The Rocks of *Harriman State Park*

Talk with the Experts
American Canoe Association

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Lamont-Doherty Earth Observatory
Columbia University

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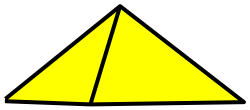
Part 1

Everything Changes

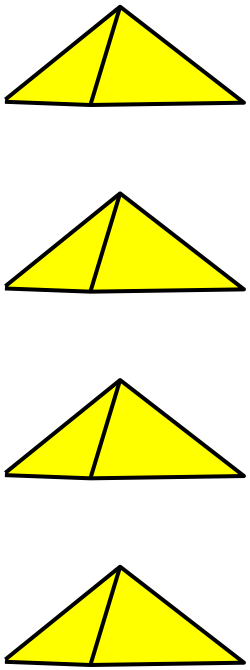
Very Old

Great Pyramid at Giza
roughly 5000 years old



1 pyramid

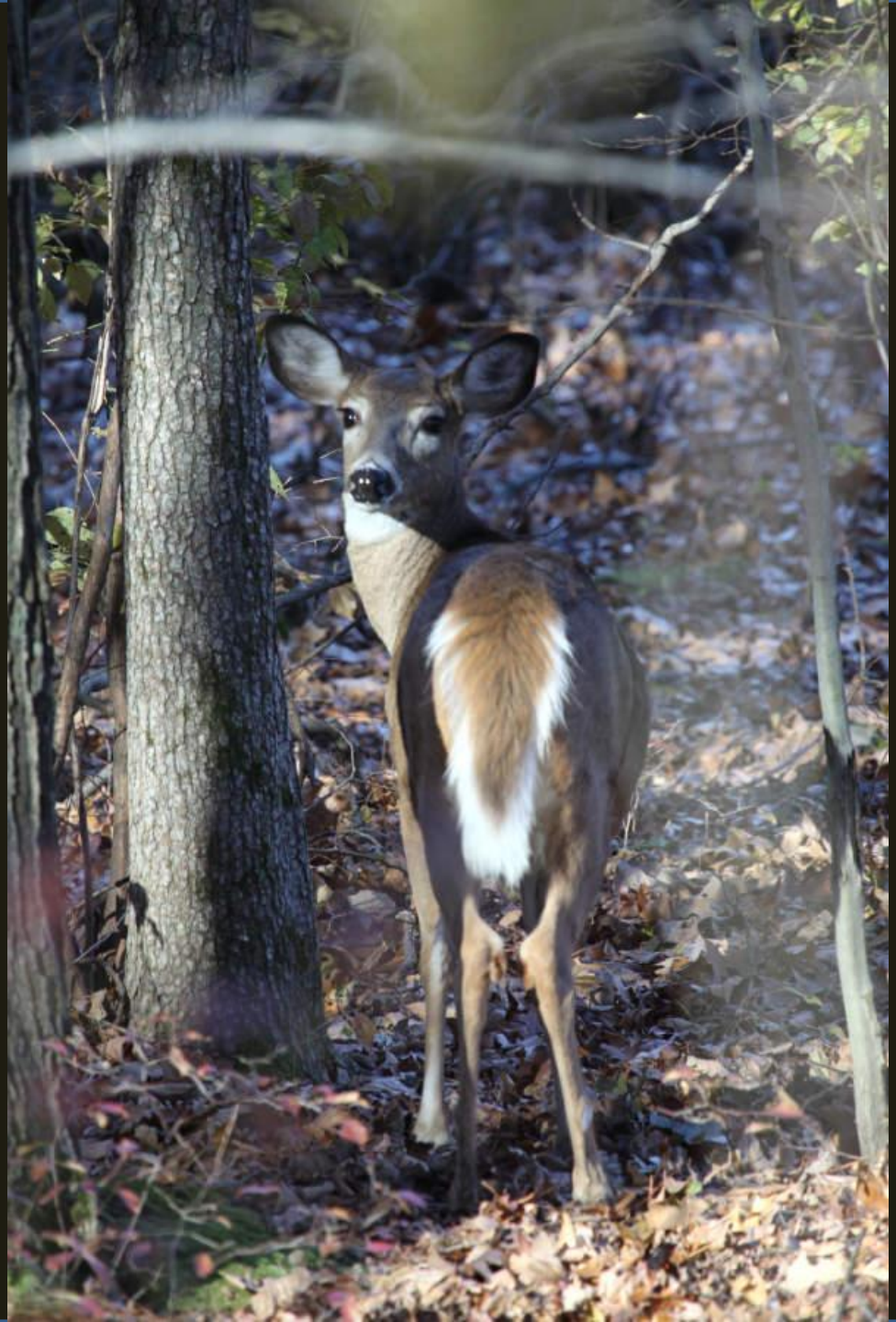
5000 years



Imagine

what
Harriman State Park
was like
4 Pyramids Ago ?

(20,000 years)



Whitetail Deer

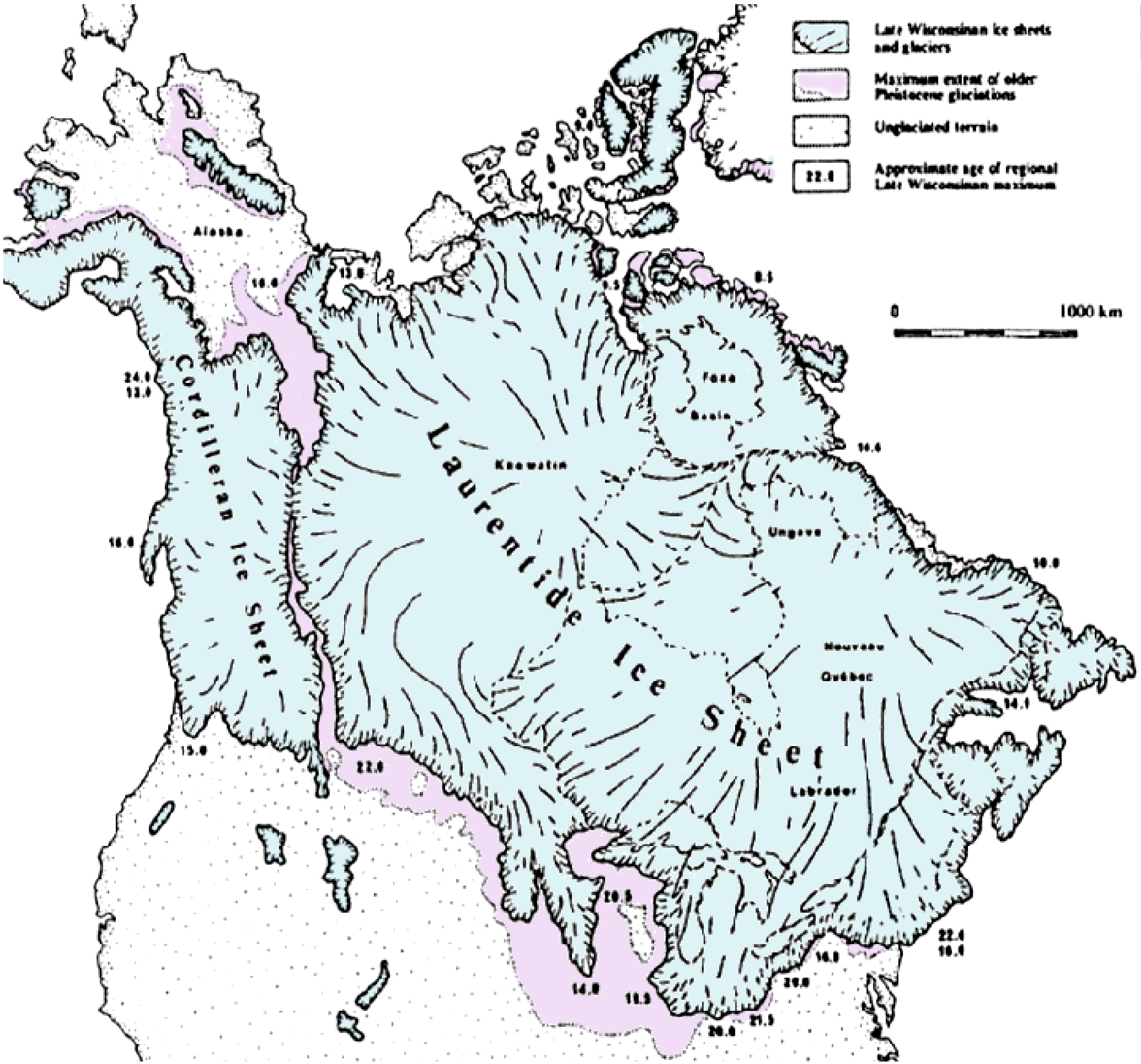
Whitetail Deer


Greenland Ice Sheet

Absolutely nothing

lived in the Harriman Park

20,000 years ago

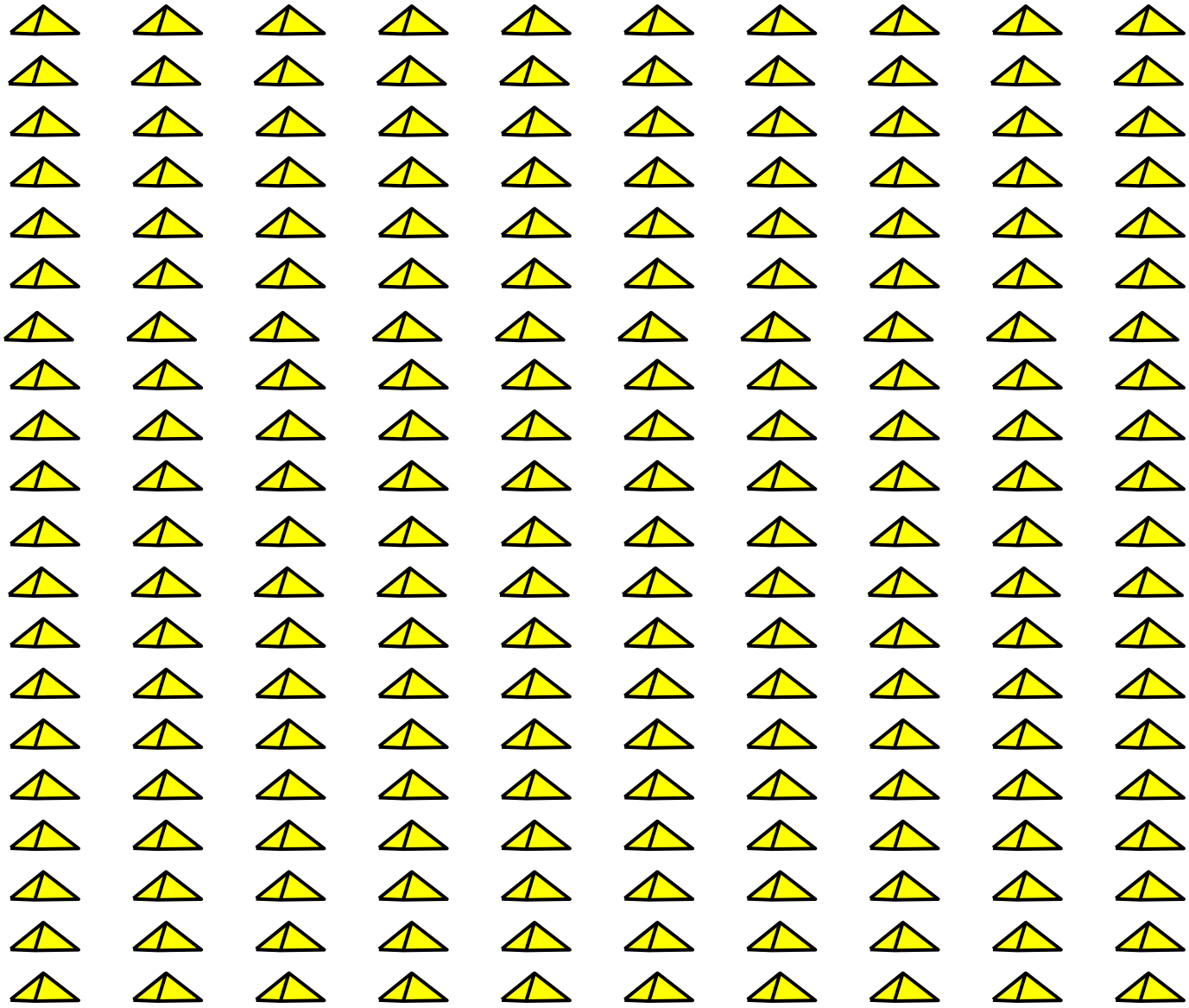


Late Wisconsinan ice sheets and glaciers
Maximum extent of older Pleistocene glaciations
Unglaciated terrain
Approximate age of regional Late Wisconsinan maximum
0
1000 km
Alaska
Cordilleran Ice Sheet
Laurentide Ice Sheet
Keewatin
Foxe Basin
Ungava
Nouveau Québec
Labrador

