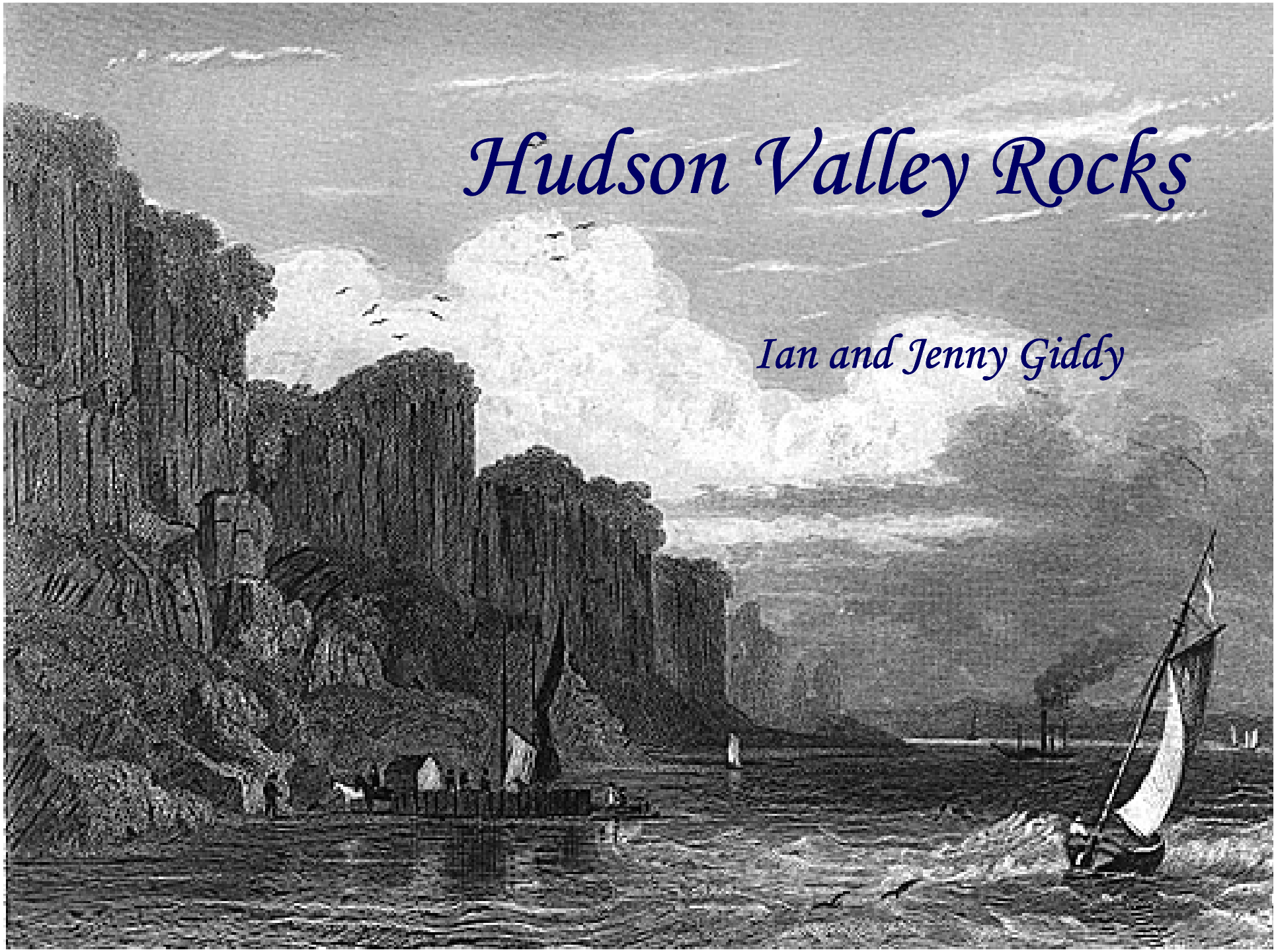


Hudson Valley Rocks

Ian and Jenny Giddy

Geology of New York State

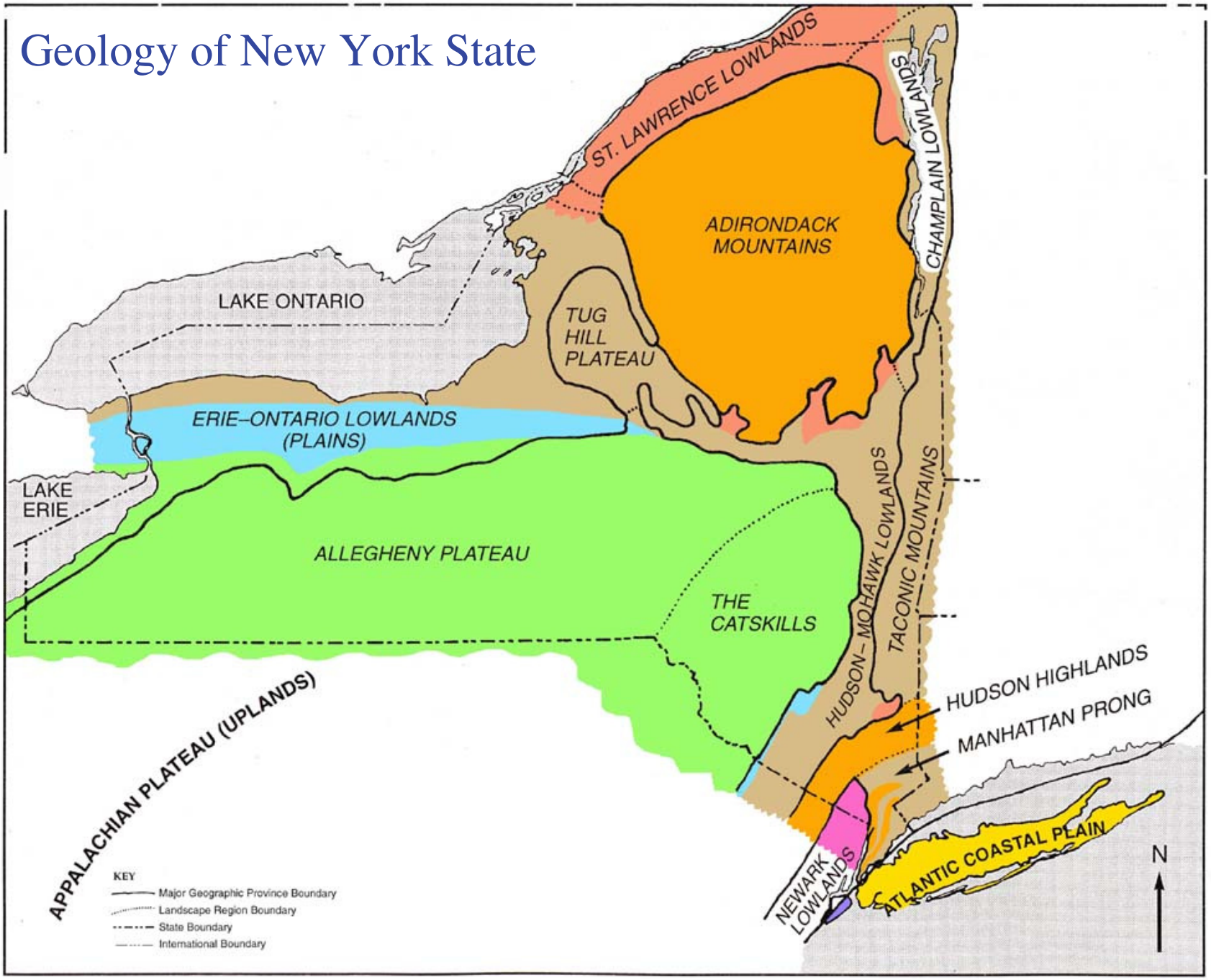
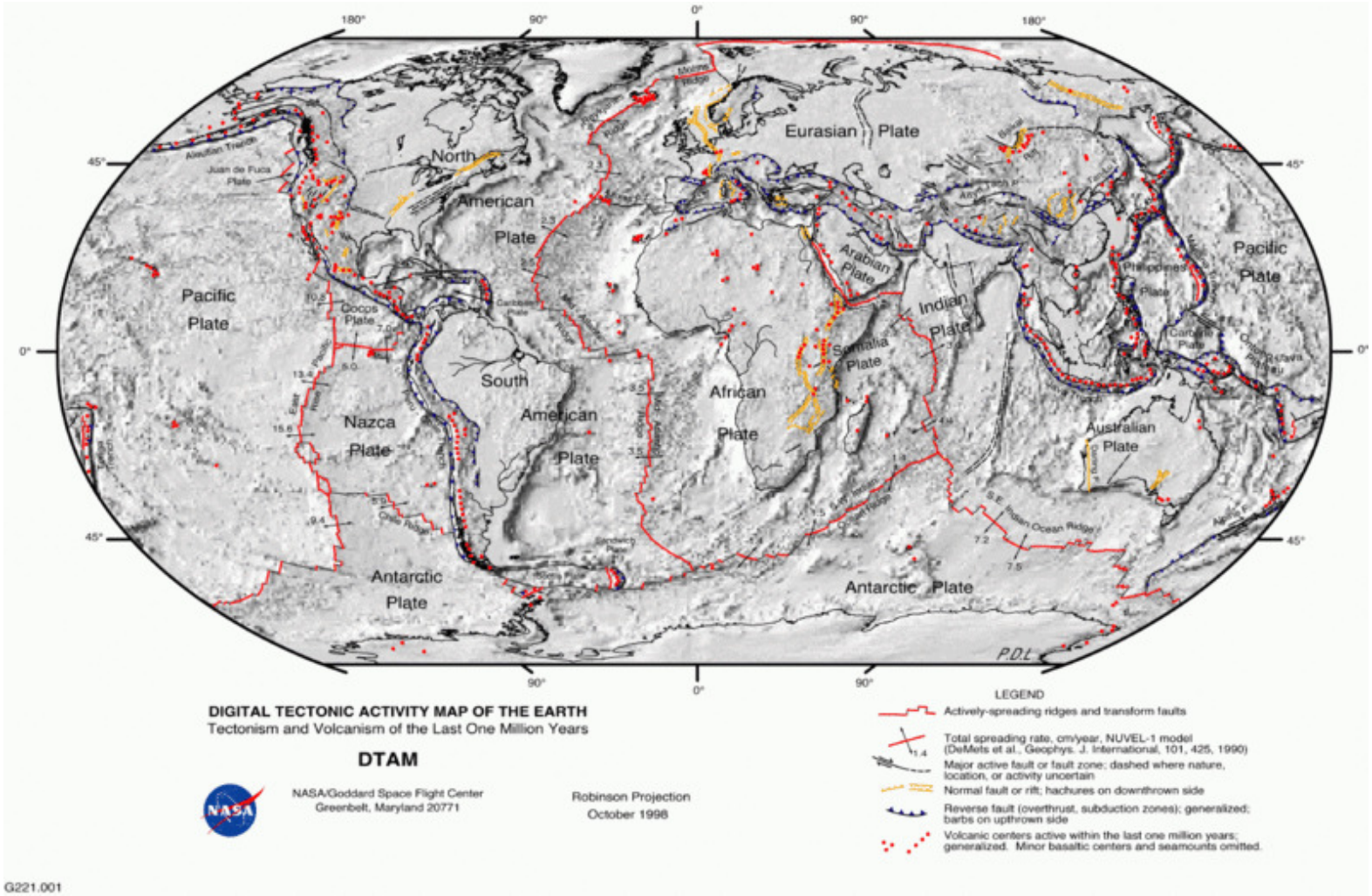
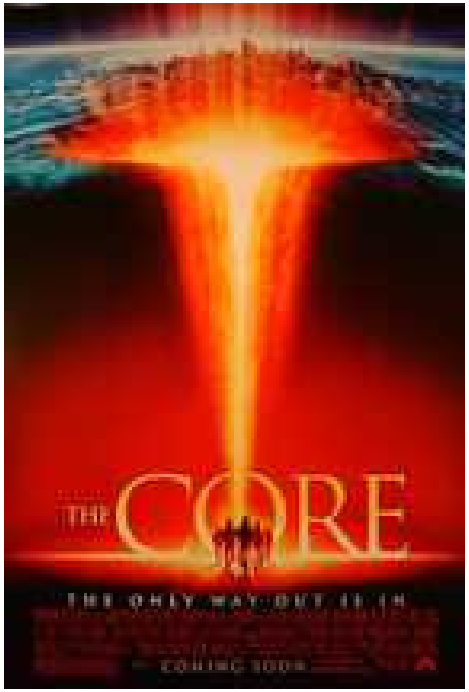


