In the beginning, there was geology

Where we're going today

1. 425 Ma (Million years ago) – Silurian salt

2. 390 Ma – Devonian seashore

3. 15,000 years ago – Pleistocene Ice age

4. Today – Post glacial

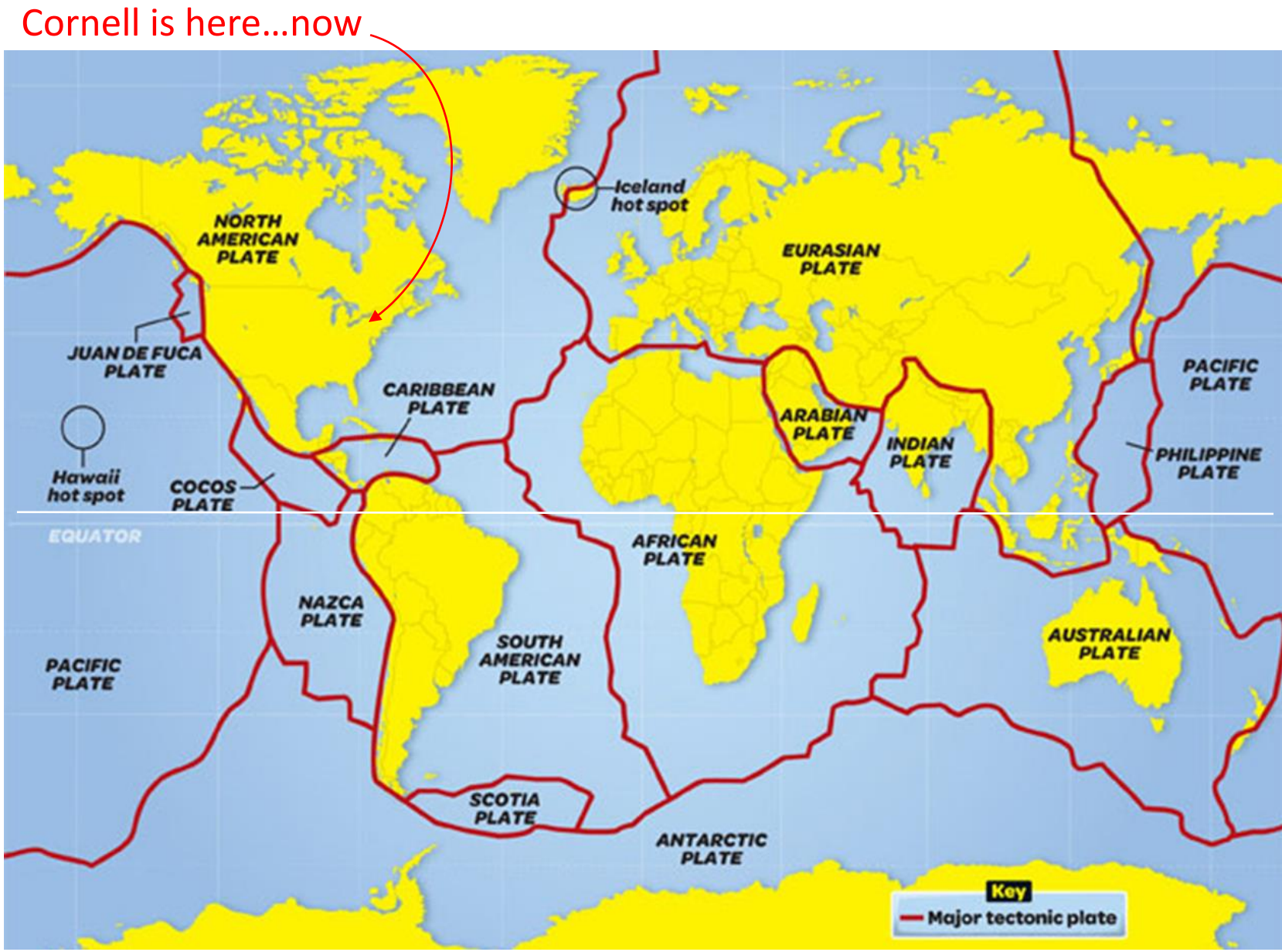
Cornell

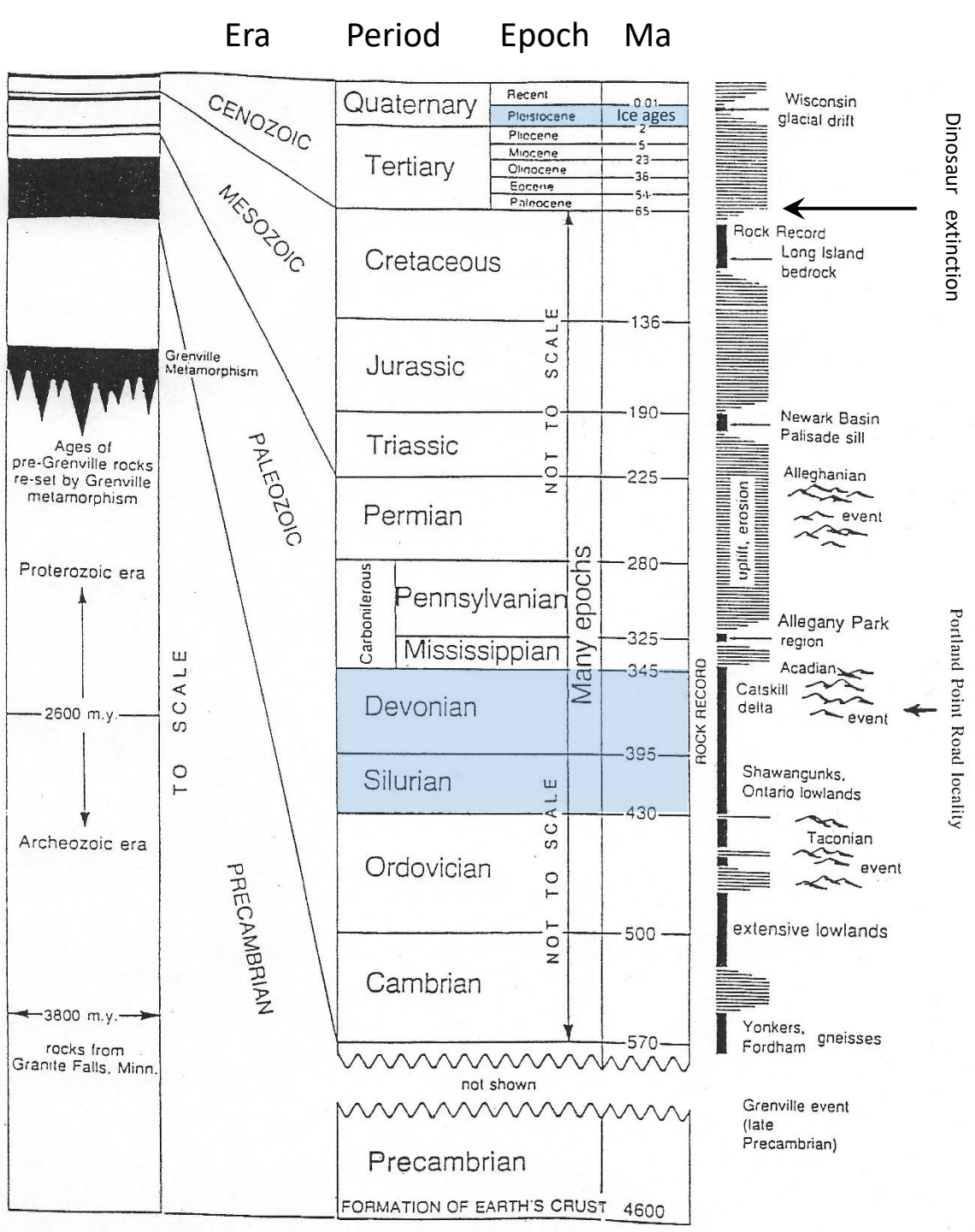
The crust of the Earth is composed of about 20 plates that move over the surface driven by tectonic forces, i.e., convection of heated magma under the plates.

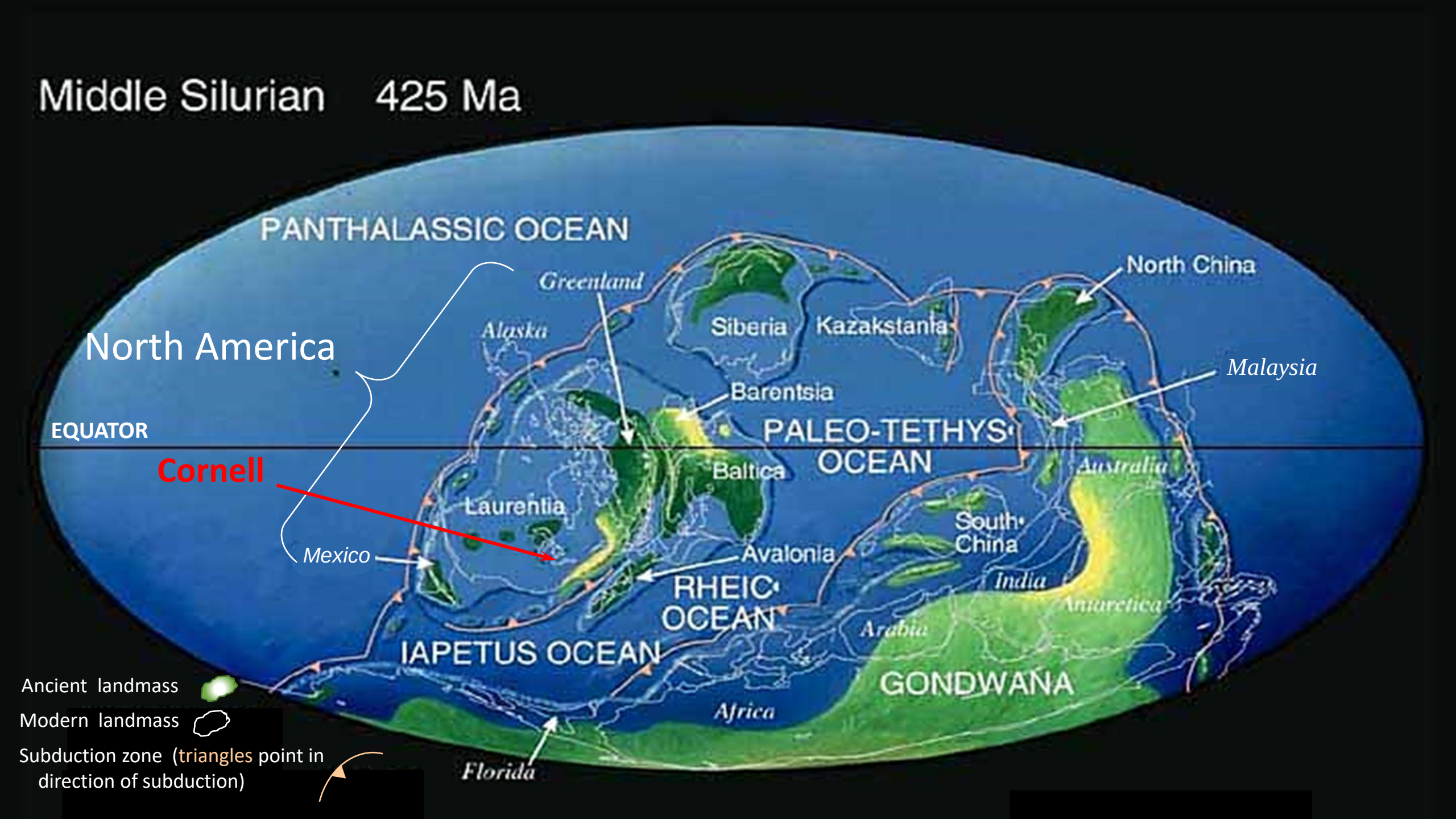
Continental plates are composed of lighter rock than oceanic plates, thus, they float higher.