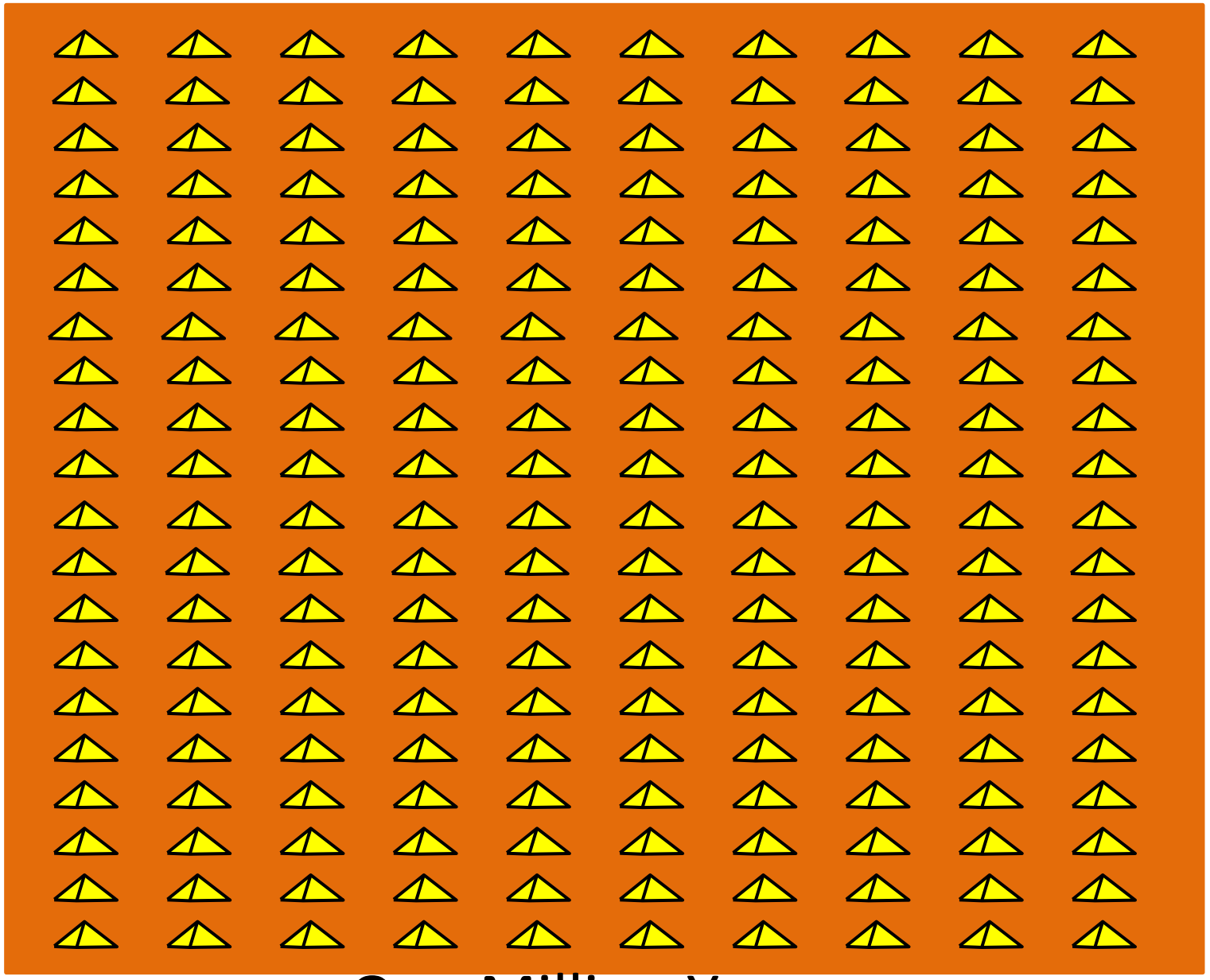

Late Wisconsinan ice sheets and glaciers
Maximum extent of older Pleistocene glaciations
Unglaciated terrain
22.4
Approximate age of regional Late Wisconsinan maximum
0
1000 km
Alaska
Cordilleran Ice Sheet
Laurentide Ice Sheet
Keewatin
Foxe Basin
Ungava
Nouveau Québec
Labrador
Harriman State Park