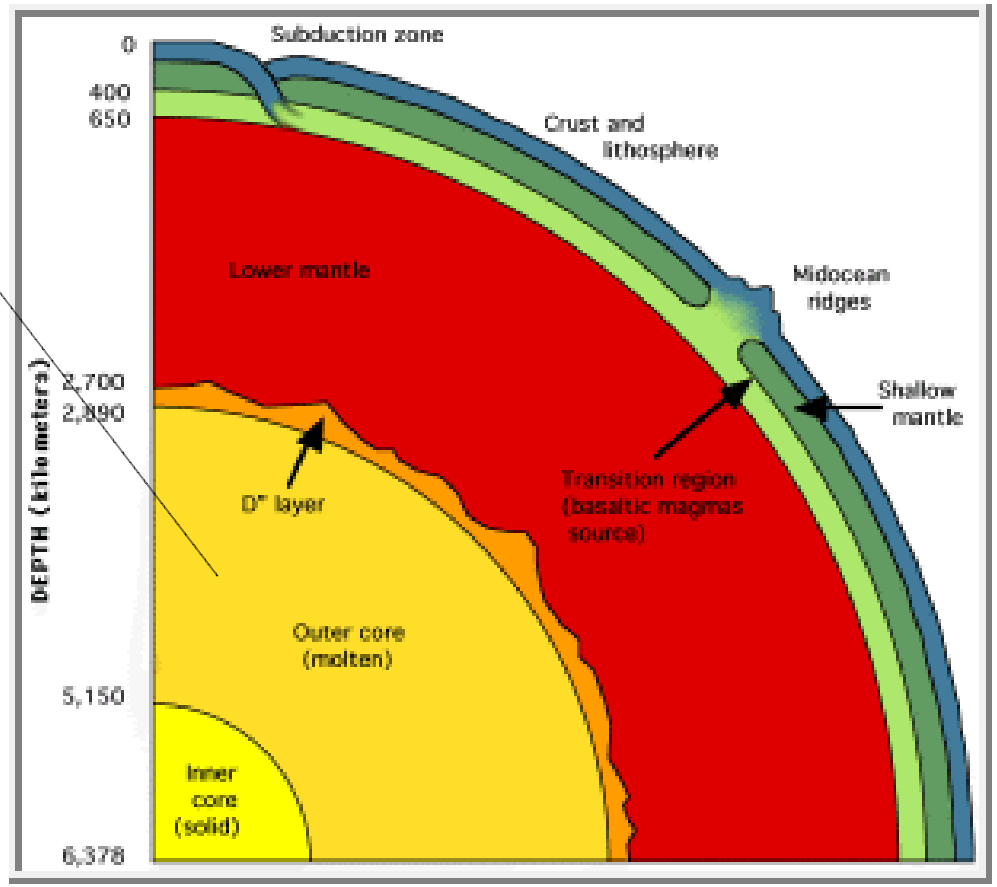
Plate Tectonics: The dance of the continents


Eurasian Plate
North American Plate
Pacific Plate
Cocos Plate
Nazca Plate
South American Plate
African Plate
Arabian Plate
Indian Plate
Somalia Plate
Australian Plate
Antarctic Plate
Antarctic Plate
Pacific Plate
Philippines Plate
Caroline Plate
Juan de Fuca Plate
Aleutian Trench
Caribbean Plate
Scotia Plate
Sandwich Plate
Chile Ridge
East Pacific Rise
Mid-Atlantic Ridge
Mohns Ridge
Gakkel Ridge
Carlsberg Ridge
Mid-Indian Ridge
S.E. Indian Ocean Ridge
Ninetyeast Ridge
Chagos-Laccadive Ridge
Kermadec Trench
Tonga Trench
Java Trench
Sunda Trench
Philippine Trench
Ryukyu Trench
Kuril Trench
Japan Trench
Kermadec Trench
Tonga Trench
Java Trench
Sunda Trench
Philippine Trench
Ryukyu Trench
Kuril Trench
Japan Trench
Aleutian Trench
Mariana Trench
Caroline Trench
Cocos Trench
Chile Trench
Peru Trench
Middle America Trench
Puerto Rico Trench
Caribbean Trench
Scotia Trench
Sandwich