Remember, however, that at any past geological time

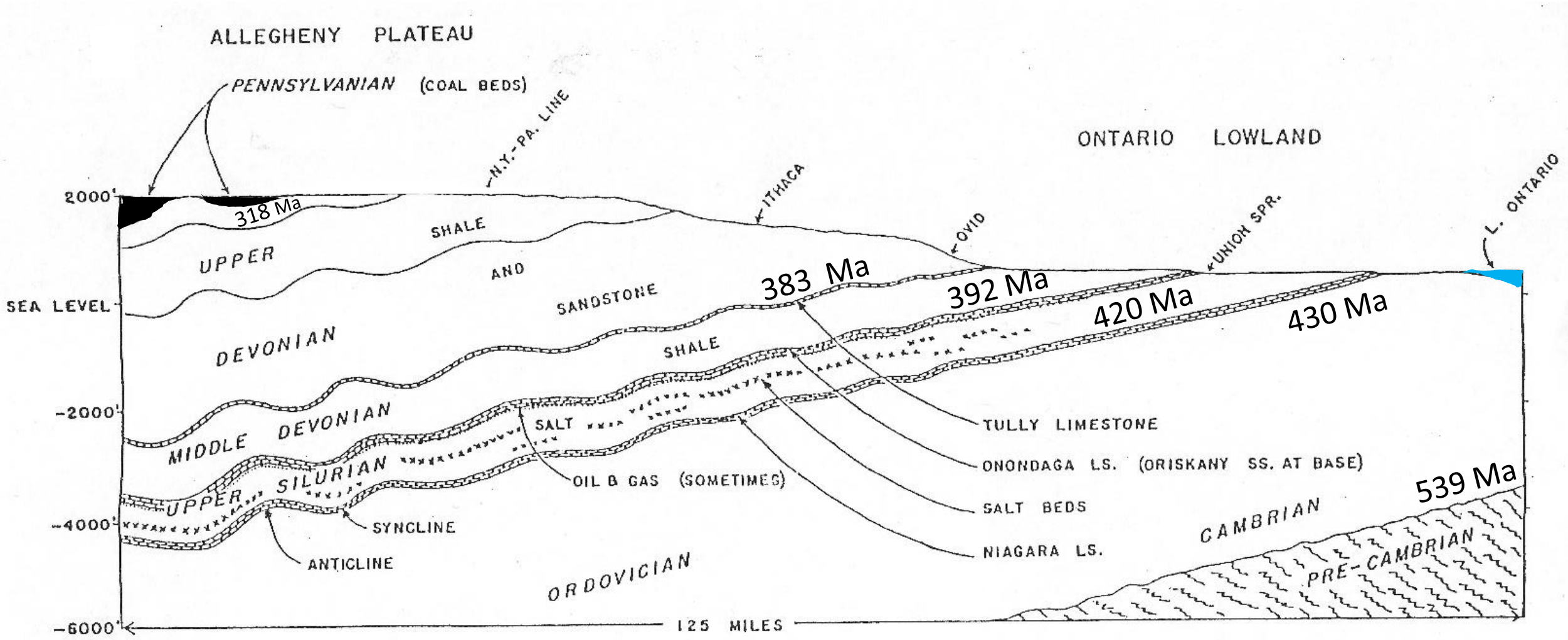
1. the continent likely had a different position on the Earth, e.g., Greenland had tropical forests, and
2. part of the continent may have been under water.




Era
Period
Epoch
Ma
CENOZOIC
MESOZOIC
PALEOZOIC
PRECAMBRIAN
Quaternary
Recent
Pleistocene
Ice ages
0.01
Tertiary
Pliocene
Miocene
Oligocene
Eocene
Paleocene
2
5
23
36
54
65
Cretaceous
136
Jurassic
190
Triassic
225
Permian
280
Carboniferous
Pennsylvanian
Mississippian
325
345
Devonian
395
Silurian
430
Ordovician
500
Cambrian
570
Precambrian
4600
FORMATION OF EARTH'S CRUST
NOT TO SCALE
Many epochs
ROCK RECORD
TO SCALE
Grenville Metamorphism
Ages of pre-Grenville rocks re-set by Grenville metamorphism
Proterozoic era
2600 m.y.
Archeozoic era
3800 m.y.
rocks from Granite Falls, Minn.
not shown
Wisconsin glacial drift
Dinosaur extinction
Rock Record
Long Island bedrock
Newark Basin
Palisade sill
Alleghanian
event
uplift, erosion
Allegany Park region
Acadian
Catskill delta
event
Portland Point Road locality
Shawangunks, Ontario lowlands
Taconian
event
extensive lowlands
Yonkers, Fordham gneisses
Grenville event (late Precambrian)


Middle Silurian 425 Ma
PANTHALASSIC OCEAN
North America
Greenland
Alaska
Siberia
Kazakstania
North China
Malaysia
Barentsia
EQUATOR
PALEO-TETHYS OCEAN
Cornell
Baltica
Australia
Laurentia
South China
Mexico
Avalonia
India
RHEIC OCEAN
Antarctica
Arabia
IAPETUS OCEAN
GONDWANA
Africa
Florida
Ancient landmass
Modern landmass
Subduction zone (triangles point in direction of subduction)

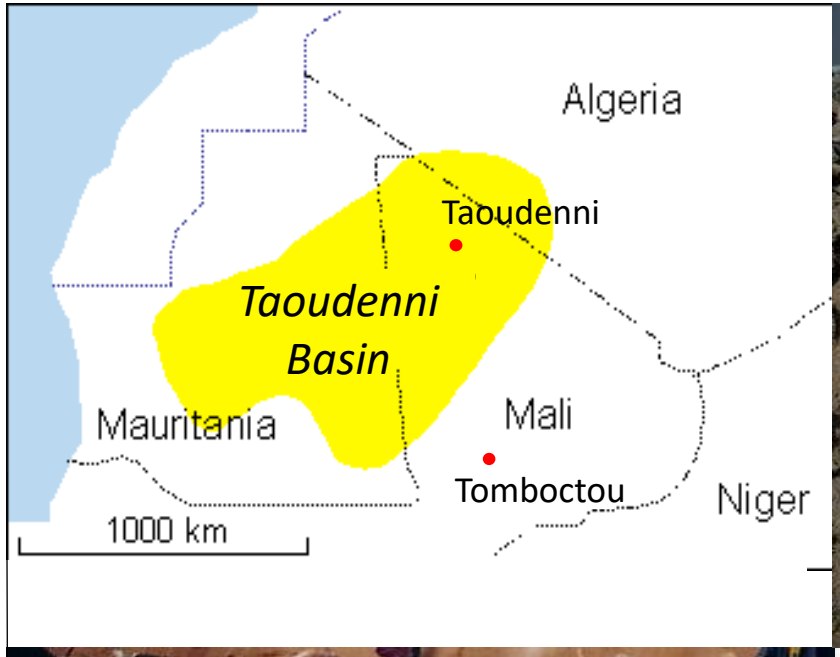
South to north section through the bedrock of Central New York

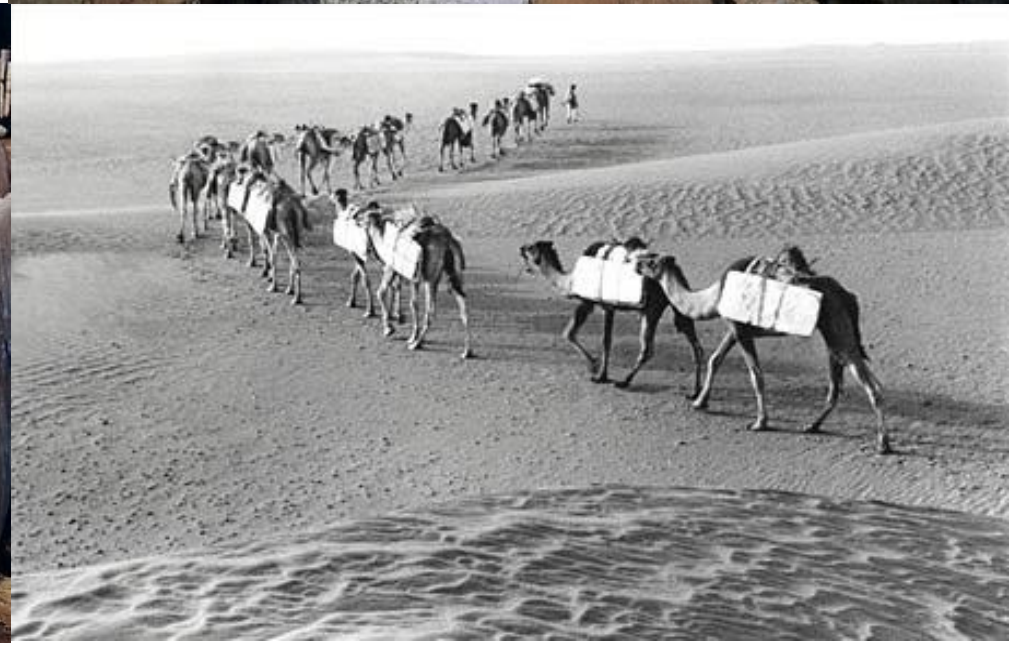


south north

Below the salt

For millennia salt caravans have crossed the Sahara desert





Sea salt evaporation method

In Brittany (NW France), sea salt called *Sel de Mer* or *Fleur de Sel* has also been harvested by hand for ages by evaporating sea water along the coast in shallow pools

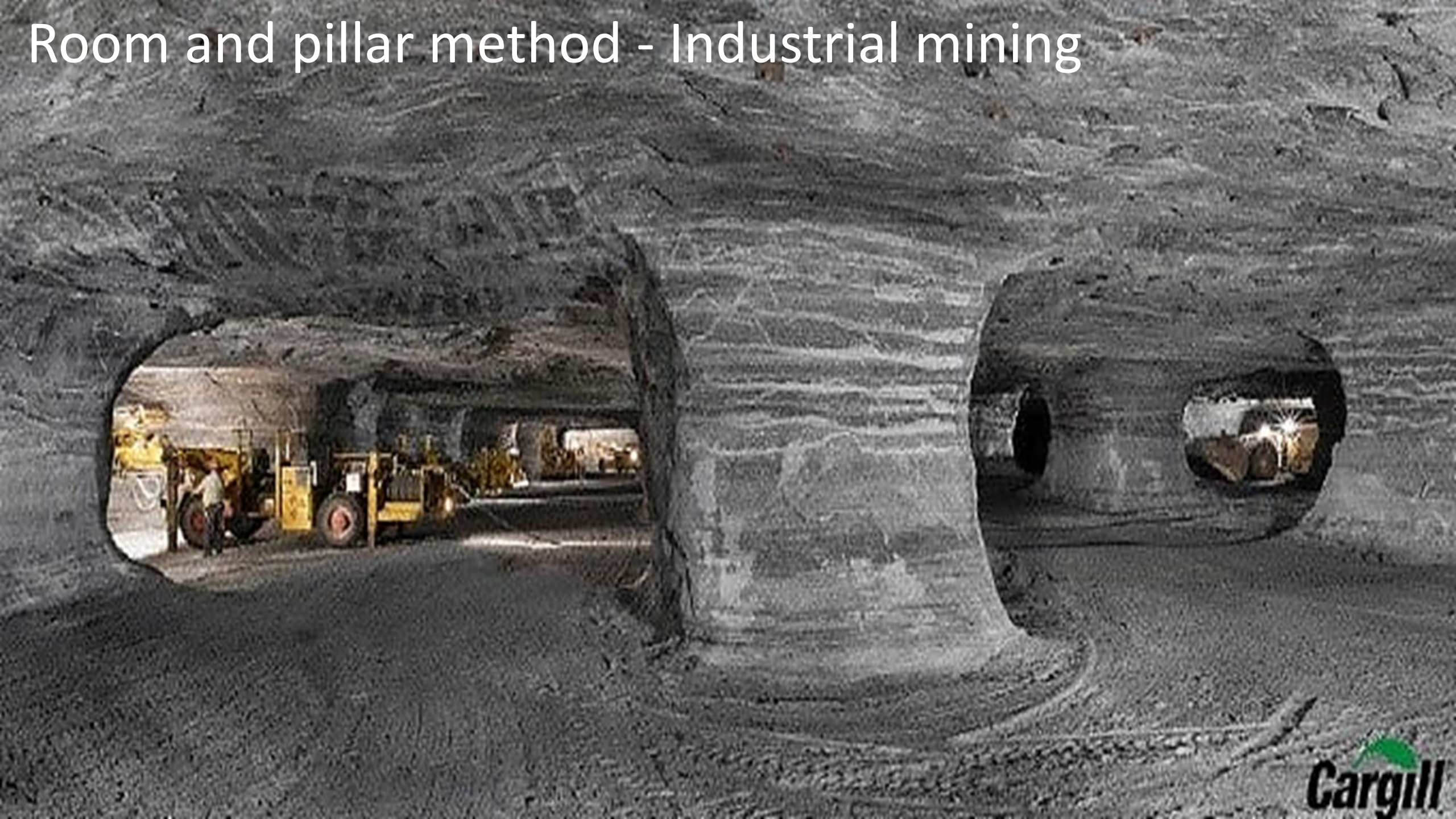
In SW Britain, a famous sea salt called Maldon is produced the same way