Twenty Thousand Years

not all that long ago

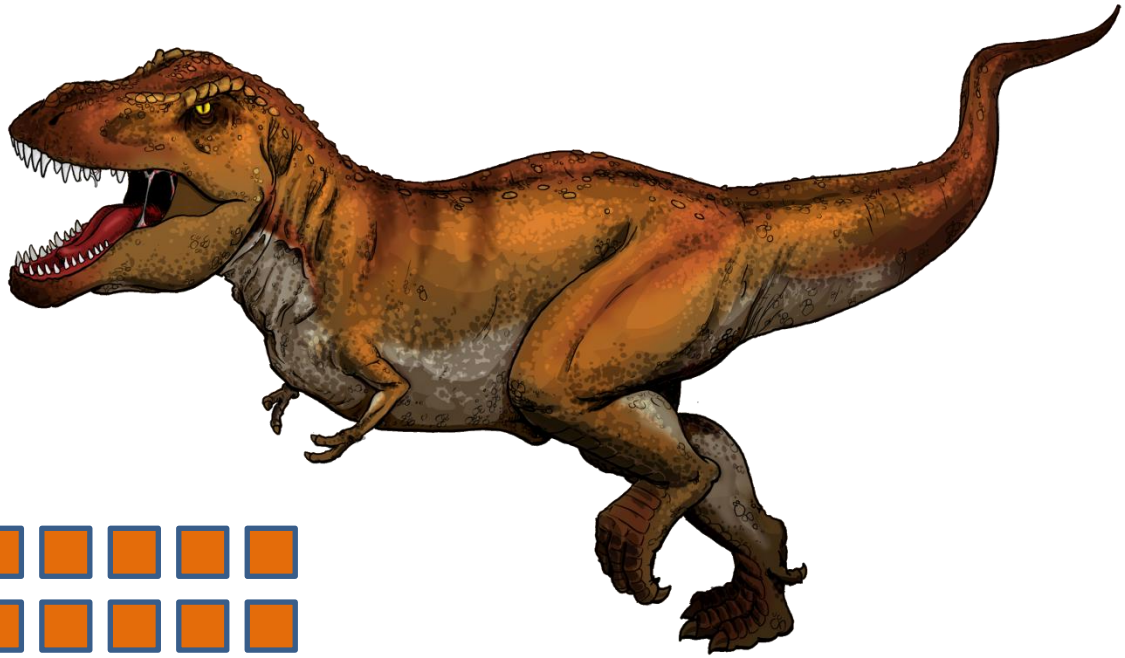


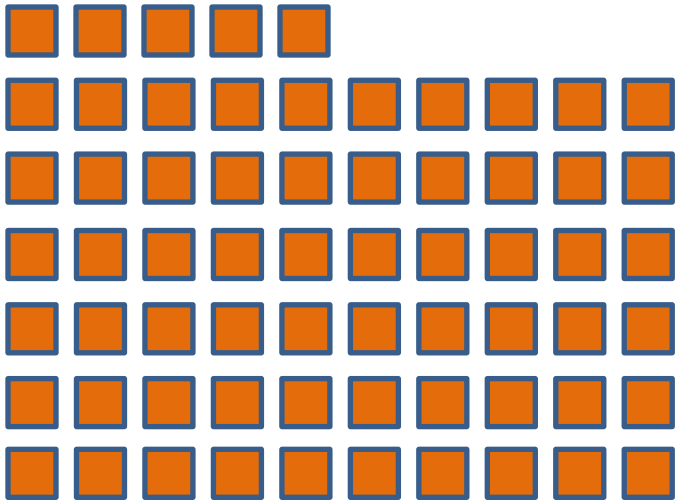
200 pyramids = One Million Years



One Million Years

Death of the Dinosaurs
65 Million Years ago



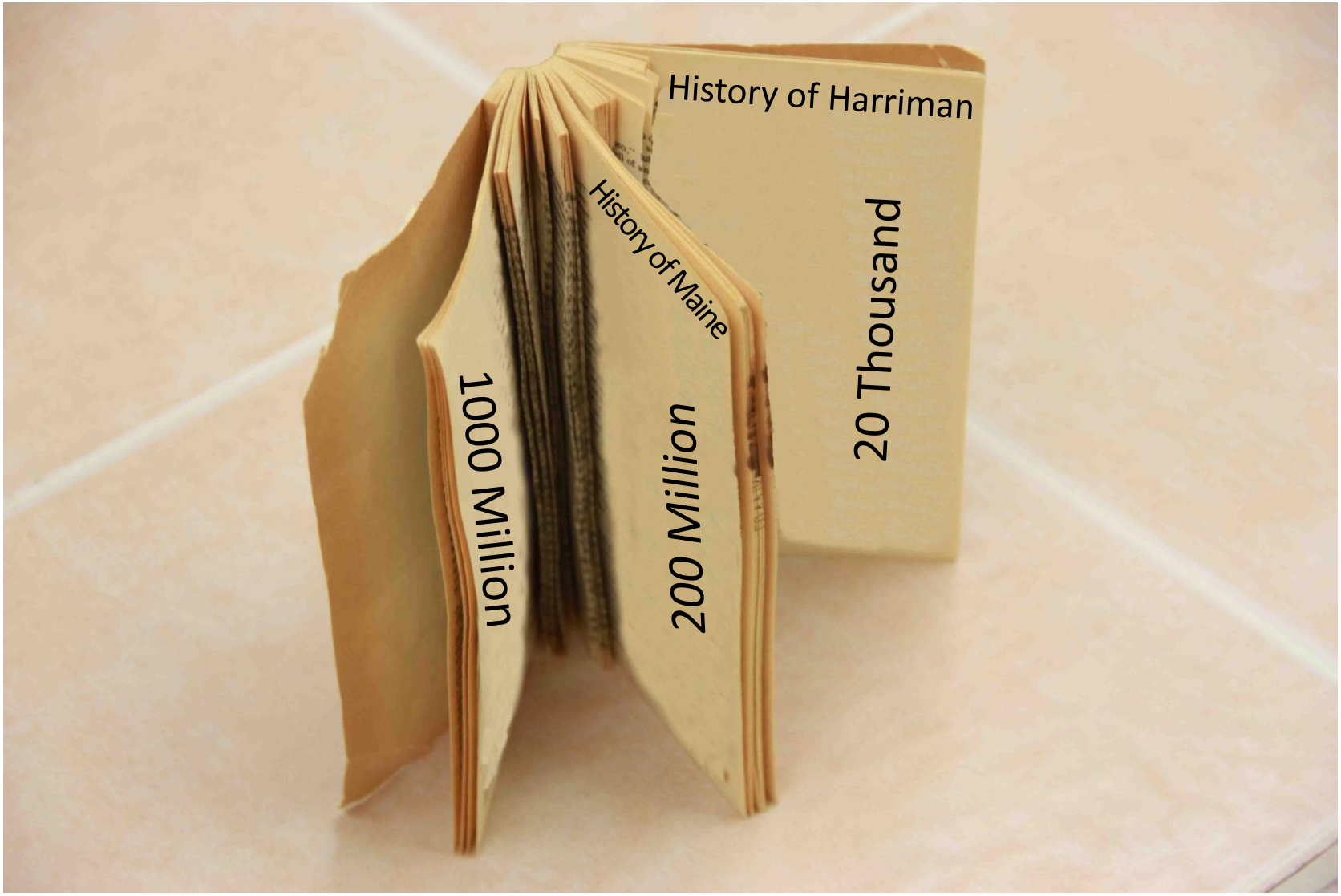


65 boxes of 200 pyramids

Part 2

Rocks tell a Story

but an incomplete story



Erosion

destroys rocks

but also

brings them to the Earth’s surface

Erosion

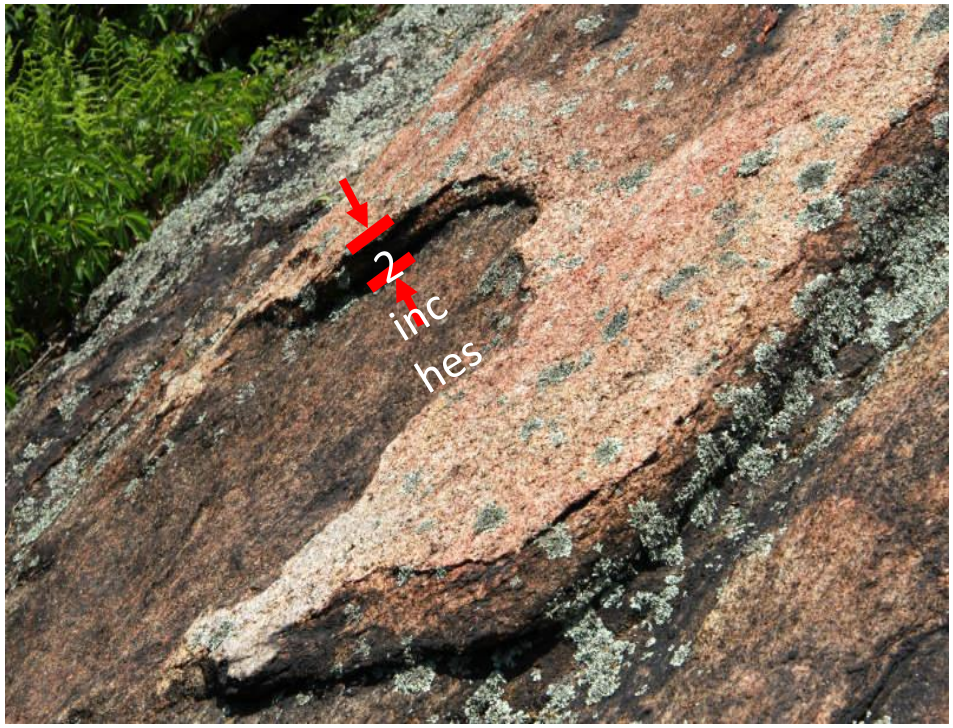
destroys rocks

Bad for Geologists

but also

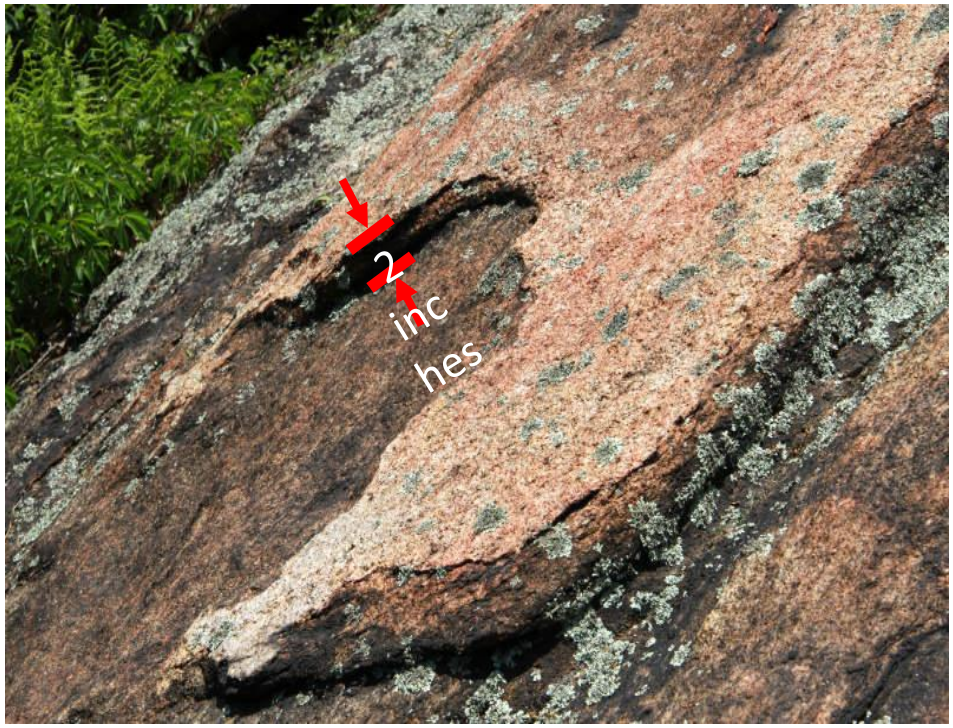
brings them to the Earth's surface

Good for Geologists



2 inches in 20,000 years

40,000 inches in 400 Million Years

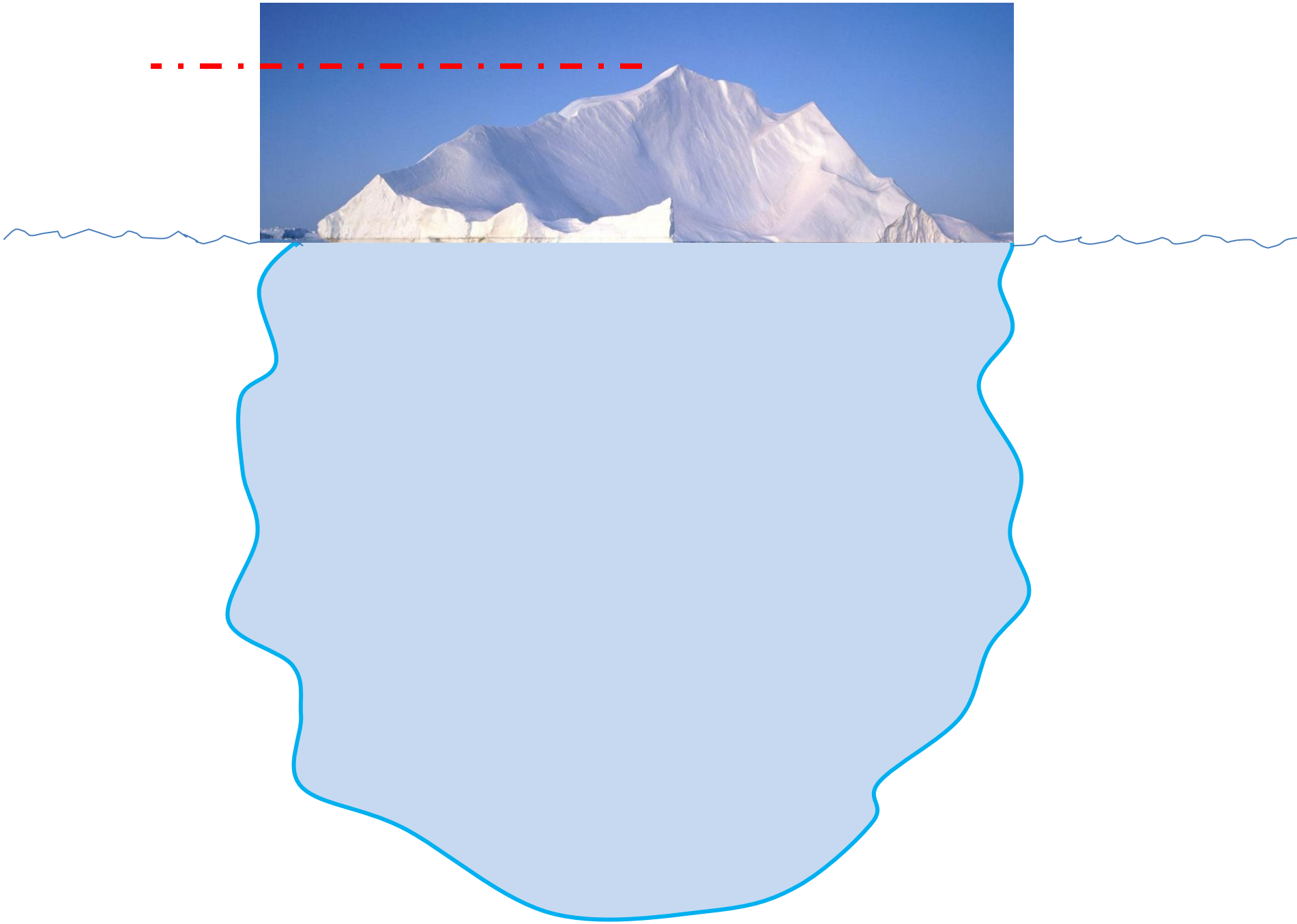


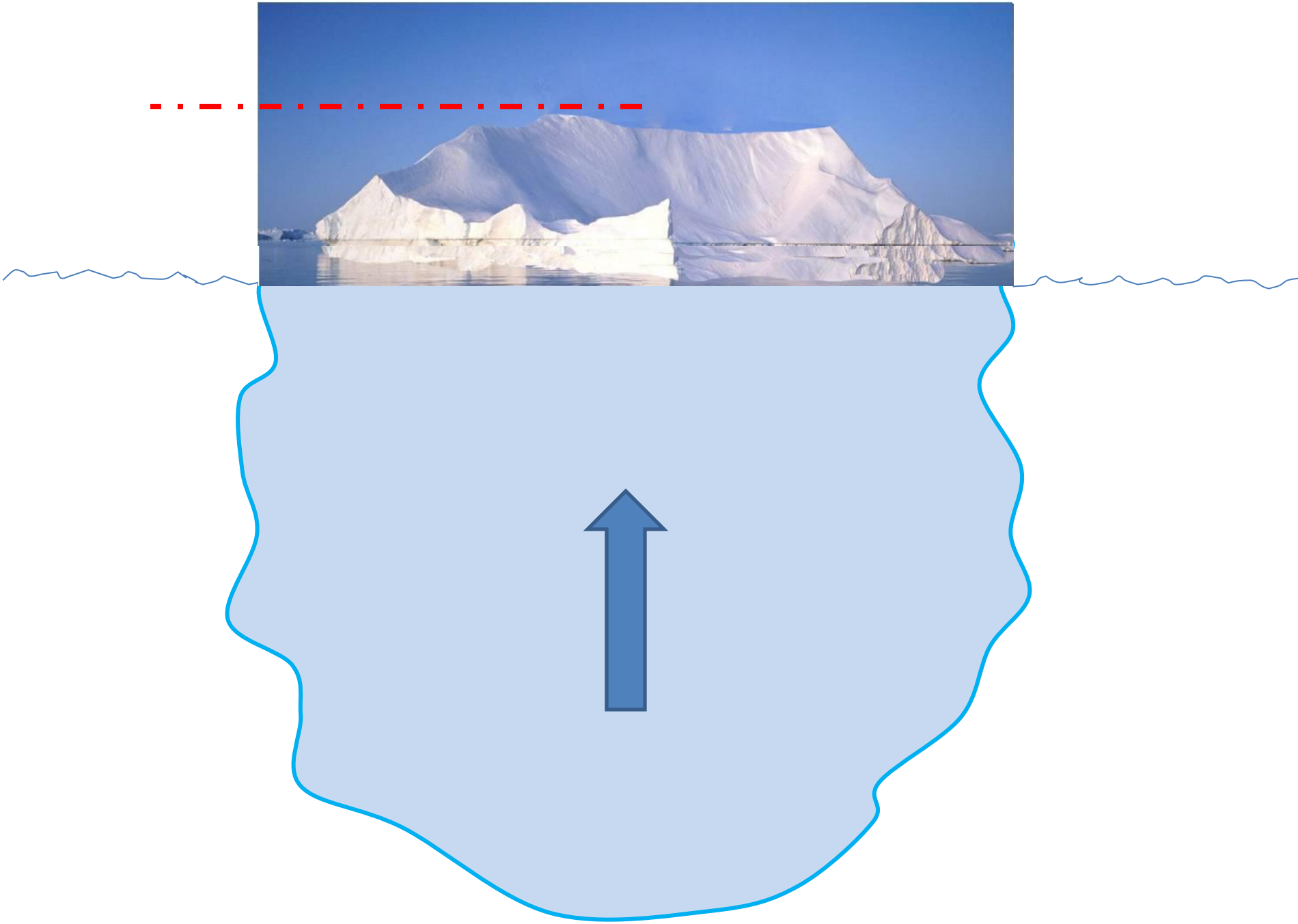
2 inches in 20,000 years

100,000 inches in 1000 Million Years

About a mile and a half !

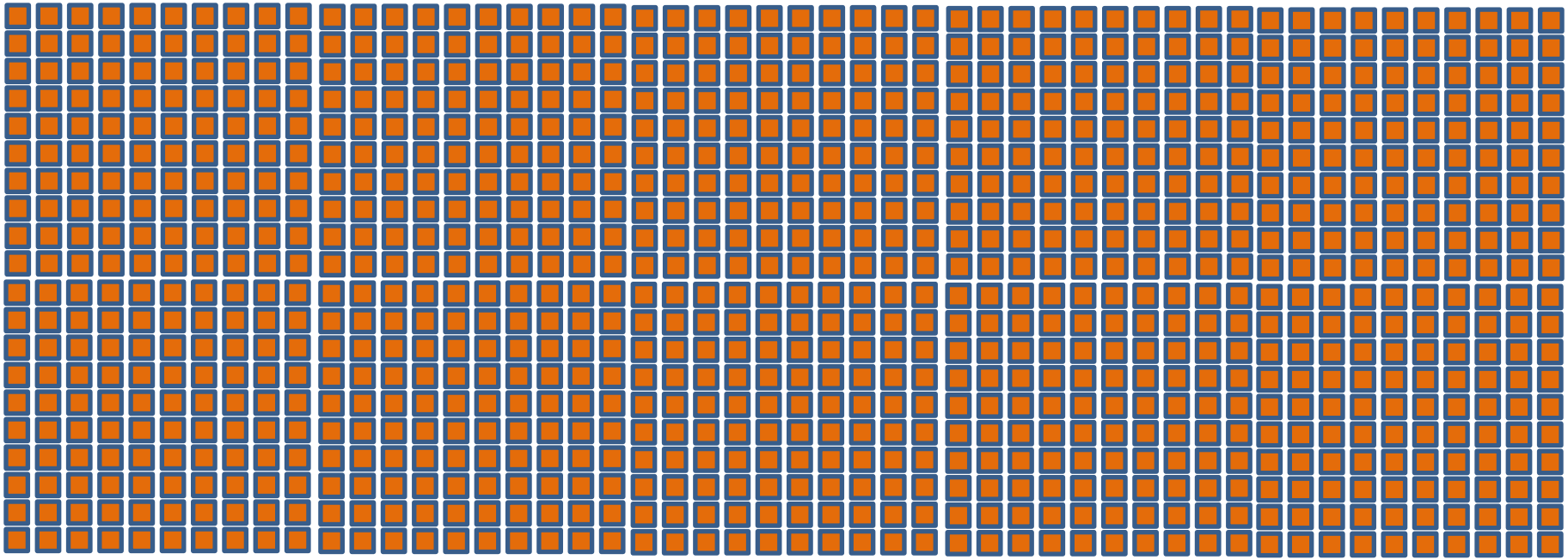
How can you erode a half mile off the land without it being underwater?