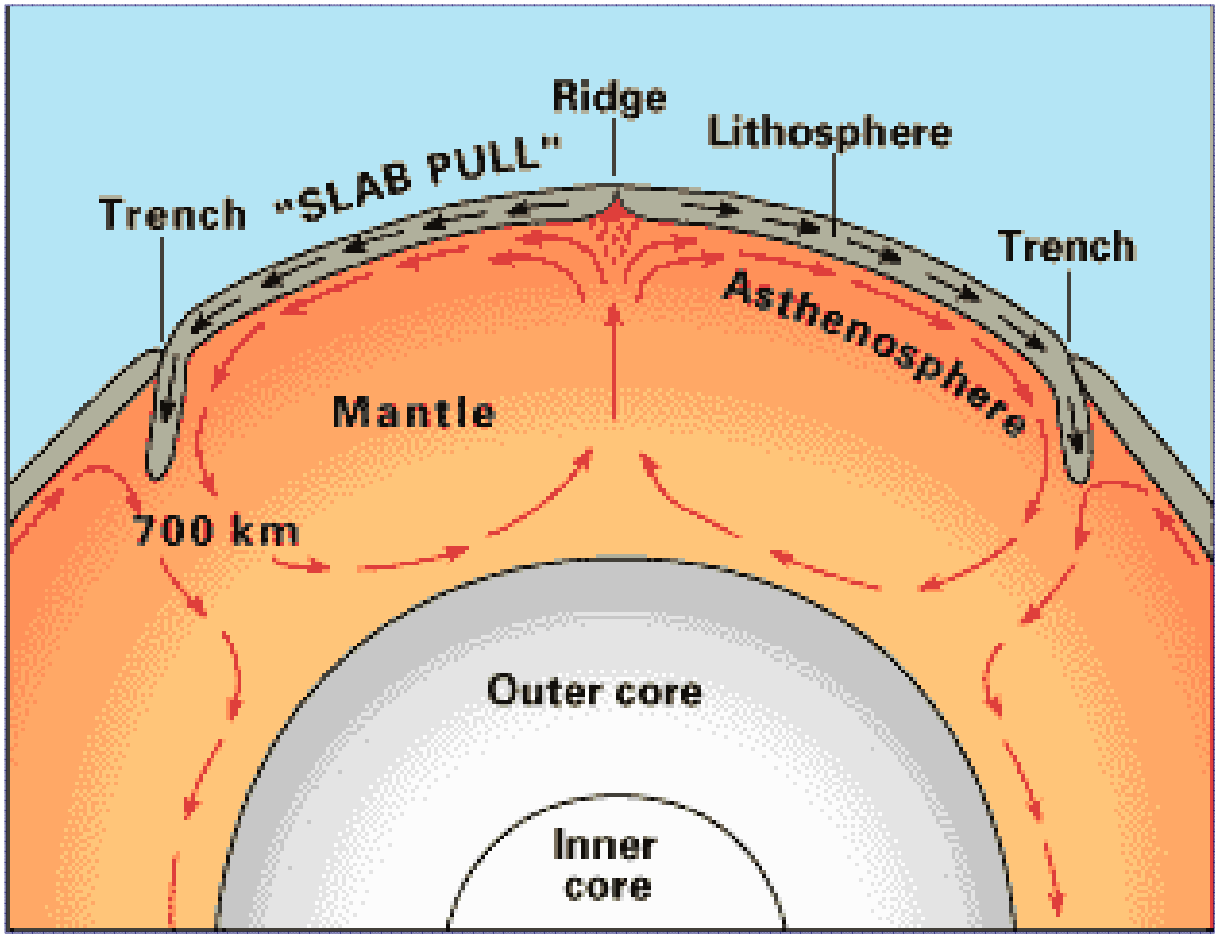
The Earth's core is hot

Radioactive processes

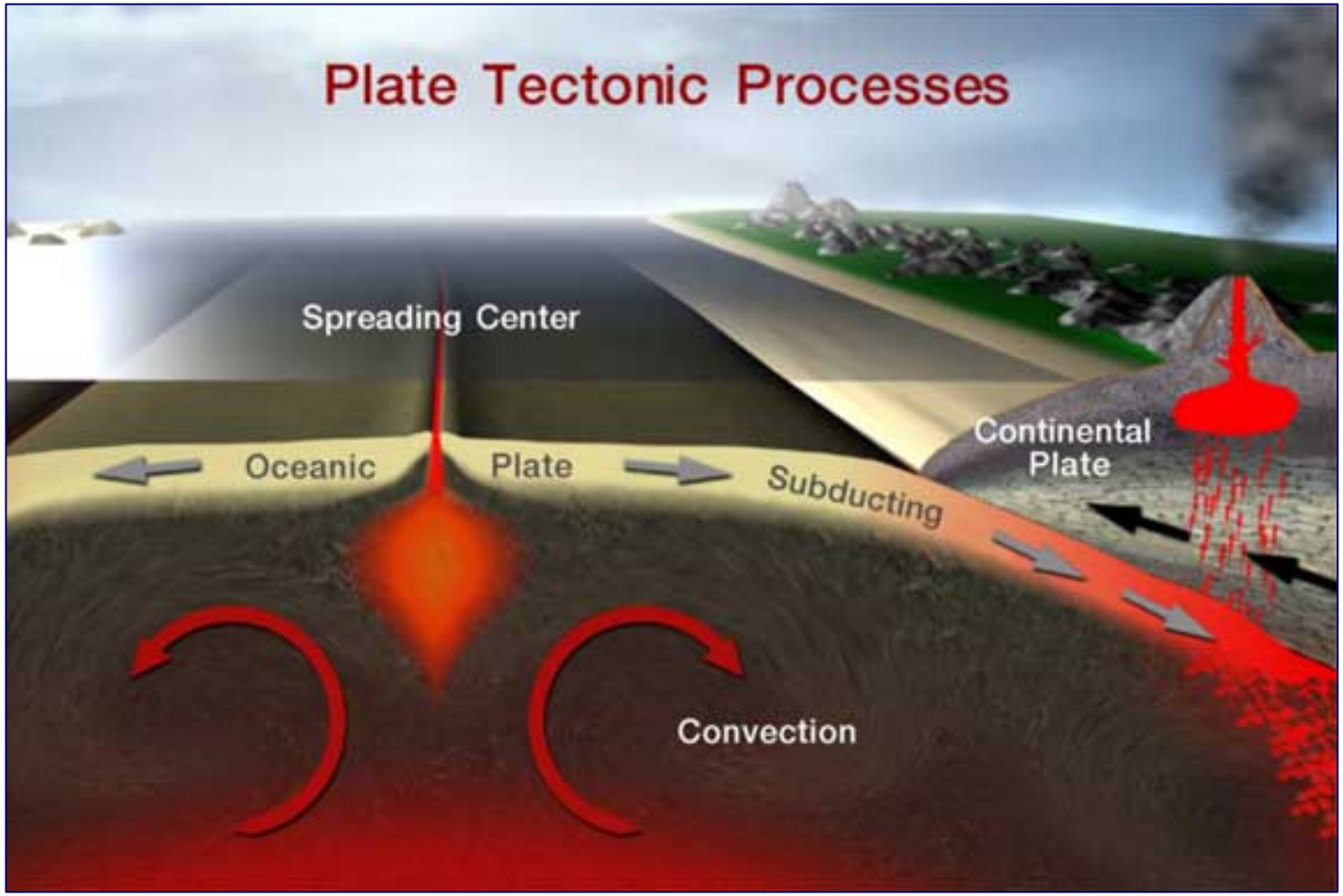




Causing convection currents in the earth's mantle

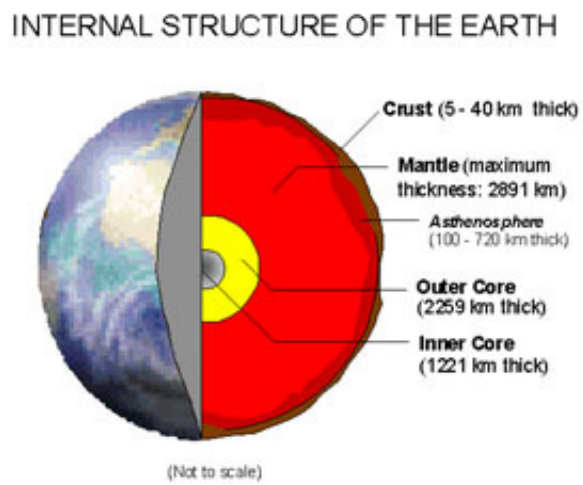


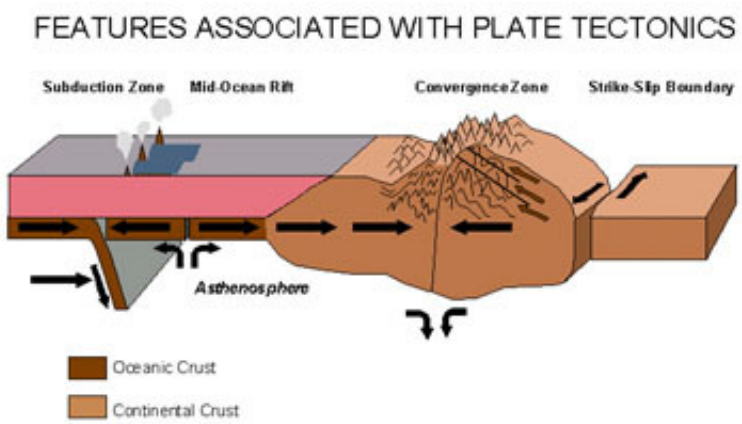
Forcing continents apart



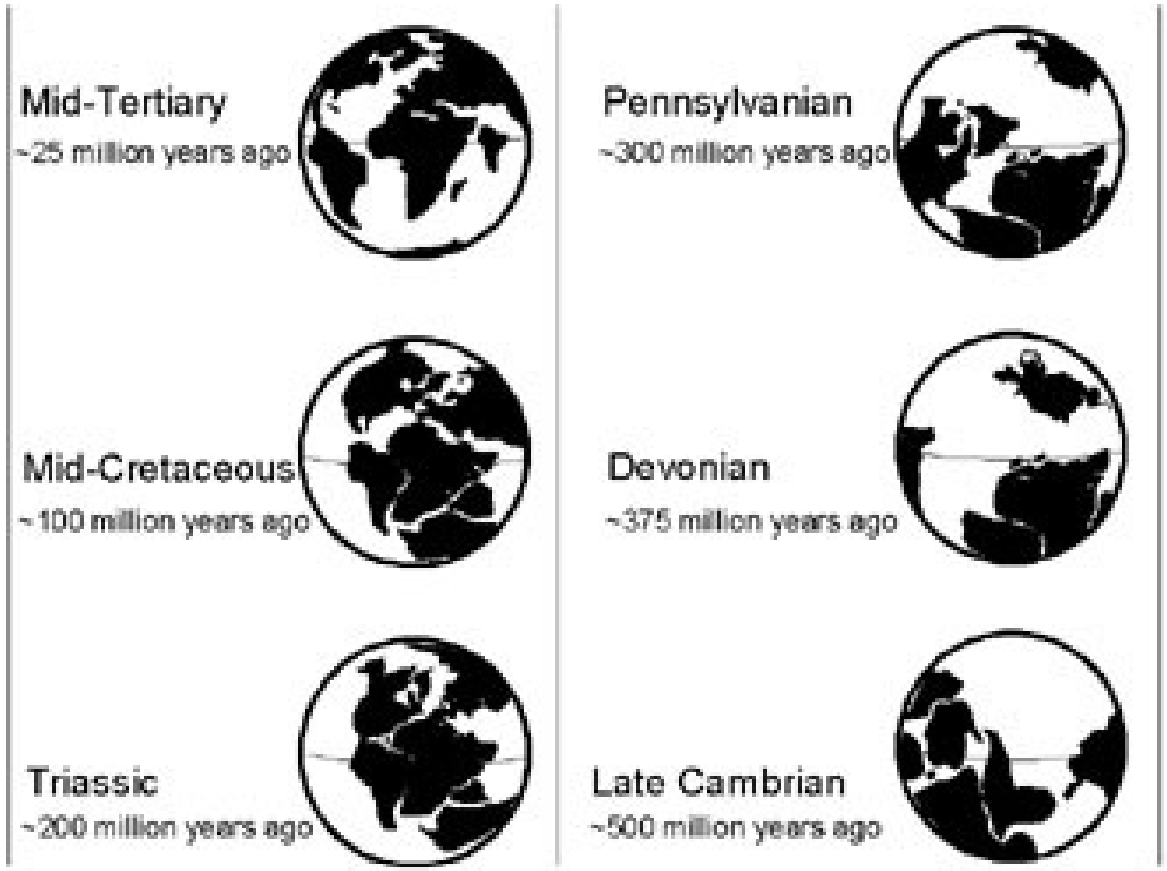
Structure of the Earth: inside and surface

- These diagrams help us identify some features of the Earth's composition:
  - Hot and cold
  - Light and heavy
  - Thick and thin
  - Static and dynamic





Moving the continents around

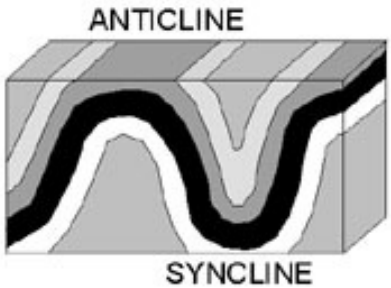


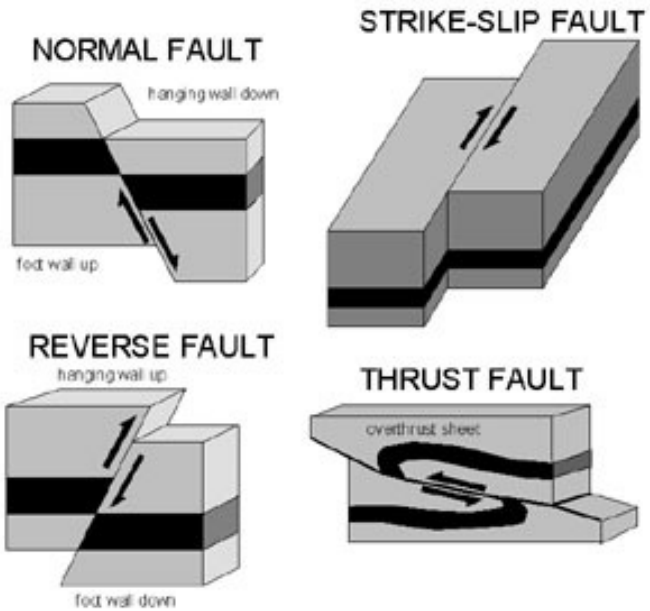
Manifested in shifts and twists

- Question 1. Where can we find fault?