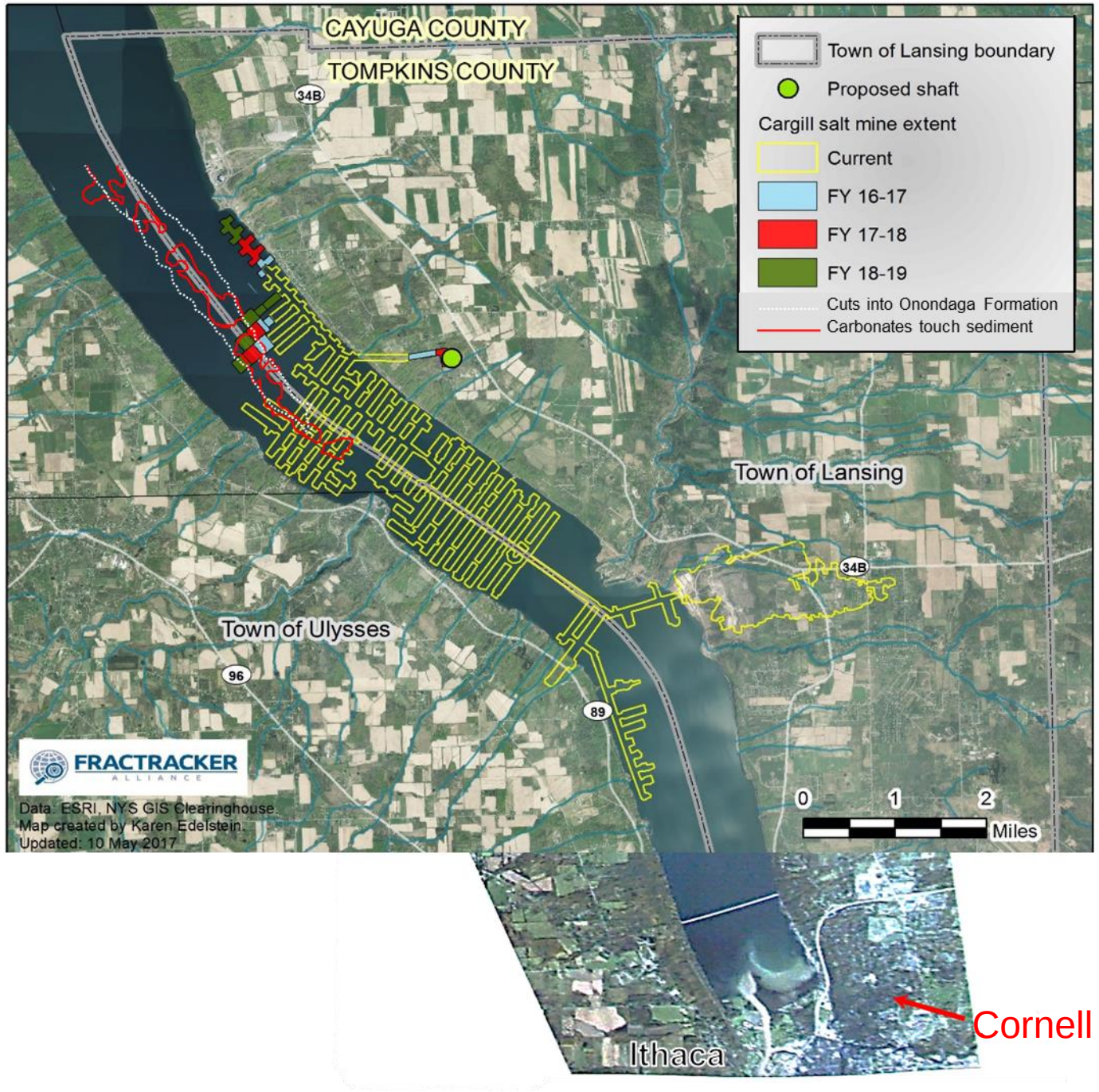
Brine evaporation method in Syracuse, NY

Similar to the sea salt method of evaporation, NaCl crystals are harvested from salty brine pumped to the surface from the Silurian salt strata.

Before 1900, Syracuse NY, a.k.a. Salt City, supplied most of the salt in the US.

Room and pillar method - Industrial mining

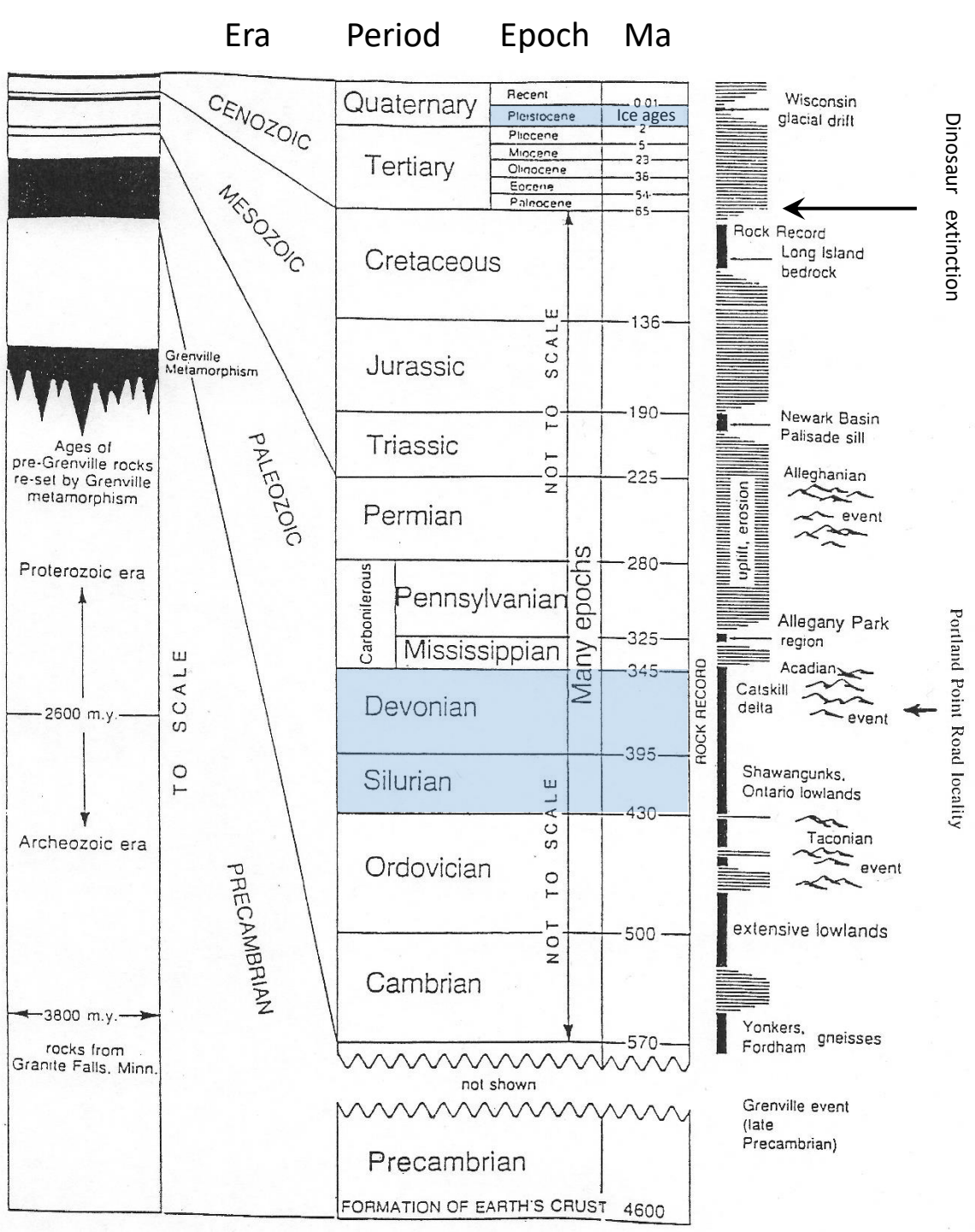




Cargill Corp mines about 13,000 acres of room and pillar chambers under Cayuga Lake

The entrance mine shaft and surface operation is located in Lansing, NY, just north of Ithaca