Part 3

The Age of Bacteria
(and not much else)
1000 million years ago



Era when most of Harriman Park rocks were formed

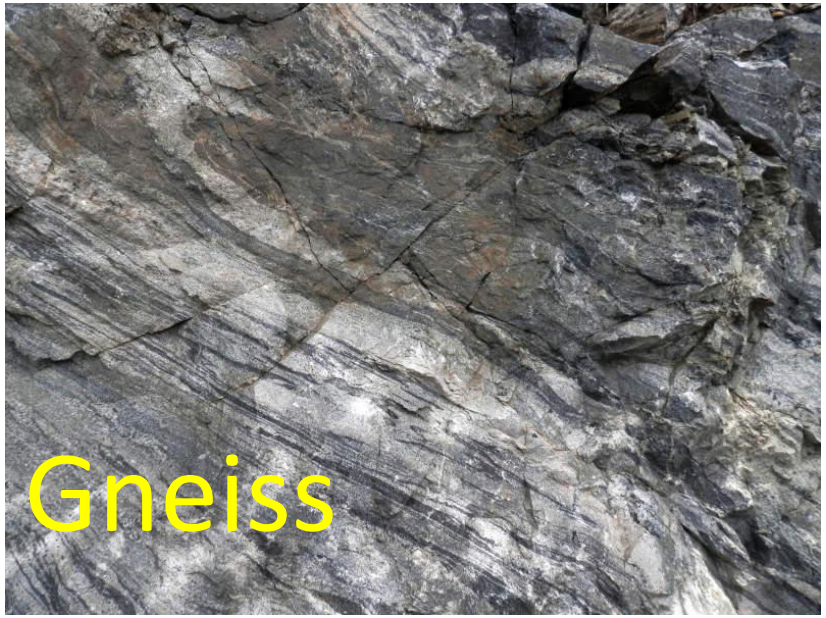
Two major rock types


Gneiss


Granite

A Metamorphic Rock
Banded
Brown or Grey in Color
Layers of sand and clay
Deeply buried and “cooked” (metamorphosed) by heat and pressure

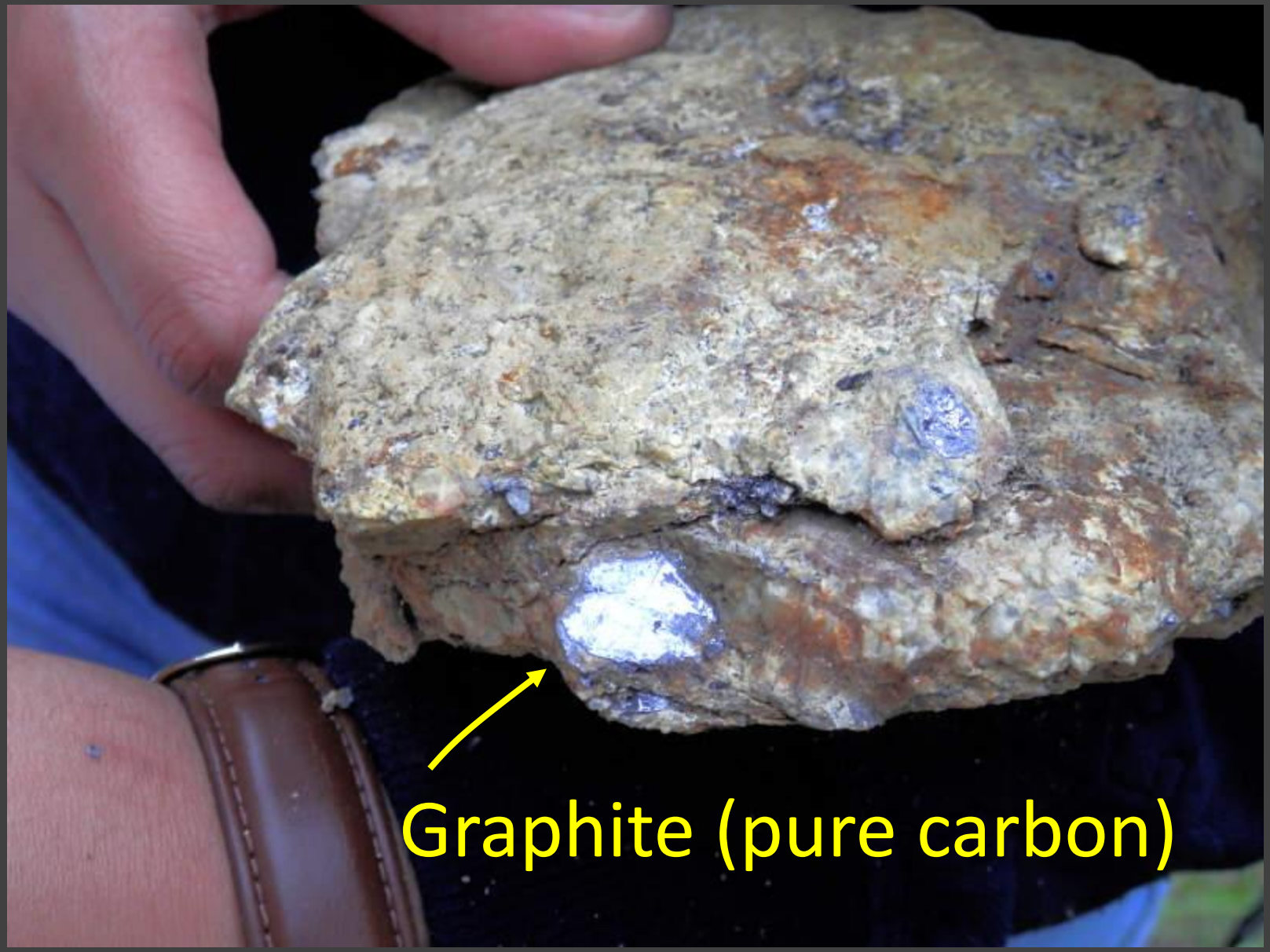
An Igneous Rock
No bands
White or beige in Color
Solidified molten rock
Very hard to erode
so tends to form hilltops
(Bear Mountain,
Popolopen Torne, etc)



Originally layers of sand and clay.

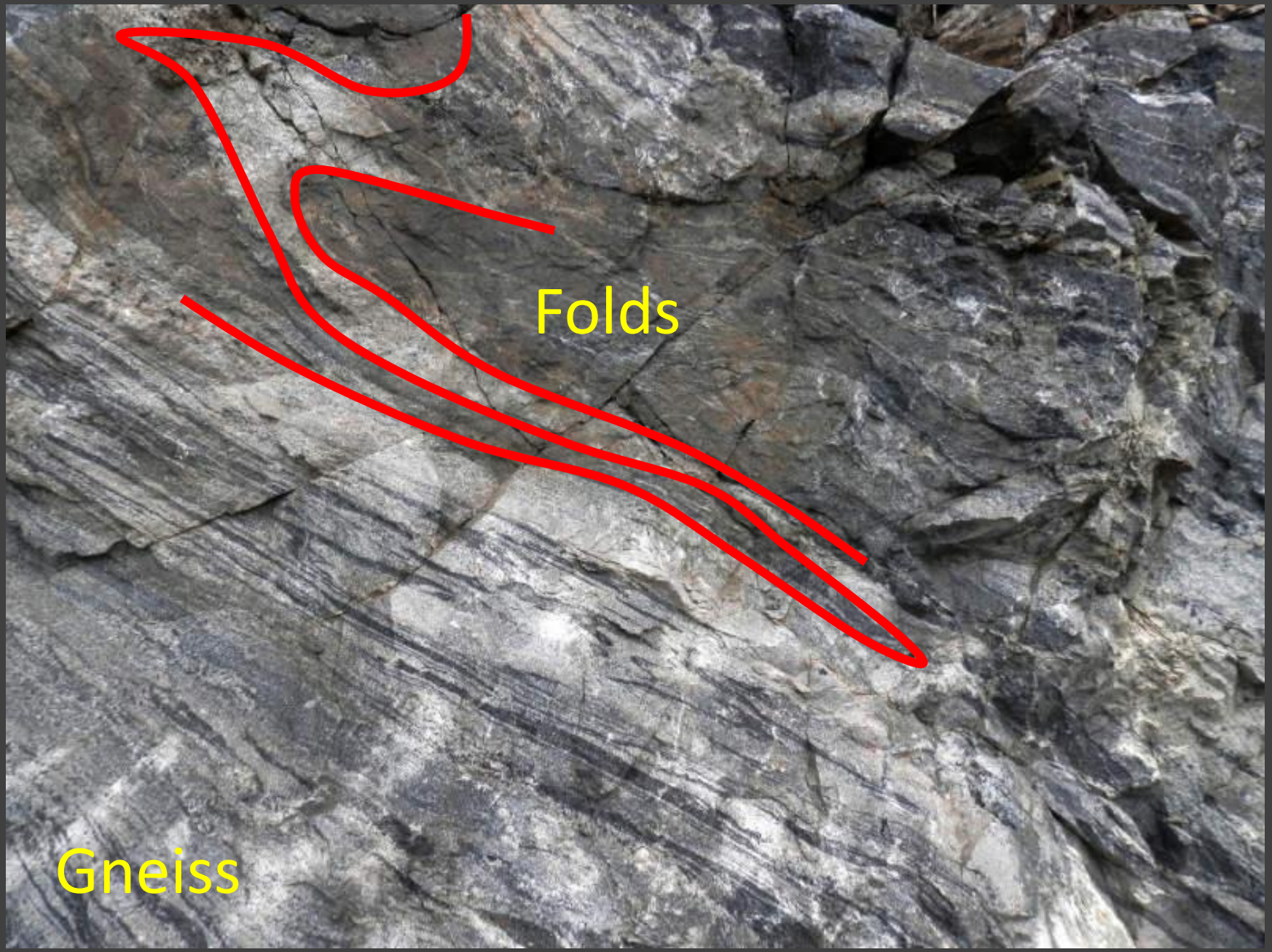
Formed at surface of earth

Might there have been living things?