- Question 2. What kind of cline is the Route 209 cut?

High earthquake activity occurs in places where plates of Earth's crust collide, as in California and Japan.

The eastern United States, on the other hand, sits in the middle of a continental plate, where less frequent movement indicates a mature process





Here in the Hudson Valley:

- Begin with the Grenville Orogeny ("mountain building event")
- Later, the Taconics came to America
- Two more Orogenies: Acadian and Alleghenian
- The seas came and went, leaving fossils
- Then the ice ages.
- *Question: during the "Age of Land Plants," where were we?*

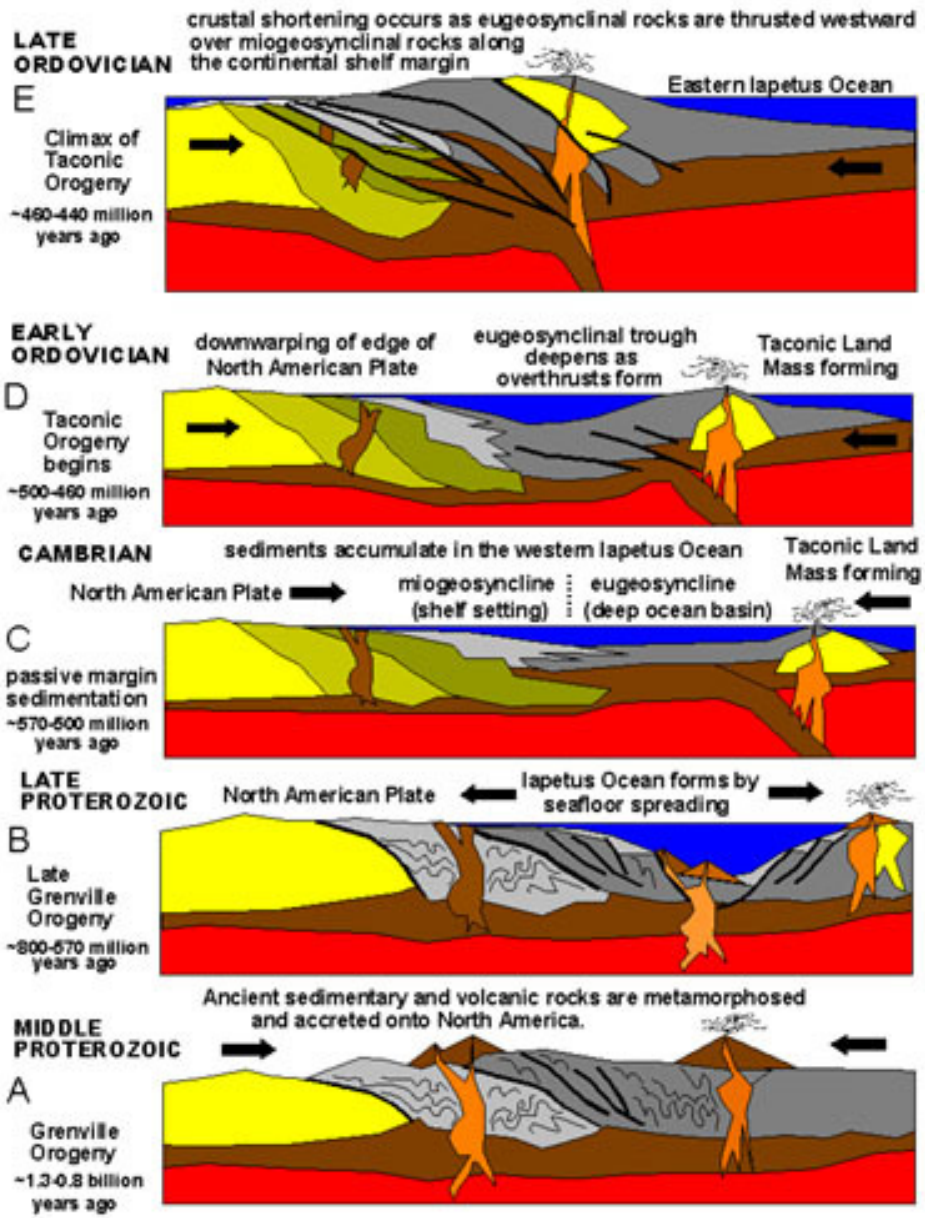
GEOLOGIC TIME SCALE FOR NEW YORK CITY AREA

