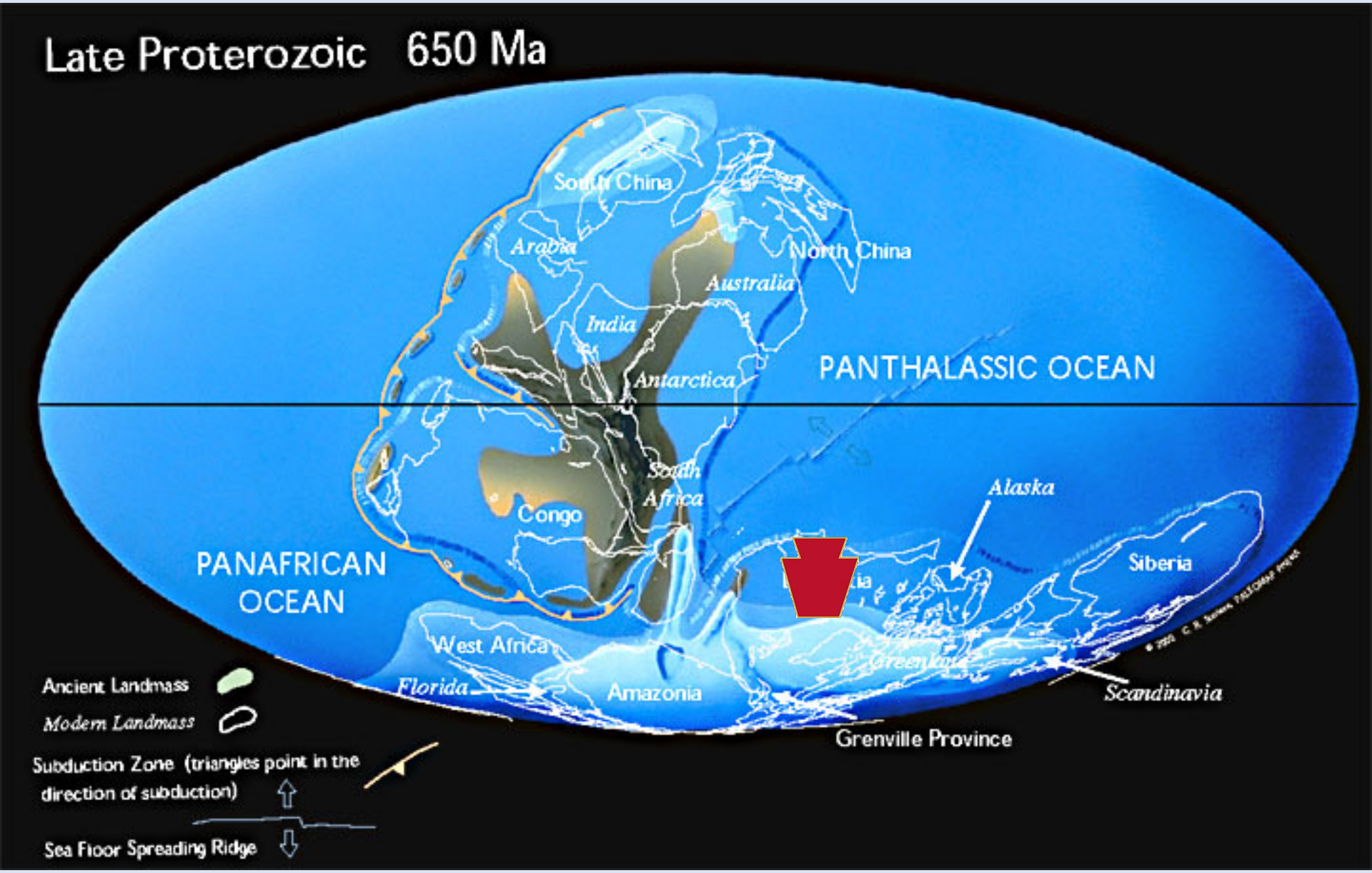
https://www.britannica.com/biography/William-Penn-English-Quaker-leader-and-colonist

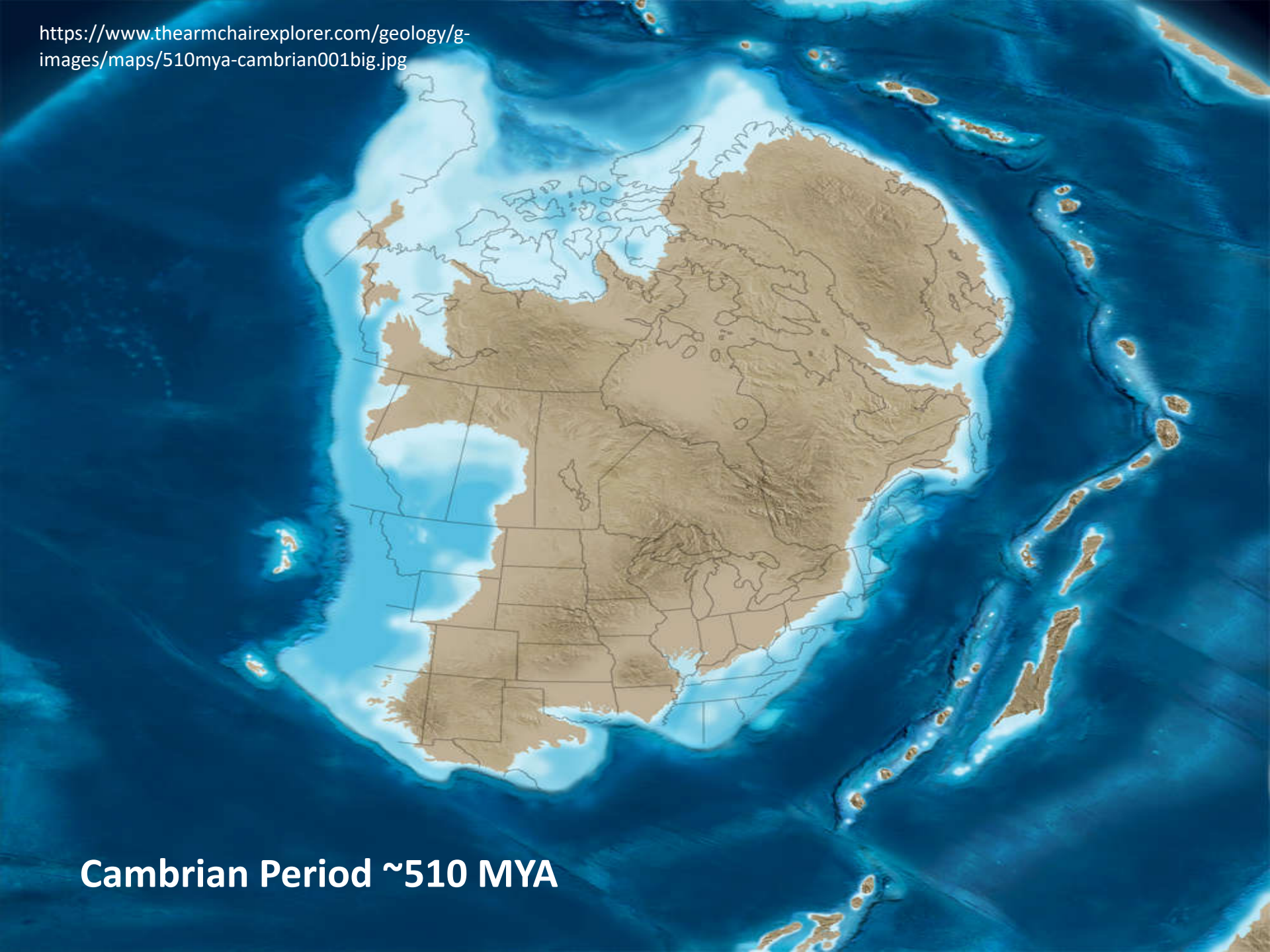
Geologic Time Scale

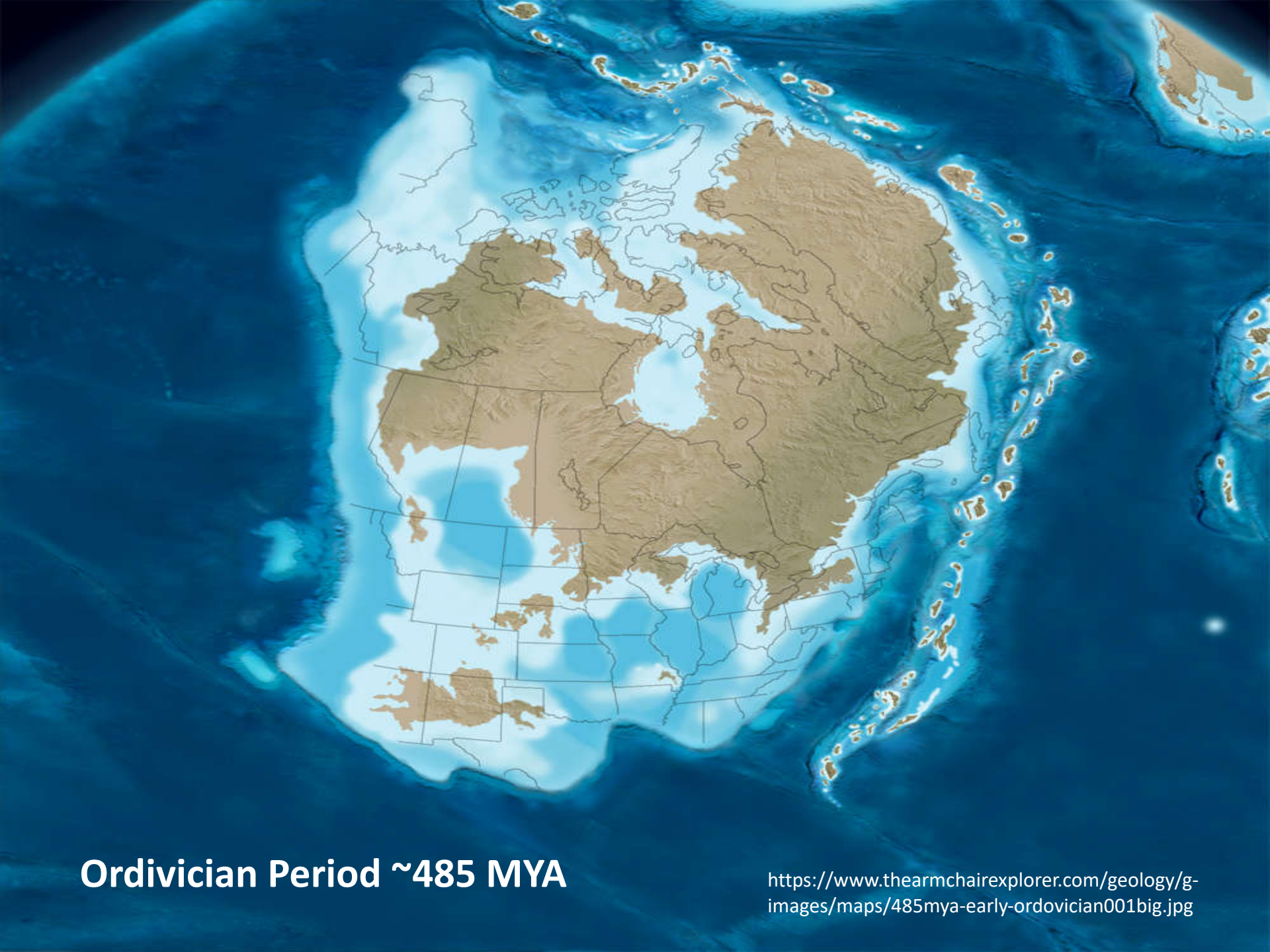
Use of Fossils to Date Rocks




2 Million years
Humans evolve
65
Million years
Dinosaurs go extinct
570
Million years
Emergence of
animal life
1 billion sheets of paper
= 63.3 miles
4,550
Million years
Earth is formed


Late Proterozoic 650 Ma
South China
Arabia
North China
Australia
India
Antarctica
PANTHALASSIC OCEAN
South Africa
Congo
Alaska
PANAFRICAN OCEAN
Siberia
West Africa
Florida
Amazonia
Greenland
Scandinavia
Grenville Province
Ancient Landmass
Modern Landmass
Subduction Zone (triangles point in the direction of subduction)
Sea Floor Spreading Ridge

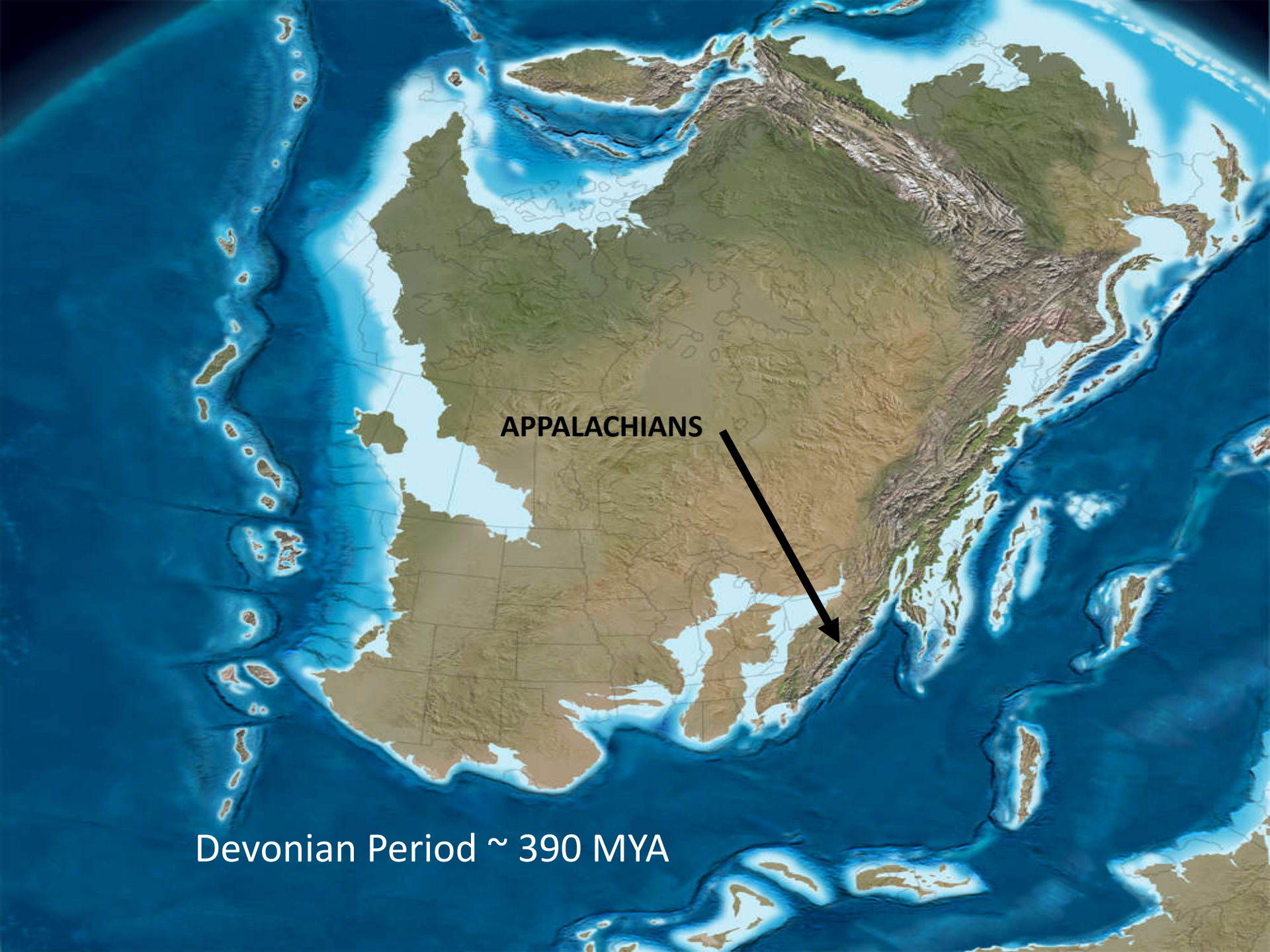

https://www.thearmchairexplorer.com/geology/g-images/maps/510mya-cambrian001big.jpg
Cambrian Period ~510 MYA



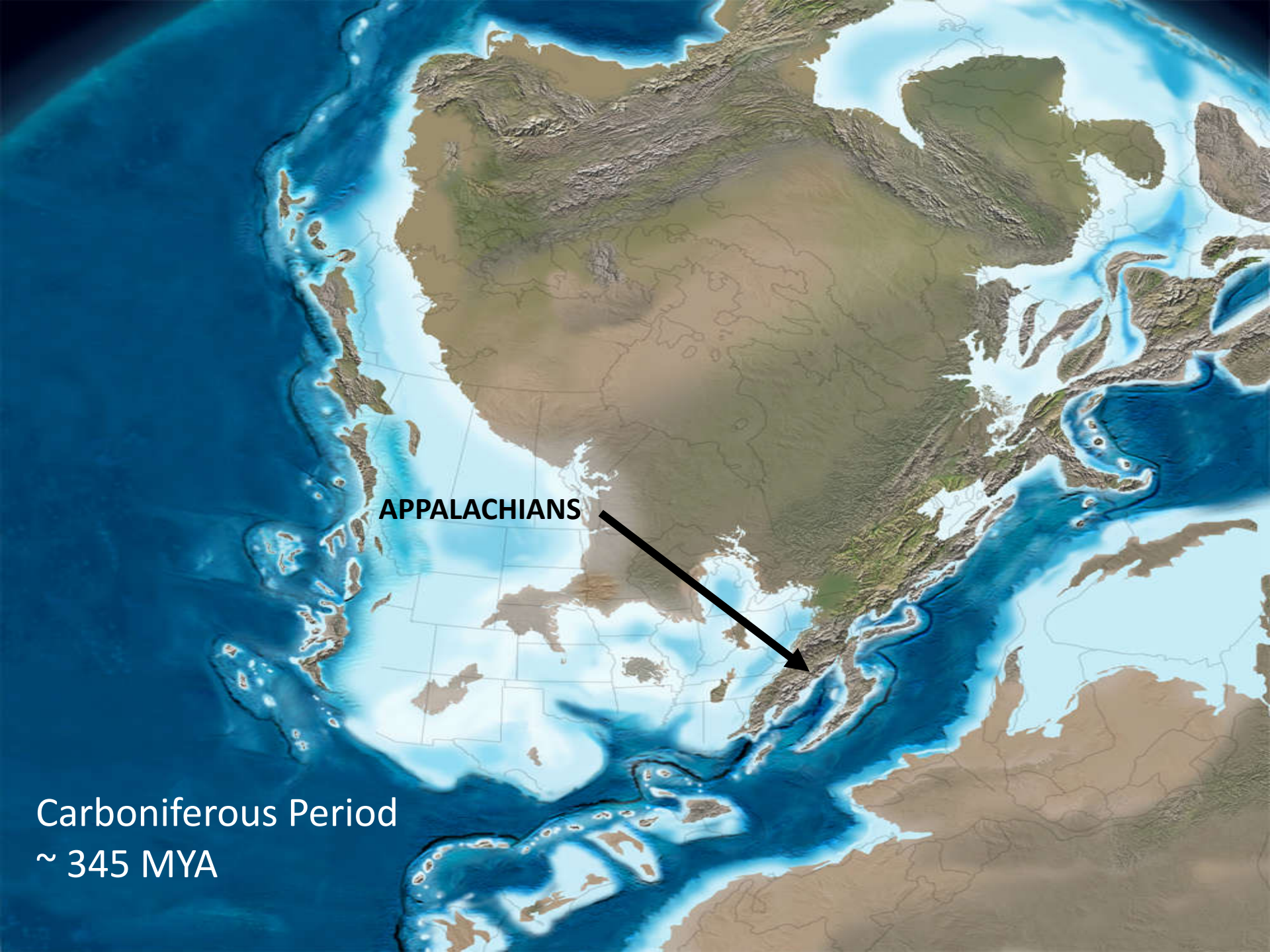
Ordivician Period ~485 MYA

https://www.thearmchairexplorer.com/geology/g-images/maps/485mya-early-ordovician001big.jpg