all that’s left of life


Gneiss


Folds
Gneiss

solid rock …. acting like dough

Needs to be deeply buried

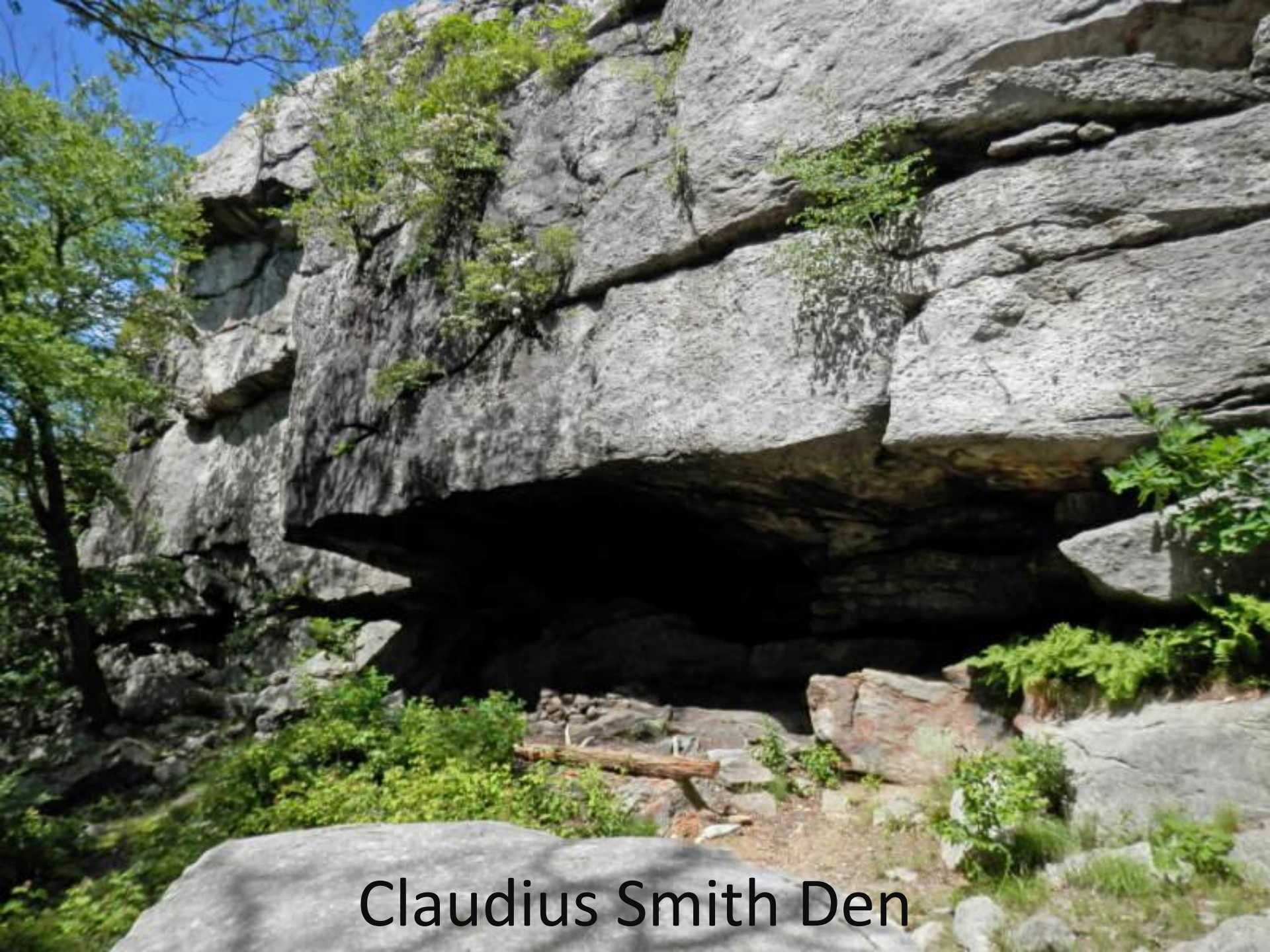
… say 5 miles …

to get hot enough to be metamorphosed and folded

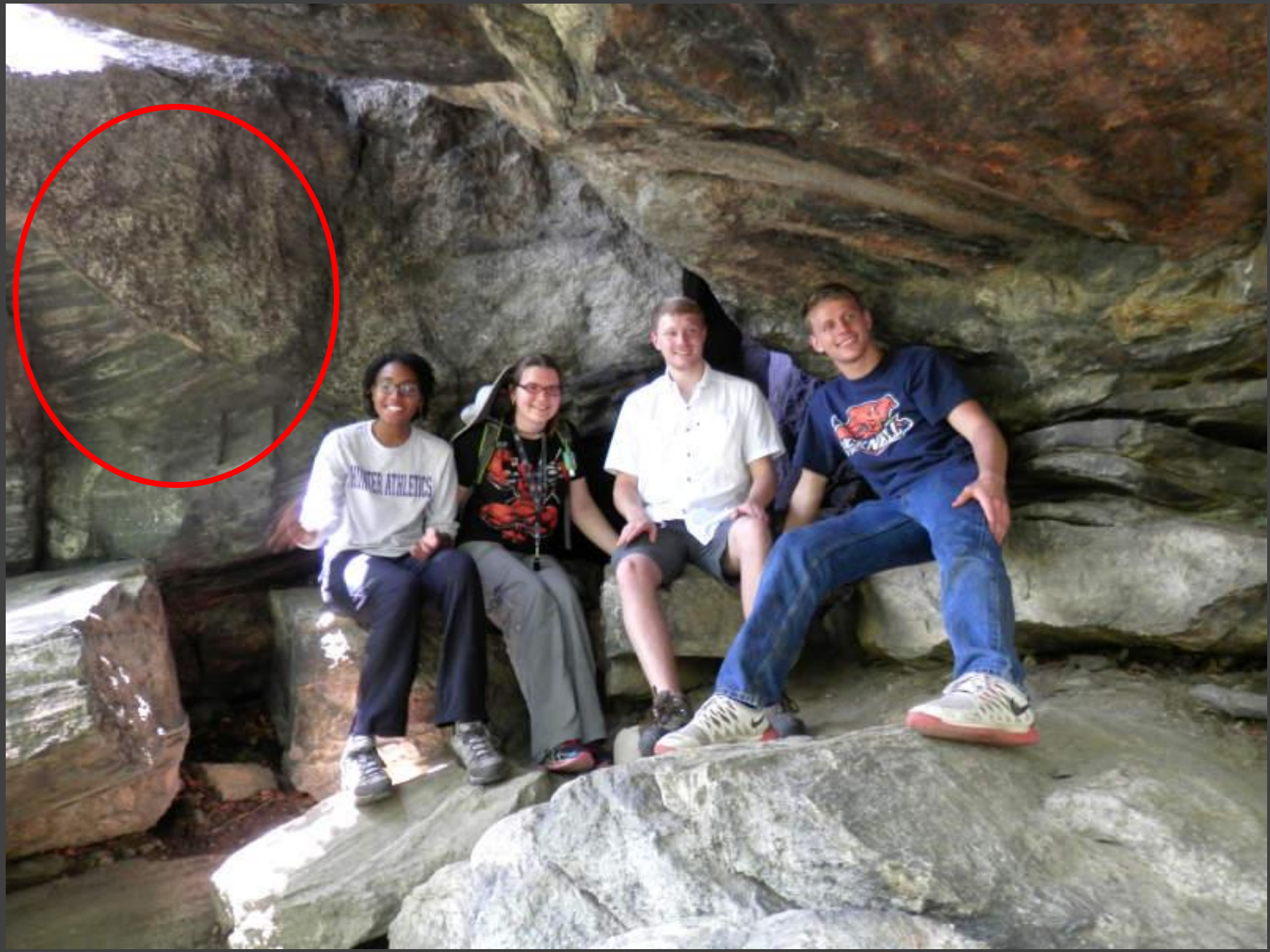
when was it buried?

An Igneous Rock
Very hot conditions
think **volcano**

Which is older?
Gneiss, or
Granite?



Claudius Smith Den



Geological Logic

The granite cuts the gneiss
so the gneiss is the older

furthermore
the fold were already formed
when the granite was
emplaced
so the gneiss was already
deep underground before
the granite was formed

Geologists have been able to determine the age of the granite

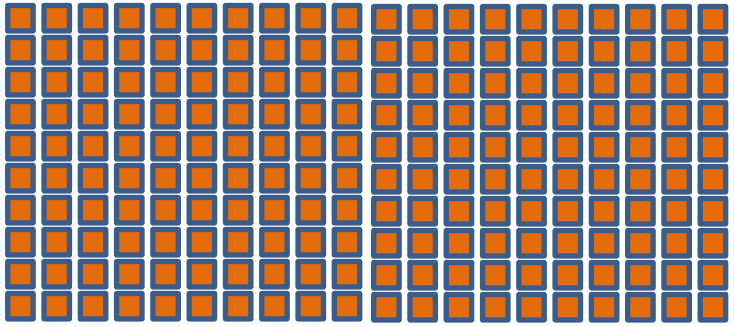
about 1000 million years

so the sediments that formed the gneiss are older than that

Part 4

The Age of Dinosaurs
(and many other animals)

200 Million years ago



Aerial view of Harriman State Park


Lake Tiorati
Lake Welch
Stony Point
Tuxedo Park
ACA
Pomona
Sloatsburg
Map
Traffic
2 mi
2 km
©2011 Google - Imagery ©2011 TerraMetrics - Terms of Use
Report a problem

do you see the lines?

# of hills and valleys?


A
Map
Traffic
2 mi
2 km
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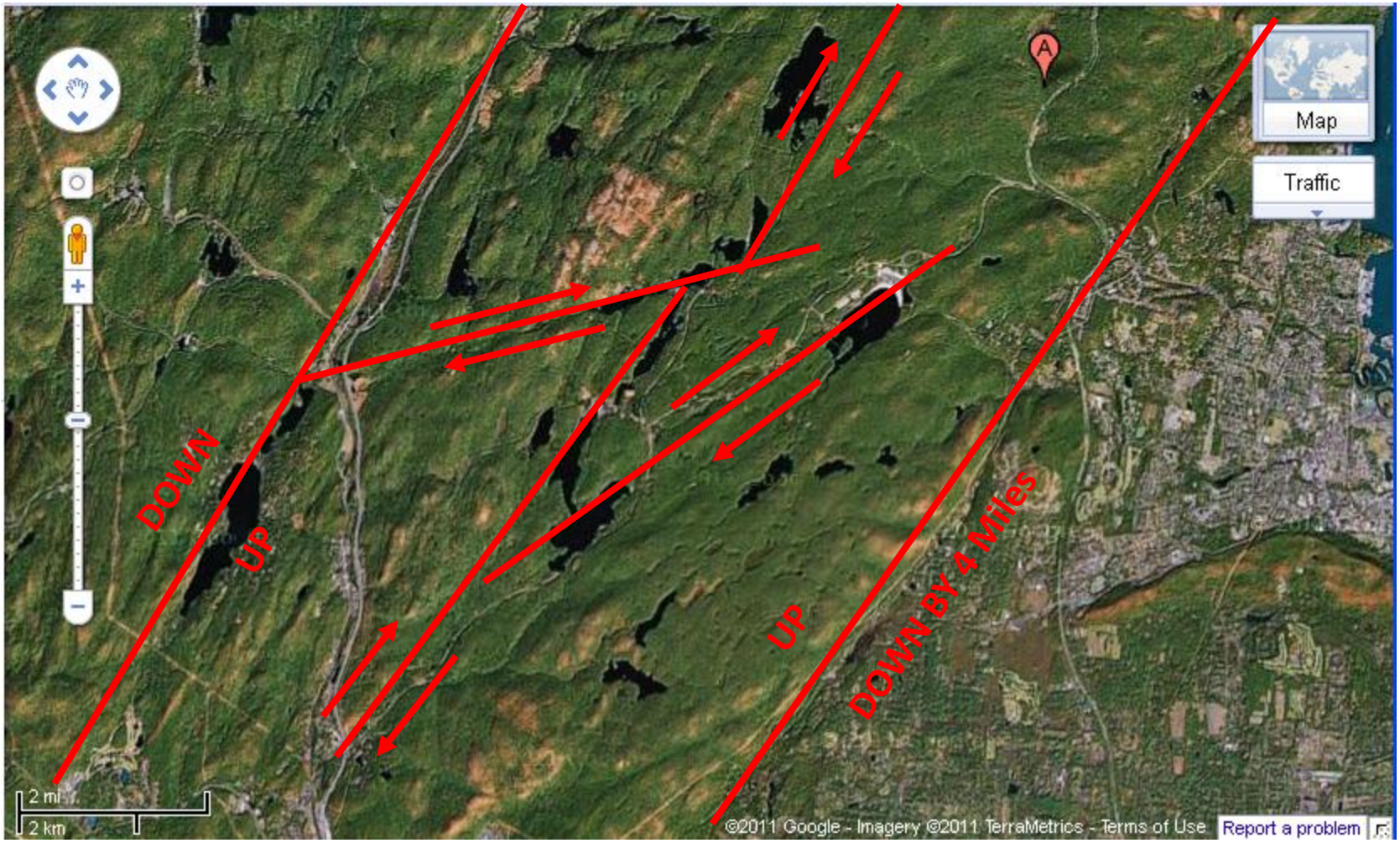
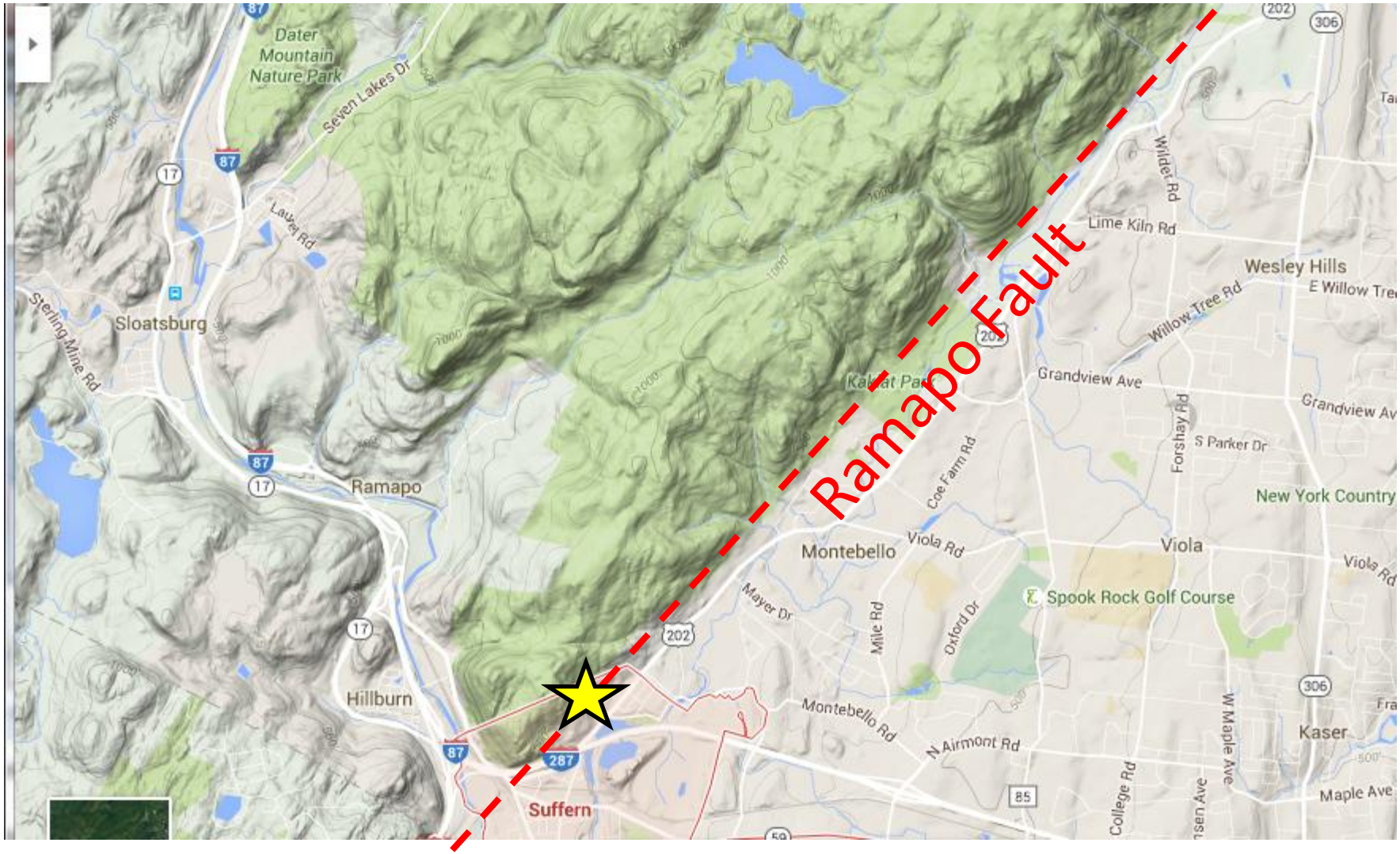
Lines are Geological Faults