The mine yields about 2 M tons of rock salt per year that is used primarily for road salt in the NE United States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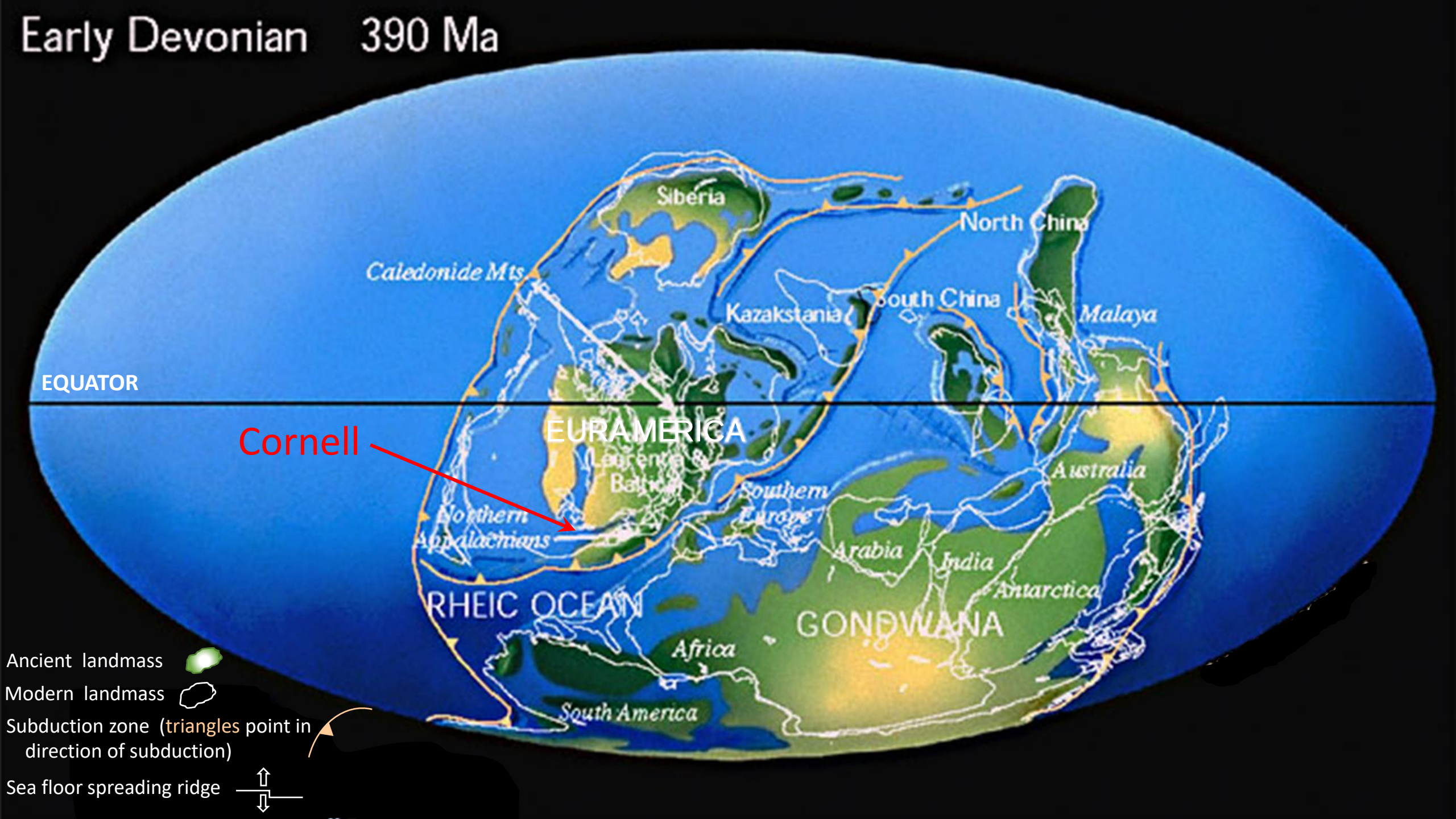
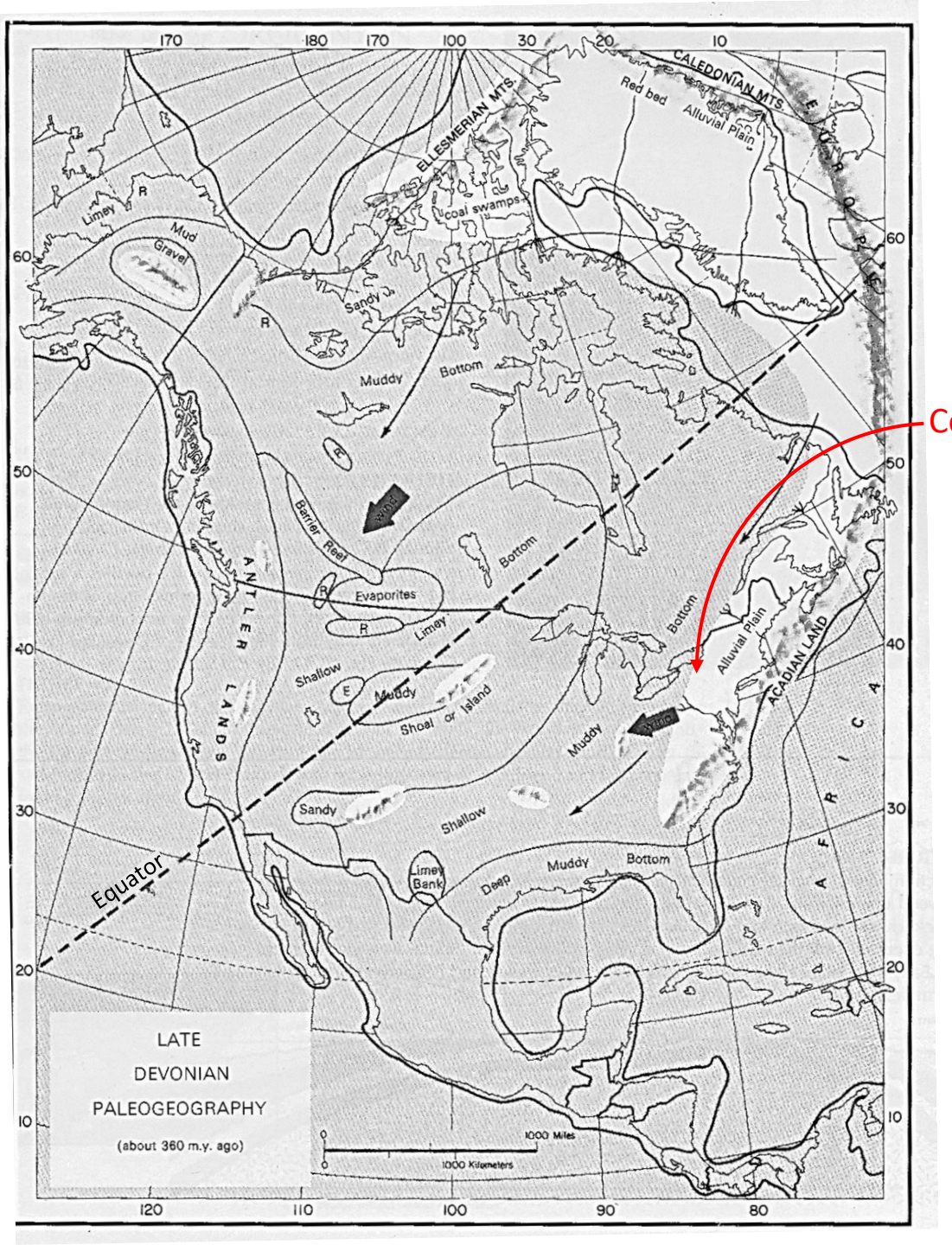

Early Devonian 390 Ma
Siberia
North China
Caledonide Mts
Kazakstania
South China
Malaya
EQUATOR
Cornell
EURAMERICA
Laurentia &
Baltica
Southern
Europe
Northern
Appalachians
Australia
Arabia
India
Antarctica
RHEIC OCEAN
GONDWANA
Africa
South America
Ancient landmass
Modern landmass
Subduction zone (triangles point in direction of subduction)
Sea floor spreading ridge

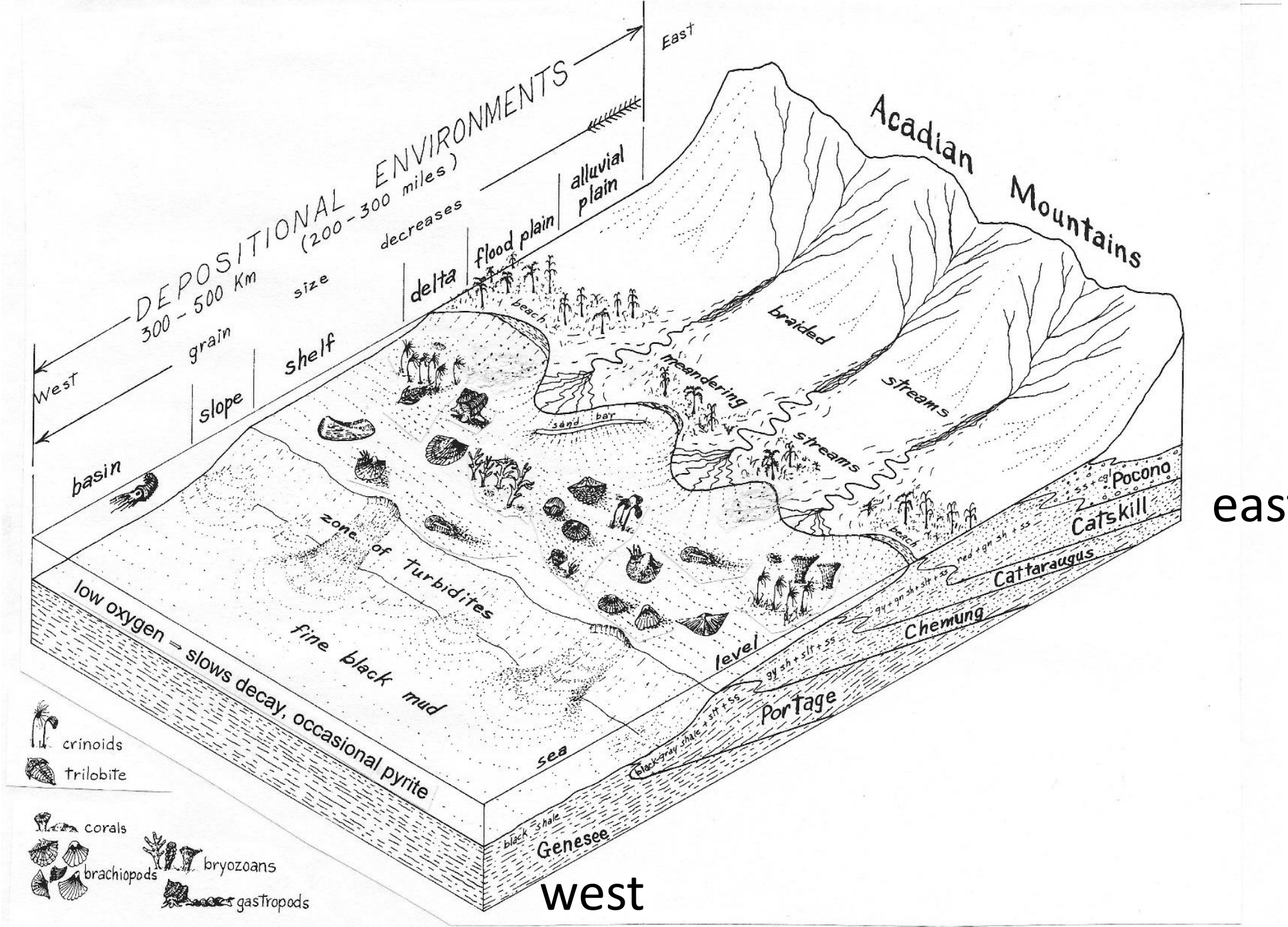
Devonian Period

All the continental plates came together starting about 335 Ma to form a super continent called Pangea that lasted until about 175 Ma.

As part of this collision, some continental fragments collided with New England and ca. 370 Ma raised the Acadian Mountains.

The “Finger Lakes” region lay under water closer or farther offshore depending upon the sea level.

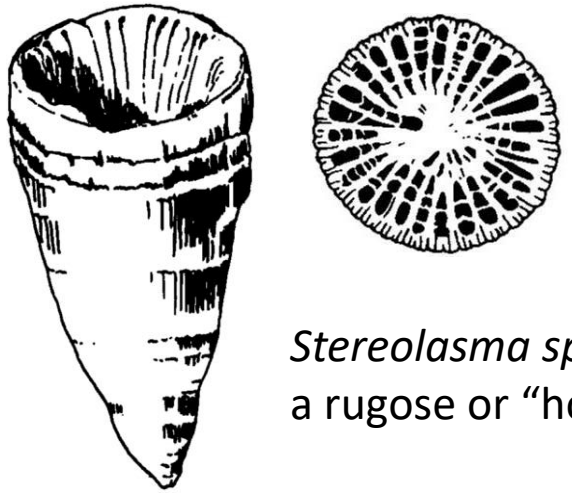



DEPOSITIONAL ENVIRONMENTS
(200 - 300 miles)
300 - 500 Km
West
East
grain size decreases
basin
slope
shelf
delta
flood plain
alluvial plain
Acadian Mountains
beach
sand bar
meandering streams
braided streams
zone of turbidites
fine black mud
low oxygen ⇒ slows decay, occasional pyrite
sea level
Pocono
Catskill
Cattaraugus
Chemung
Portage
Genesee
black shale
crinoids
trilobite
corals
brachiopods
bryozoans
gastropods

east

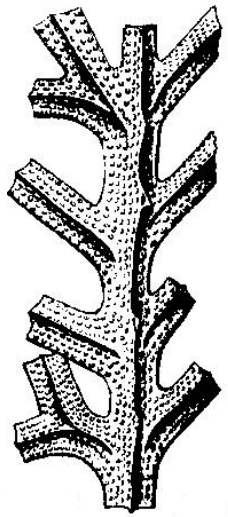
west

Phylum Cnidaria (corals, etc.)