Silurian Period ~ 430 MYA

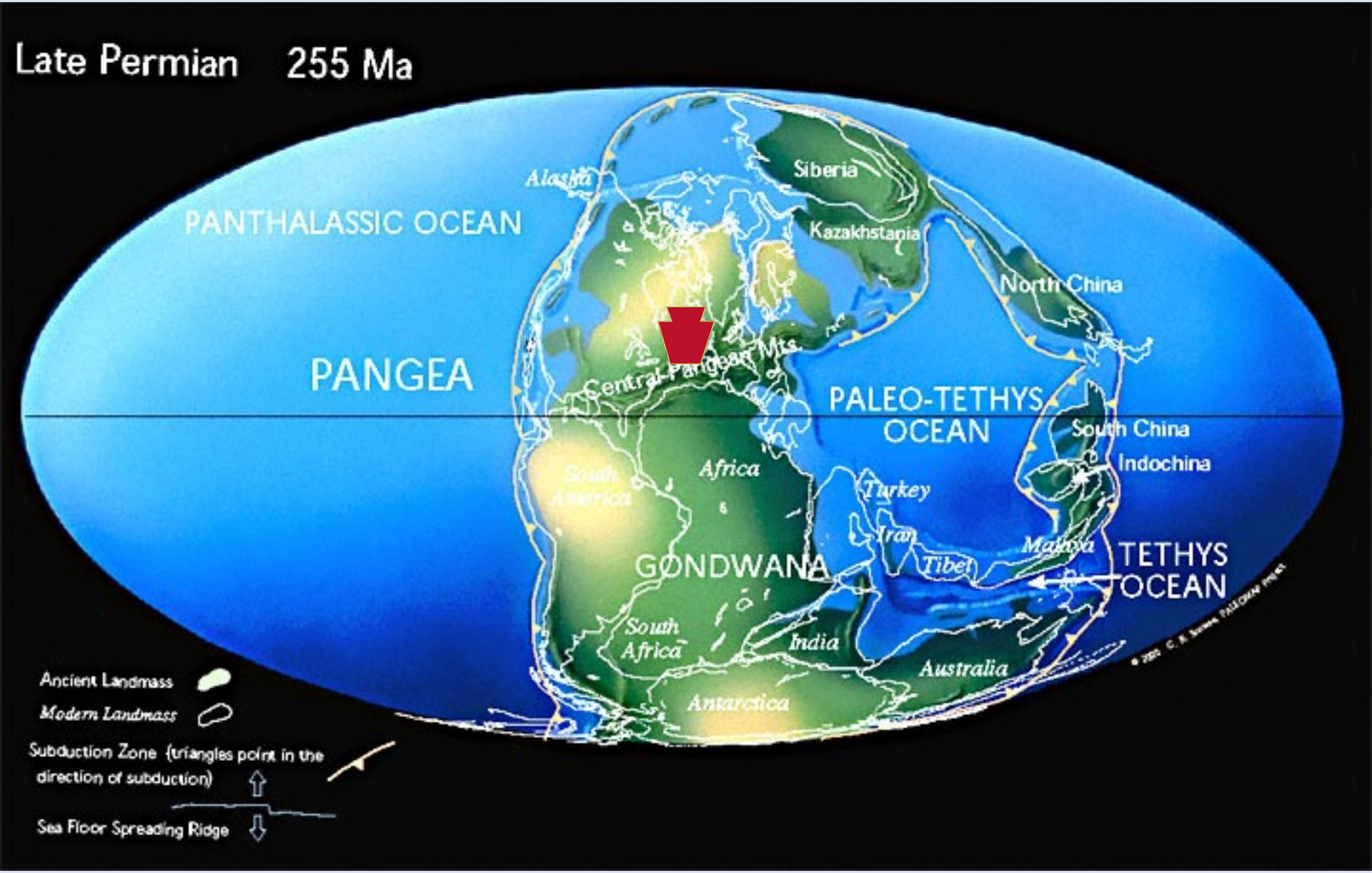


Devonian Period ~ 390 MYA



Carboniferous Period
~ 345 MYA


APPALACHIANS
Permian Period
~ 290 MYA


Late Permian 255 Ma
PANTHALASSIC OCEAN
Alaska
Siberia
Kazakhstania
North China
PANGEA
Central Pangean Mts.
PALEO-TETHYS OCEAN
South China
Indochina
Africa
South America
Turkey
Iran
Malaya
Tibet
TETHYS OCEAN
GONDWANA
South Africa
India
Australia
Antarctica
Ancient Landmass
Modern Landmass
Subduction Zone (triangles point in the direction of subduction)
Sea Floor Spreading Ridge

Pennsylvania looked like the Himalayas 250 MY ago

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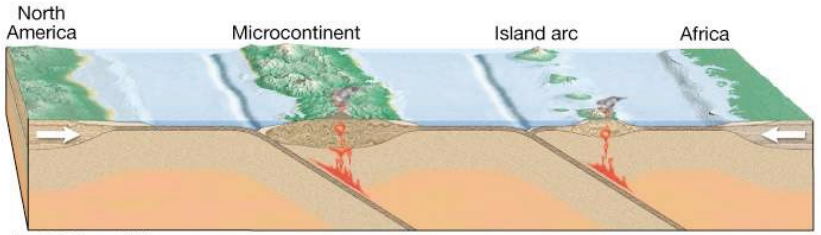
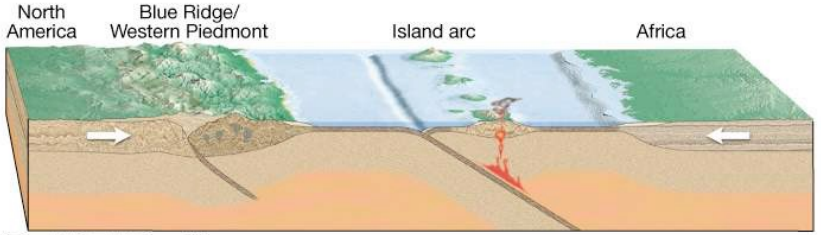
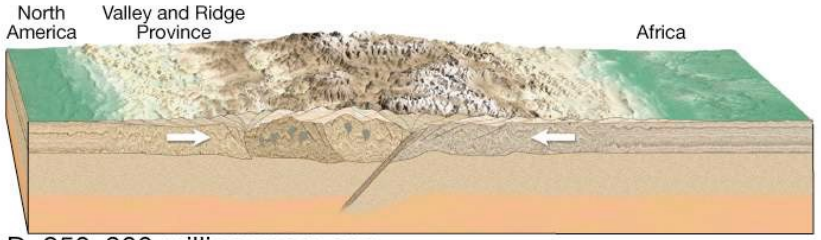


A. 600 million years ago

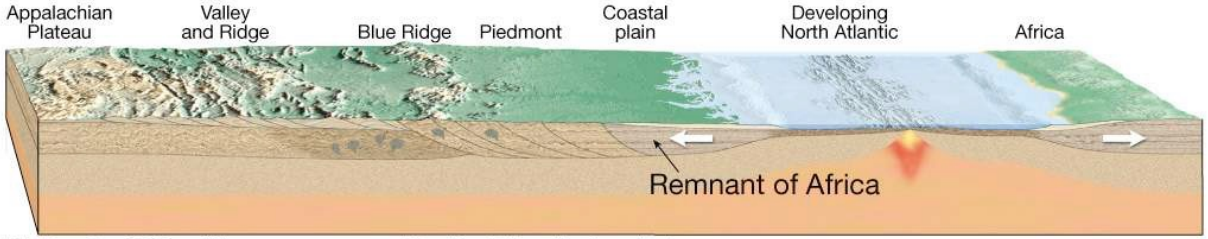


B. 450–500 million years ago

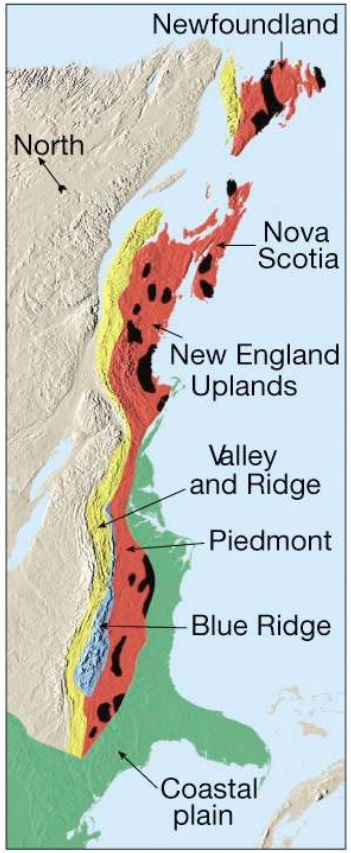
C. 400 million years ago



D. 250–300 million years ago



E. Begin 200 million years ago North Atlantic begin to open



F. Major structural features of the Appalachians

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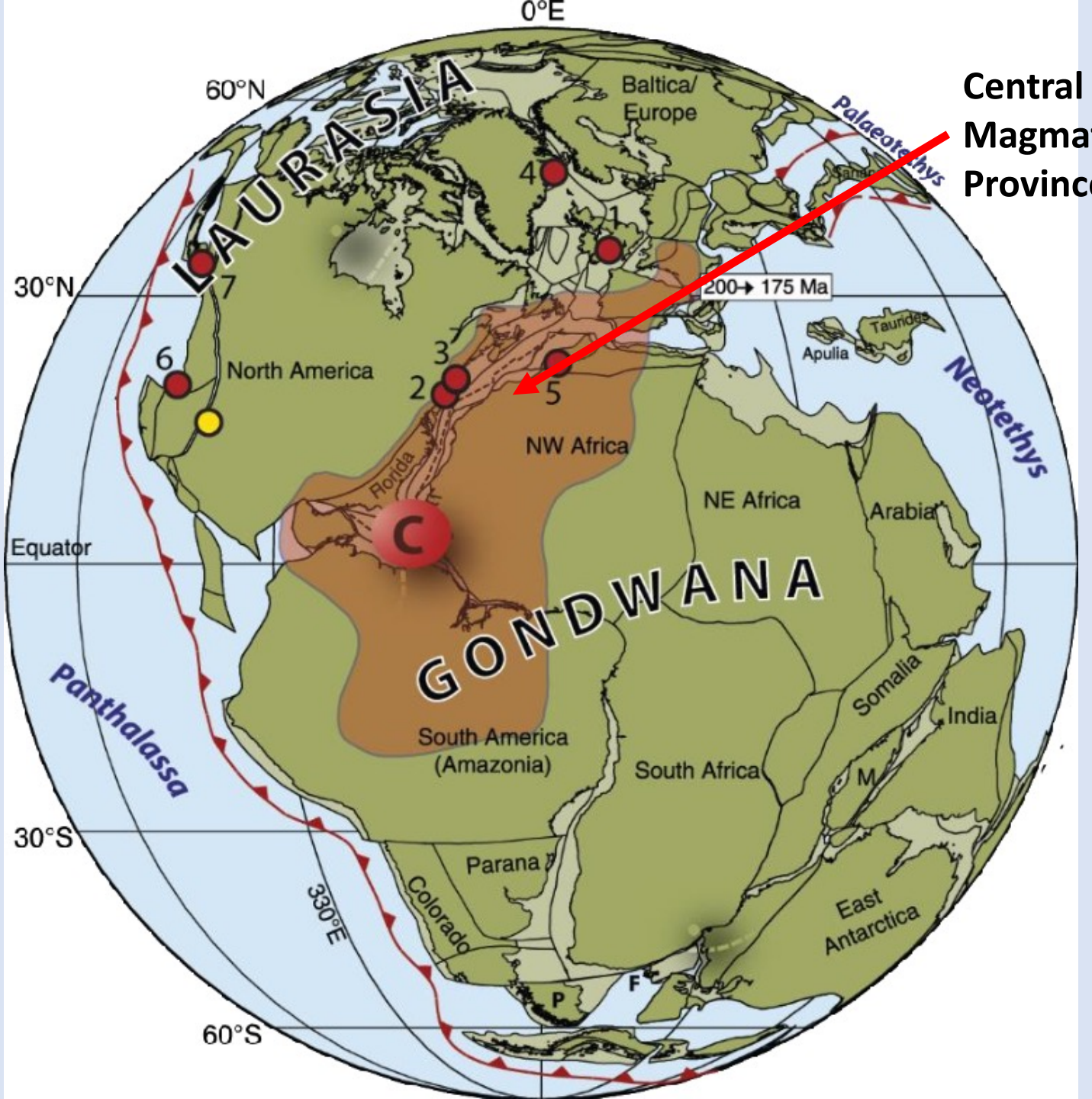
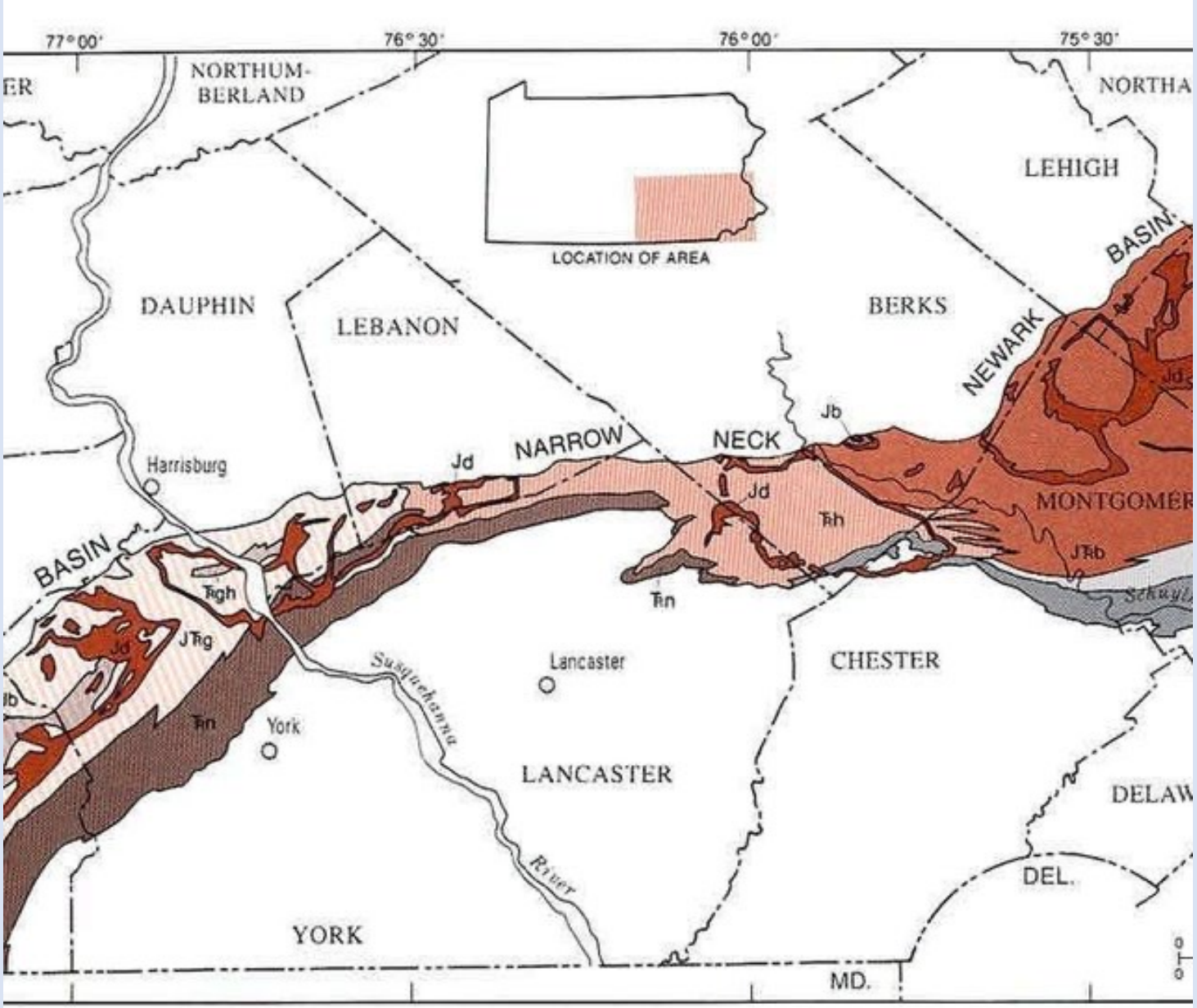
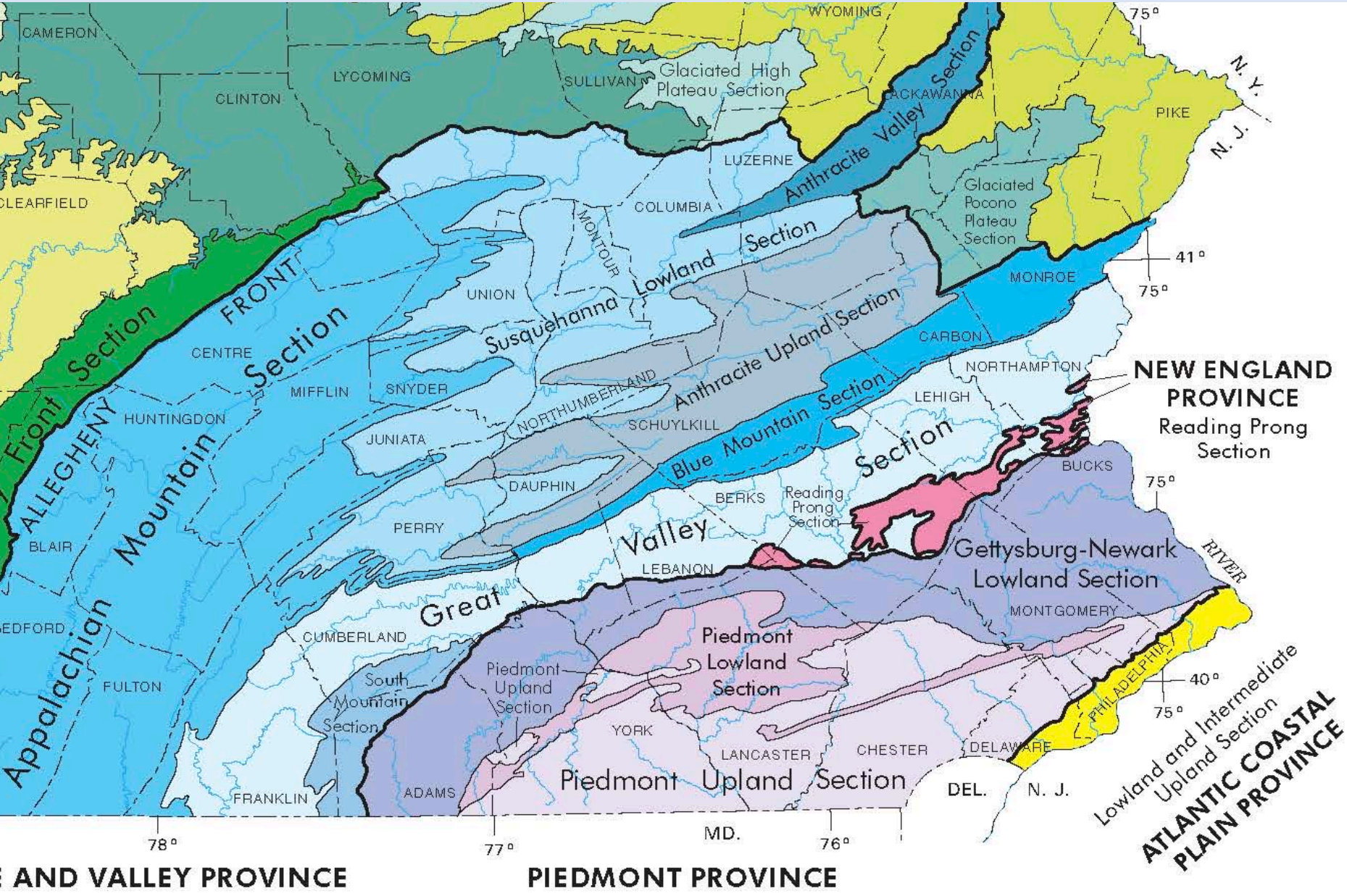
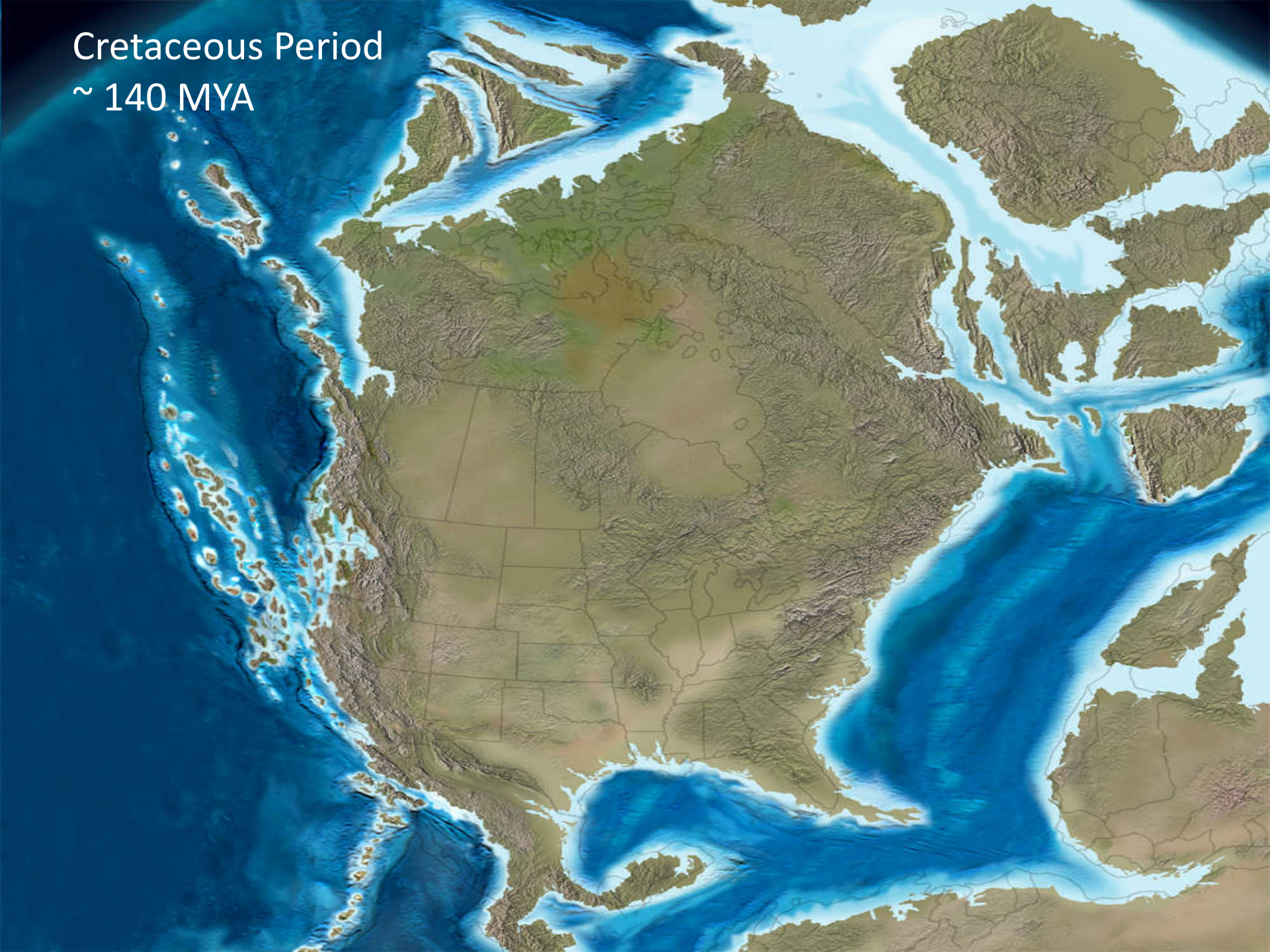
Triassic Period
~ 245 MYA
ATLANTIC OCEAN
N