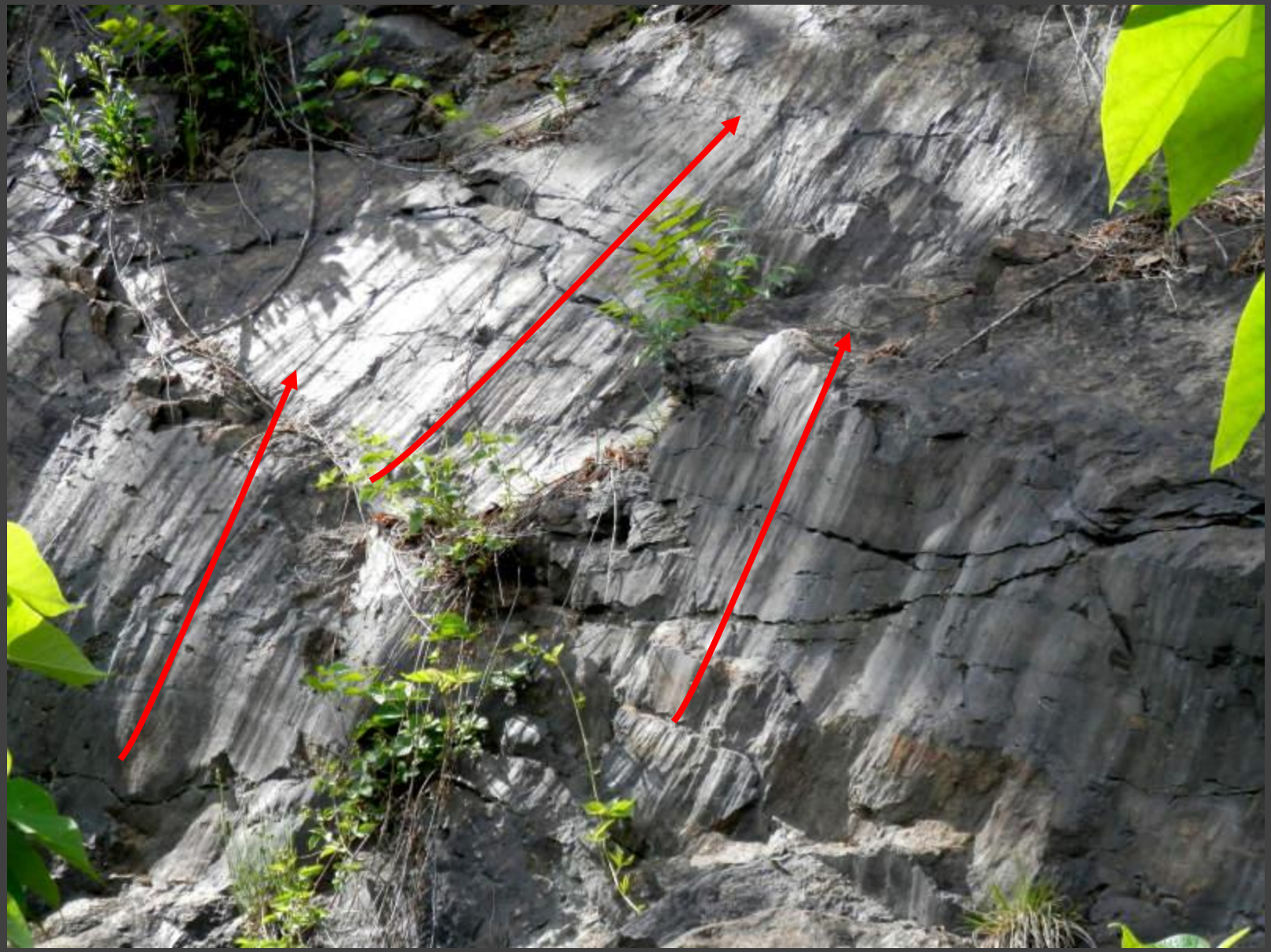
Right-most is the “Ramapo Fault



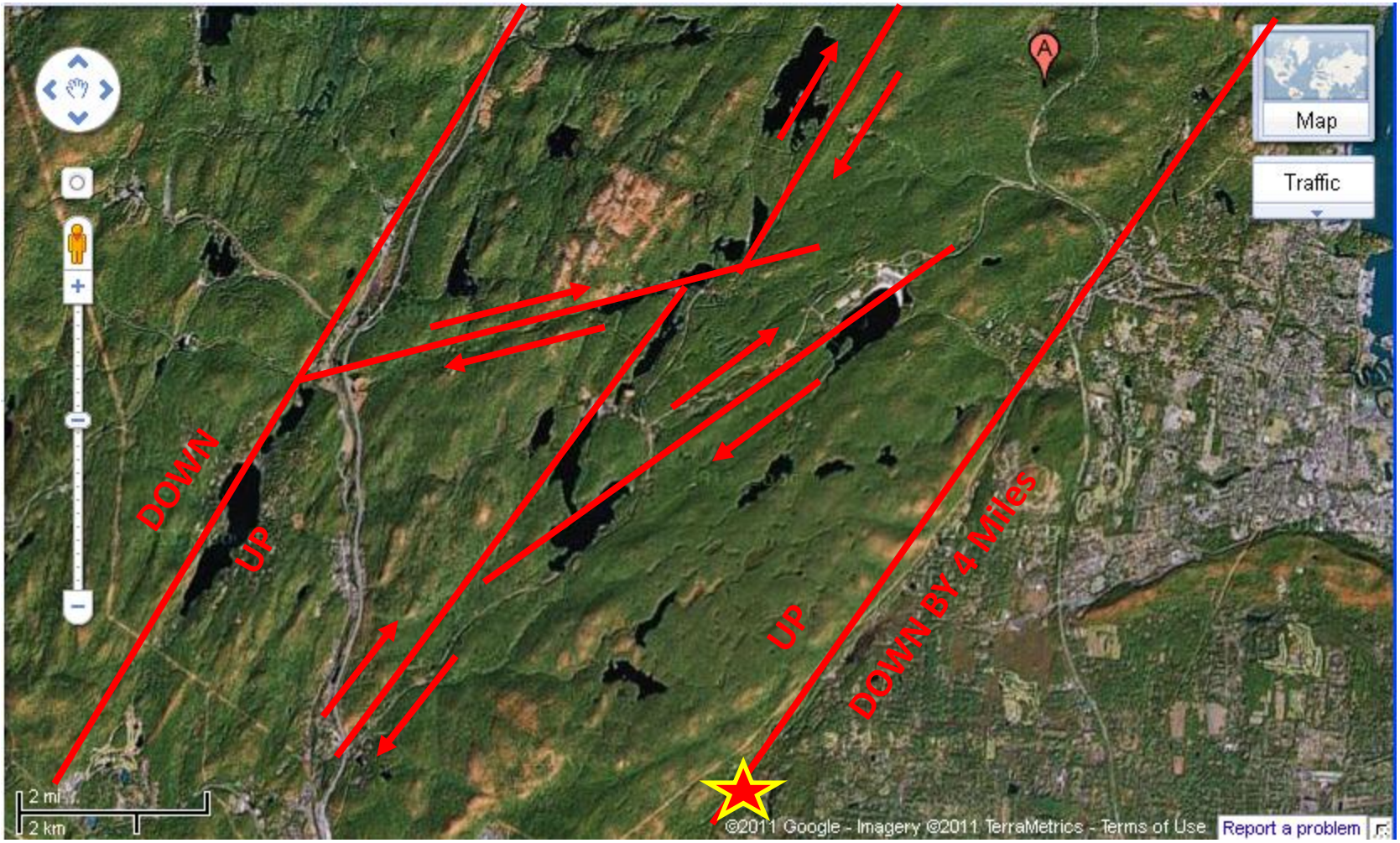
With some effort you can work out the direction the land moved


Ramapo Fault
Dater Mountain Nature Park
Seven Lakes Dr
Sloatsburg
Sterling Mine Rd
Laurel Rd
Ramapo
Hillburn
Suffern
Montebello
Viola Rd
Viola
Spook Rock Golf Course
Mayer Dr
Mile Rd
Oxford Dr
Coe Farm Rd
Forshay Rd
S Parker Dr
Grandview Ave
Wilder Rd
Lime Kiln Rd
Wesley Hills
Willow Tree Rd
New York Country
Montebello Rd
N Airmont Rd
College Rd
W Maple Ave
Maple Ave
Kaser
87
17
287
202
306
85

Slickenslides – grooves from fault motion



When was the faulting?




Boulders in sandstone

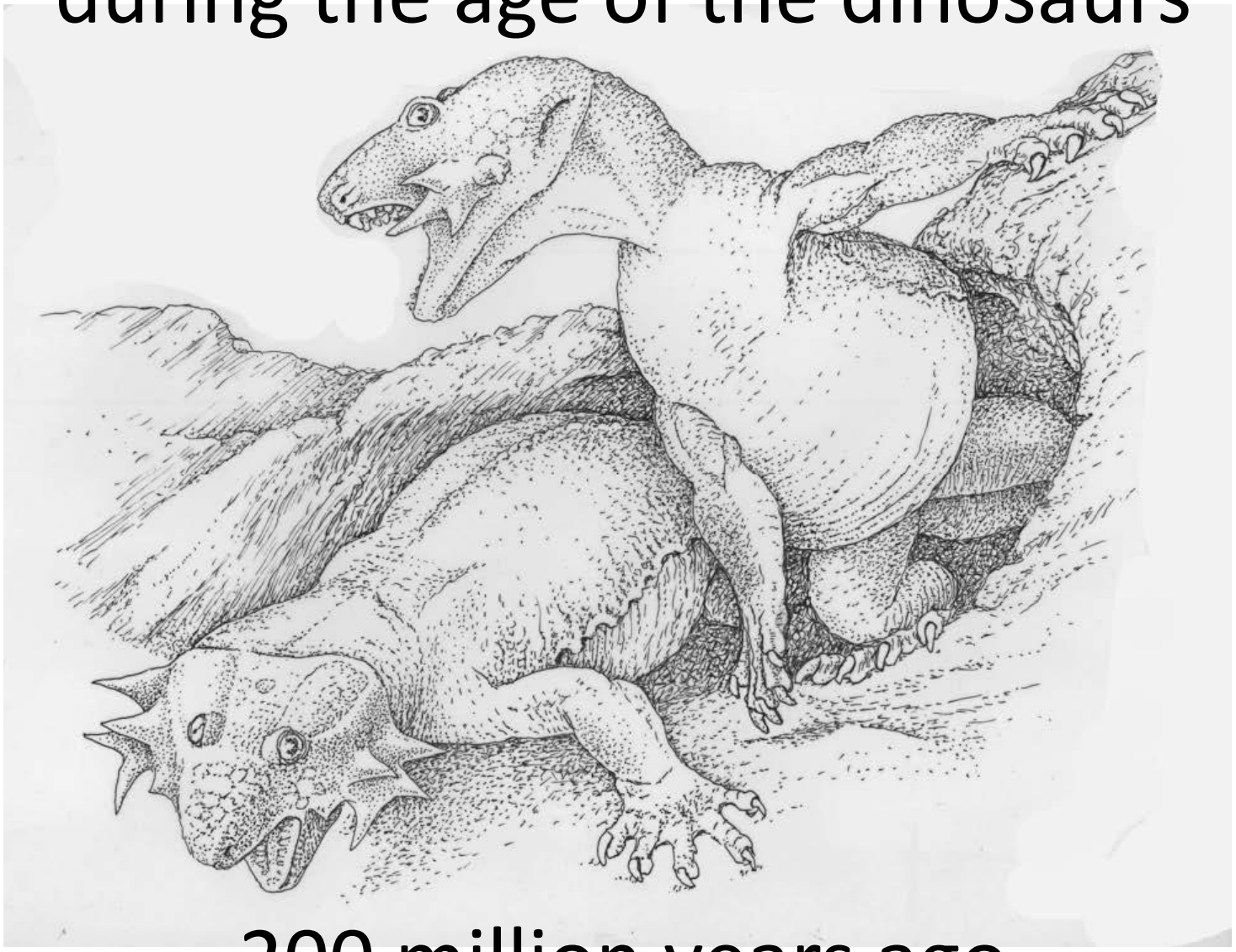
rock debris coming out of a steep stream valley into a low lying area