	Holocene	10,000 years ago to present Human Invasion/modern sea level rise
	*.01	
	Pleistocene	Several major glacial advances into the New York region from Canada
	1.6	
TERTIARY	Pliocene	
	5	
	Miocene	"global cooling begins ~16 million YBP
	24	
	Oligocene	*"Age of Mammals"*
	37	
	Eocene	Many Transgressions and Regressions of the sea across the Coastal Plain
	58	
	Paleocene	
	66	
MESOZOIC	Cretaceous	Modern Coastal Plain develops Modern river systems begin to organize Massive Reefs along continental shelf
	144	
	Jurassic	*"Age of Dinosaurs"* Atlantic Ocean invades northward along spreading rift system
	208	
	Triassic	Newark Basin "Palisades Disturbance"
	245	
PALEOZOIC	Permian	Alleghenian Orogeny affects the Valley & Ridge Region of East Coast
	286	
	Pennsylvanian	*Coal Swamps and "first reptiles"*
	320	
	Mississippian	*"Age of Fishes"*
	360	
	Devonian	Acadian Orogeny affects Northeast
	406	
	Silurian	*"Age of Land Plants begins"*
	438	
	Ordovician	Taconic Orogeny affects Northeast
	505	
	Cambrian	*"Age of Early Invertebrates"*
	570	
PRECAMBRIAN		1.2 billion - oldest rock in NY region "Grenville Orogeny" affects East Coast *4.6 billion - Earth "forms" in solar nebula

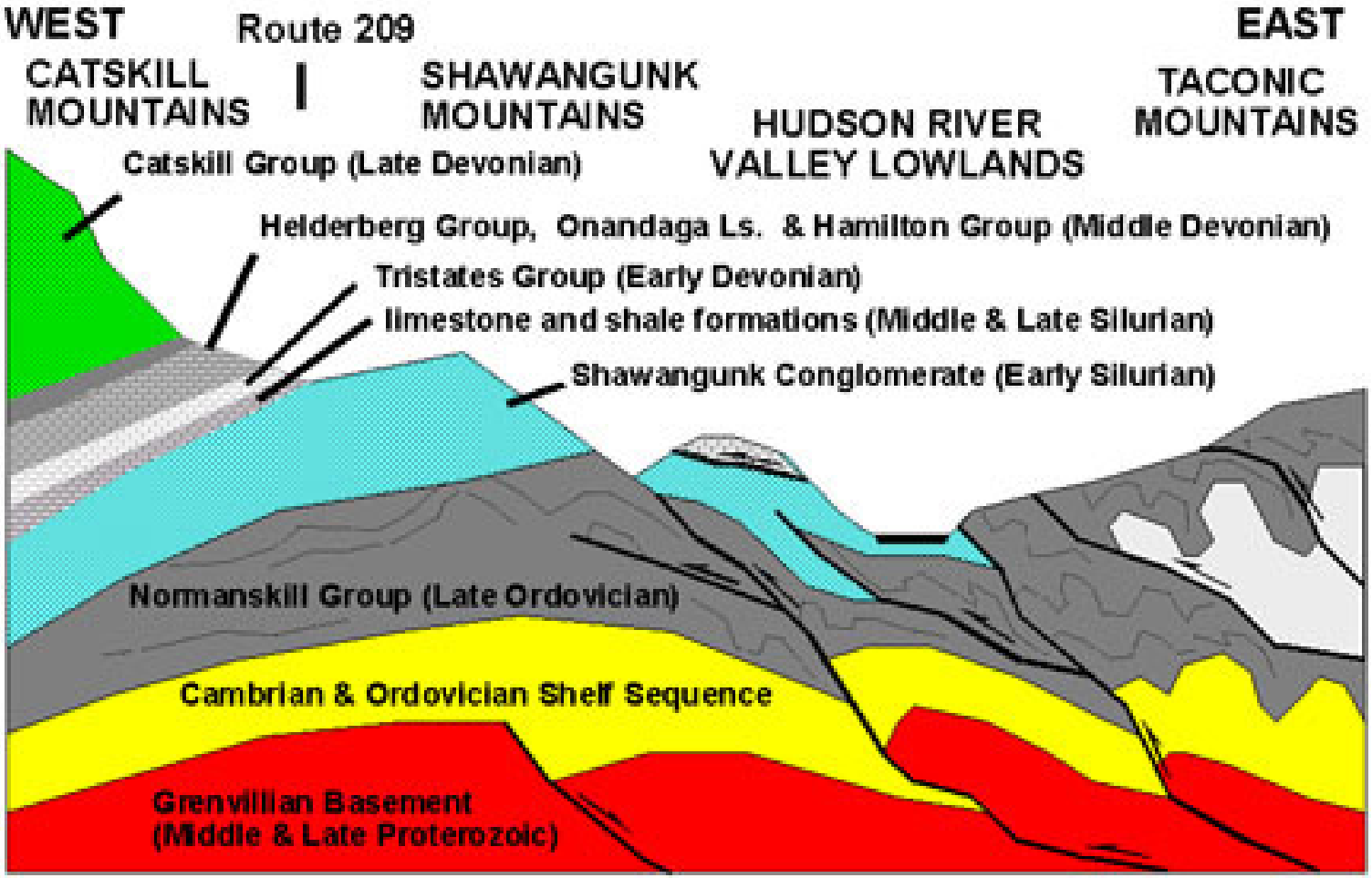
(*million of years before present)