Stereolasma spp.,
a rugose or “horn” coral

Phylum Bryozoa

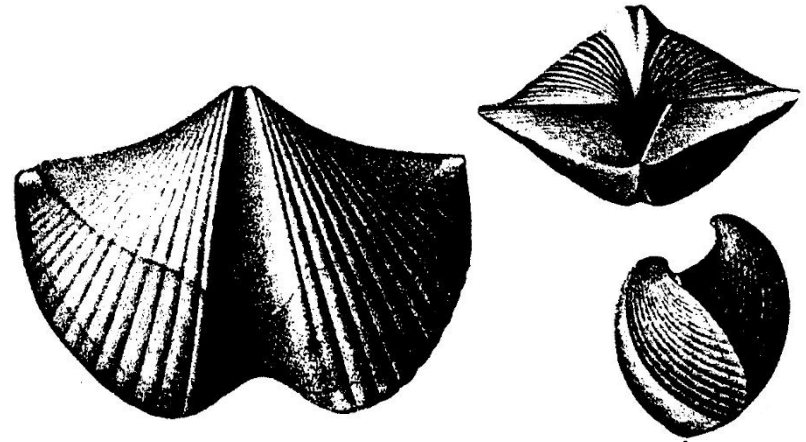


Taniopora spp., a bryozoan colony

SUPERPHYLUM LOPHOPHORATA

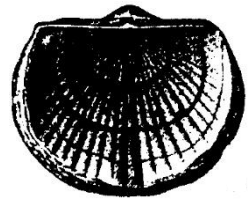
Phylum Brachiopoda

Ambocoelia umbonata



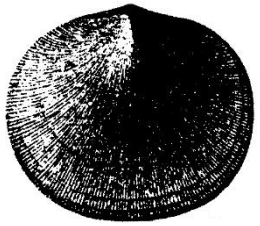
Spinocyrtia granulosa

Devonochonetes coronatus

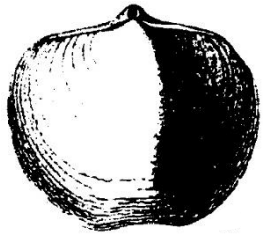


Tropidoleptus carinatus

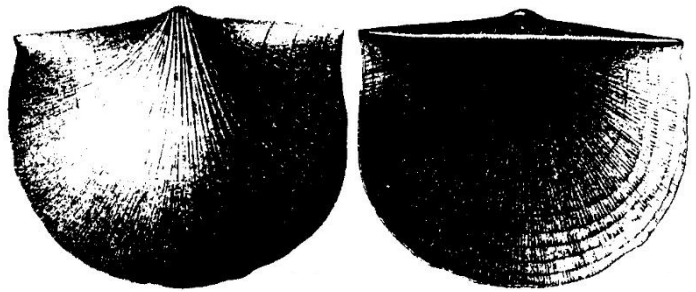
Mucrospirifer mucronatus



Rhipidomella spp.



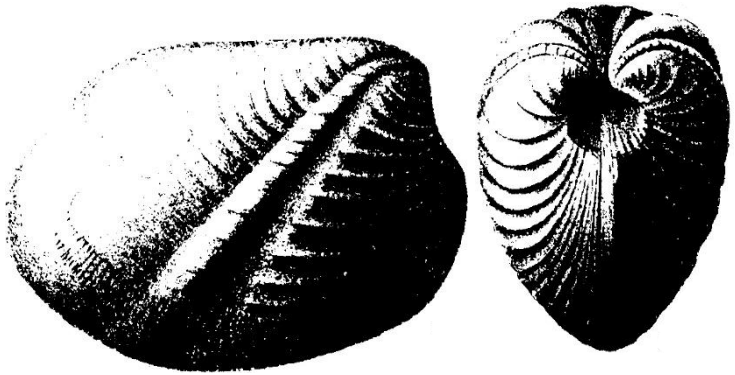
Athyris spiriferoides



Strophodonta demissa

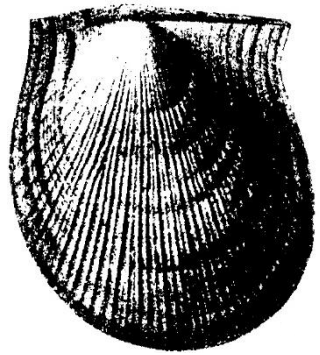
Phylum Mollusca

Class Pelecypoda (Clams)

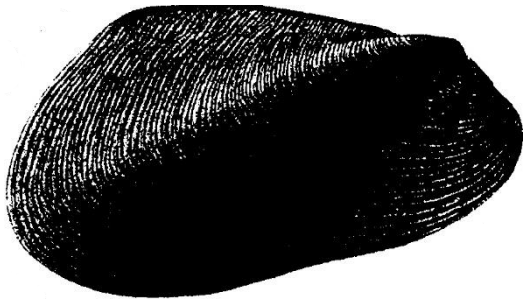


Grammysia bisulcata

Paleoneilo constricta



Lyriopecten orbiculatus

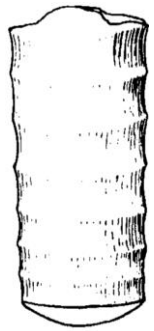


Modiomorpha concentrica

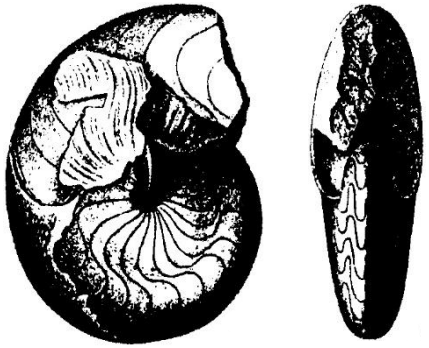
Class Gastropoda (snails)

Paleozygopleura hamiltoniae

Class Cephalopoda (squid, nautiloids, etc.)

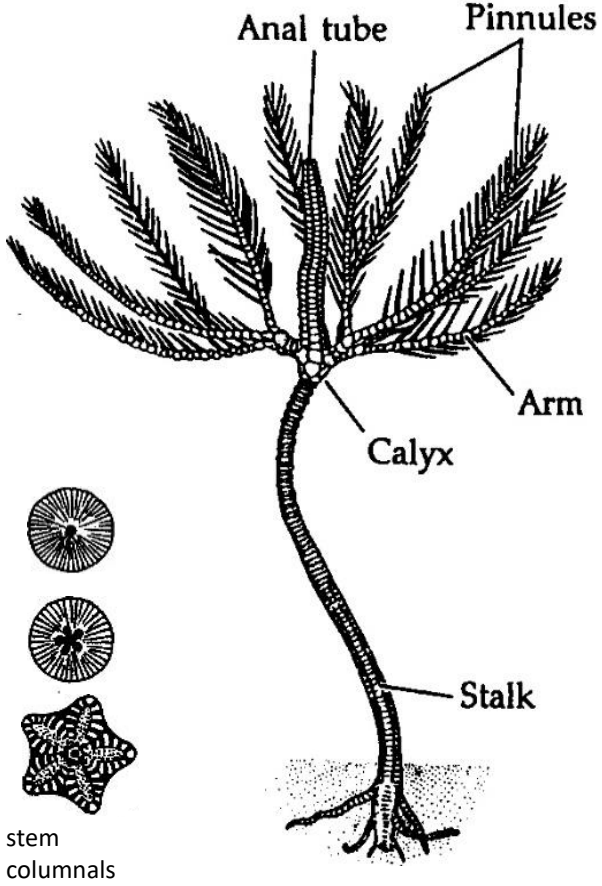


Spyroceras spp.



Tornoceras uniangularis

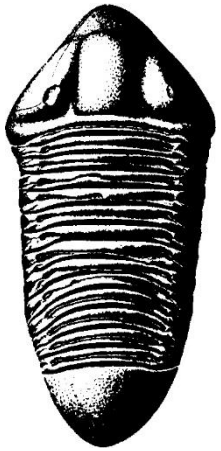
Phylum Echinodermata
Class Crinoidea



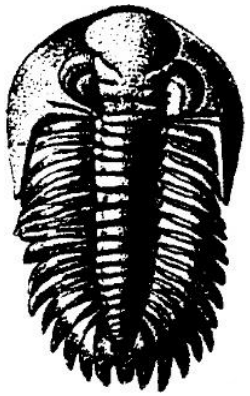
Crinoid or
"sea lily"