Central Atlantic Magmatic Province
0°E
60°N
30°N
Equator
30°S
60°S
330°E
LAURASIA
GONDWANA
Baltica/ Europe
North America
NW Africa
NE Africa
Arabia
Apulia
Taurides
South America (Amazonia)
South Africa
Somalia
India
Madagascar
East Antarctica
Parana
Colorado
Florida
Panthalassa
Palaeotethys
Neotethys
200→175 Ma
1
2
3
4
5
6
7
C
P
F


77°00'
76°30'
76°00'
75°30'
NORTHUM-
BERLAND
NORTHA
LEHIGH
LOCATION OF AREA
DAUPHIN
LEBANON
BERKS
BASIN
NEWARK
Jb
Jd
NARROW
NECK
Harrisburg
Jd
Jd
Trh
MONTGOMER
JTrb
BASIN
Trgh
Trn
JTrg
Jd
Susquehanna
Lancaster
CHESTER
Trn
York
LANCASTER
DELAW
River
DEL.
YORK
MD.
EXPLANATION
Jd Jb
Diabase (Jd) and basalt (Jb; three areas or
JTrg
Gettysburg Formation
Trgh
Heidlersburg Member of Gettysburg Formation
Trn
New Oxford Formation
Trh
Hammer Creek Formation
JTrb
Brunswick Group

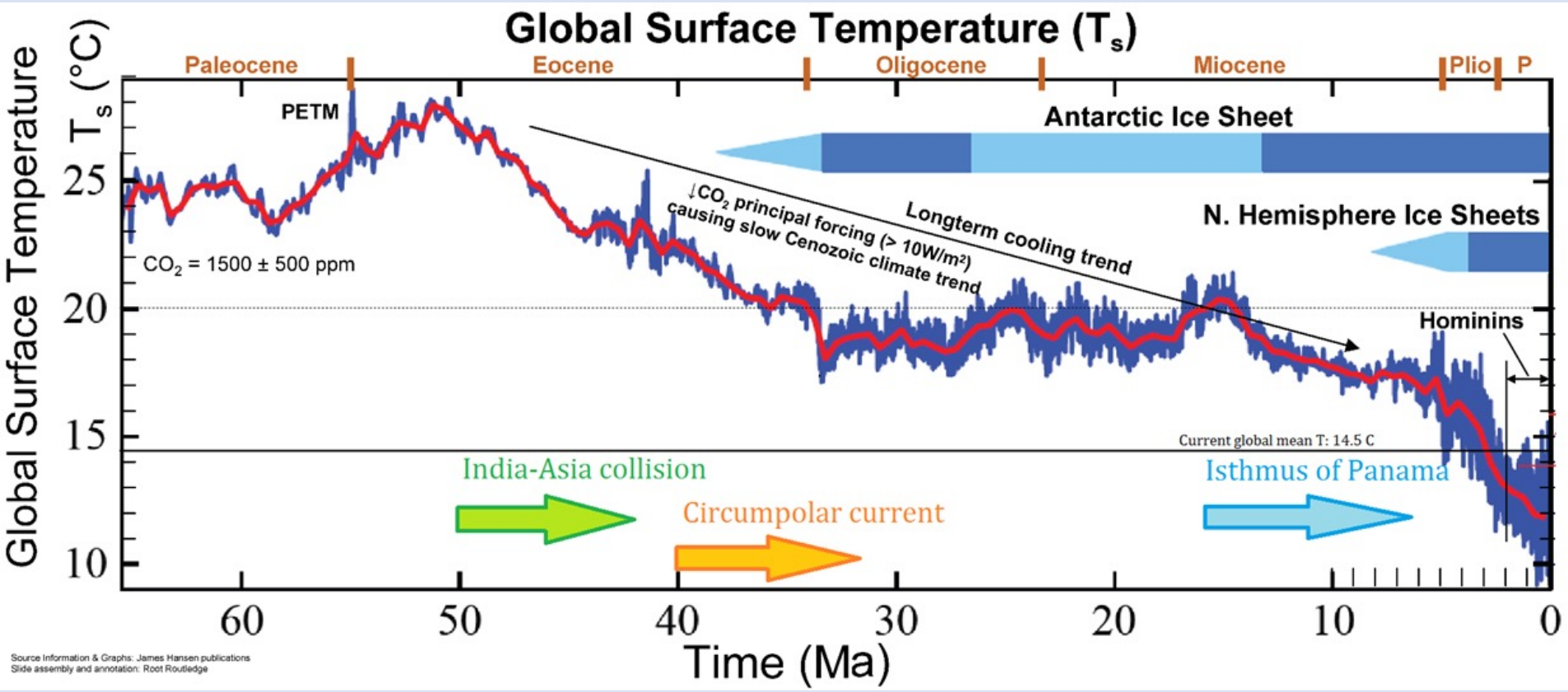

WYOMING
CAMERON
LYCOMING
CLINTON
SULLIVAN
Glaciated High Plateau Section
LUZERNE
Anthracite Valley Section
LACKAWANNA
PIKE
N. Y.
N. J.
CLEARFIELD
COLUMBIA
MONTOUR
Anthracite Upland Section
Glaciated Pocono Plateau Section
41°
75°
MONROE
UNION
Susquehanna Lowland Section
CENTRE
FRONT
Section
Front Section
CARBON
NORTHAMPTON
NEW ENGLAND PROVINCE
Reading Prong Section
MIFFLIN
SNYDER
NORTHUMBERLAND
LEHIGH
HUNTINGDON
SCHUYLKILL
Blue Mountain Section
ALLEGHENY
Mountain
JUNIATA
BUCKS
75°
DAUPHIN
BERKS
Reading Prong Section
Valley
PERRY
BLAIR
LEBANON
Gettysburg-Newark Lowland Section
RIVER
Great
Appalachian
MONTGOMERY
CUMBERLAND
Piedmont Lowland Section
Piedmont Upland Section
South Mountain Section
FULTON
PHILADELPHIA
40°
75°
YORK
LANCASTER
CHESTER
DELAWARE
Lowland and Intermediate Upland Section
ATLANTIC COASTAL PLAIN PROVINCE
Piedmont Upland Section
ADAMS
FRANKLIN
DEL.
N. J.
MD.
78°
77°
76°
E AND VALLEY PROVINCE
PIEDMONT PROVINCE


Jurassic Period
~ 195 MYA
ATLANTIC OCEAN

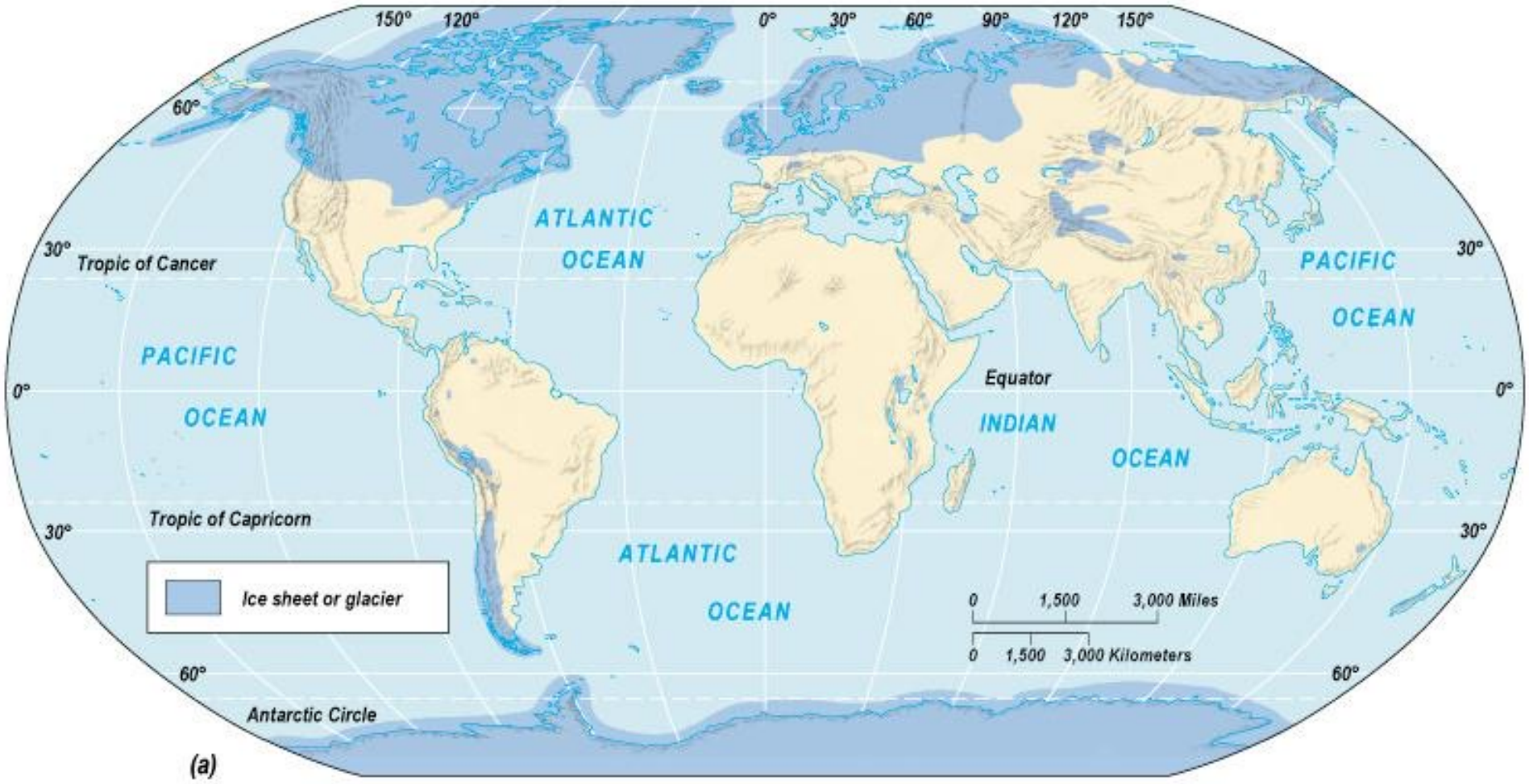

Cretaceous Period
~ 140 MYA


Paleogene Period
~ 60 MYA


Neogene Period
~ 15 MYA

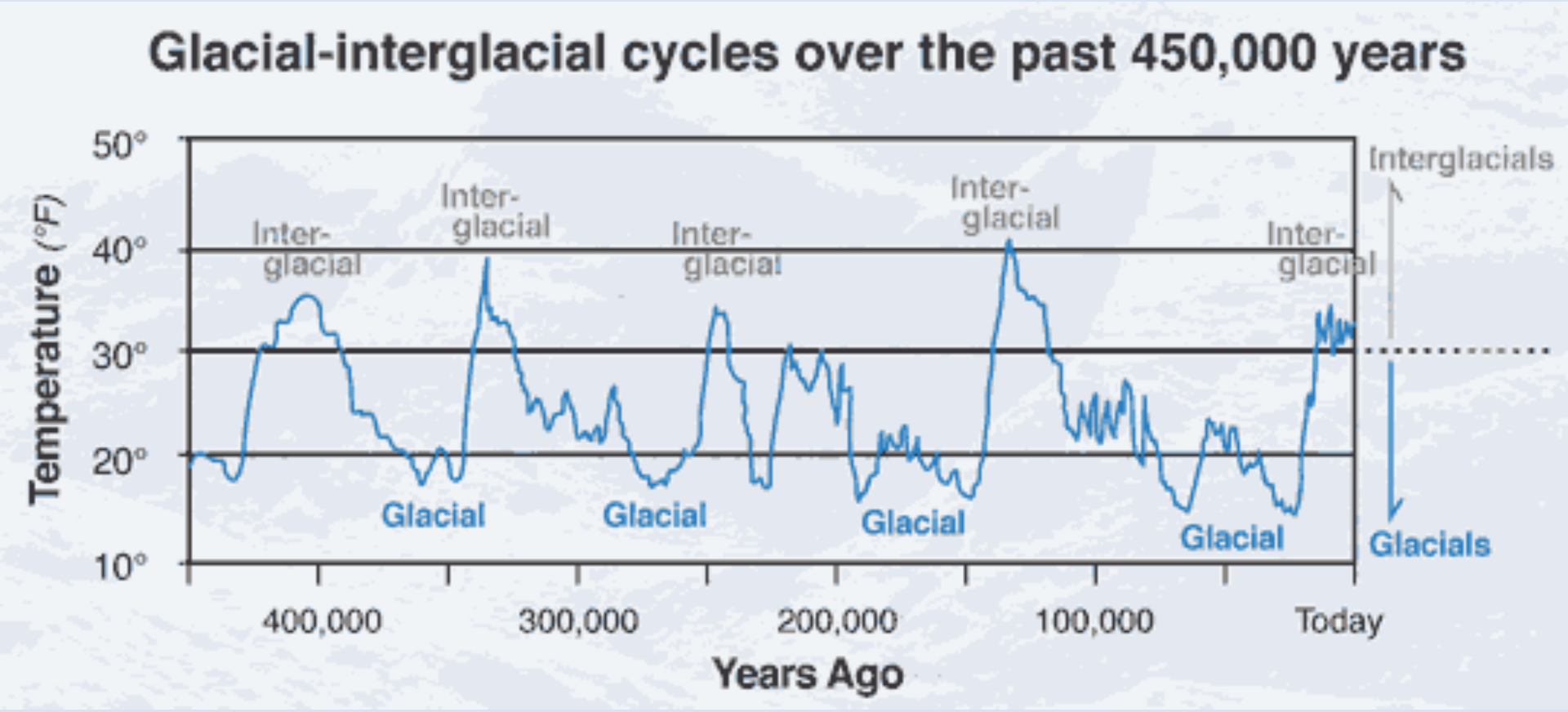

Global Surface Temperature (T_s)
Paleocene
Eocene
Oligocene
Miocene
Plio
P
PETM
Antarctic Ice Sheet
N. Hemisphere Ice Sheets
$\downarrow CO_2$ principal forcing (> 10W/m²)
causing slow Cenozoic climate trend
Longterm cooling trend
CO_2 = 1500 ± 500 ppm
Hominins
Current global mean T: 14.5 C
India-Asia collision
Circumpolar current
Isthmus of Panama
Global Surface Temperature T_s (°C)
25
20
15
10
60
50
40
30
20
10
0
Time (Ma)
Source Information & Graphs: James Hansen publications
Slide assembly and annotation: Root Routledge

