

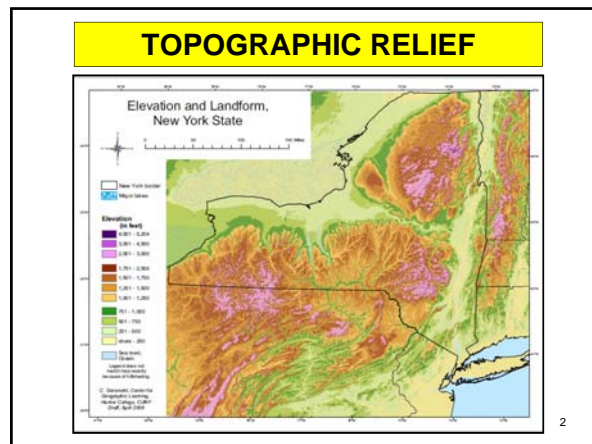
## 3: PHYSICAL GEOGRAPHY

### An Overview of the Natural Landscape of New York State

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## Definitions

*Geography: Study of people living on the surface of the earth.*

**Geology:** the study of the earth and its processes.

**Geomorphology:** the study of landforms.

**Topography:** the study of surface features.

3

## GEOLOGIC PROCESSES

**TECTONIC** (building)

- Folding
- Faulting
- Volcanism

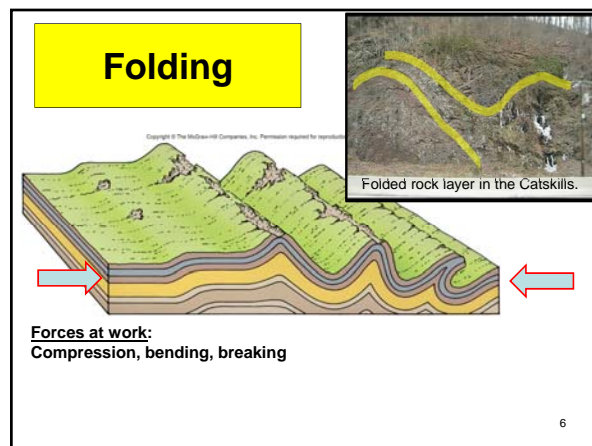
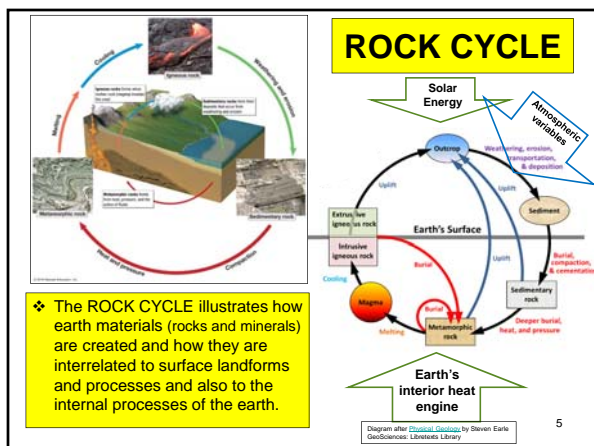
**GRADATIONAL** (wearing down)

- Weathering** (gradation in place): mechanical and chemical
- Mass wasting** (gradation by gravity)
- Agents of Erosion** (gradation with movement and reposition: take-move-place)
  - Running water
  - Moving ice
  - Wind
  - Wave action
  - Long shore currents

**NATURAL PROCESSES**

- Mass movements
- Earthquakes
- Volcanic eruptions
- Subsidence
- Flooding

4



### Deformed Strata Eastern Catskills

Cross section showing orientation of strata from Hudson River west to the Catskill Mountains.

Shawangunk Mts. Walkkill Valley

### Faulting

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**Forces at work:** movement, tension, breaking

Lake Champlain, Lake George and Sacandaga Lake (not shown) are in rift valleys (also called grabens).

### Volcanism

Evidence of volcanic activity is seen in lava formations, hot springs and some rock units in the Taconic Mts. along the eastern border.

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**Forces at work:** melting, movement of molten material. An eruption can be explosive or gentle.