The Taconics Arrive

- It took about 300 million years



Hudson Valley Cross Section

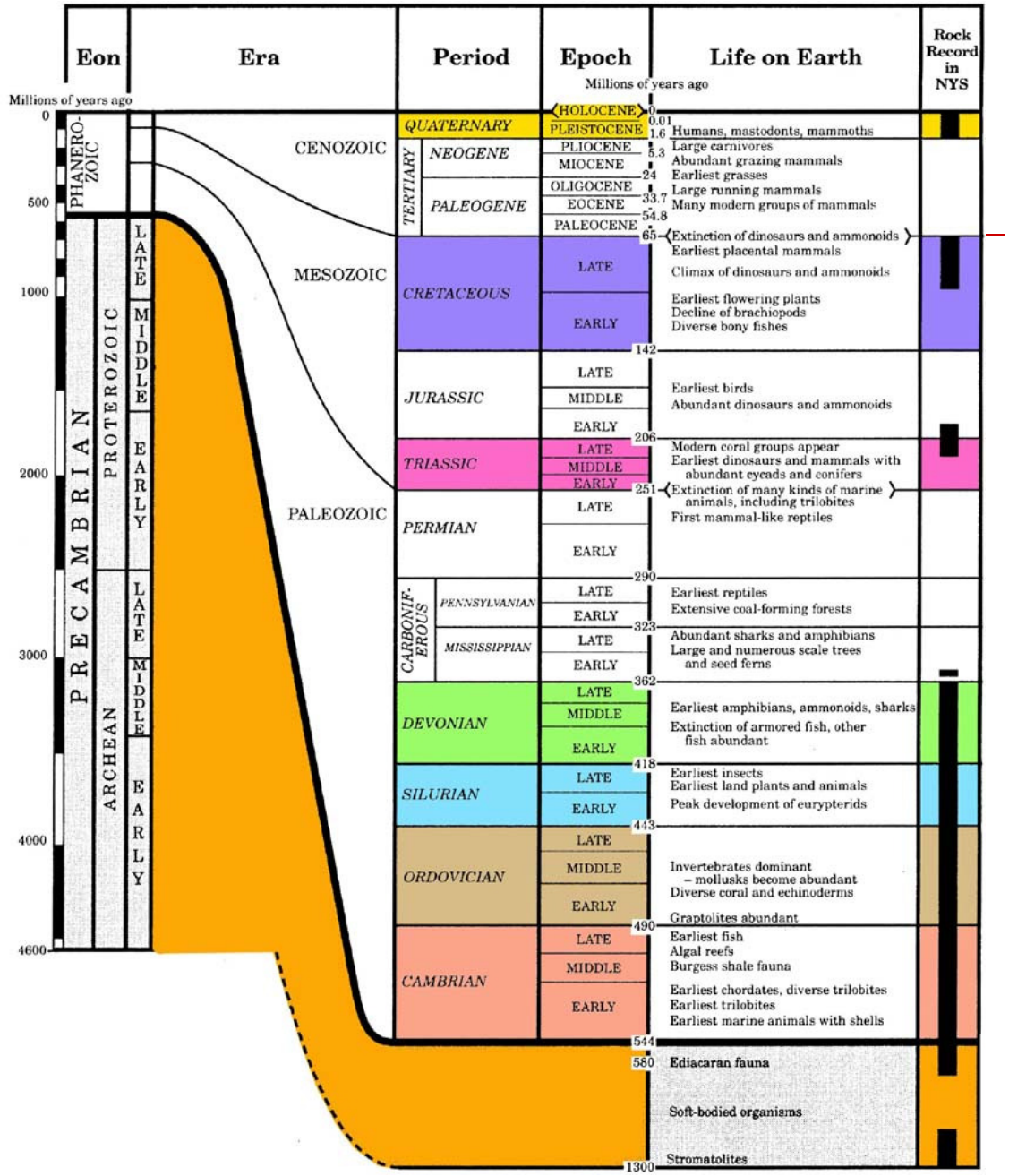


Fossils in the Hudson Valley

- Around 410 million years ago, sea levels rose. The area that is now the northeastern United States, including New York, was near the equator, and the oceans were warm and tropical.
- Marine life thrived on the sea bottom, and the skeletons of these marine organisms piled up on the seafloor. Some of these skeletons were made of calcium carbonate, which formed lime mud that eventually became limestone.

Rock Records

- New York State contains old rock and many fossil records
- These include
  - Dinosaur bones and tracks
  - Brachiopods and trilobites
  - Even billion-year-old stromatolites from the Saratoga Springs area.



Northeast USA

Look for:

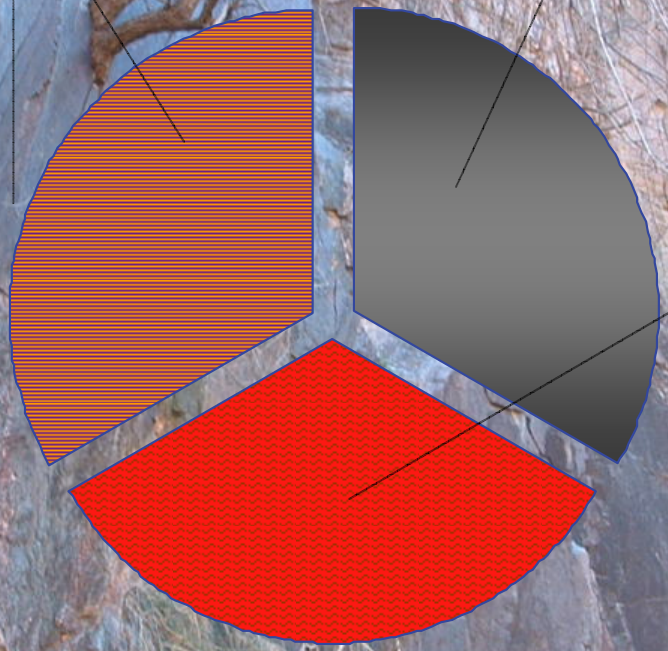
- Appalachians
- Hudson Valley
- Adirondacks
- Catskills

Basic Rockology

Sedimentary

Formed under pressure from layered residues of eroded rock and organic material

Examples: sandstone, mudstone, limestone



Igneous

Formed from molten magma within the earth

Examples: granite, basalt

Metamorphic

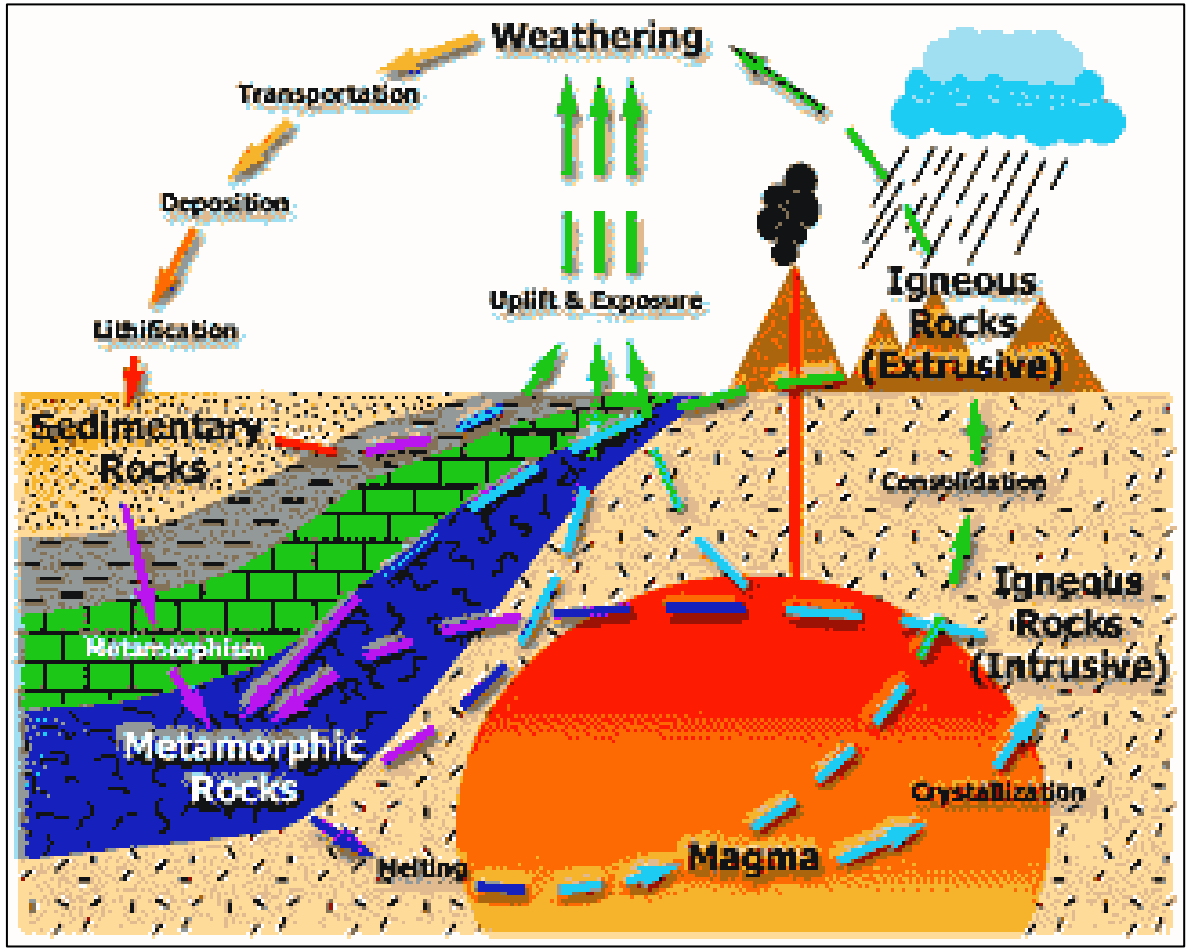
Metamorphized under great heat and pressure from other rocks

Examples:

limestone→marble

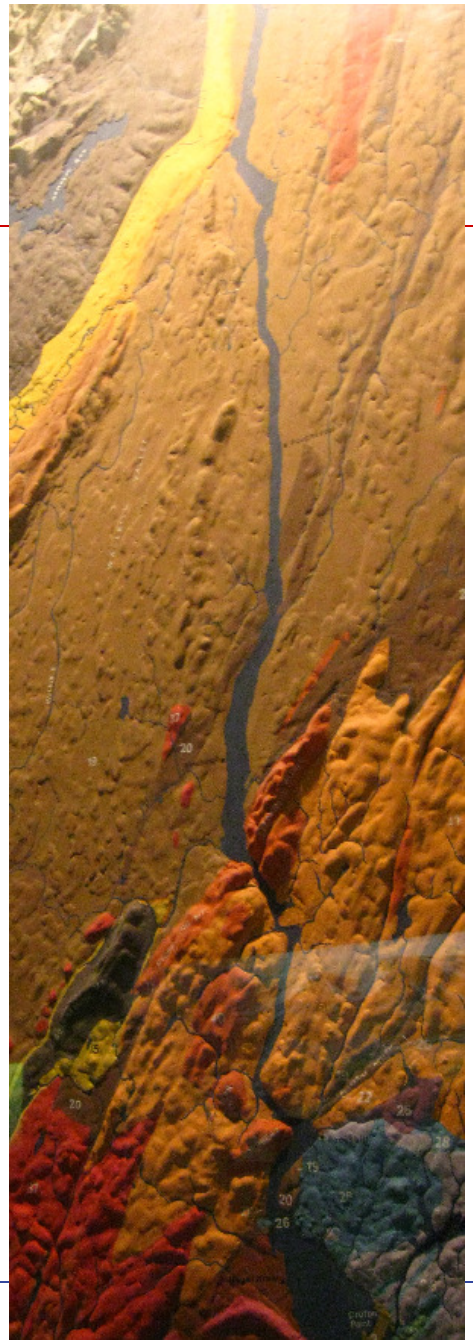
Mudstone→slate

Rock Around the Clock



Rocks in the Hudson Valley

- Igneous rocks: The Hudson Palisades
- Metamorphic rocks: The Hudson Highlands
- Sedimentary rocks: The Catskills
- *Question: what can one expect to find in the Catskill sedimentary rock?*