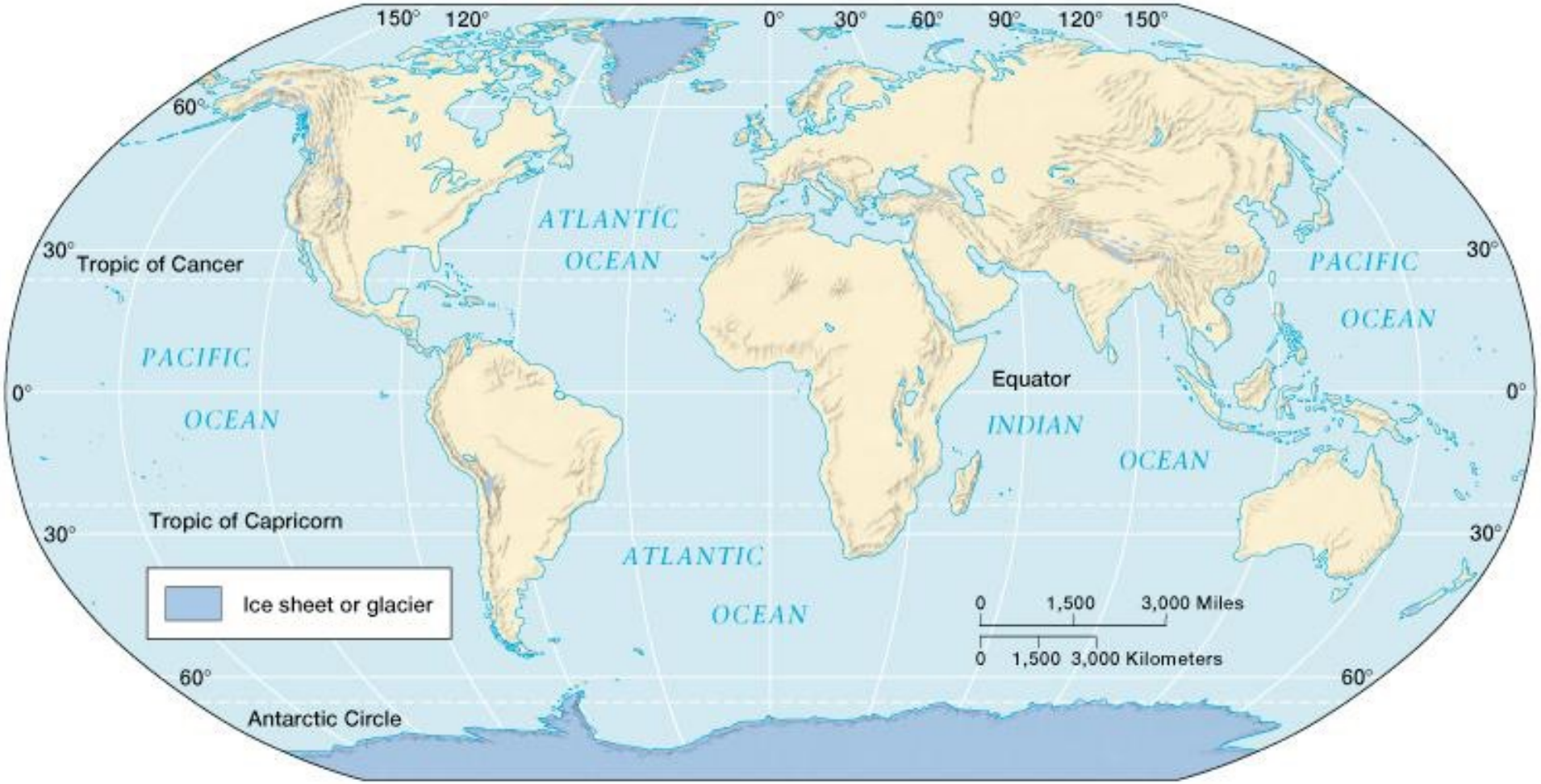

ICE AGE™



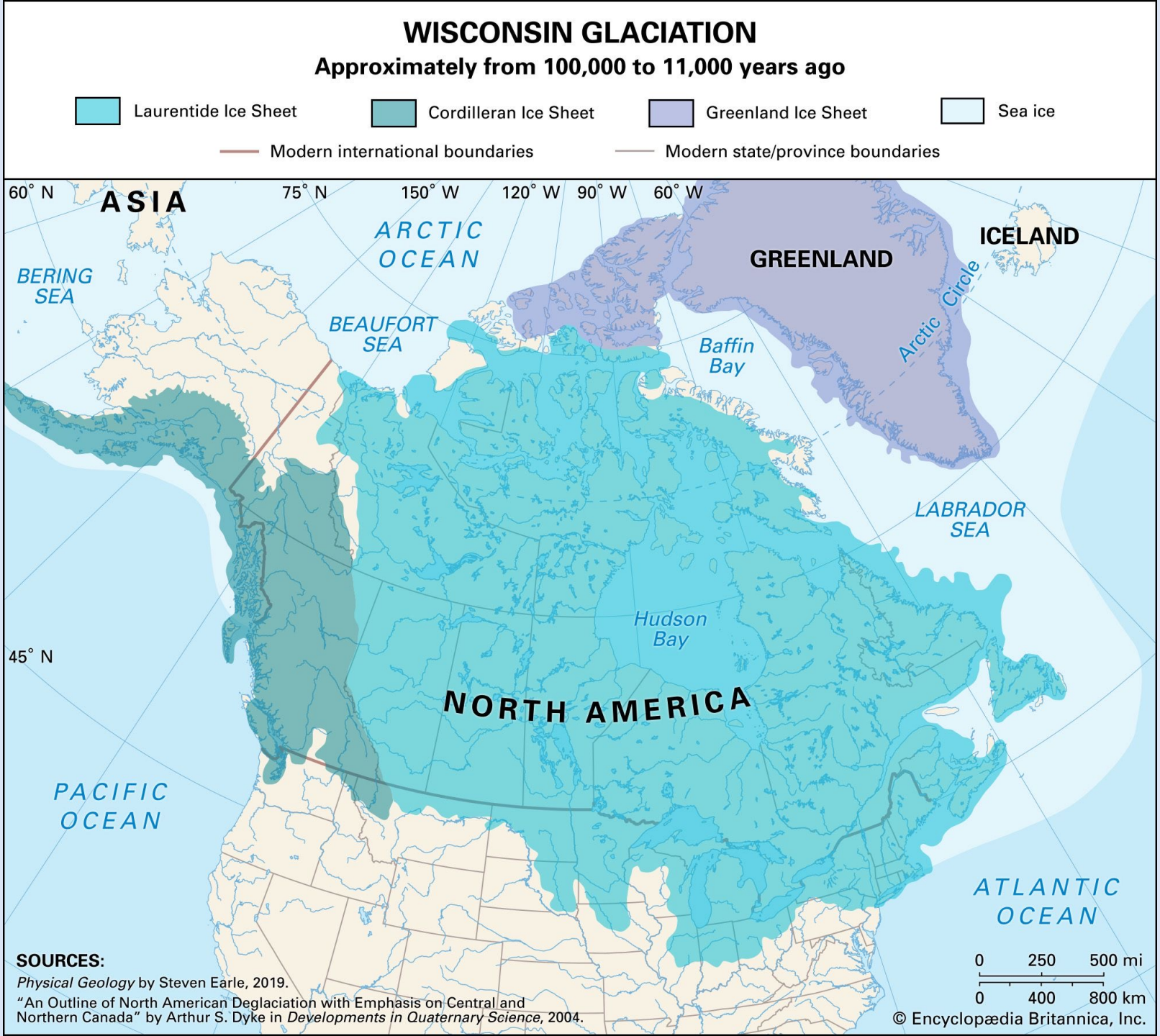
Maximum Extent of Pleistocene Glaciation - 1/3 of land surface 2.5 Ma to 10 Ka

Last glacial maximum peaked 18,000 years ago and is considered to have ended ~10,000 B.P.

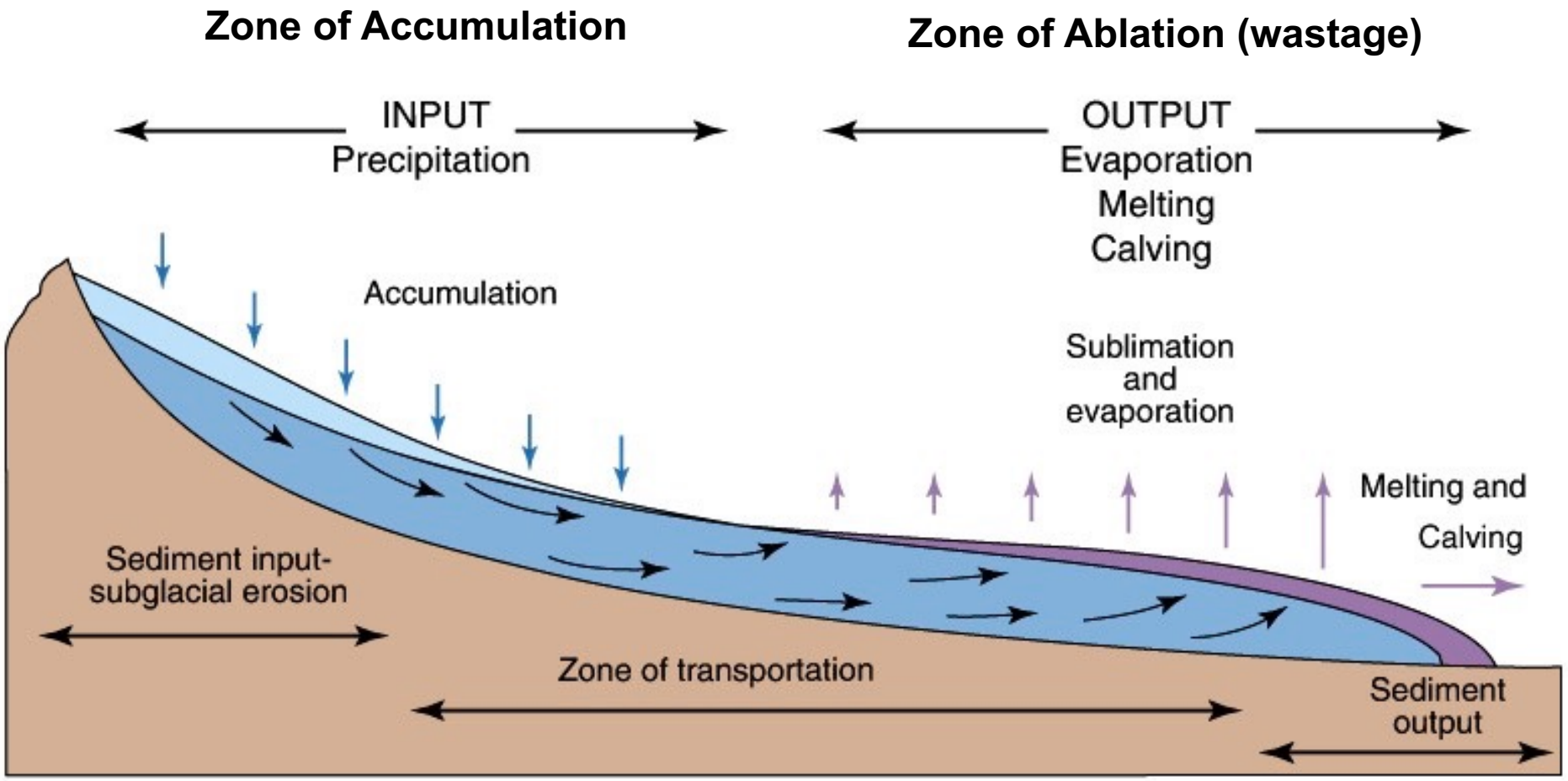

Glacial-interglacial cycles over the past 450,000 years
Temperature (°F)
50°
40°
30°
20°
10°
Inter-glacial
Inter-glacial
Inter-glacial
Inter-glacial
Inter-glacial
Glacial
Glacial
Glacial
Glacial
Interglacials
Glacials
400,000
300,000
200,000
100,000
Today
Years Ago



Current Extent of Glaciation -
about 10% of land surface

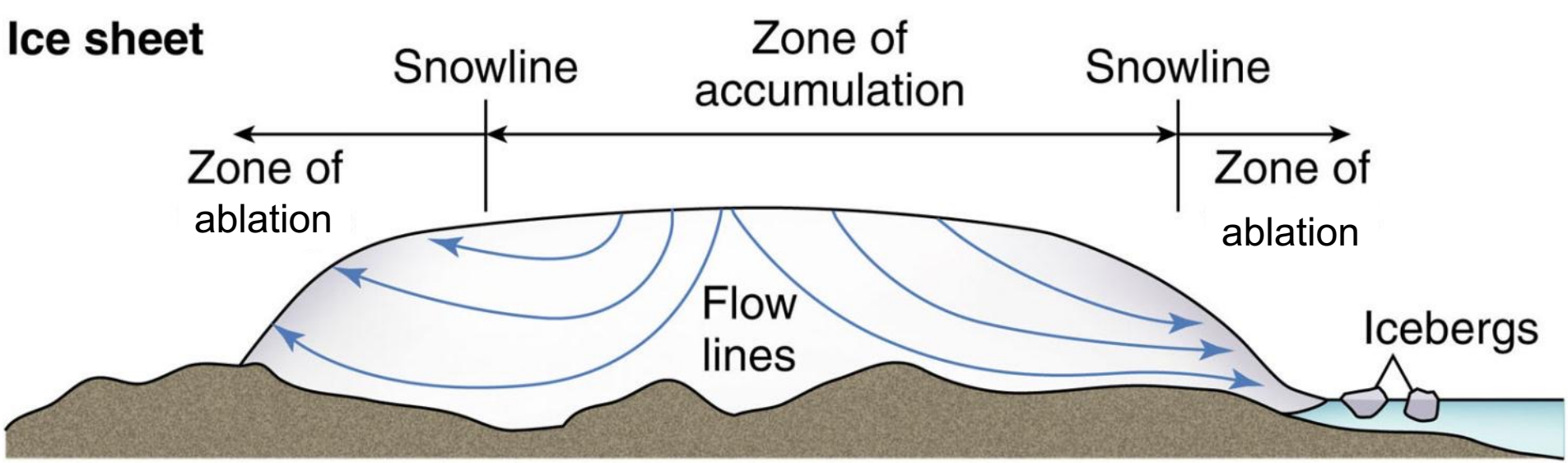

WISCONSIN GLACIATION
Approximately from 100,000 to 11,000 years ago
Laurentide Ice Sheet
Cordilleran Ice Sheet
Greenland Ice Sheet
Sea ice
Modern international boundaries
Modern state/province boundaries
60° N
75° N
150° W
120° W
90° W
60° W
45° N
ASIA
ARCTIC OCEAN
BERING SEA
BEAUFORT SEA
GREENLAND
ICELAND
Arctic Circle
Baffin Bay
LABRADOR SEA
Hudson Bay
NORTH AMERICA
PACIFIC OCEAN
ATLANTIC OCEAN
SOURCES:
Physical Geology by Steven Earle, 2019.
"An Outline of North American Deglaciation with Emphasis on Central and Northern Canada" by Arthur S. Dyke in Developments in Quaternary Science, 2004.
0 250 500 mi
0 400 800 km
© Encyclopædia Britannica, Inc.