### Stark's Knob and Taconic Mts.

Pillow basalts from western Newfoundland in Canada, to Stark's Knob in New York, and south into New Jersey and Pennsylvania are similar in age and reflect the first orogeny (mountain-building episode) in the Appalachians. This is the ca. 460 to 440 million-year-old Taconic orogeny.

**Tectonic Model of Taconic Orogeny**

The Taconic orogeny resulted a collision of the eastern edge of ancient North America with a volcanic island arc which had subducted under the eastern edge. Remnants of this collision episode, island arcs are preserved along the eastern Connecticut River valley.

As the volcanic arc was pushed west into Vermont and eastern New York and the continent buckled in front of it, cracks opened in the earth's crust. The Stark's Knob basalt lava flowed out of these cracks into the sea covering eastern North America. Fossil snails found between the basalt pillows by State Museum researchers indicate an Early or, more likely, Middle Ordovician age of the pillow basalt. These snails also show that the pillows were formed in relatively shallow sea water.

### New England Seismic Network including NYS

Earthquakes occur throughout NE United States and SE Canada.

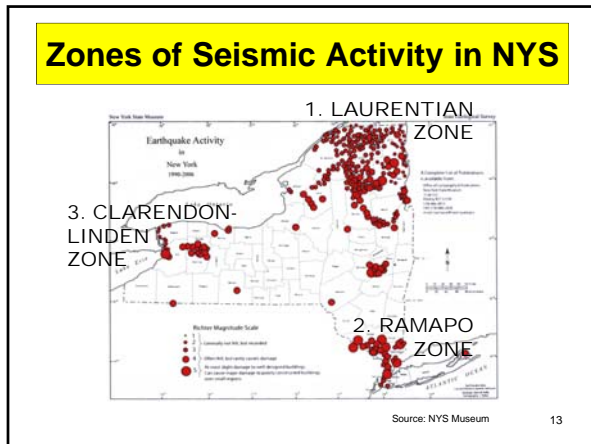
- There are two major earthquake cluster zones in eastern NYS and a minor one in western NYS.

Earthquakes are caused by adjustments to the earth's surface (rebound) as tension is released.

### US East Coast Seismic Hazard Potential

**Explanation**

%g	Seismic Design Category
125	E Greatest
83	D <sub>2</sub>
67	D <sub>1</sub>
50	D <sub>0</sub>
33	C
17	B
0	A Least

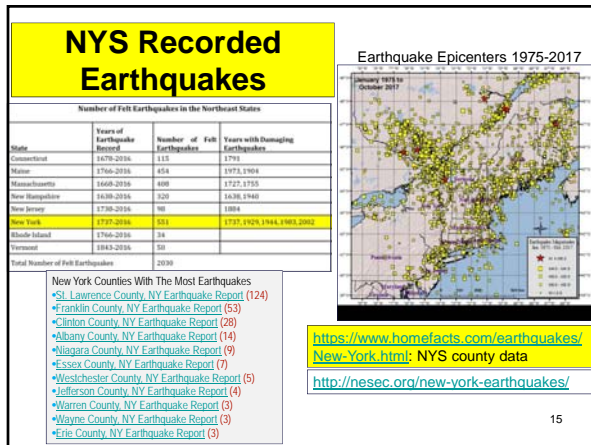


### Assessing Seismic Risk

Modified Mercalli Scale vs. Richter Scale		
I. Instrumental	Not felt	1-2
II. Just perceptible	Felt by only a few people, especially on upper floors of tall buildings	3
III. Slight	Felt by people lying down, seated on a hard surface, or in the upper stories of tall buildings	3.5
IV. Perceptible	Felt indoors by many, by few outside; dishes and windows rattle	4
V. Rather strong	Generally felt by everyone; sleeping people may be awakened	4.5
VI. Strong	Trees sway, chandeliers swing, bells ring, some damage from falling objects	5
VII. Very strong	General alarm; walls and plaster crack	5.5
VIII. Destructive	Felt in moving vehicles; chimneys collapse; poorly constructed buildings seriously damaged	6
IX. Ruinous	Some houses collapse; pipes break	6.5
X. Disastrous	Obvious ground cracks; railroad tracks bent; some landslides on steep hillsides	7
XI. Very disastrous	Few buildings survive; bridges damaged or destroyed; all services interrupted (electrical, water, sewage, railroads); severe landslides	7.5
XII. Catastrophic	Total destruction; objects thrown into the air; river courses and topography altered	8