look what else you find in the sandstones

so the faulting looks to have occurred during the age of the dinosaurs

200 million years ago

so the faulting looks to have occurred during the age of the dinosaurs

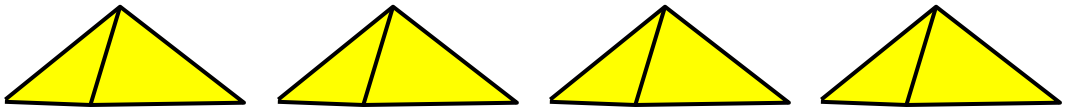


200 million years ago

Part 5

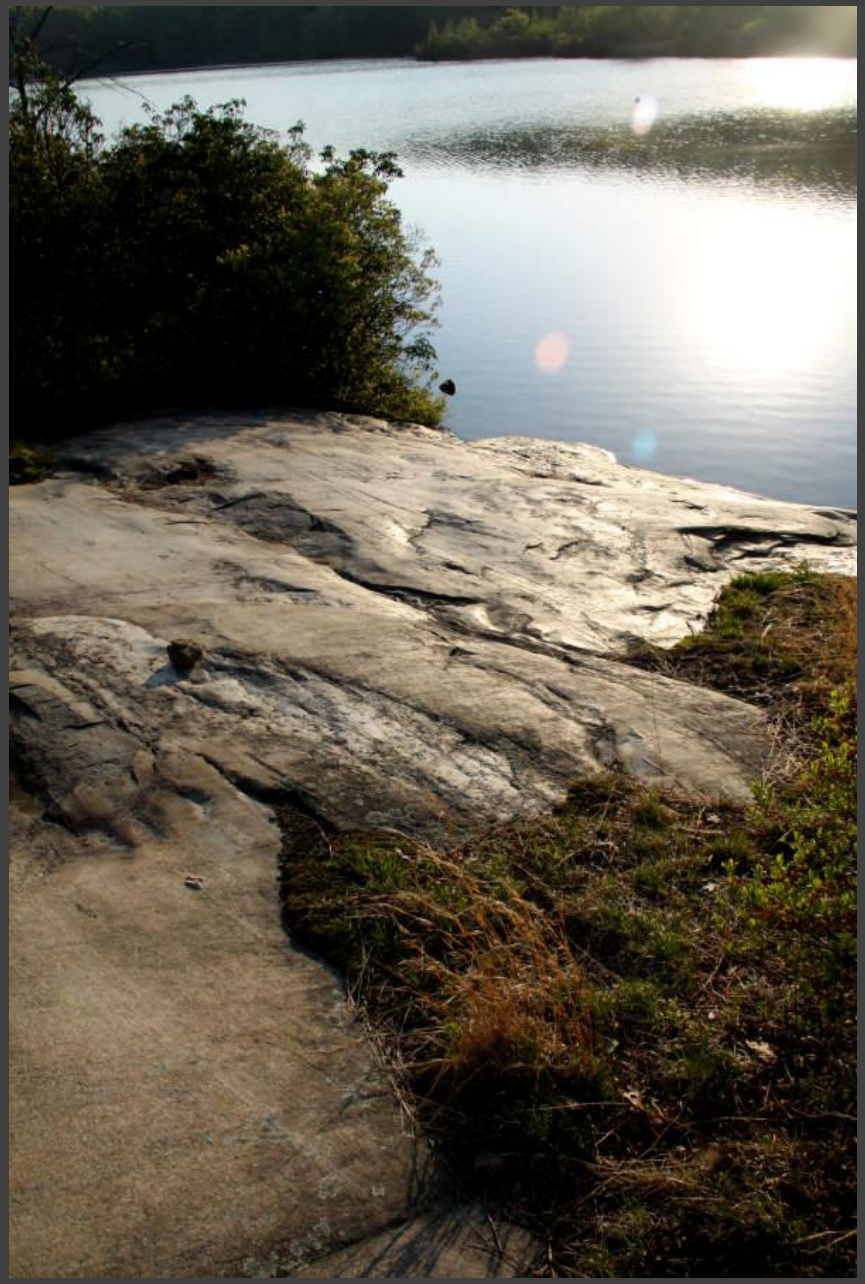
The Ice Age

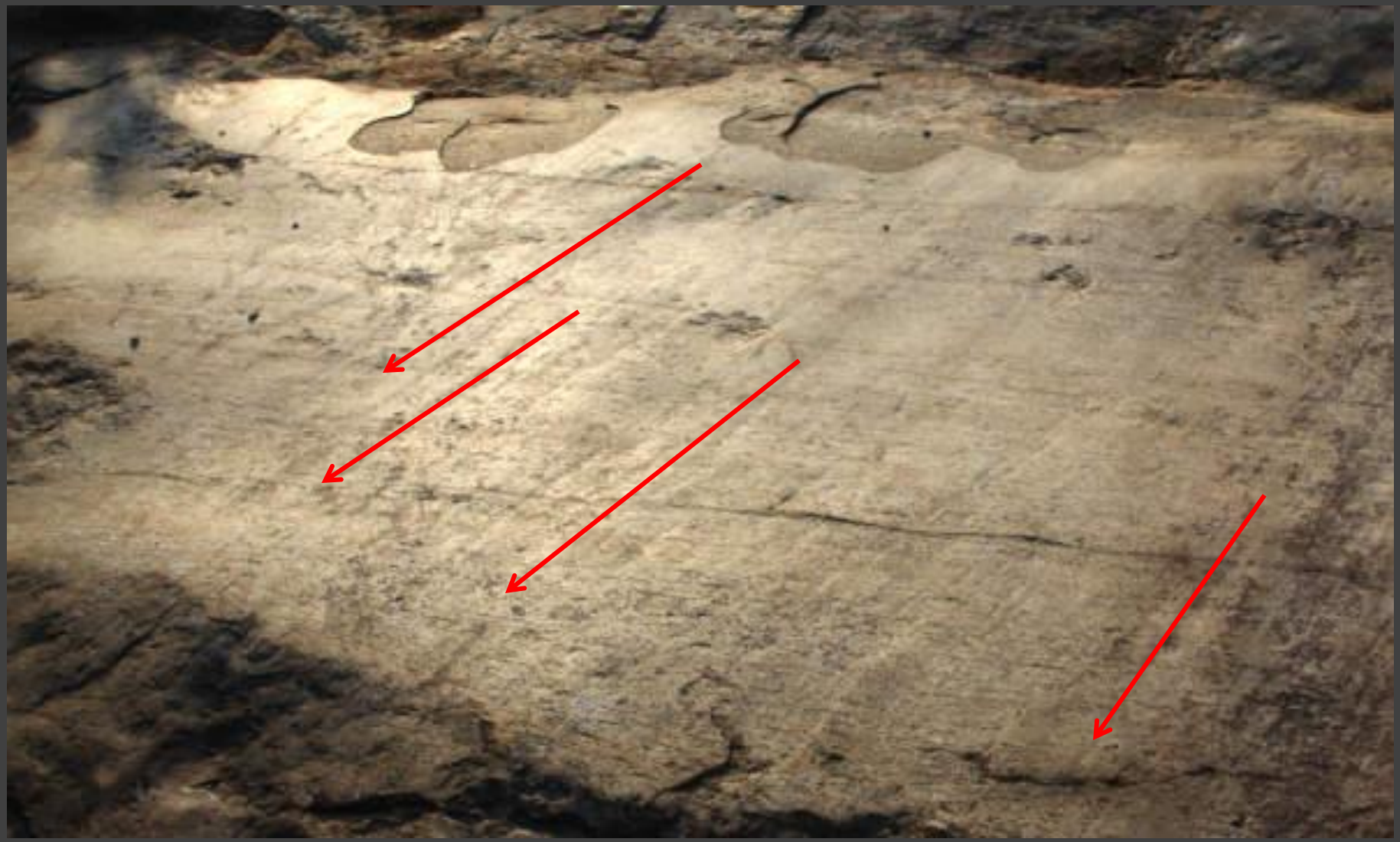
which ended
20,000 years ago



Glacier in Iceland

Glacial scratches



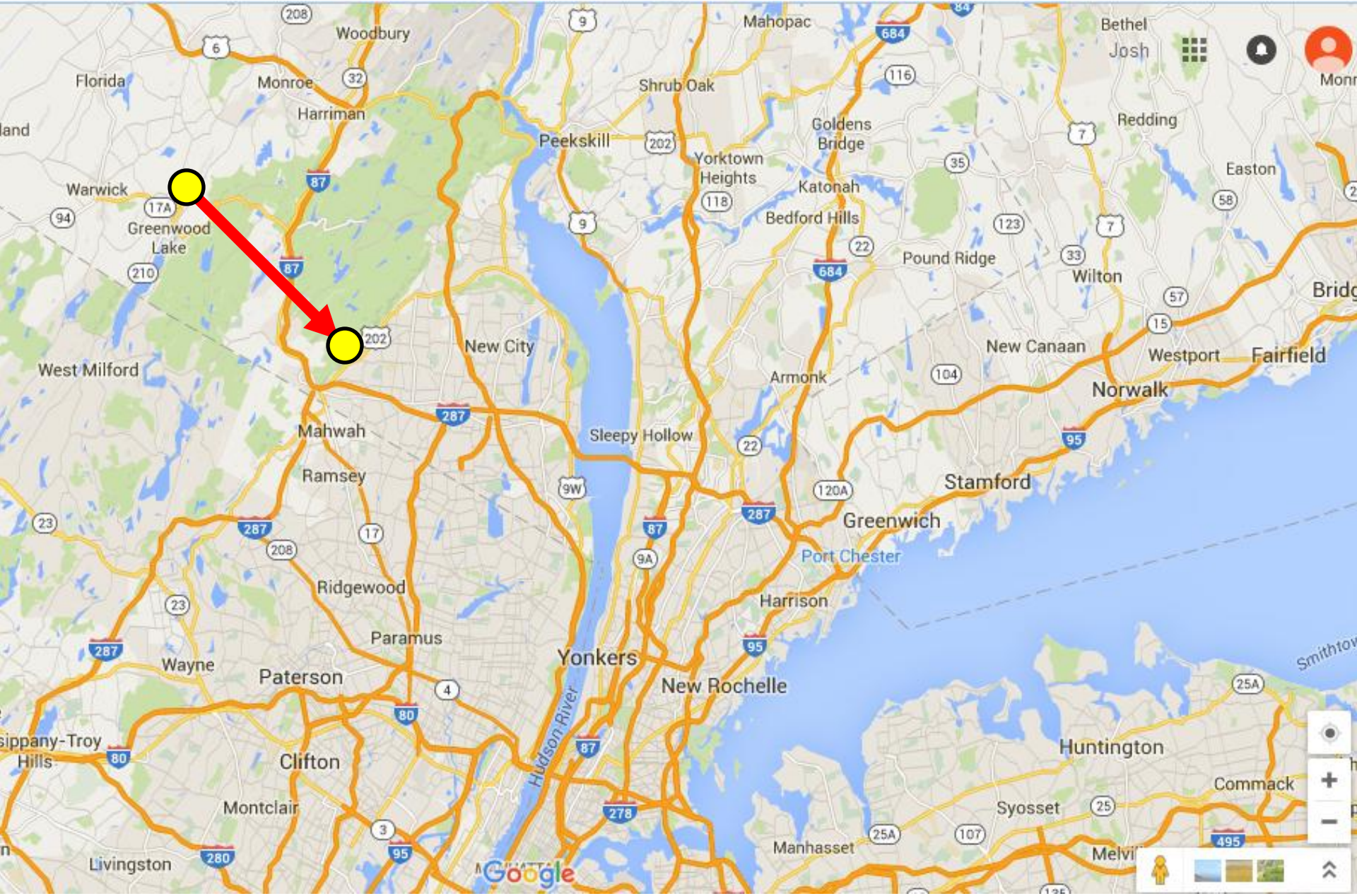


Erratic Boulders


Harriman State Park

Do you recognize this rock?