Glacial System



Think of a glacier as a slow conveyor belt, it still moves forward even while it's shrinking

A Continental Glacier System



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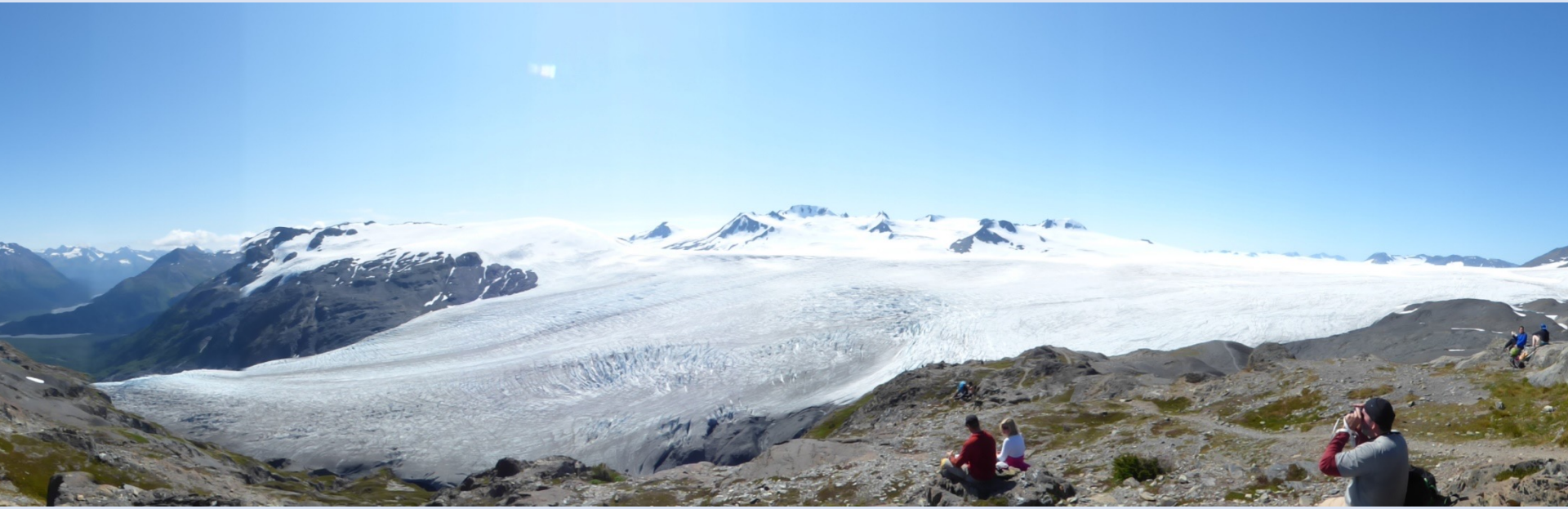
Gratuitous Penguin Photo

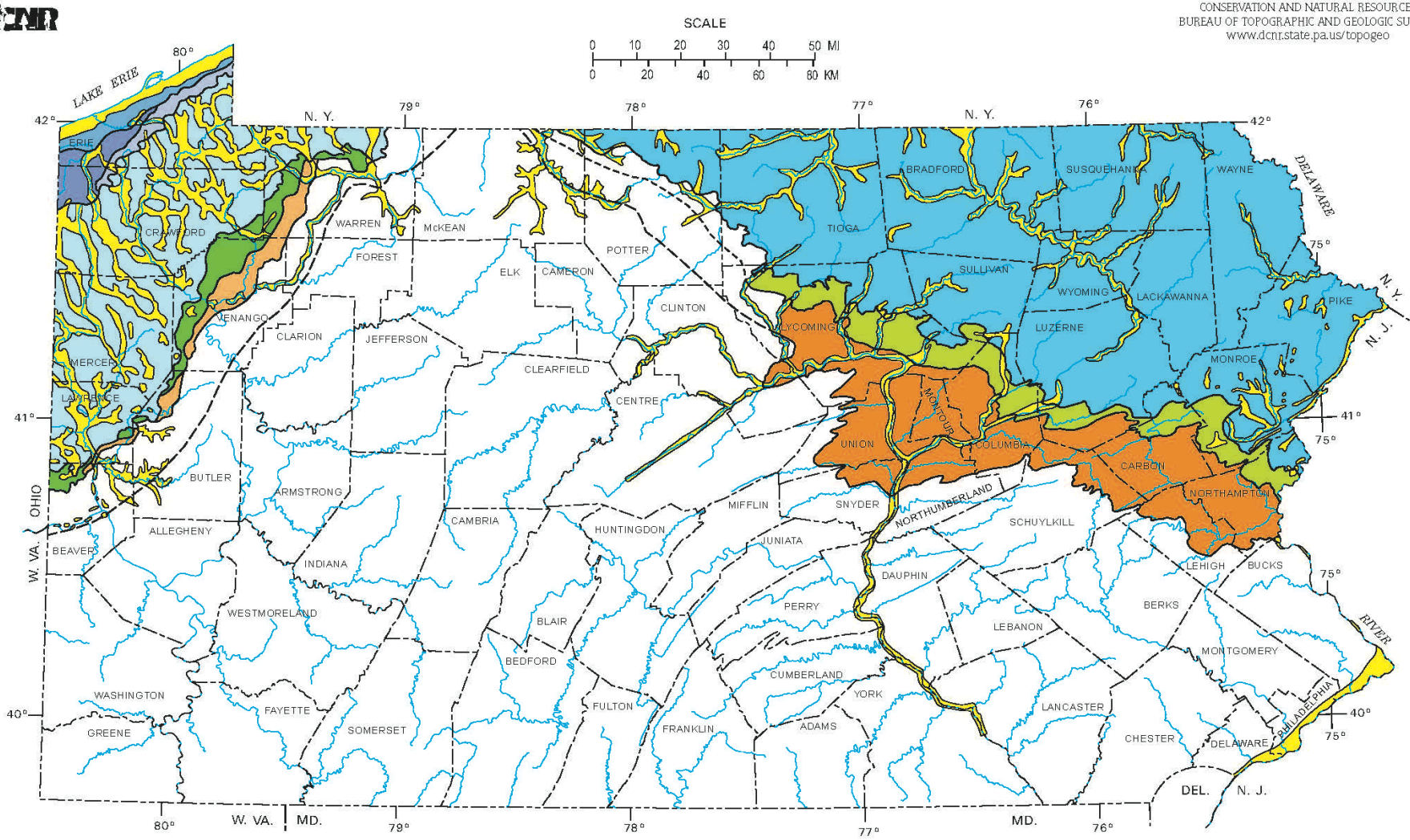
The Harding Ice Sheet



MAP 59

GLACIAL DEPOSITS OF PENNSYLVANIA

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF
CONSERVATION AND NATURAL RESOURCES
BUREAU OF TOPOGRAPHIC AND GEOLOGIC SURVEY
www.dcnr.state.pa.us/topogeo



EXPLANATION

RECENT TO LATE ILLINOIAN (0–198,000 yrs.)

STRATIFIED DRIFT

Sand and gravel in eskers, kames, kame terraces, and outwash, principally in valleys; silt and clay in lake deposits in formerly ice-dammed valleys; lake clays and beach sands and gravels along Lake Erie; thin (Recent) to thick (late Illinoian) soils.

WISCONSINAN (17,000–22,000 yrs.)

ASHTABULA TILL
HIRAM TILL
LAVERY TILL
KENT TILL

Thick, gray, clayey to silty to sandy till covering over 75 percent of the ground; topography is mainly gently undulating, but there is also some knob-and-kettle topography; thin soil.

OLEAN TILL

Moderately thick, gray to grayish-red, sandy till covering 25 to 50 percent of the ground; very thin till covers an additional 25 percent of the ground; topography reflects the underlying bedrock; thin soil.

LATE ILLINOIAN (132,000–198,000 yrs.)

TITUSVILLE TILL
UNNAMED TILLS

Thin, gray (Titusville) to brown and grayish-red (unnamed), clayey to sandy till covering 10 to 25 percent of the ground; topography reflects the underlying bedrock; moderately thick, well-developed soil.

PRE-ILLINOIAN (>770,000 yrs.)

MAPLEDALE TILL
UNNAMED TILLS

Thin, gray, clayey to silty till in patches covering up to 10 percent of the ground; topography reflects the underlying bedrock; thick, well-developed soil, commonly having a yellowish-red color.

SYMBOLS

Southern limit of glacial advance

Approximate limit of Illinoian advance

Approximate limit of pre-Illinoian advance

By W. D. Sevon and D. D. Braun.
Second Edition, 1997; Second Printing, 2000.

2200-MP-DCNR3027
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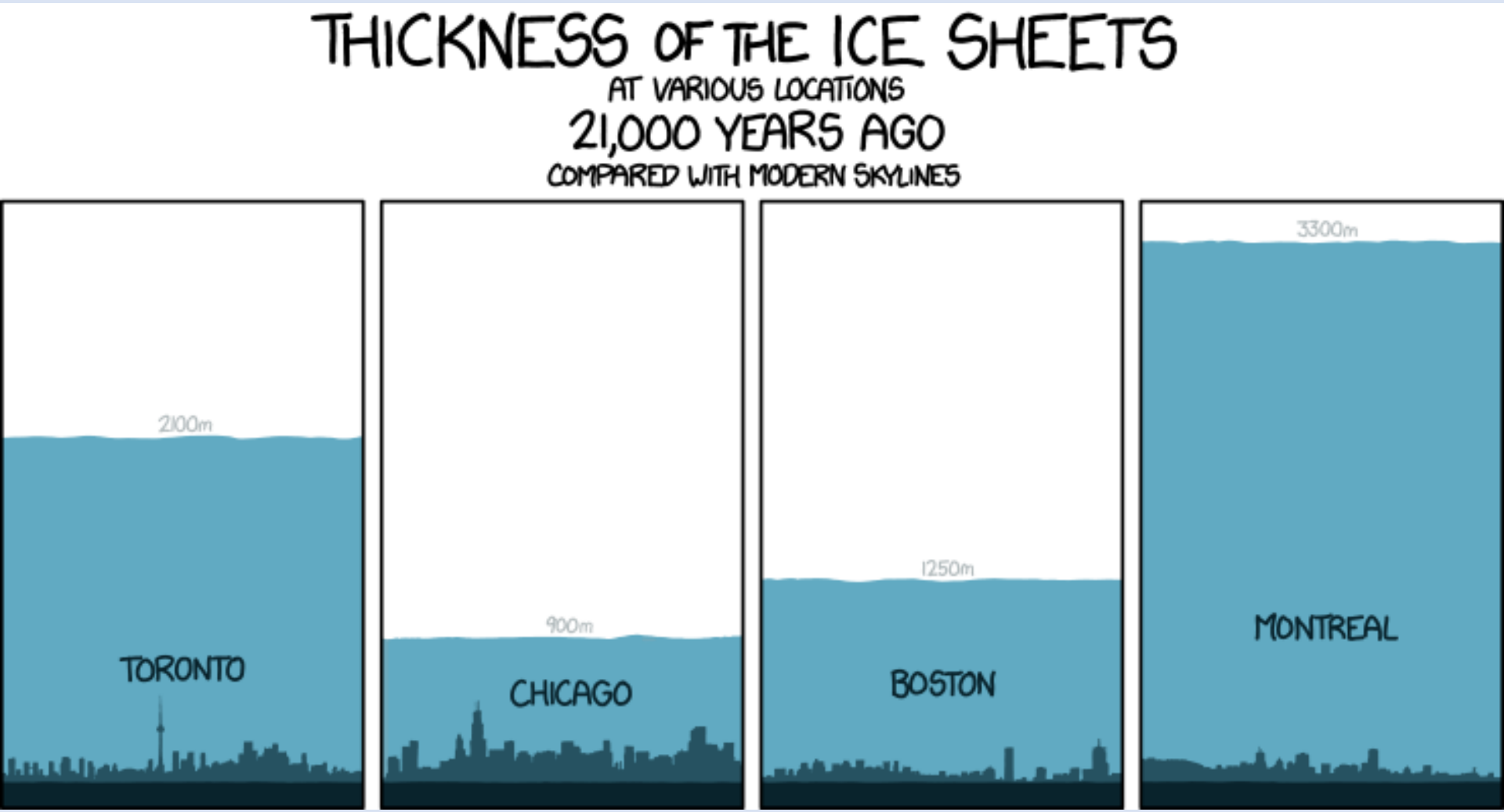
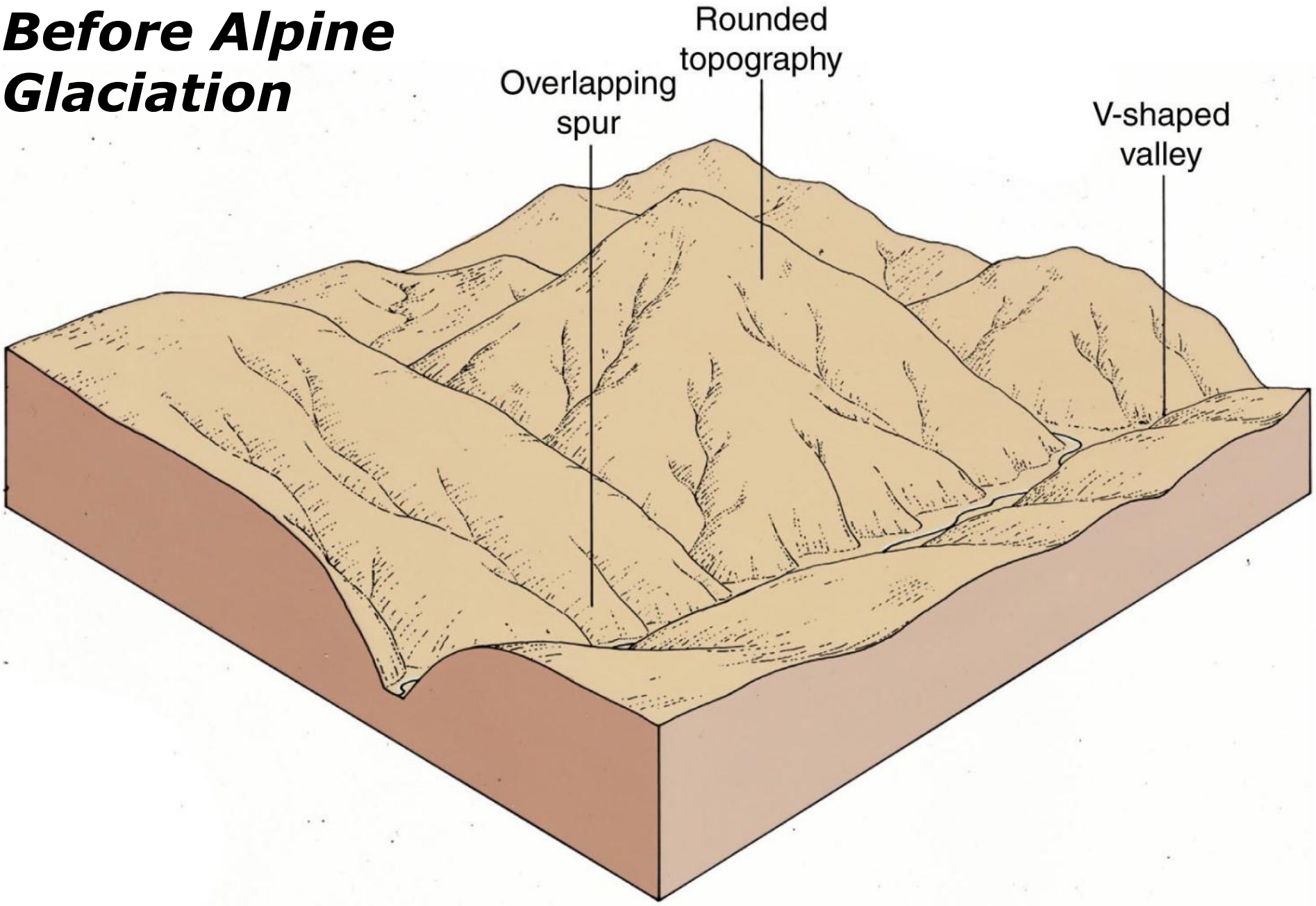


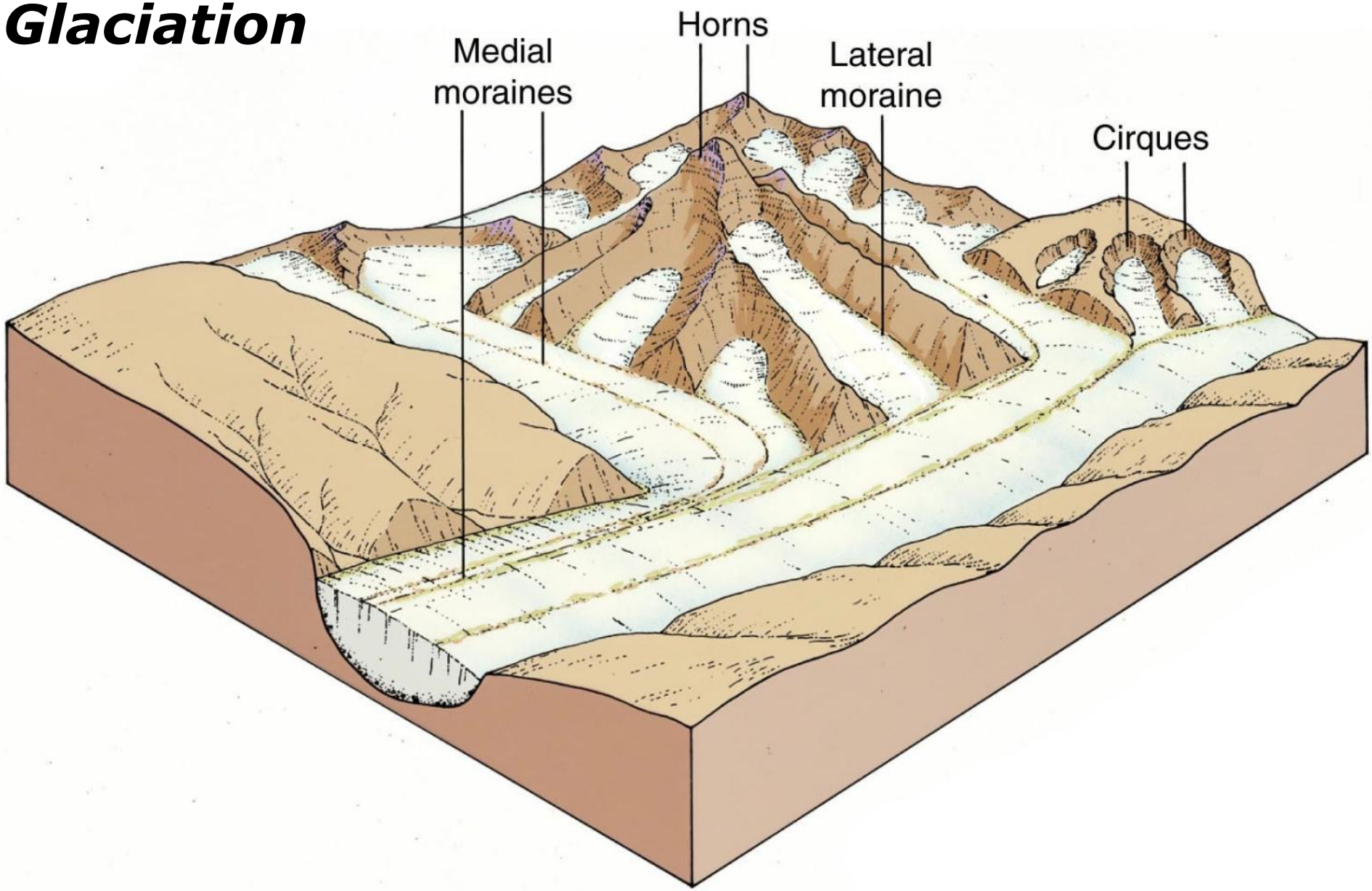
https://www.explainxkcd.com/wiki/index.php/1225:_Ice_Sheets