4

Source: <http://www.us-tsunami-warnings.com/pages/mercalli-scale>



### Types of Rocks

There are 3 categories of rocks, each formed differently, each with different resistances to erosion:

- **Sedimentary**
- **Igneous**
- **Metamorphic**

Surface rock layer not covered by soil  
Adirondack State Park

16

### Types of Rocks

- **Sedimentary** – Rocks formed by the **compaction of eroded material** from other rocks or precipitates from dissolved minerals **under pressure from the weight of successive layers.**

Watkins Glen State Park, Tompkins Co.

- ✓ They make up 75% of the earth's surface.

17

### Sedimentary Rocks

Sediments are laid down in **horizontal** layers.

The layers are then often **deformed** by folding and faulting or **displaced** by volcanic activity.

They are **eroded** by running water.

in Ausable Chasm, Essex Co.

18

## Helderberg Escarpment

Figure 8.4. The block diagram of the Helderberg Escarpment shows the relationship between the bedrock strata and the land surface. The escarpment exists because the strata of the Middle and Coarse-grained formations (part of the Helderberg Group) is more resistant to erosion than the sandstone and shale of the underlying Schoharie Formation. Locate the place on Plate 3 where the Helderberg Group lies directly on top of the Schoharie Formation. There is a large gap in the rock record in this area.

19

## Types of Rocks

- **Igneous** – Rocks formed by the **cooling and solidification** of molten material.
  - ✓ The rate of cooling determines its crystalline structure.
  - ✓ The rate of cooling determines the creation of minerals.

20

## Igneous Rocks

**Igneous rocks are found at the surface in three areas:**

- (1) SE NYS from Staten Island to Rockland Co. along the Palisades sill.
- (2) NE NYS in the Saratoga Springs area where there are hot springs and pillow lava formations. (Pillow lava is a formation created when molten rock hits cool water.)
- (3) The Hudson Highlands and Adirondacks contain igneous rock of Pre-Cambrian age.

21

## Palisades Sill

**Sill:** a horizontal underground lava flow intruded between layers of sedimentary rock.

22

## Igneous Rocks

Pillow lava at Stark's Knob, NY >>

Below, recent pillow lava underwater off of Hawaii.

<< Volcanic sill, Haverstraw, NY (Rockland Co.) related to the Palisades formation.

23

## Types of Rocks

- **Metamorphic** – Rocks formed by the addition of **great heat and pressure** to existing sedimentary, igneous and metamorphic rocks.

Examples:


- shale (sed.) becomes slate
- sandstone (sed.) becomes quartzite
- limestone (sed.) becomes marble
- granite (ign.) becomes gneiss
- basalt (ign.) becomes schist

Visit the NYS Museum web site ([www.nysm.nysed.gov](http://www.nysm.nysed.gov)). Look over the "Geology Collection" of NYS minerals and rocks.

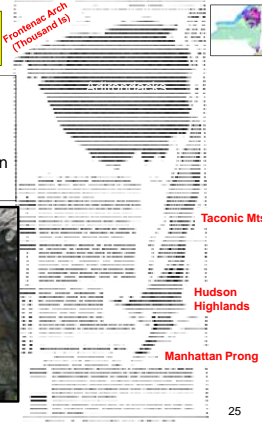
24

## Metamorphic Rocks

Metamorphic rocks are found in the Adirondack Mts., Thousand Islands region (Frontenac Arch) and in eastern NYS (Taconic Mts., Hudson Highlands and the Manhattan Prong).



Banded gneiss, a metamorphic rock, in the Adirondacks.