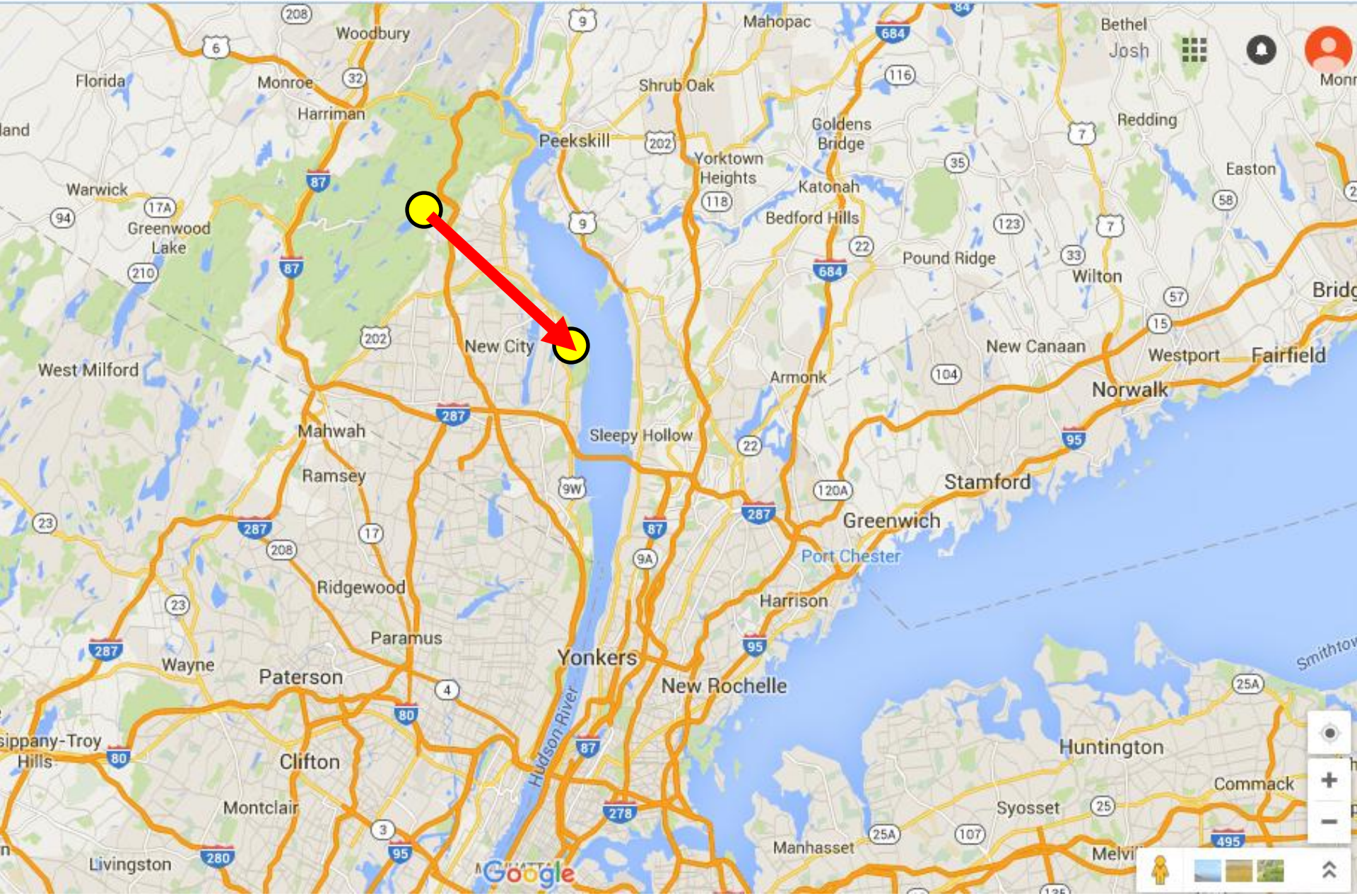
Bearford Mountain


Woodbury
Florida
Monroe
Harriman
Warwick
Greenwood Lake
West Milford
Mahwah
Ramsey
Ridgewood
Paramus
Wayne
Paterson
Clifton
Montclair
Livingston
Peekskill
Shrub Oak
Yorktown Heights
Goldens Bridge
Katonah
Bedford Hills
Pound Ridge
Wilton
New City
Sleepy Hollow
Armonk
New Canaan
Westport
Fairfield
Norwalk
Stamford
Greenwich
Port Chester
Harrison
Yonkers
New Rochelle
Hudson River
Mahopac
Bethel
Redding
Easton
Huntington
Commack
Syosset
Manhasset
Google

Little Tor

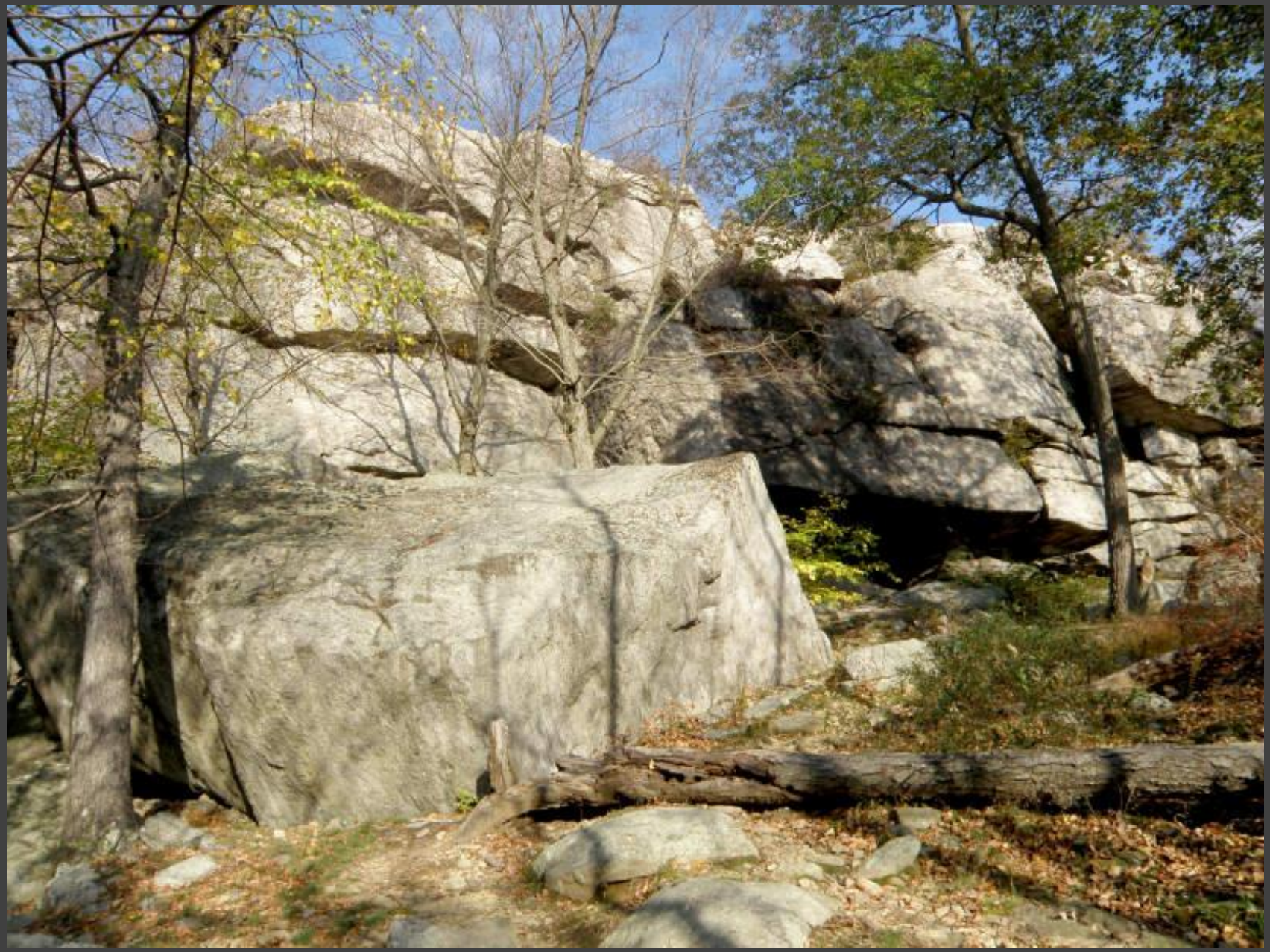
Little Tor

Harriman Park as seen from Little Tor


Woodbury
Florida
Monroe
Harriman
Warwick
Greenwood Lake
West Milford
Mahwah
Ramsey
Ridgewood
Paramus
Wayne
Paterson
Clifton
Montclair
Livingston
Peekskill
Shrub Oak
Yorktown Heights
Mahopac
Goldens Bridge
Katonah
Bedford Hills
Pound Ridge
Wilton
Redding
Bethel
Josh
Easton
New City
Sleepy Hollow
Armonk
New Canaan
Westport
Fairfield
Norwalk
Stamford
Greenwich
Port Chester
Harrison
Yonkers
New Rochelle
Hudson River
Huntington
Commack
Syosset
Manhasset
Google

Glacially Plucked Cliff

Glacier in Iceland



Claudius Smith Den

Pine Meadow Lake

The Kitchen Stairs

So when you walk around the Park …

Listen to the Story told by the Rocks!

and great talking with you!

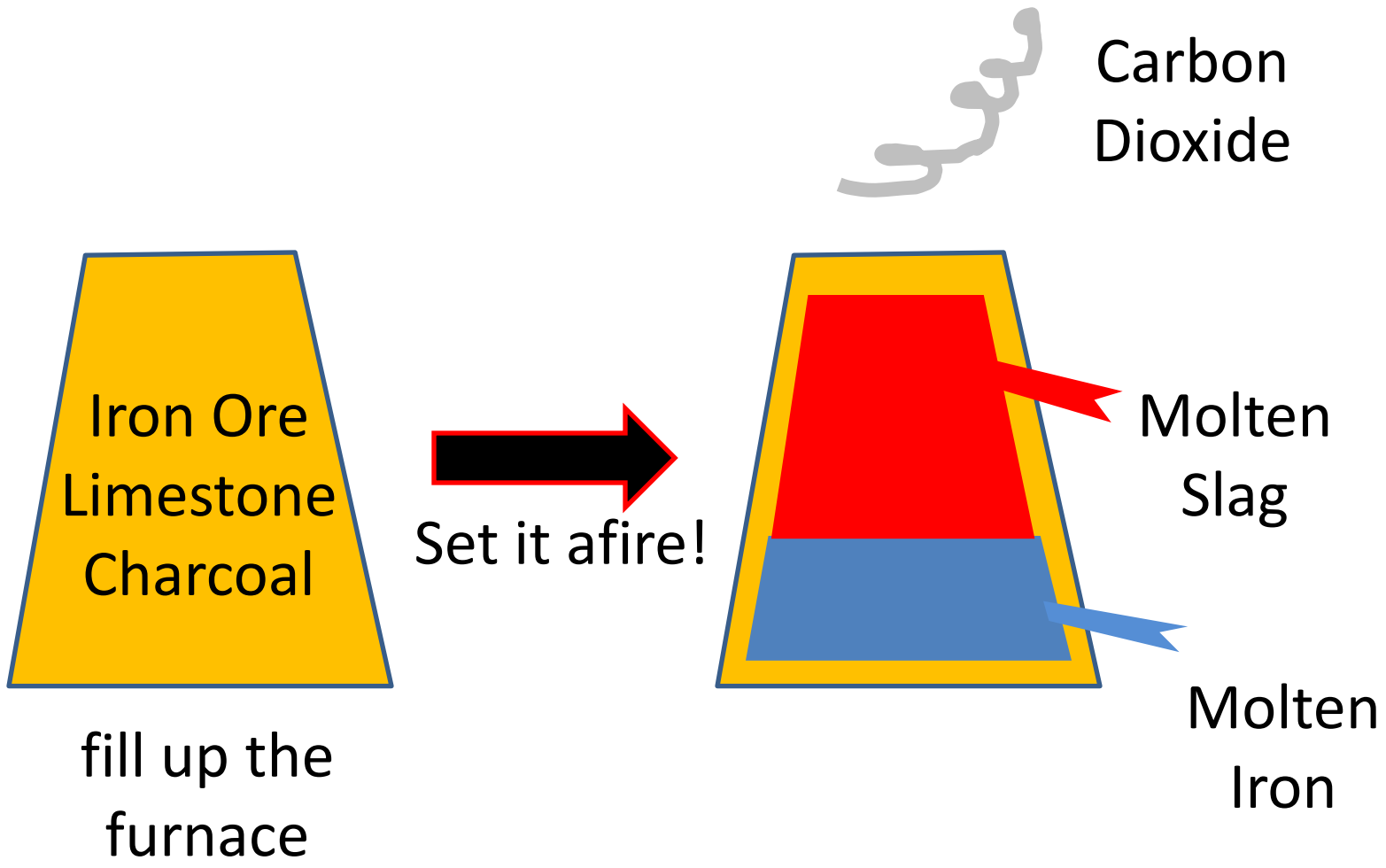
Addendum

There’s gold in them there hills!

Addendum

There’s ~~gold~~ **iron** in them there hills!

Southfield Iron Furnace


Carbon Dioxide
Iron Ore
Limestone
Charcoal
Set it afire!
Molten Slag
Molten Iron
fill up the furnace

Hudson River Chain, Revoutionary War

Magnetite (Iron Ore)

The magnetite
occurs in small veins
usually near the granites

geologists are not sure
why it formed

Slag (waste product of refining process)

Tailings Pile of Black Ash Mine

Black Ash Mine