GLACIER LAKES

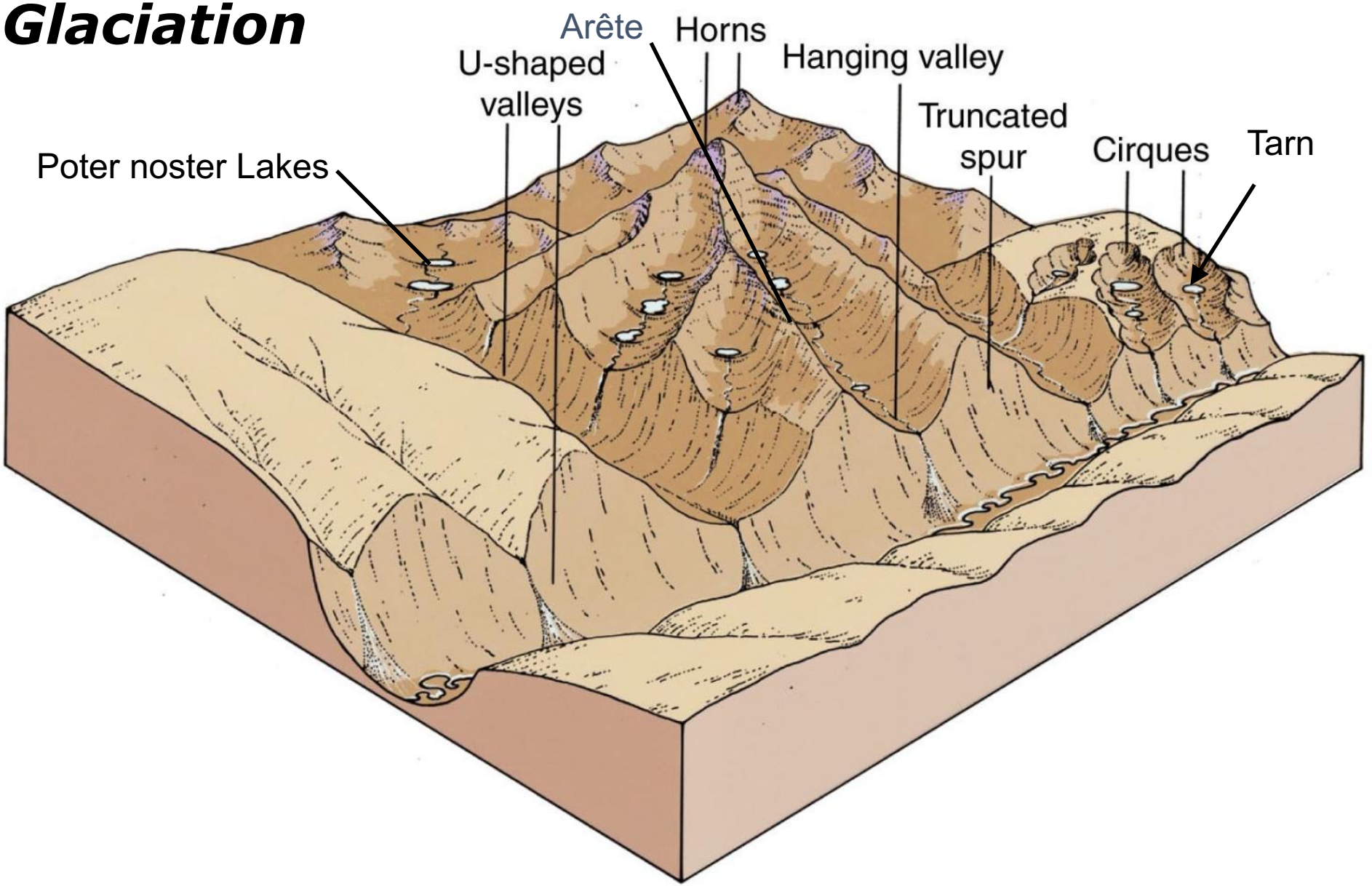
Before Alpine Glaciation



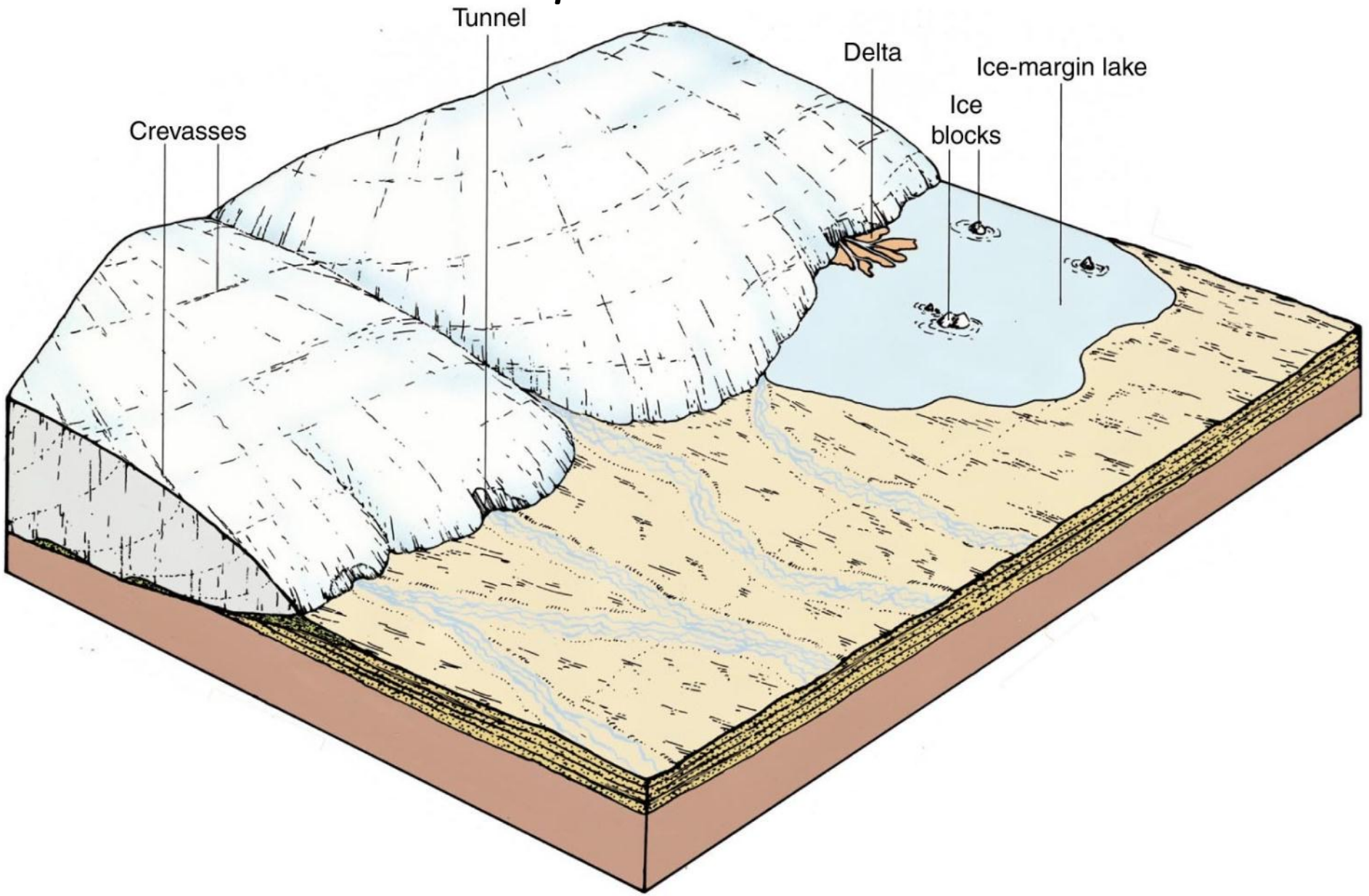
During Alpine Glaciation



After Alpine Glaciation

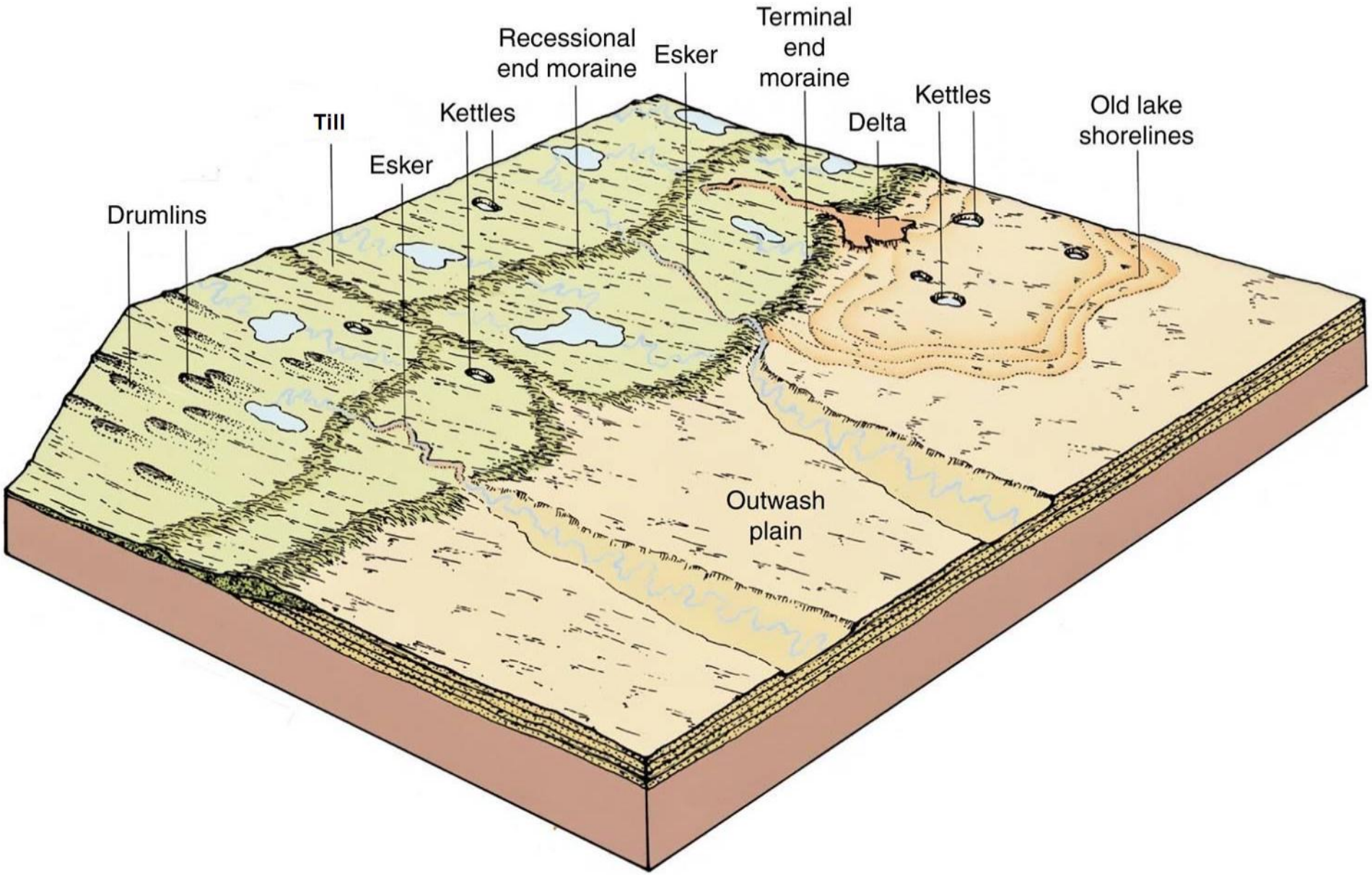


Continental Glacier Depositional Features



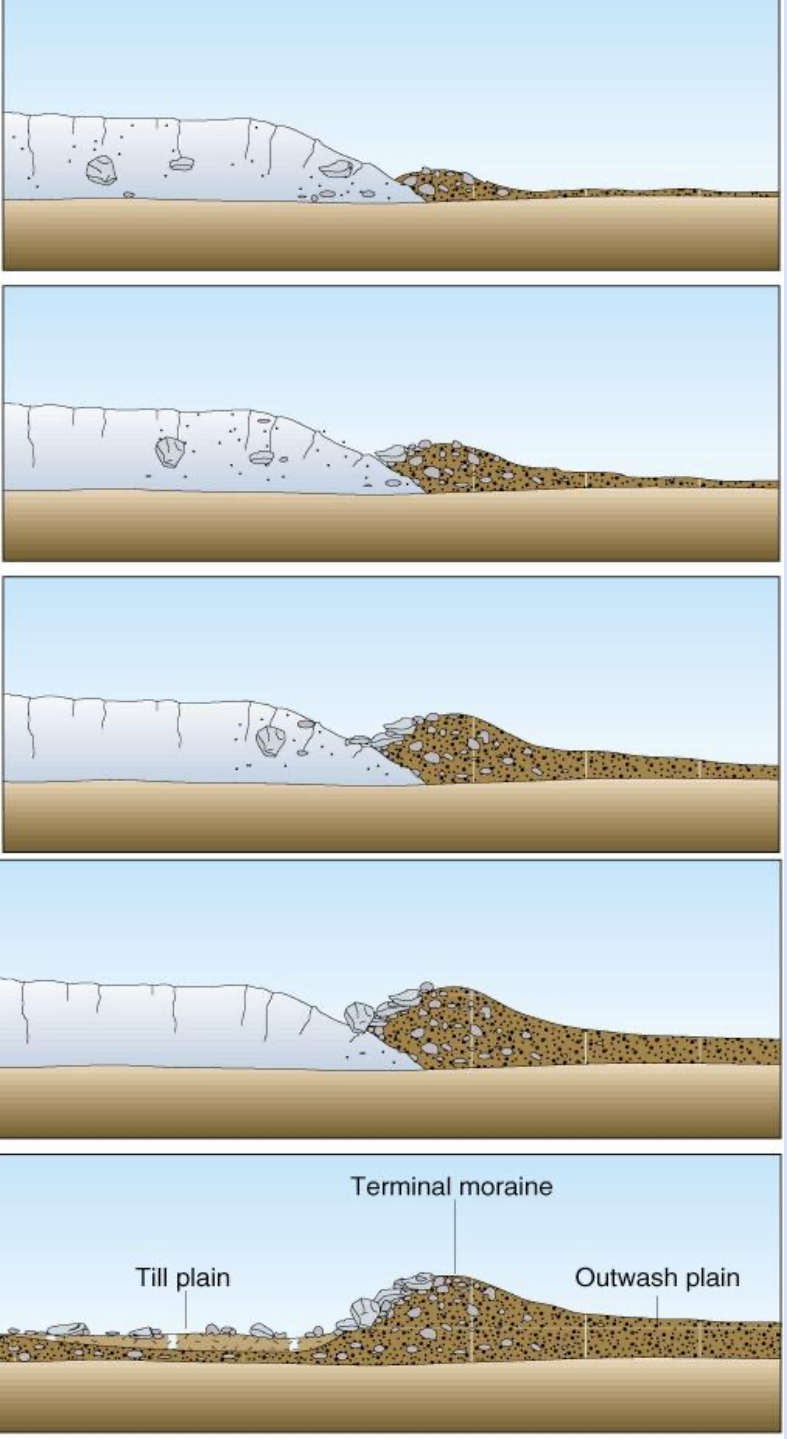
During Glaciation

Continental Glacier Depositional Features

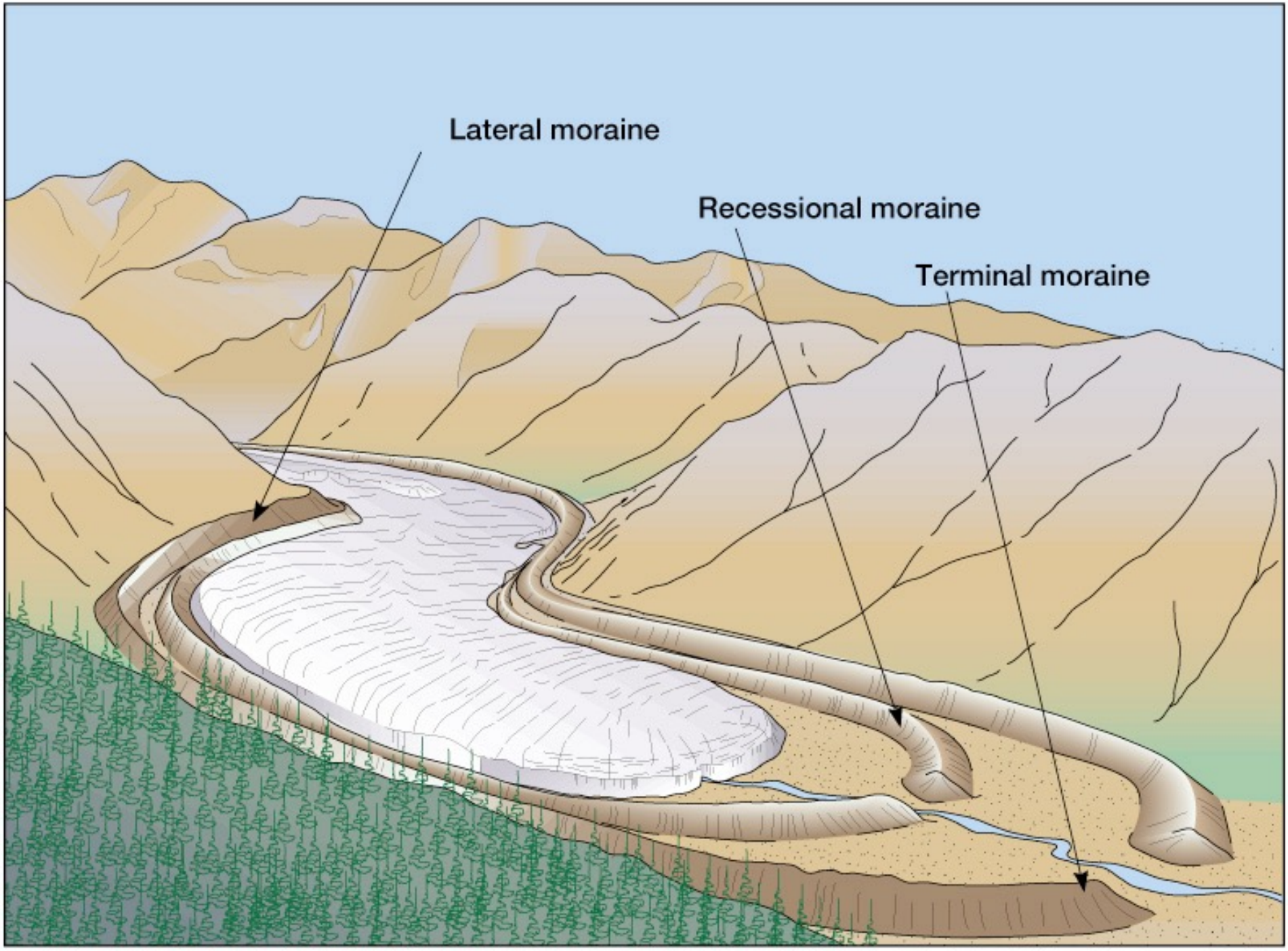


After Glaciation

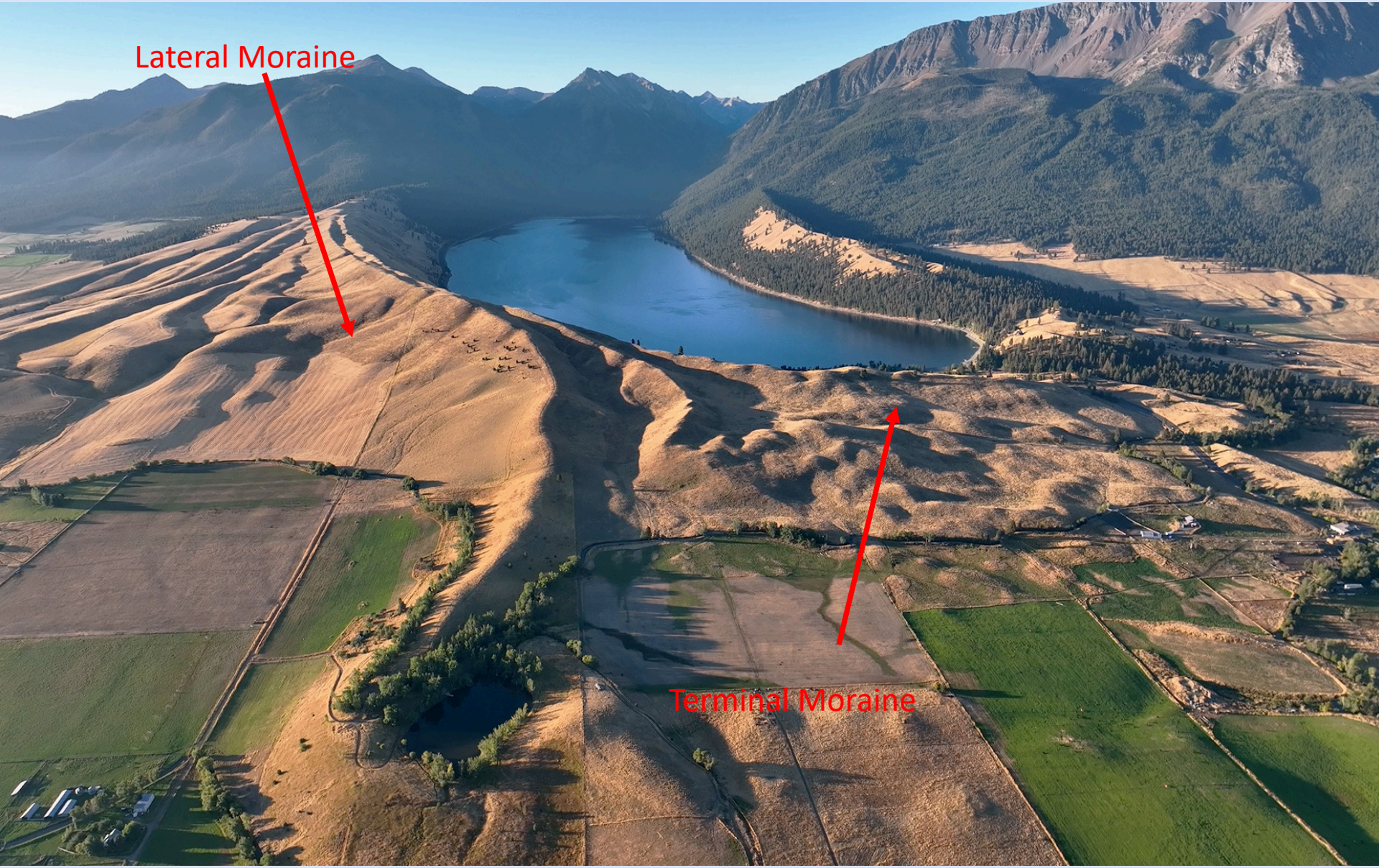
Moraines



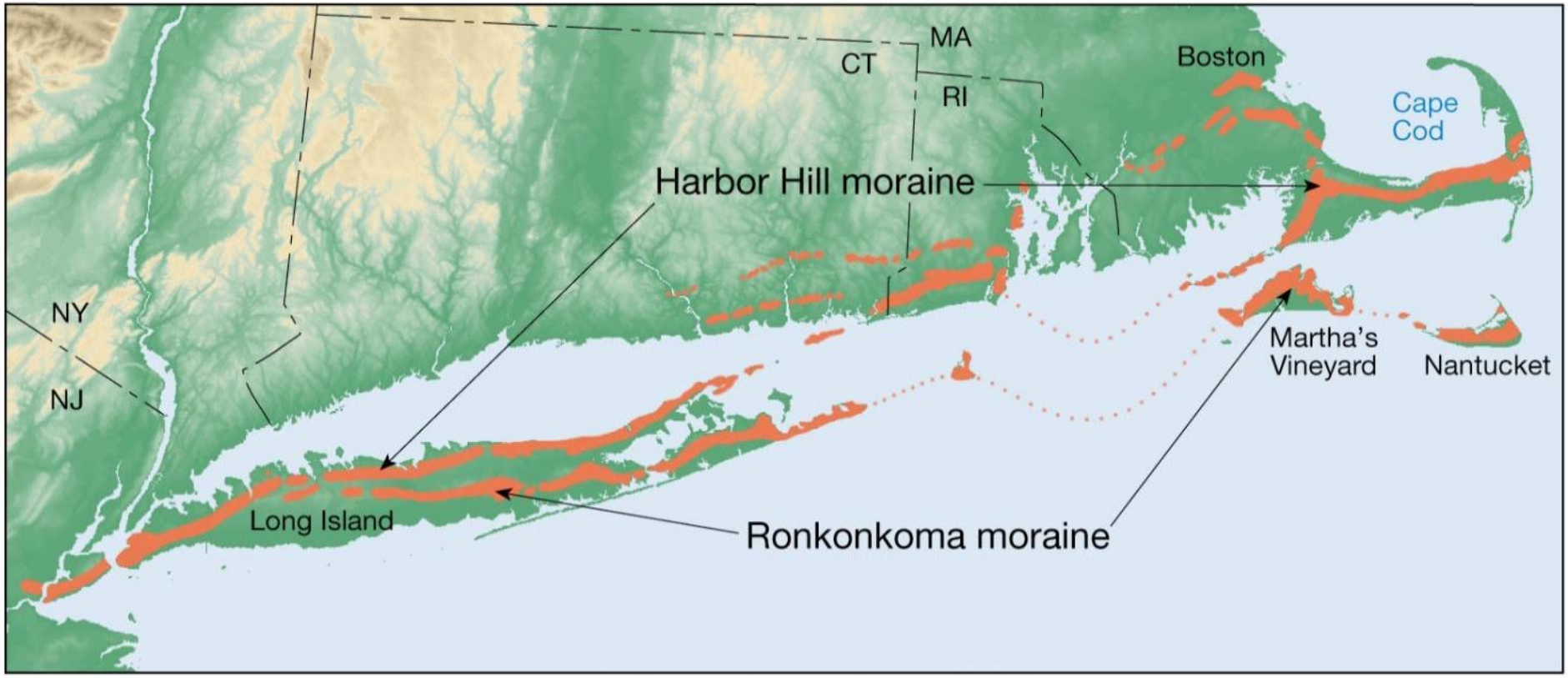
Glacial Moraine


Lateral moraine
Recessional moraine
Terminal moraine

Glacial Lake



Glacial Deposits of New England



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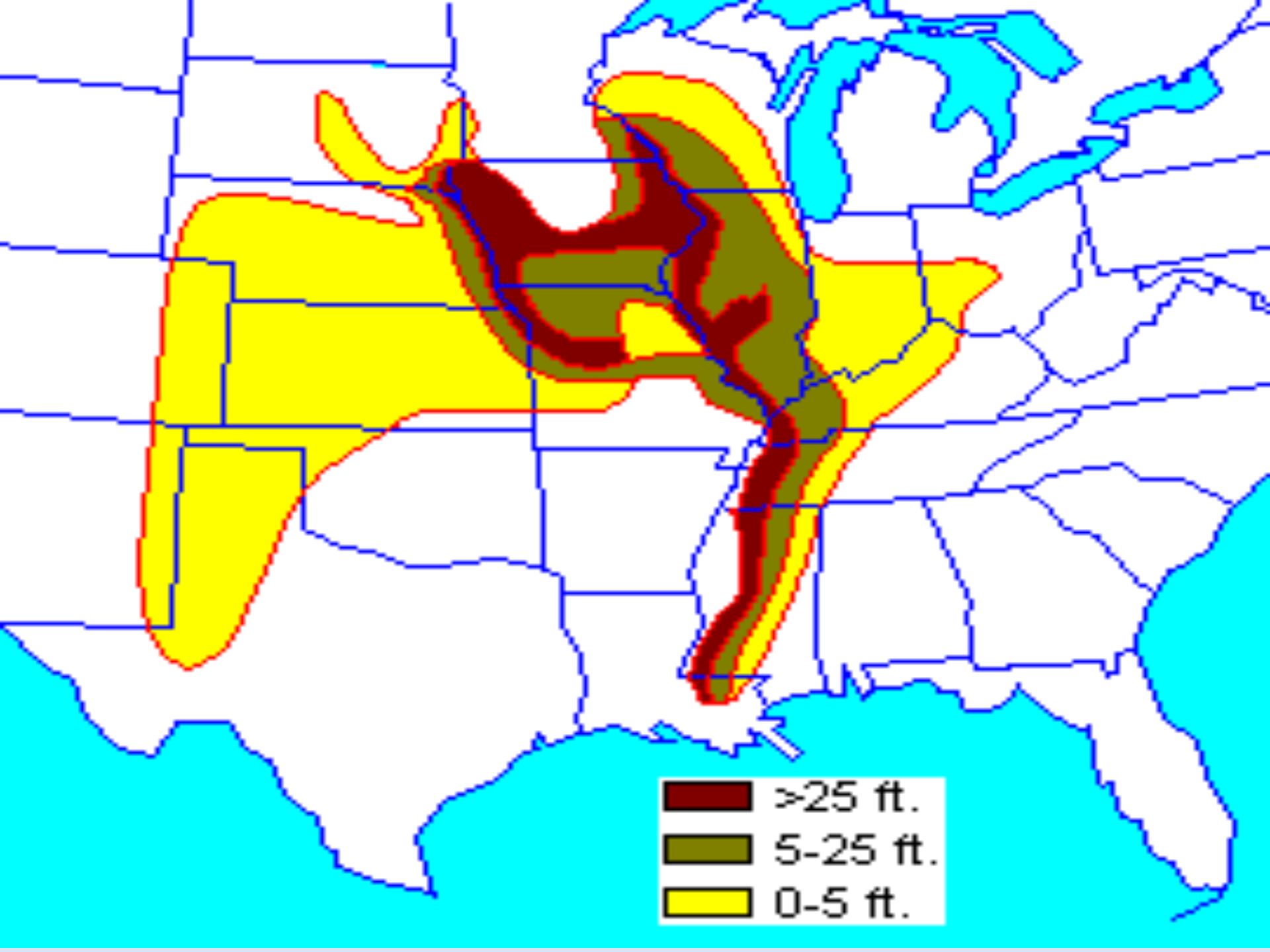
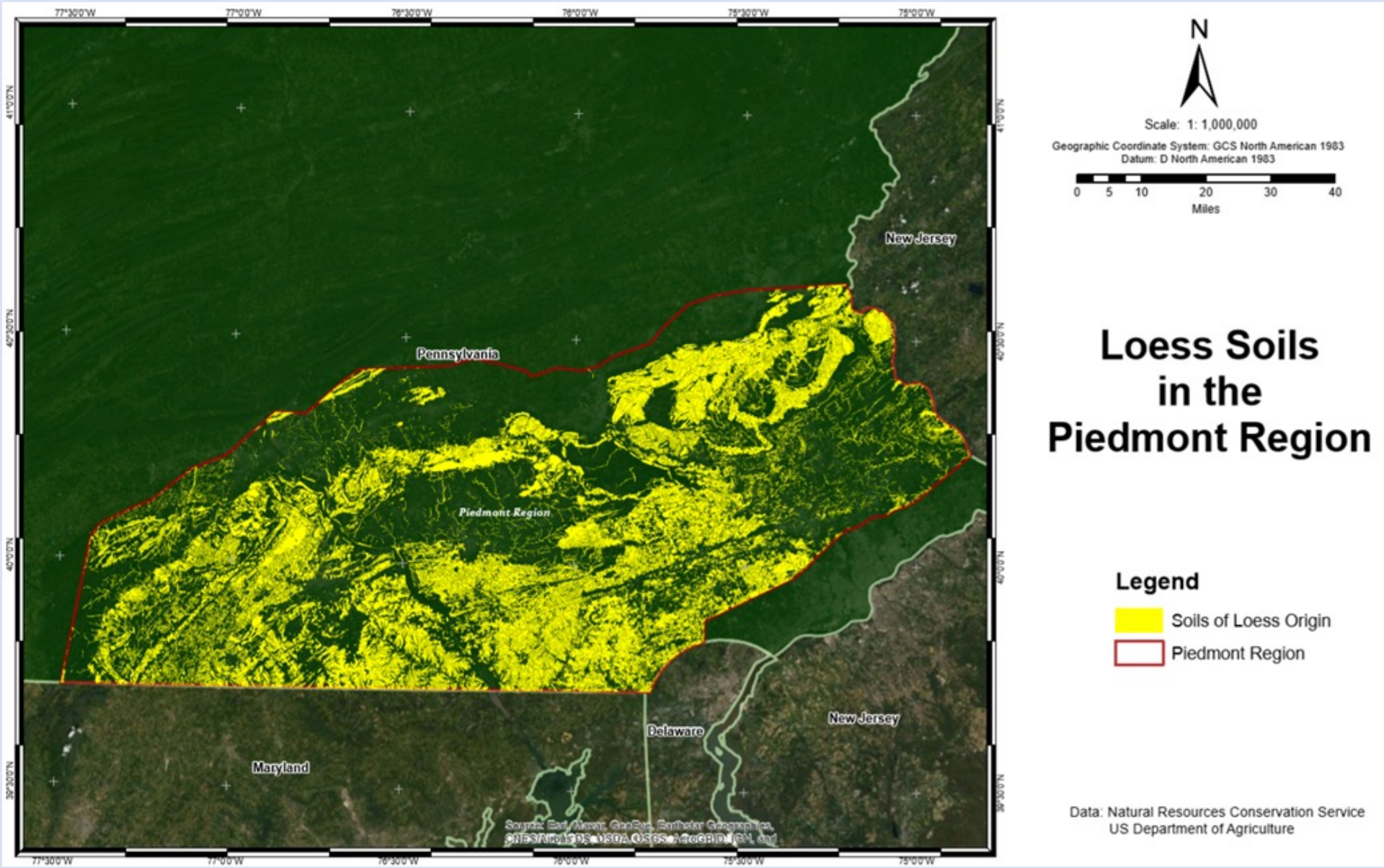