Ancyrocrinus

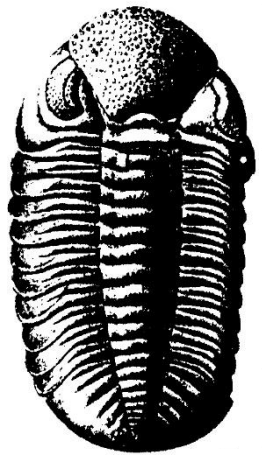
Phylum Arthropoda Class Trilobita



Dipleura dekayi

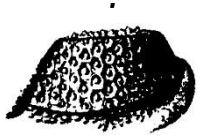


Greenops boothi

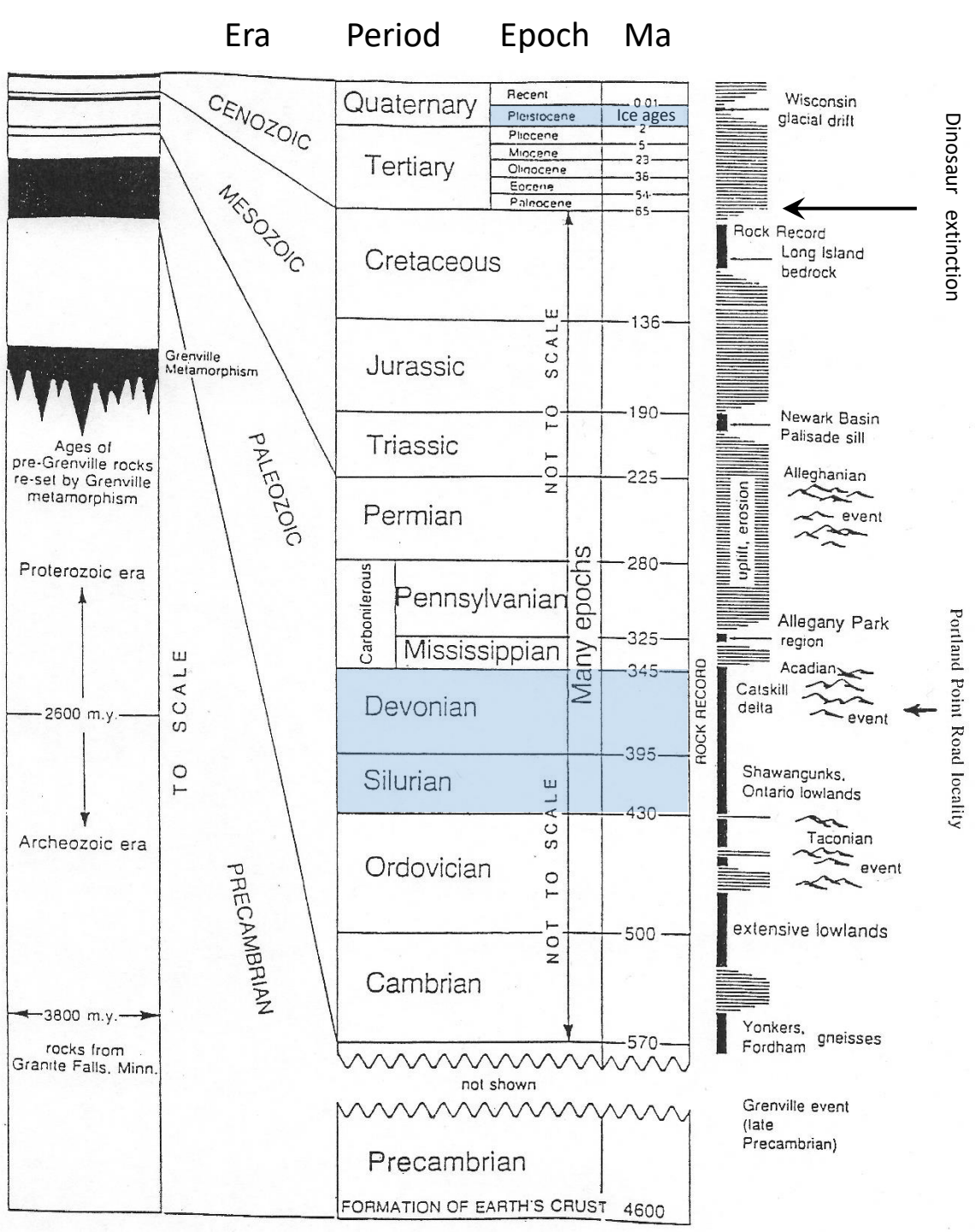


Eldredgeops (Phacops) *rana*

enrolled



compound eye,
magnified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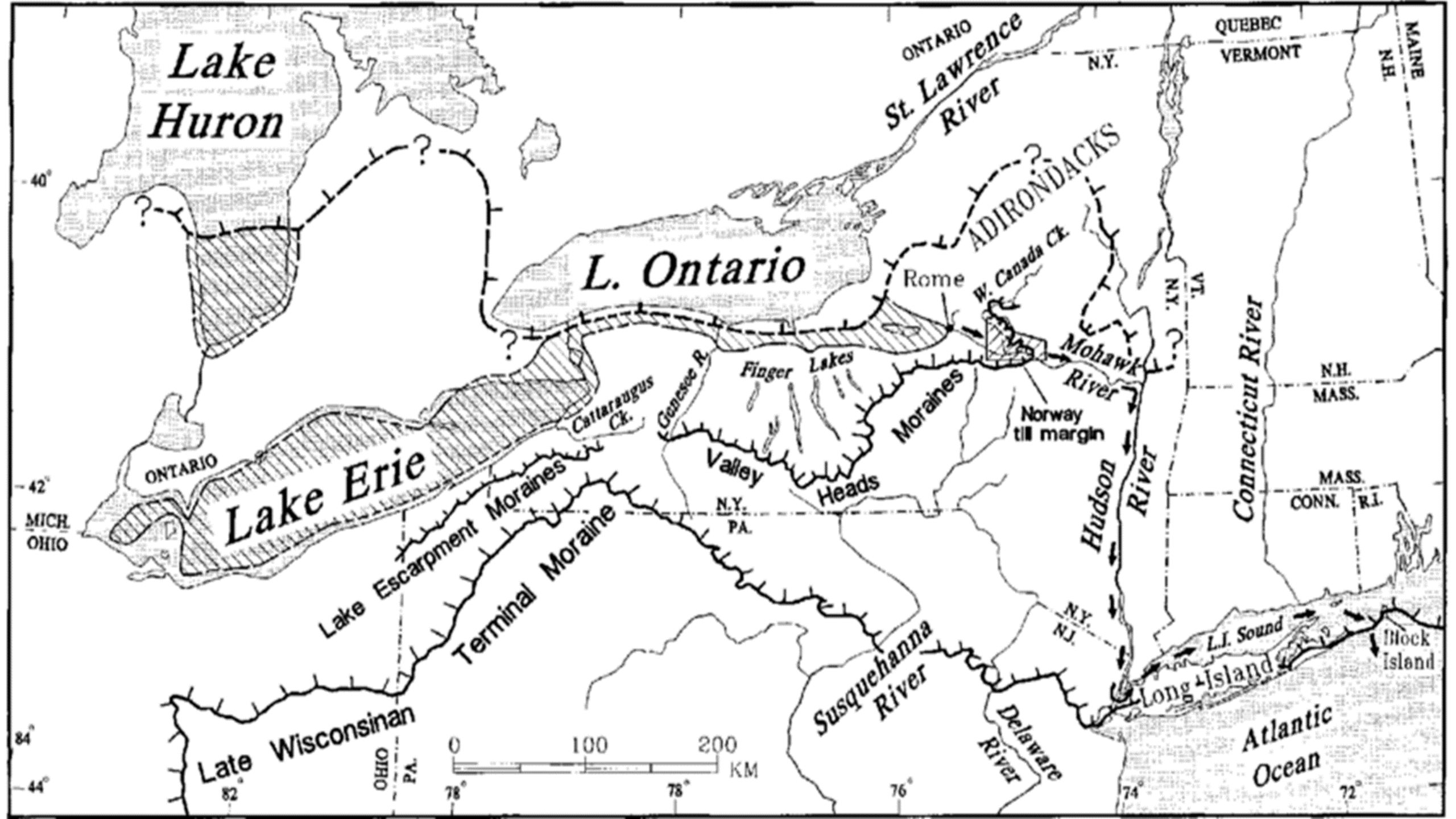
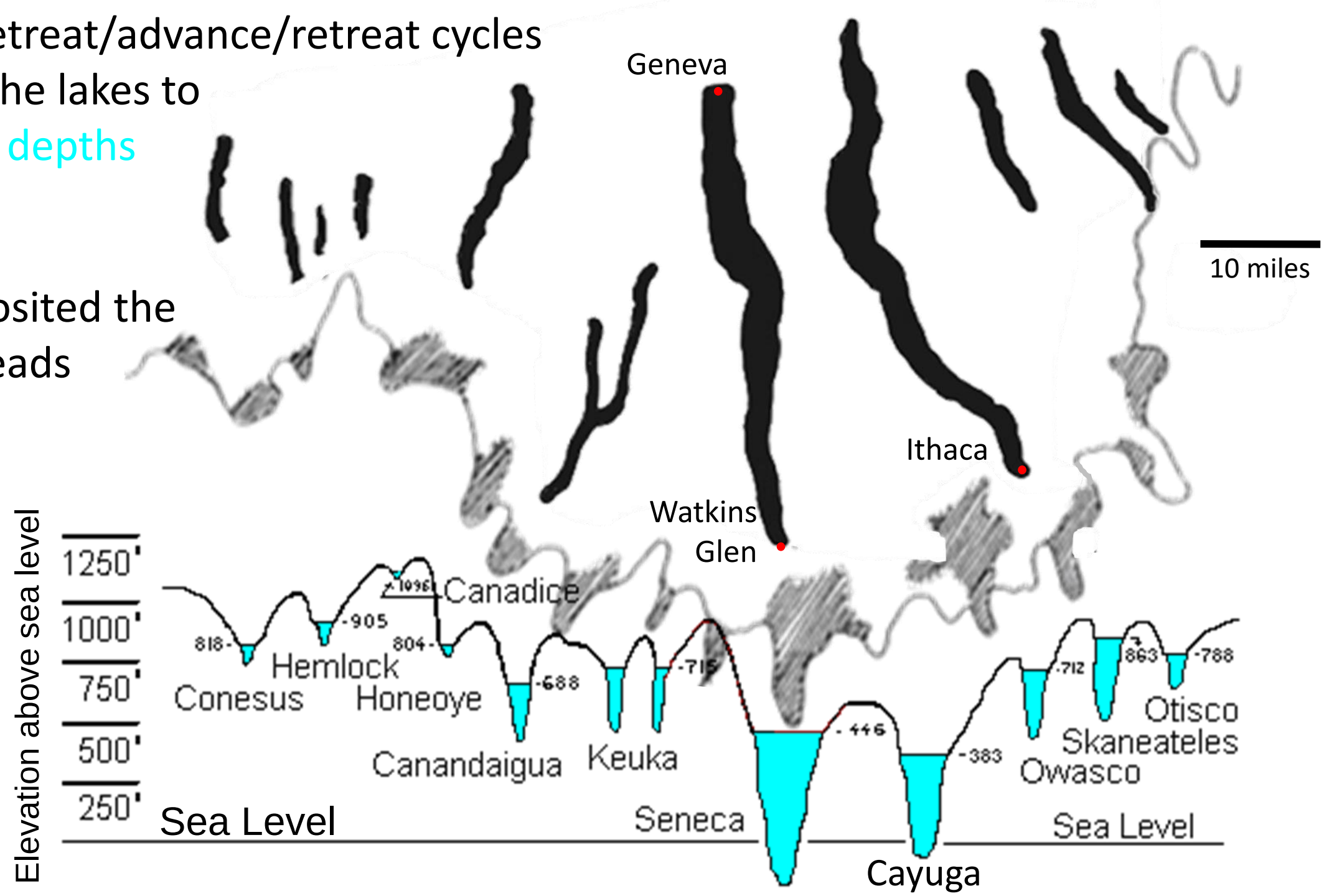
Last glacial maxiumum 18 Ka


Lake Huron
L. Ontario
Lake Erie
St. Lawrence River
ONTARIO
N.Y.
QUEBEC
VERMONT
MAINE
N.H.
ADIRONDACKS
Rome
W. Canada Ck.
VT.
N.Y.
Connecticut River
Mohawk River
N.H.
MASS.
Genesee R.
Finger Lakes
Moraines
Norway till margin
Cattaraugus Ck.
ONTARIO
Valley Heads
N.Y.
PA.
Hudson River
MASS.
CONN.
R.I.
MICH.
OHIO
Lake Escarpment Moraines
Terminal Moraine
Late Wisconsinan
OHIO
PA.
Susquehanna River
N.Y.
N.J.
Delaware River
L.I. Sound
Long Island
Block Island
Atlantic Ocean
0
100
200
KM
40°
42°
44°
82°
78°
78°
76°
74°
72°