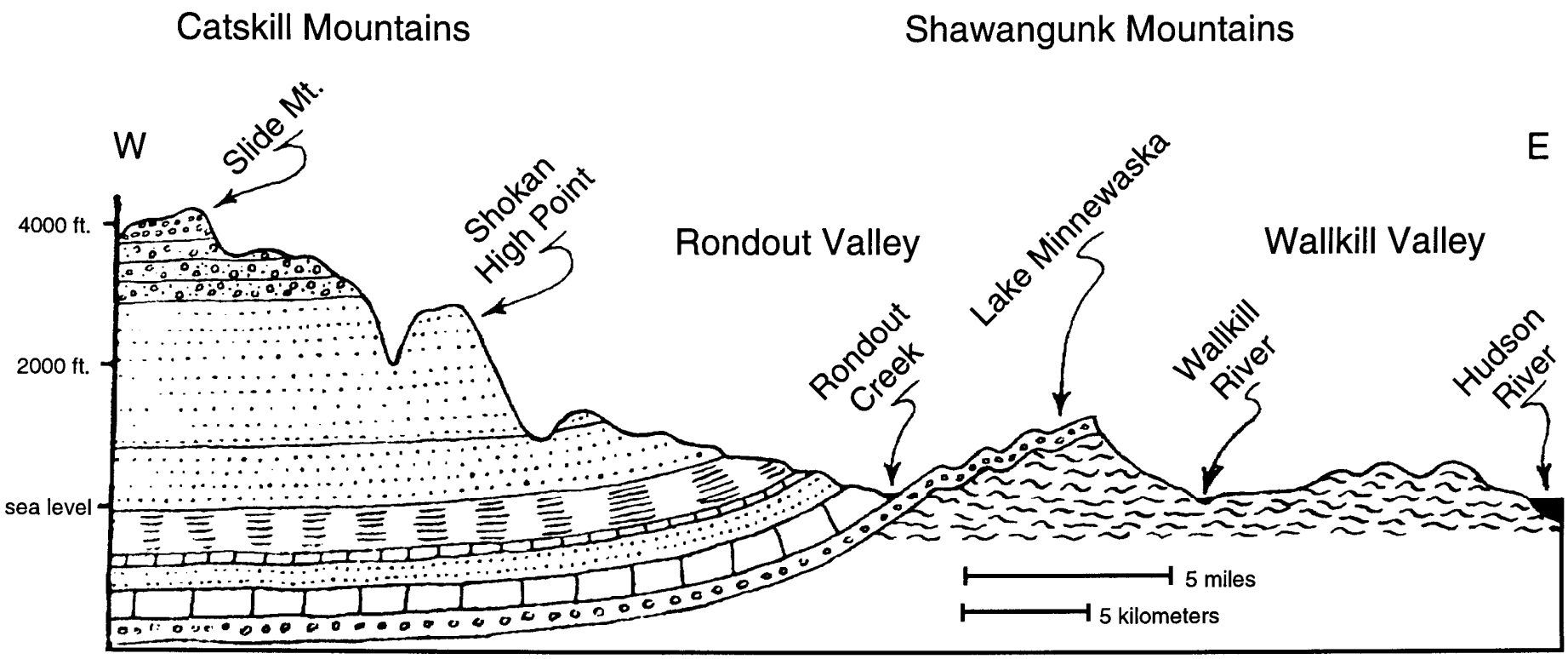
The Hudson Palisades

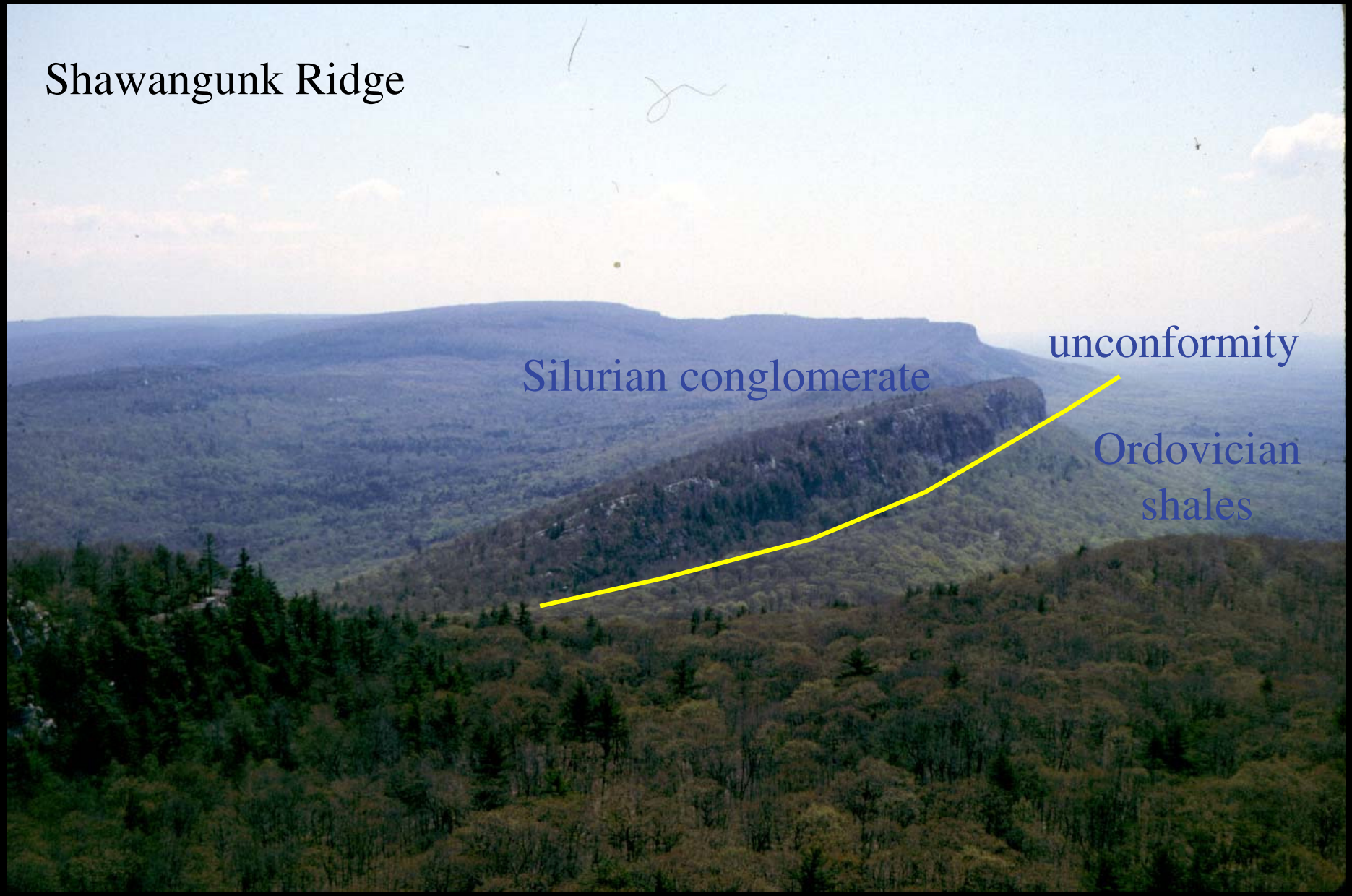
The Palisades formed approximately 200 million years ago at the close of the Triassic Period, by the intrusion of molten magma upward into sandstone. The molten material cooled and solidified before reaching the surface. Subsequent water erosion of the softer sandstone left behind the hard basalt columns that we see today.

The Hudson Highlands

- Formed 1-1.3 billion years ago, during the Grenville Orogeny
- Primary types of bedrock are granite gneiss and schist, which are highly resistant to erosion
- The gneiss and schist are metamorphosed igneous and sedimentary rocks.

