Hudson Valley Rocks

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Geology of New York State
Plate Tectonics: The dance of the continents
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

- **Mid-Tertiary**: ~25 million years ago
- **Pennsylvanian**: ~300 million years ago
- **Mid-Cretaceous**: ~100 million years ago
- **Devonian**: ~375 million years ago
- **Triassic**: ~200 million years ago
- **Late Cambrian**: ~500 million years ago
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 Inversion/modern sea level rise
- **Pleistocene**: Several major glacial advances into the New York region from Canada
- **Miocene**
  - "global cooling begins ~16 million YBP"
  - "Age of Mammals"
  - Many Transgressions and Regressions of the sea across the Coastal Plain
- **Cretaceous**
  - Modern Coastal Plain develops
  - Modern river systems begin to organize
  - Massive Reefs along continental shelf
  - "Age of Dinosaurs"
- **Jurassic**
  - Atlantic Ocean invades northward along spreading rift system
  - Newark Basin "Palisades Disturbance"
- **Triassic**
- **Permian**
  - Pennsylvanian
  - Appalachian Orogeny effects the Valley & Ridge Region of East Coast
  - Coal Swamps and "first reptiles"
  - "Age of Fishes"
- **Mississippian**
  - Devonian
  - Silurian
  - "Acadian Orogeny affects Northeast"
  - "Age of Land Plants begins"
- **Ordovician**
  - Cambrian
  - "Taconic Orogeny affects Northeast"
  - "Age of Early Invertebrates"
- **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
**Igneous**
- Formed from molten magma within the earth
- Examples: granite, basalt

**Sedimentary**
- Formed under pressure from layered residues of eroded rock and organic material
- Examples: sandstone, mudstone, limestone

**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

Catskill Mountains

W

Slide Mt.

Shakan High Point

4000 ft.

2000 ft.

sea level

Rondout Valley

Shawangunk Mountains

E

Rondout Creek

Lake Minnewaska

Wallkill Valley

Wallkill River

Hudson River

5 miles

5 kilometers
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 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 is this soil made of?
- What is this soil made of?
- What kind of rocks would you expect to see?

Soil

Porous bedrock

Non-porous bedrock

Water table

Non-porous bedrock Porous bedrock Water table
Shale, limestone, sandstone, quartzite and conglomerate
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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