Glacial retreat/advance/retreat cycles gouged the lakes to different depths

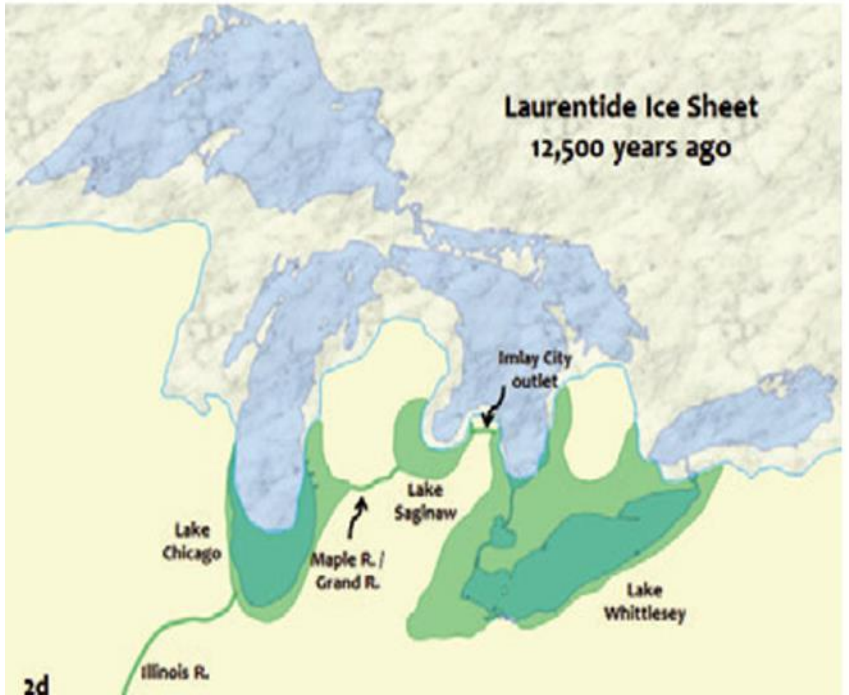
and deposited the Valley Heads moraine

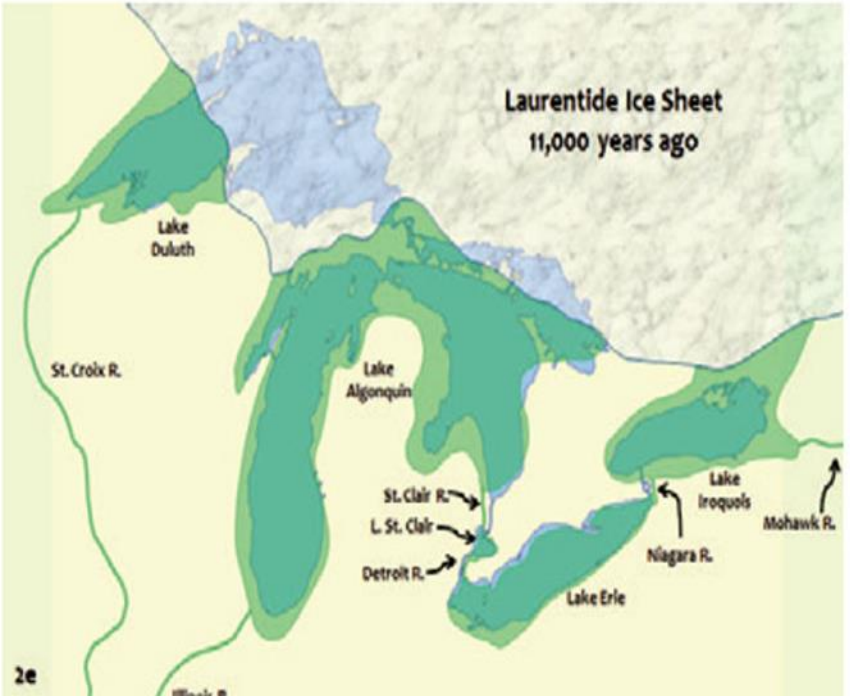



Laurentide Ice Sheet
14,800 years ago
Superior
Chippewa
Michigan
Saginaw
Huron -
Erie
2a


Laurentide Ice Sheet
14,000 years ago
2b

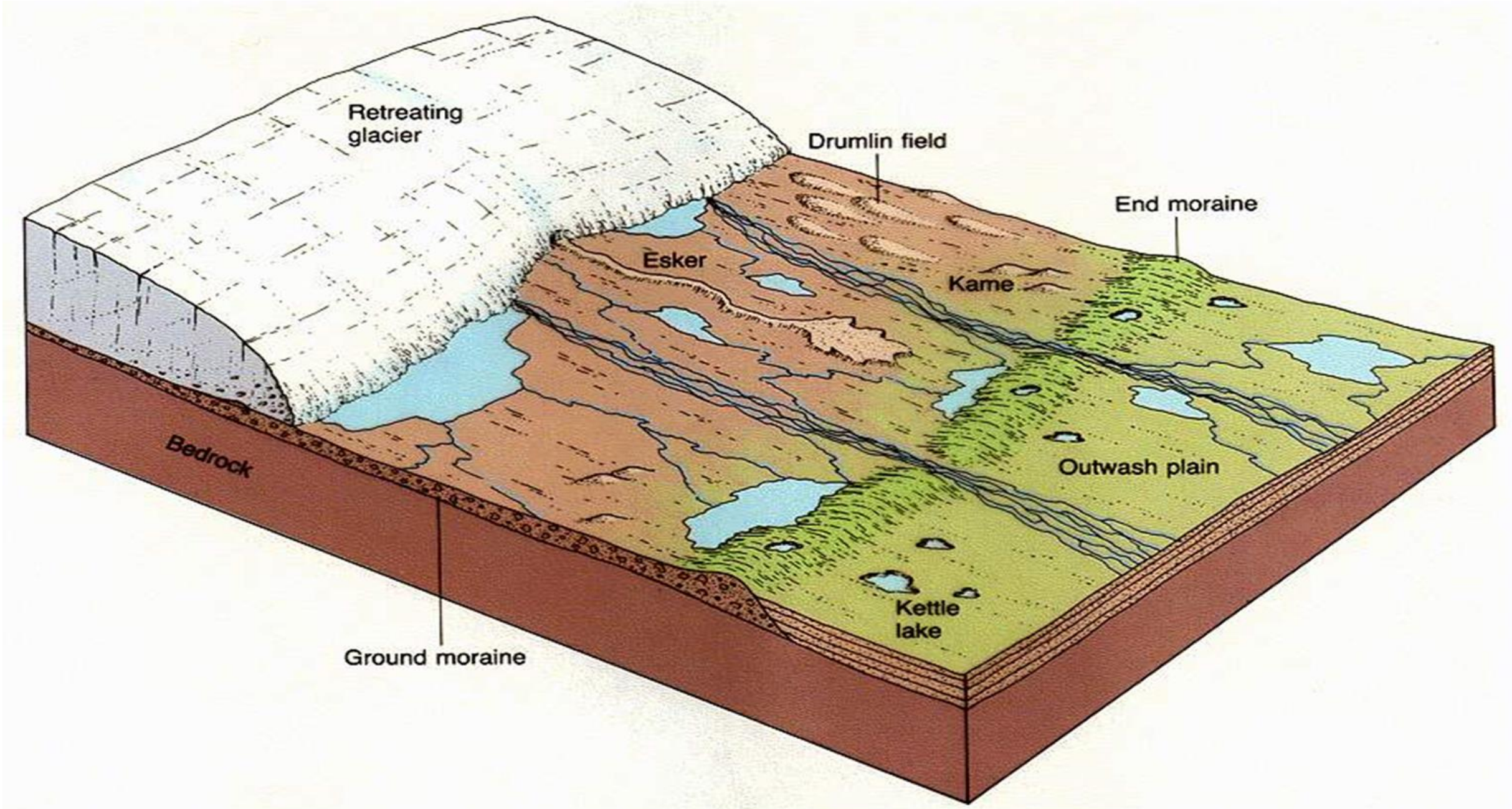

Laurentide Ice Sheet
13,800 years ago
Imlay City
outlet
Lake
Saginaw
Lake
Chicago
Maple R. /
Grand R.
Illinois R.
Lake
Maumee
2c

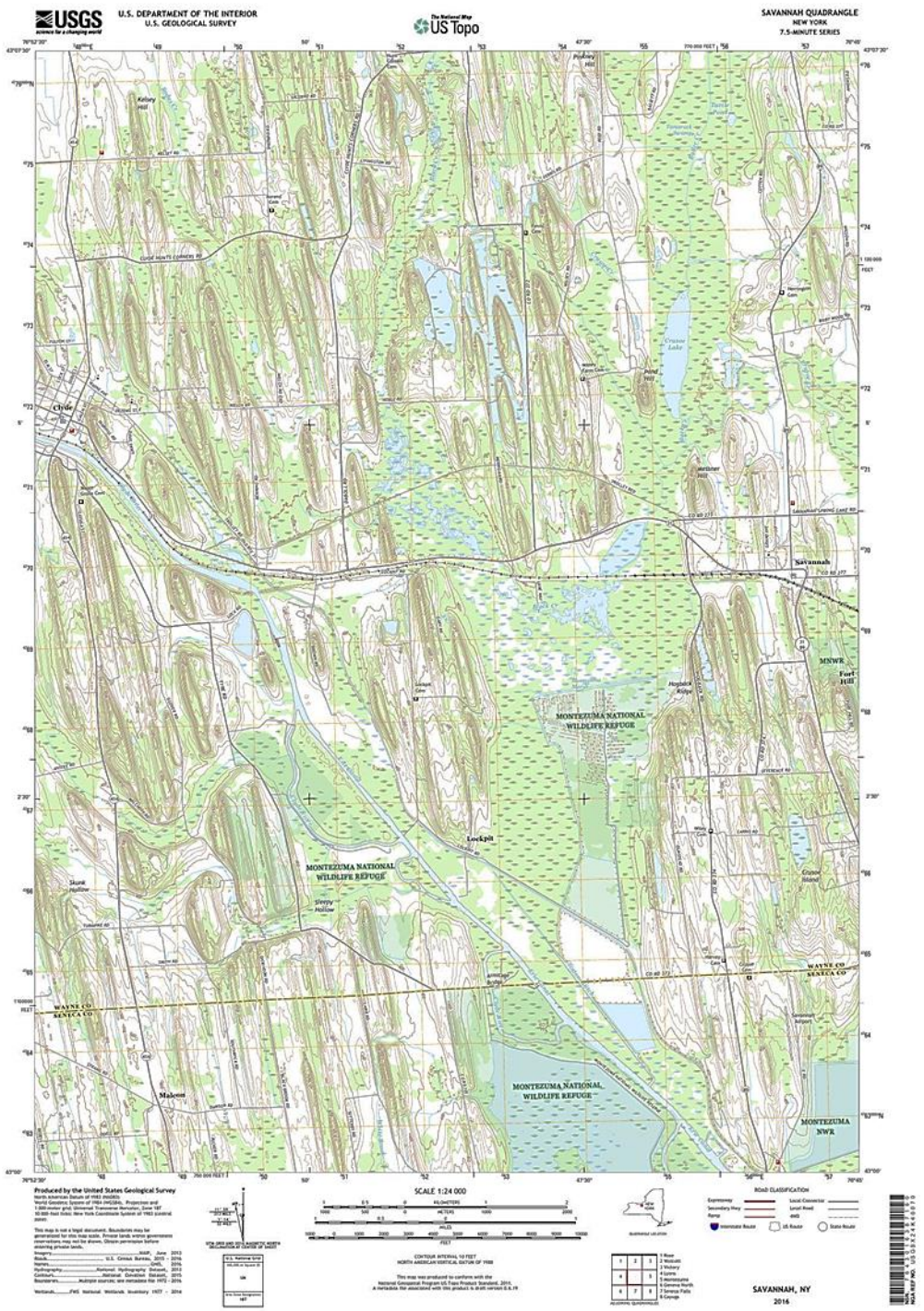

Laurentide Ice Sheet
12,500 years ago
Imlay City
outlet
Lake
Saginaw
Lake
Chicago
Maple R. /
Grand R.
Lake
Whittlesey
Illinois R.
2d


Laurentide Ice Sheet
11,000 years ago
Lake
Duluth
St. Croix R.
Lake
Algonquin
St. Clair R.
L. St. Clair
Detroit R.
Lake
Iroquois
Mohawk R.
Niagara R.
Lake Erie
2e


9,500 years ago
St. Marys R.
Paleo-Ottawa R.
Lake
Superior
Champlain Sea
Lake
Stanley
Lake
Chippewa
Mohawk R
Niagara R.
Lake Erie
2f