Glacial Deposits: till

Glacial Erratics – Rocks deposited by a glacier that otherwise wouldn't be present

Outwash deposited by glacial streams

Glacial Deposition - Loess


>25 ft.
5-25 ft.
0-5 ft.



Slide Courtesy of Sheyenne Delawrence, 2020


GSA
PHOTO SCALE/FOCUS GUIDE
CM
IN
Grain Size Scale
1
2
3
4
5
mm

A drumlin – unlithified material that has been streamlined beneath a glacier

Upstate New York

Kettle Lakes

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The Human Element

Tillage Enhanced Clay Translocation

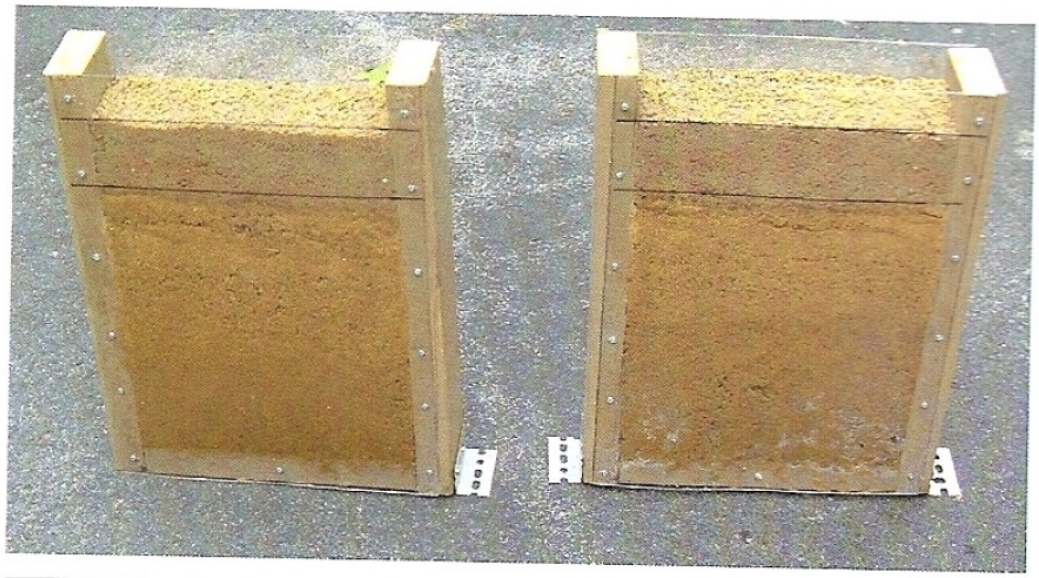


Fig. 1. An image of the two rectangular columns (30 by 90 by 9 cm) before the experiment was conducted.

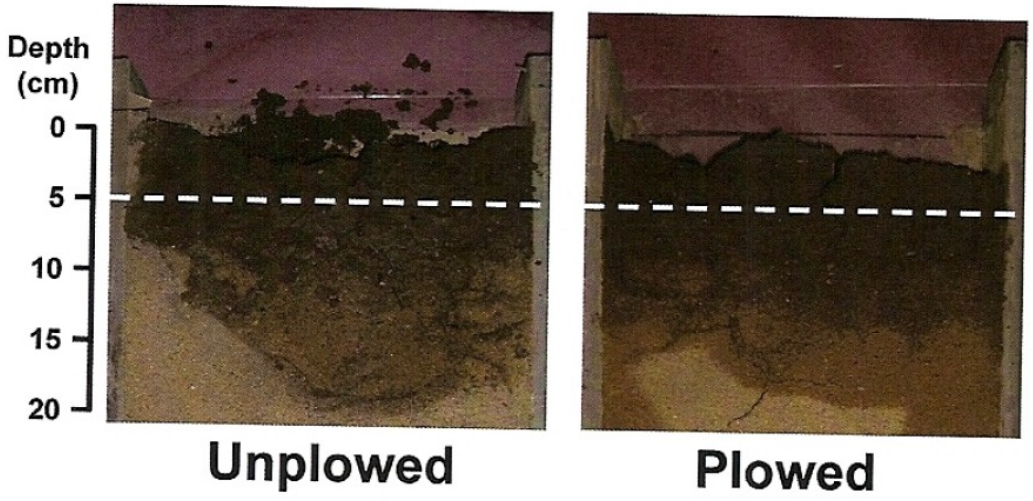


Fig. 2. Unplowed and plowed soil profiles at the end of the 152-d experiment.