The Catskills and Shawangunks

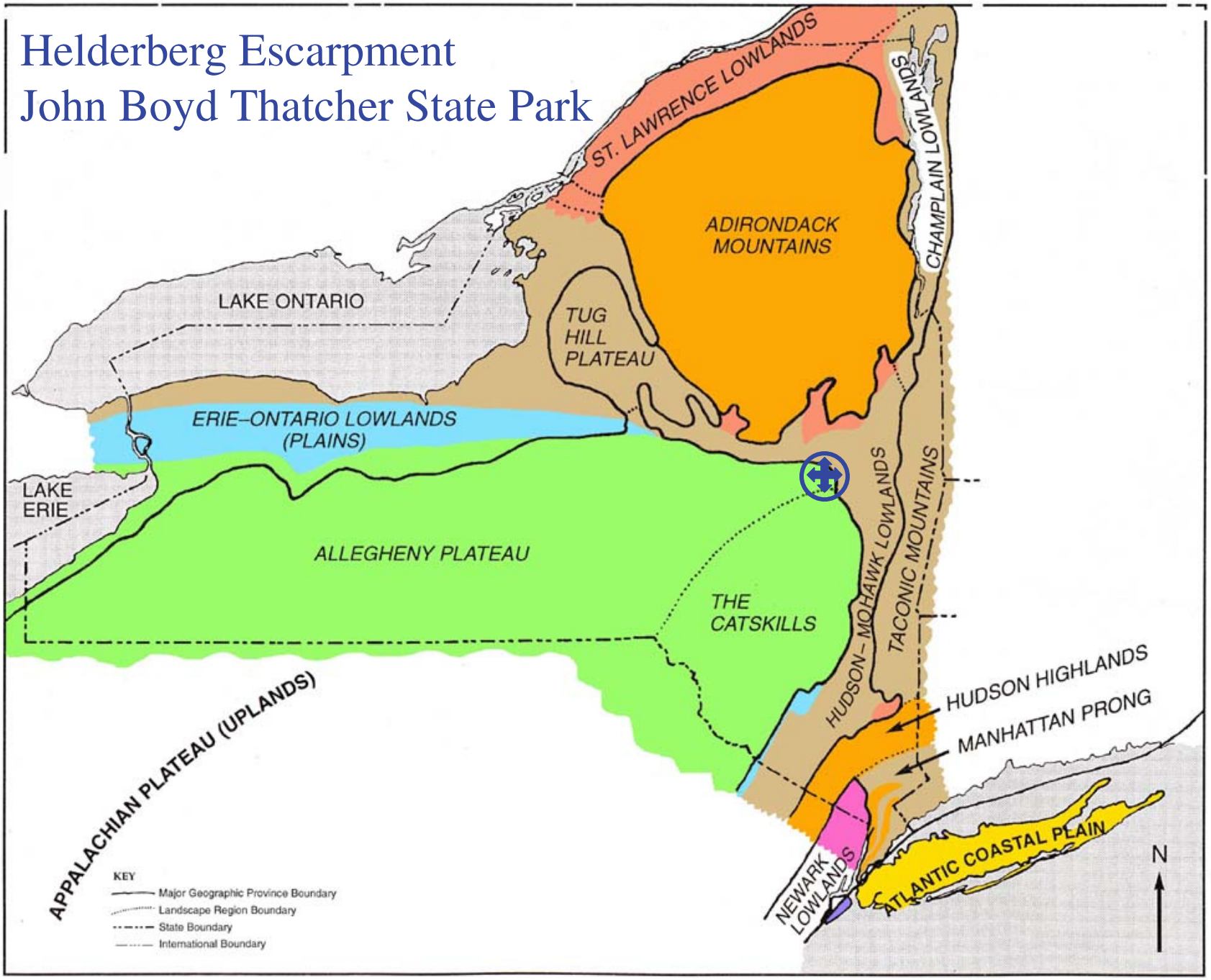



Shawangunk Ridge
unconformity
Silurian conglomerate
Ordovician
shales

Shawangunk Ridge: layers of sandstone

Sandstone overlying red floodplain shales, Catskill Mts.
Roadcut on 23A “The Rip Van Winkle Trail”.

Helderberg Escarpment
John Boyd Thatcher State Park



Helderberg Escarpment

Helderberg Escarpment

There's life in these rocks.

The Ice Ages

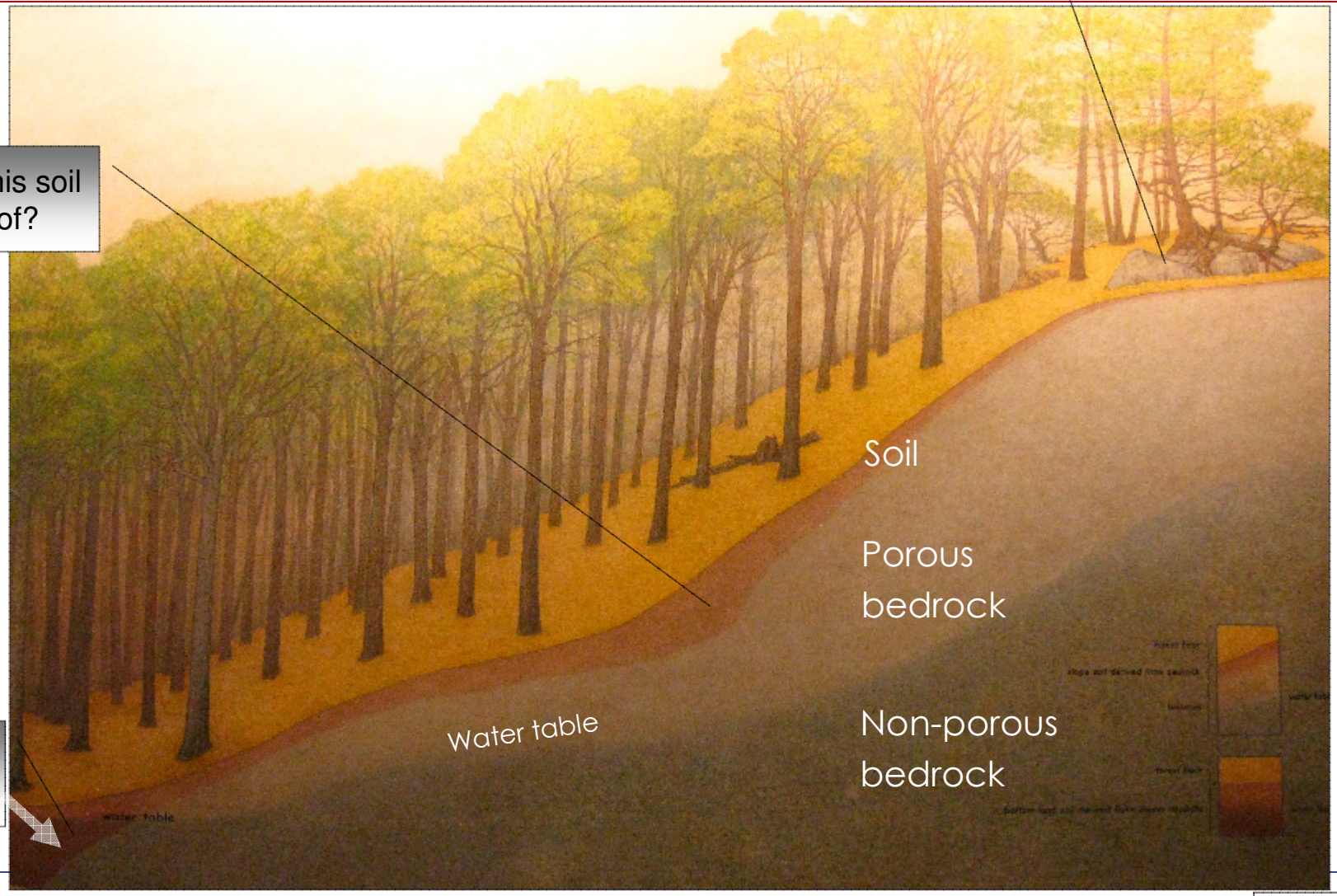
- The latest was the Wisconsin glaciation, which retreated about 12,000 years ago.
- This area was under about a mile of ice.
- The advance and retreat of the ice left many features that one can see in the Catskills today, including:
  - Glacial lakes
  - Ice striations and polished rocks
  - Potholes
  - Erratics – some from Canada
  - The Long Island moraine
  - And the Hudson River fjord.

In the Catskills – below your feet

What kind of rocks would you expect to see?

What is this soil made of?

What is *this* soil made of?



Shale, limestone, sandstone, quartzite and conglomerate

SHALE

Review

- Tectonic plate movements have caused great upheavals in the Hudson Valley area, with several orogenies over the last 1.3 billion years
- Mountains rose and were eroded; seas rose and fell; ice advanced and retreated.
- Since the Triassic (200+ mya), the region has been relatively quiet
- Many old rocks, now exposed, tell the Hudson Valley story – and we can find glimpses of that story along the rivers, roads and trails of the Hudson Highlands, the Shawagunks, and the Catskills.

Further exploration

giddy.net/hudsonrocks
Van Diver, *Roadside Geology of New York*
Raymo & Raymo, *Written in Stone*

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