Glacial features of the present landscape



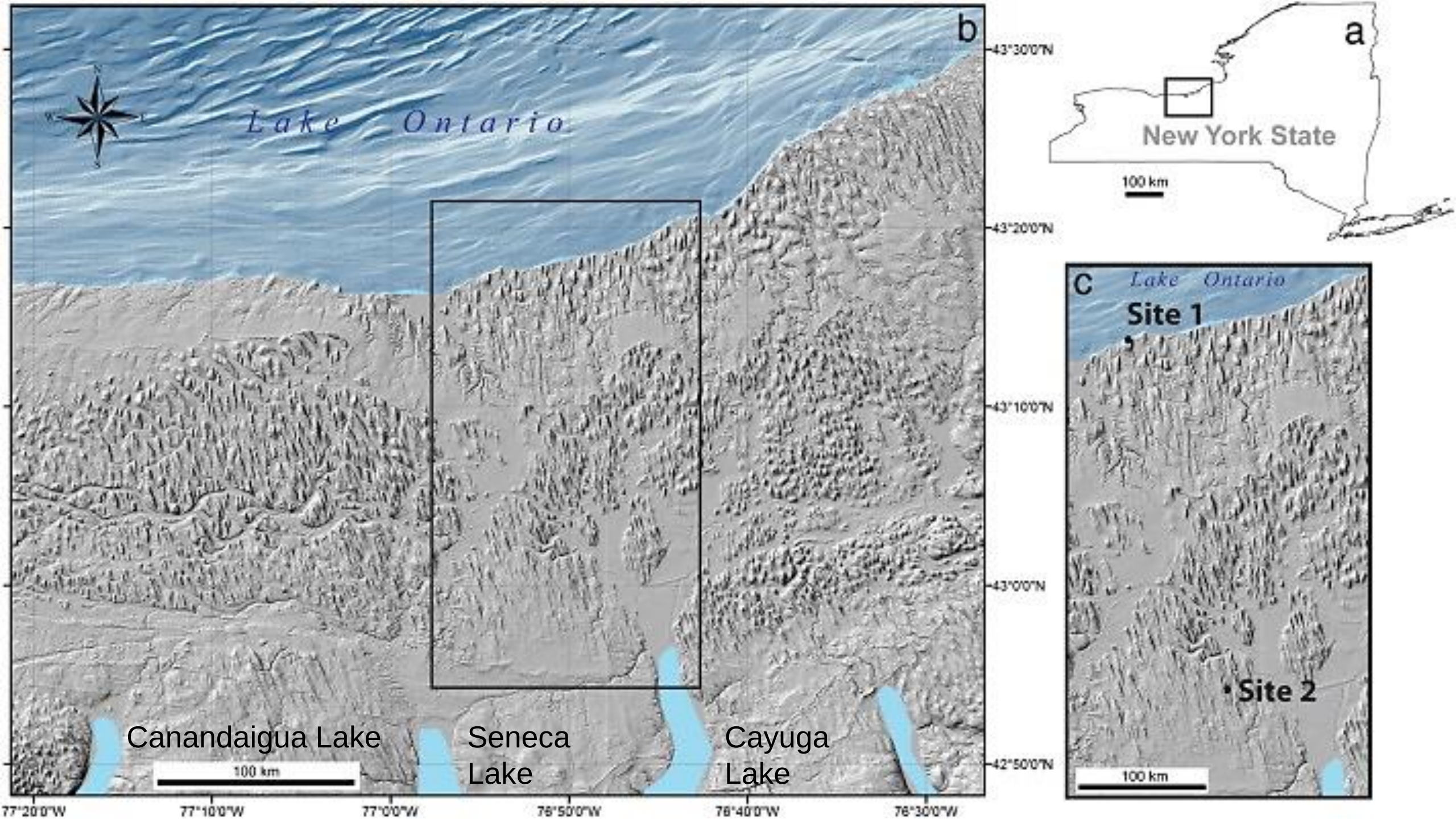


Drumlin fields crowd the topographic map of the north end of Cayuga Lake near the Montezuma National Wildlife Refuge.

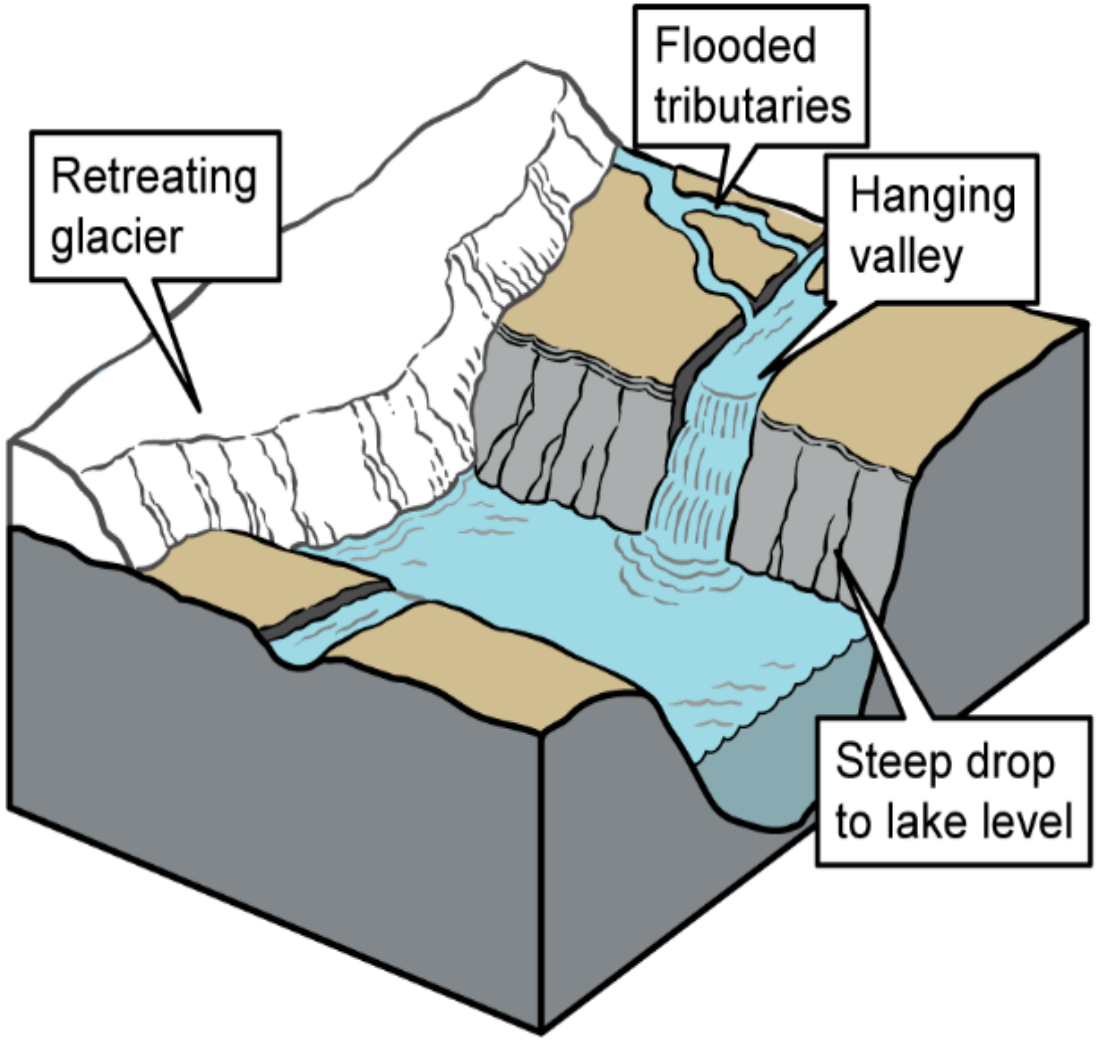
They are especially linear deposits all pointing in the same direction.

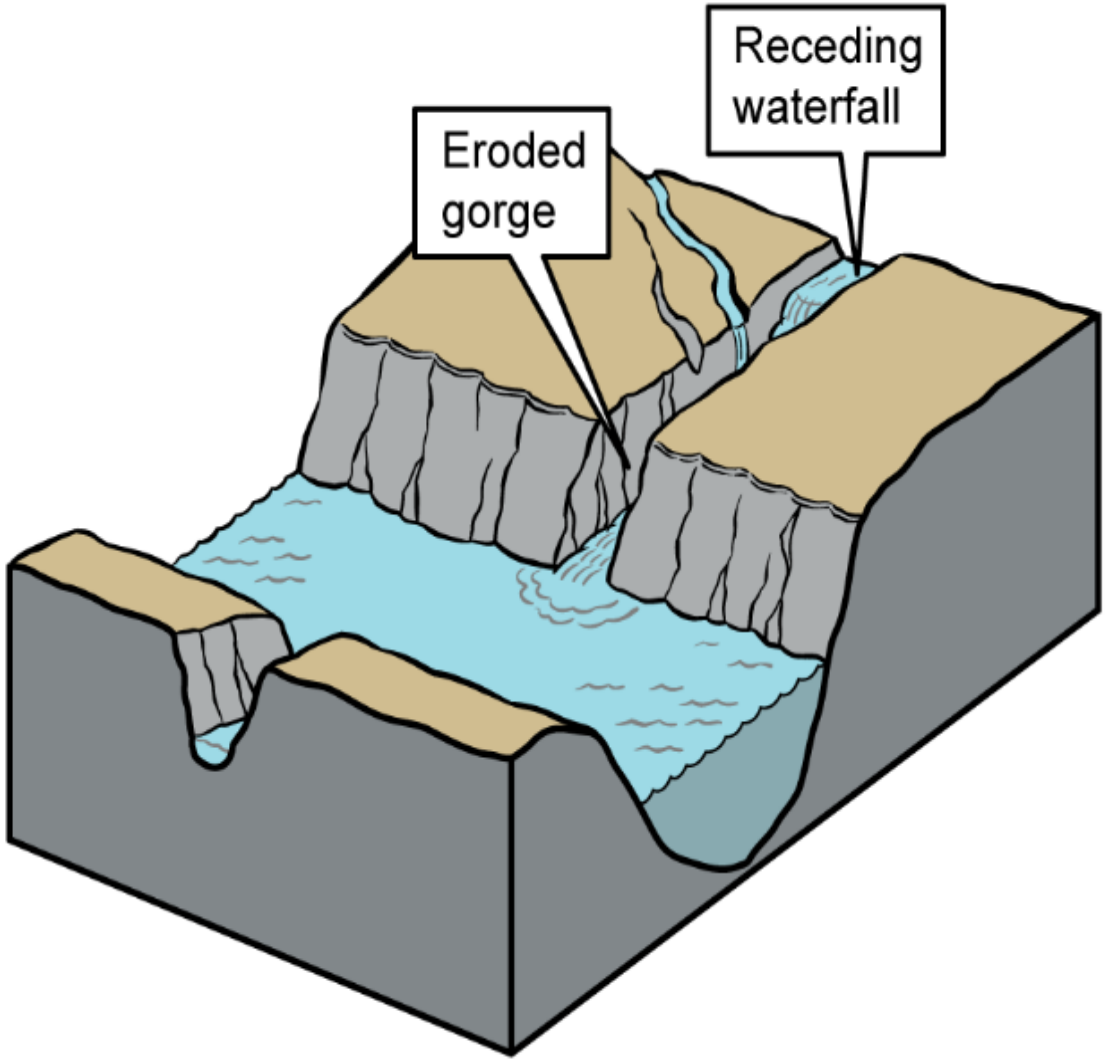
The taller ones look to be between 50’ and 100’ tall.

Hill Cumora is a drumlin in Manchester NY, about 25 mi west of this section, in which Joseph Smith said he found the gold plates in 1823 that he later transcribed into the Book of Mormon.


b
Lake Ontario
43°30'0"N
43°20'0"N
43°10'0"N
43°0'0"N
42°50'0"N
77°20'0"W
77°10'0"W
77°0'0"W
76°50'0"W
76°40'0"W
76°30'0"W
100 km
Canandaigua Lake
Seneca Lake
Cayuga Lake
a
New York State
100 km
C
Lake Ontario
Site 1
Site 2
100 km

Glacial features of the present landscape





Hanging valley: Taughannock Falls drop 215’

View to the west at the falls with overlook **P**arking area indicated

Reverse view looking east at the gorge with falls at **x.** Compare **p**arking lot. Gorge continues upstream with many, but less spectacular, cataracts

Alluvial fan of eroded gorge material deposited into the lake valley

Large flakes still fall from the bowl of the gorge as the “creek” carves back toward the headwaters

Collision of Africa with North America about 300 Ma and again about 270 Ma as the continents formed Pangaea caused two sets of fracture joints at roughly 90º to each other.

Thus, rectilinear slabs tend fall from the gorge walls

11 April 2010

Finger Lakes previously drained from the glacier to the south, as revealed by the Y-shaped Keuka Lake.

After the ice receded, the smaller western lakes still drain south into the Susquehanna River and empty into the Chesapeake bay

Eastern Finger Lakes, including the two large lakes, Seneca and Cayuga, drain north into Lake Ontario, then out the St. Lawrence into the North Atlantic