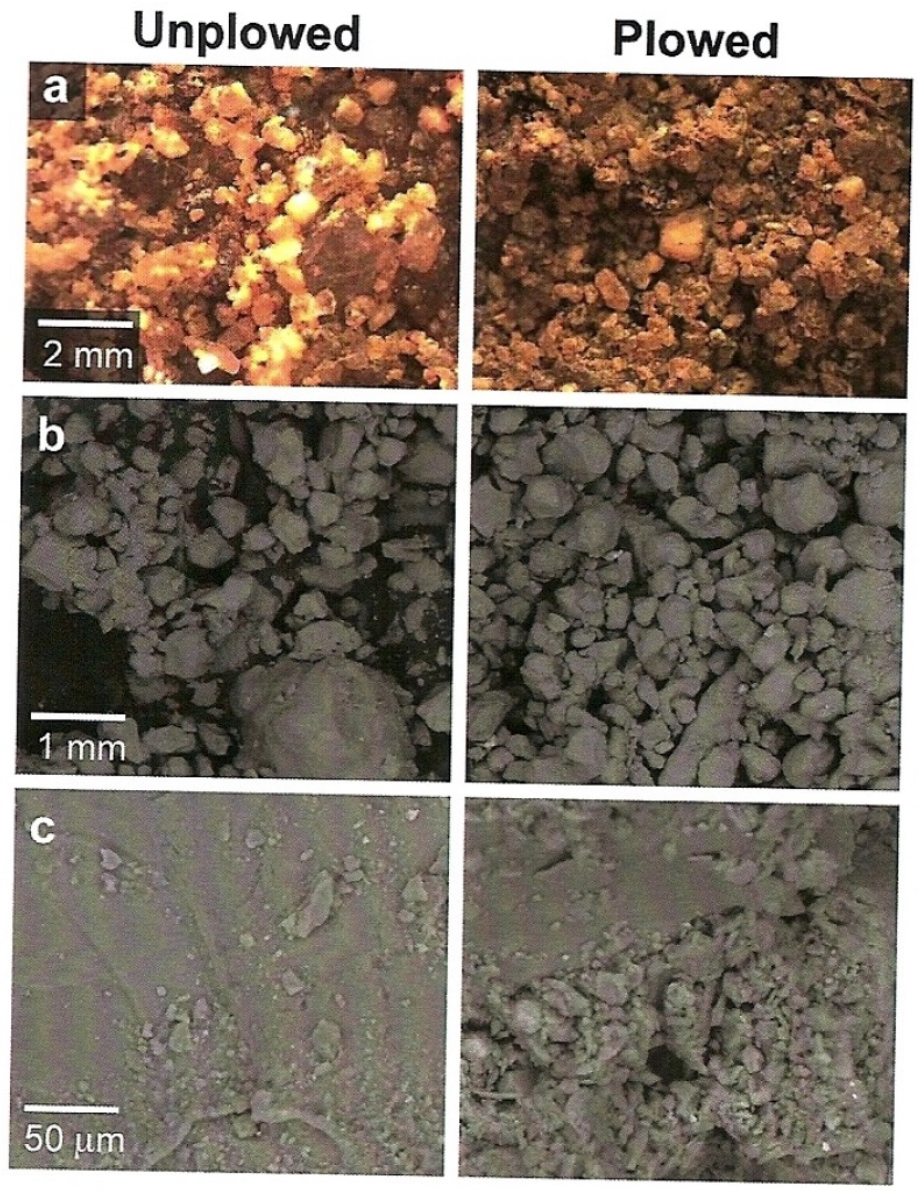
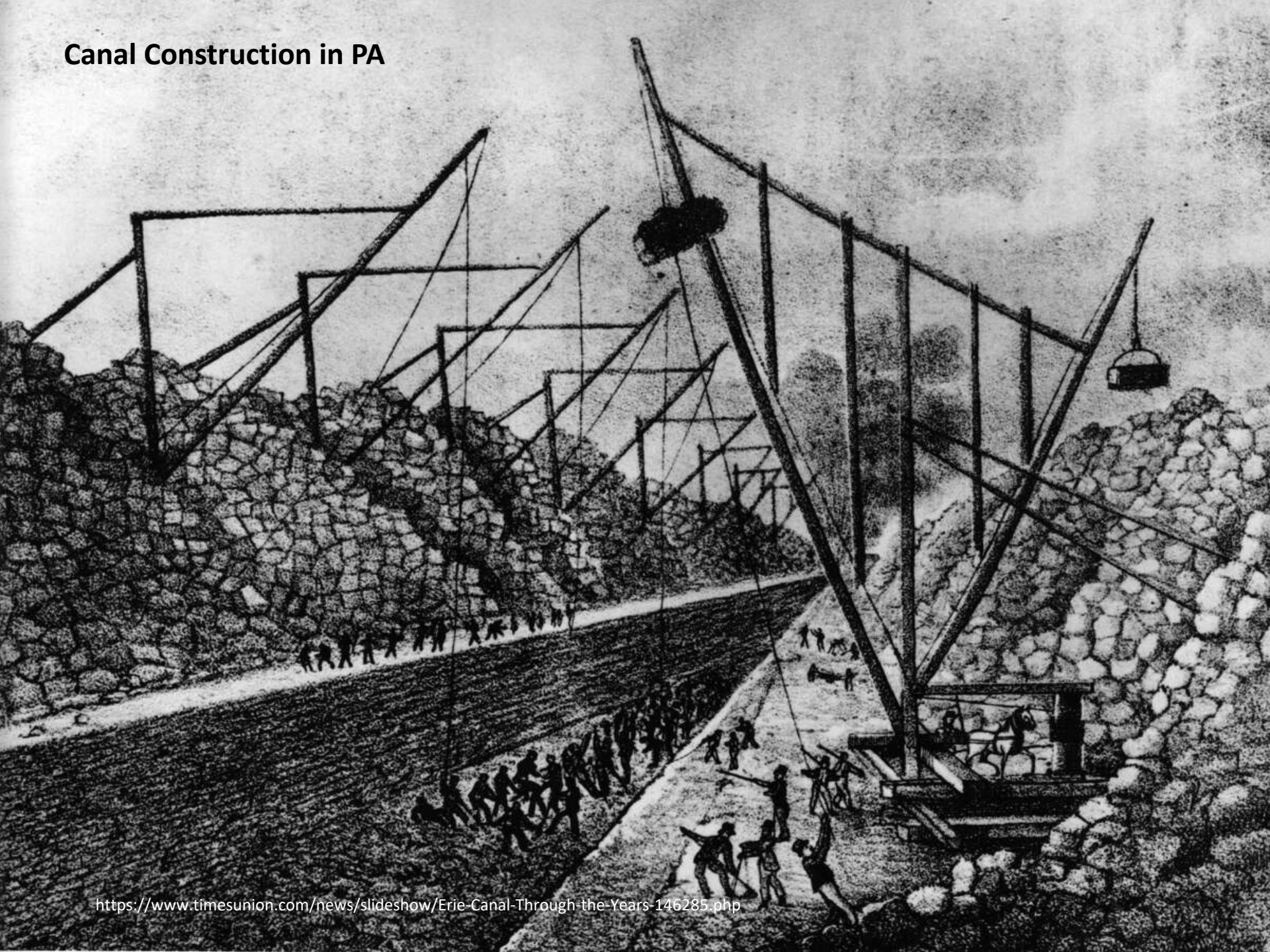
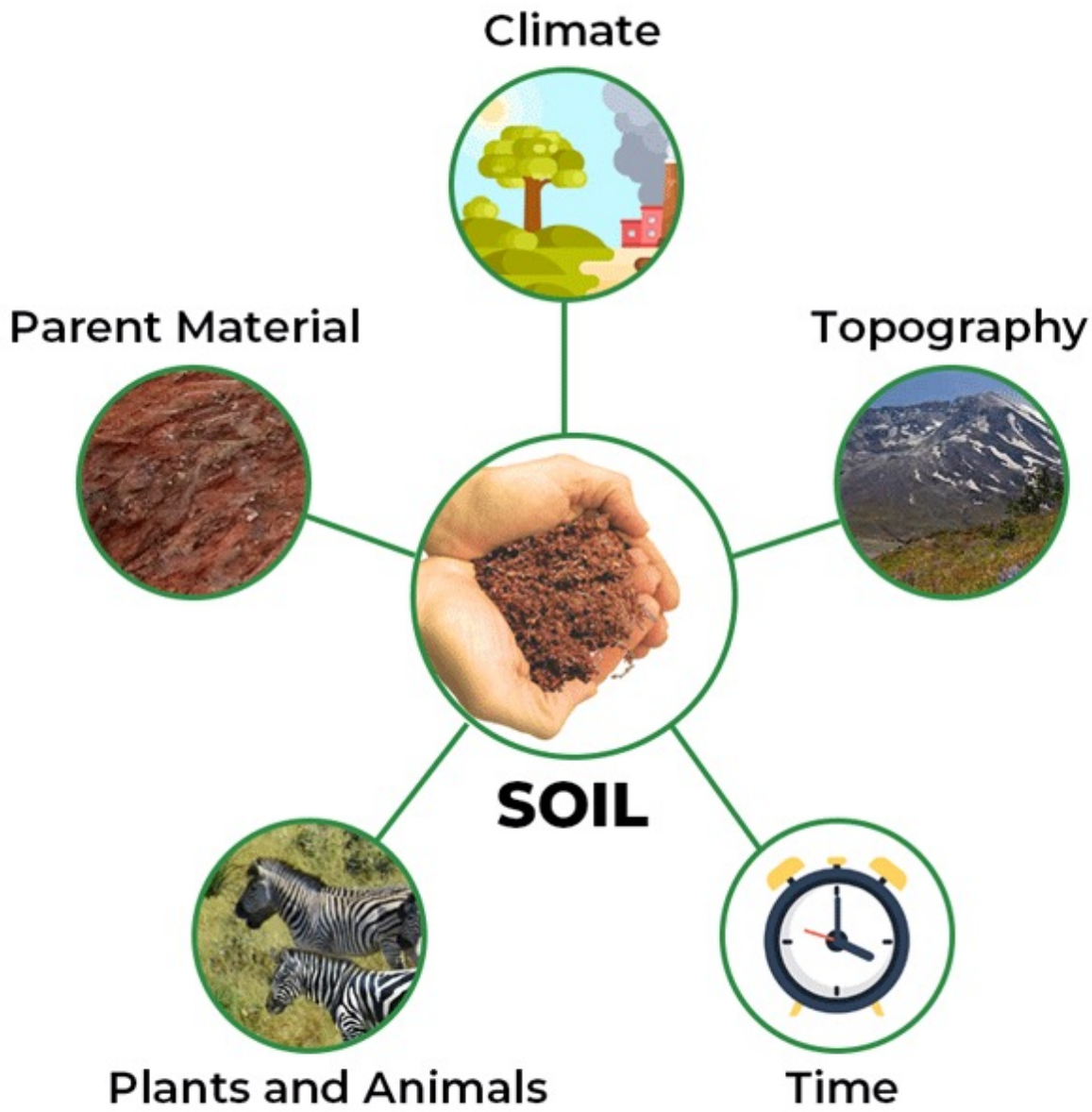


Fig. 3. Images of the unplowed and plowed soil at a depth of 10 cm using (a) an optical microscope at 14× and a scanning-electron microscope at (b) 30× and (c) 500× magnification. Note that the plowed sample shows evidence of clay films an bridging by fines.

Canal Construction in PA



https://www.timesunion.com/news/slideshow/Erie-Canal-Through-the-Years-146285.php

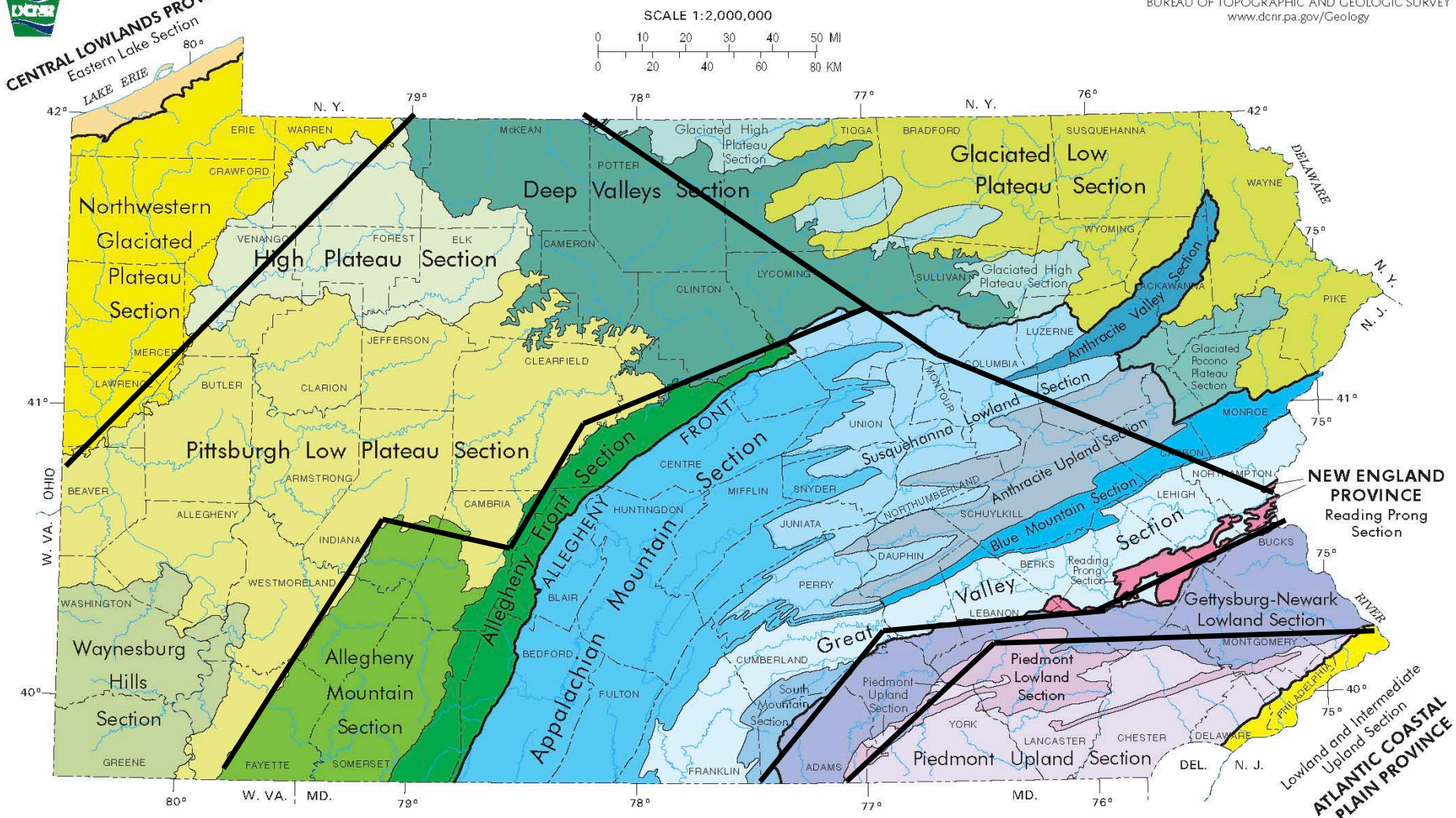


https://www.geeksforgeeks.org/soil-formation/

MAP 13

PHYSIOGRAPHIC PROVINCES OF PENNSYLVANIA

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF
CONSERVATION AND NATURAL RESOURCES
BUREAU OF TOPOGRAPHIC AND GEOLOGIC SURVEY
www.dcnr.pa.gov/Geology



EXPLANATION

CENTRAL LOWLANDS PROVINCE
- Eastern Lake Section

APPALACHIAN PLATEAUS PROVINCE
- Northwestern Glaciated Plateau Section
- High Plateau Section
- Pittsburgh Low Plateau Section
- Waynesburg Hills Section
- Allegheny Mountain Section
- Allegheny Front Section
- Deep Valleys Section
- Glaciated High Plateau Section
- Glaciated Low Plateau Section
- Glaciated Pocono Plateau Section

RIDGE AND VALLEY PROVINCE
- Appalachian Mountain Section
- Susquehanna Lowland Section
- Anthracite Valley Section
- Anthracite Upland Section
- Blue Mountain Section
- Great Valley Section
- South Mountain Section

NEW ENGLAND PROVINCE
- Reading Prong Section

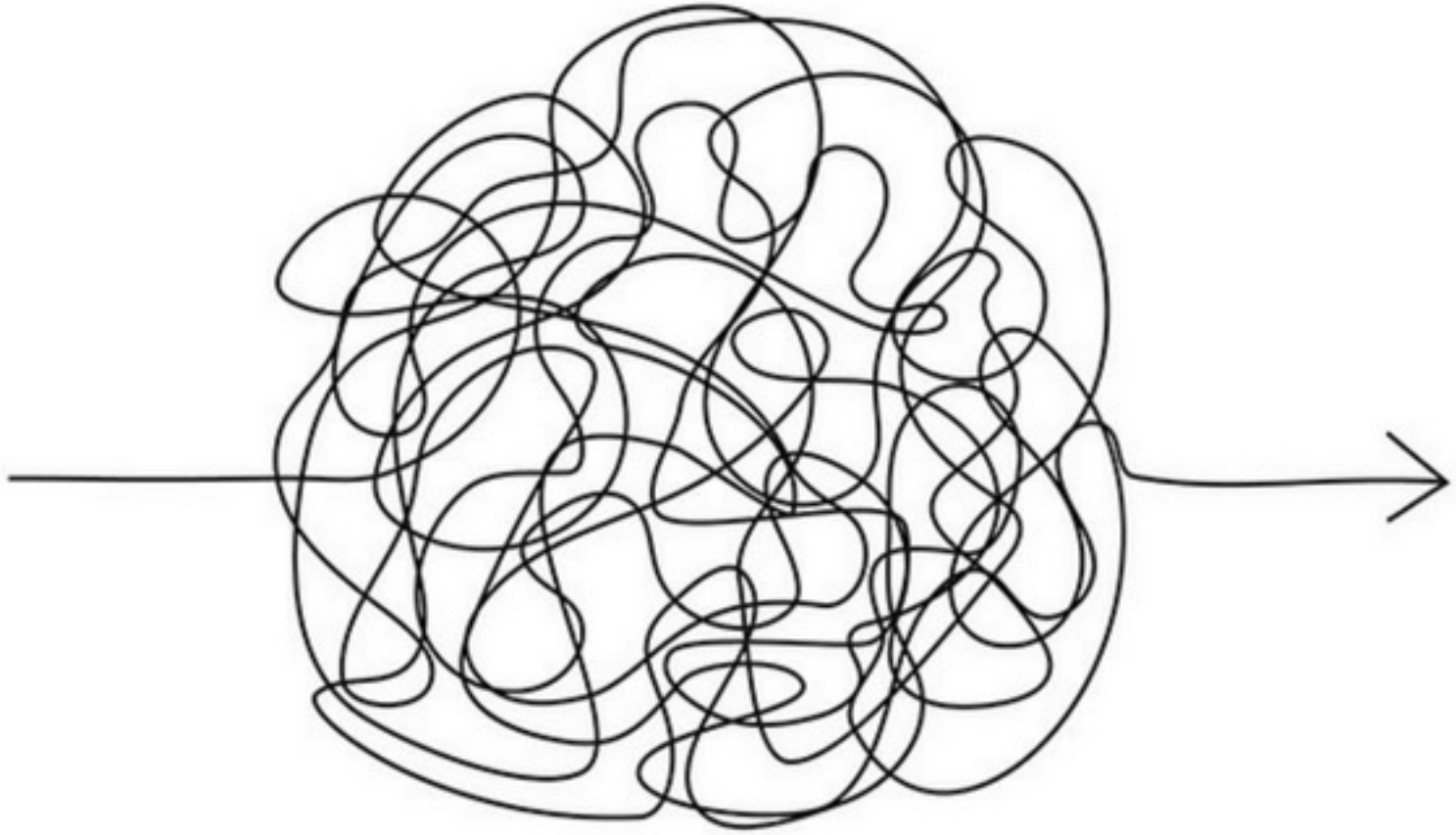
PIEDMONT PROVINCE
- Gettysburg-Newark Lowland Section
- Piedmont Lowland Section
- Piedmont Upland Section

ATLANTIC COASTAL PLAIN PROVINCE
- Lowland and Intermediate Upland Section

SYMBOLS
- Approximate boundary between physiographic provinces
- Approximate boundary between physiographic sections

Compiled by W. D. Sevon. Fourth Edition, 2000; Second Printing, 2018.

It’s Complicated




ANY
QUESTIONS?