25

## Resistance of Rocks

- ❖ The composition of the rocks give them the ability to resist forces of erosion.
  - Igneous and metamorphic rocks are generally stronger. They are resistant to erosion and form highlands.
  - Sedimentary rocks tend to be weaker. They are found in lowlands.

Together they give us a variety of surface features and slope angles.

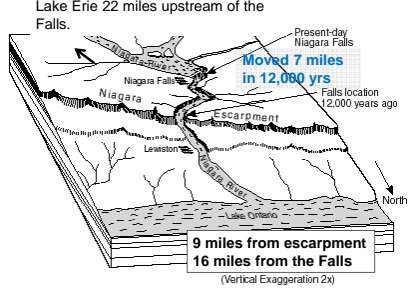
26

## Setting of Niagara Falls

The Niagara River drains Lake Erie.

It flows over the Niagara Escarpment to reach Lake Ontario.

In doing so for 12,000 yrs, it has created a 7 mile long gorge as the falling water eroded weak layers of rock.



27

## Niagara Escarpment

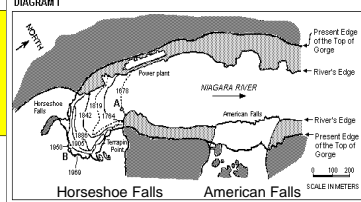
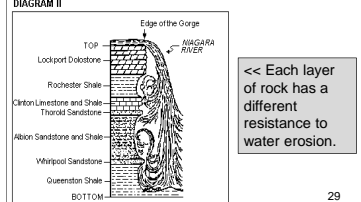


American Falls      Horseshoe or Canadian Falls

28

## Retreat of Niagara Falls

At the present rate of erosion, it will take the Niagara River 75,000 years to reach Lake Erie.

<< Each layer of rock has a different resistance to water erosion.

29

## Niagara Falls

### American Falls




1969

2017

[www.dailymail.co.uk/news/article-1338793/Niagara-Falls-ran-dry-Photos-moment-iconic-waterfall-goes-standstill.html](http://www.dailymail.co.uk/news/article-1338793/Niagara-Falls-ran-dry-Photos-moment-iconic-waterfall-goes-standstill.html) - photos of dry Niagara Falls in 1969

30

## Niagara Falls

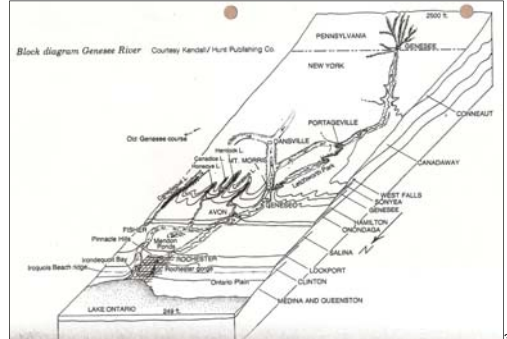


**Horseshoe or Canadian Falls**

<https://www.google.com/maps/@43.0848173,-79.0712239,1180m/data=!3m1!1e3!5m1!1e4>

31

## Genesee River



*Block diagram Genesee River* Courtesy Kendall/Hunt Publishing Co.

32


## Letchworth State Park Western NYS



**Gorge of the Genesee River in Letchworth State Park.**

33

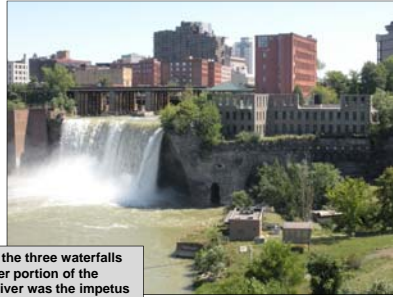
## Letchworth State Park Western NYS



**Genesee River in the "Grand Canyon of the East" at Letchworth State Park.**

<https://www.google.com/maps/@42.5924398,-78.0286122,13.97z/data=!5m1!1e4>

## High Falls on the Genesee River at Rochester



The site of the three waterfalls on the lower portion of the Genesee River was the impetus for the growth and development of Rochester as a water-powered industrial city.

35

## Landscapes of NYS

**NEXT  
PALEOGEOGRAPHY**

36