Today

1) Quiz- Vocabulary Chapter 17 and Review Chapter 8

2) iclicker review of last week

3) Glaciers and Ice Ages Lecture

4) Inconvenient Truth excerpt/ Chasing Ice Video

Nov. 27	**THANKSGIVING BREAK BEGINS**
Dec. 4.	QUIZ: Chapter 8 Review – Chapters 17 Vocabulary Chapter 17: Glaciers and Ice Ages
Dec. 11	QUIZ: Chapter 17 Review – Chapter 19 Vocabulary Chapter 19: Shores and Coastal Processes
Dec. 18 **6:00-8:00 pm**	**Exam III **VERY IMPORTANT**** Final exam start ON THE HOUR, not 10 minutes after. You may have the full 2hrs ONLY if you show up on time. If you show up late, you must be done by the time the last person who showed up on time is.

Current State of the Syllabus

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b) Summary Video +Final Review

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a) Costal erosion New Material
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Extra Credit Due Next Wednesday
No Partial Credit-Must Be Correct
Worth 10% bump to second Mid-term score

Which unconformity is depicted here?

A: Disconformity B: Angular unconformity

C: Nonconformity

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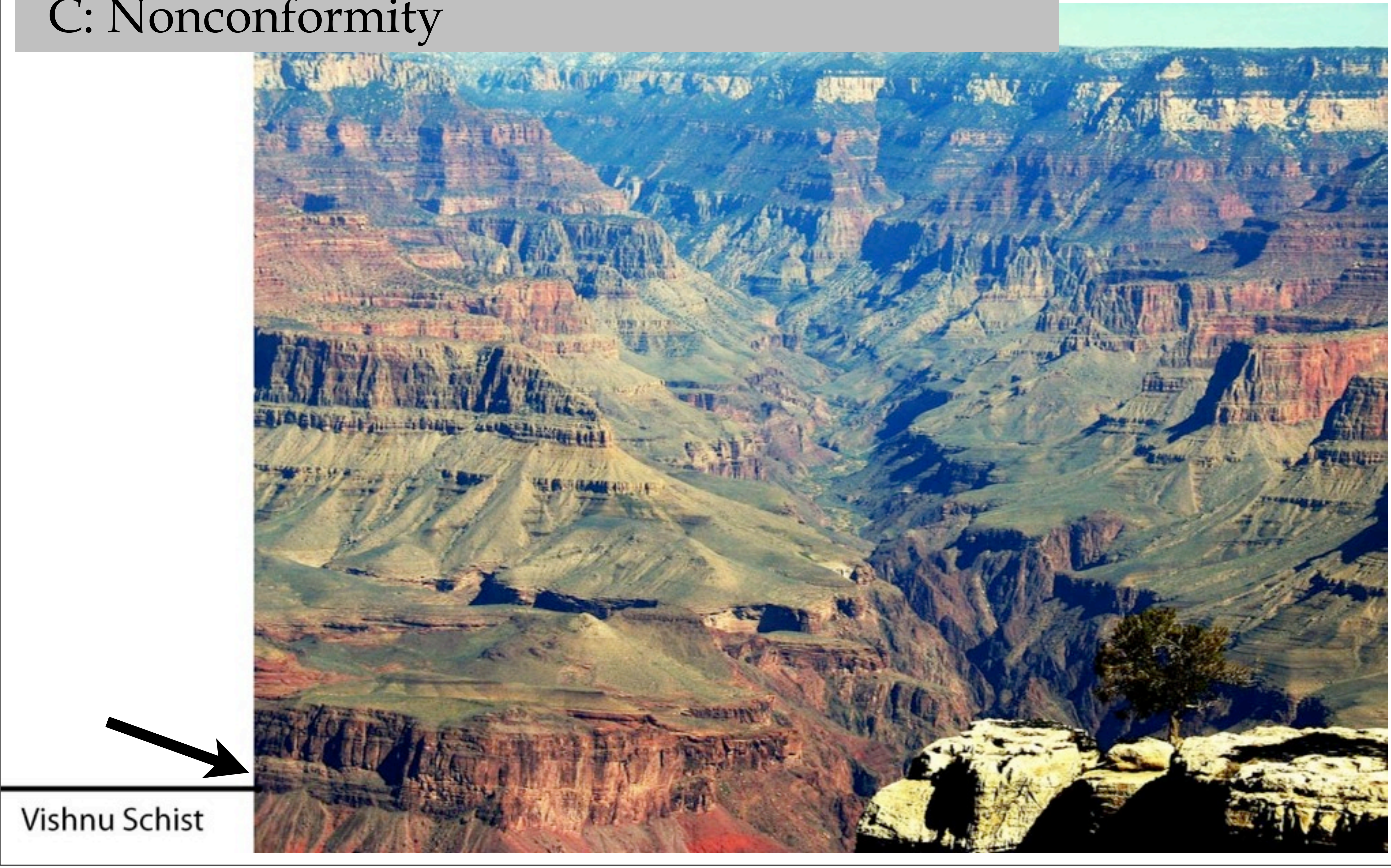

The photograph below shows a section of the Grand Canyon stratigraphy discussed last week. How many distinct compositional layers (e.g., sandstone, limestone, shale, conglomerate) of sedimentary rock <u>overlie</u> the prominent cliff that composes most of this photograph?

(A) 1

(B) 2

(C) 3

(D) 4

(E) Can’t be determined from this photograph

The photograph below shows a section of the Grand Canyon stratigraphy discussed last week. How many distinct compositional layers (e.g., sandstone, limestone, shale, conglomerate) of sedimentary rock <u>overlie</u> the prominent cliff that composes most of this photograph?

(A) 1

(B) 2

(C) 3

(D) 4

(E) Can't be determined from this photograph

This photograph shows the upper three sedimentary formations of the Grand Canyon. Which of the following is <u>not true</u>.

(A)The lower prominent cliff at the base is likely composed of Sandstone or limestone.

(B)The middle formation is likely composed of Sandstone or limestone.

(C) The upper formation is likely composed of Sandstone or limestone.

(D) Both A and B

(E) Both B and C

This photograph shows the upper three sedimentary formations of the Grand Canyon. Which of the following is <u>not true</u>.

(A)The lower prominent cliff at the base is likely composed of Sandstone or limestone.

(B)The middle formation is likely composed of Sandstone or limestone.

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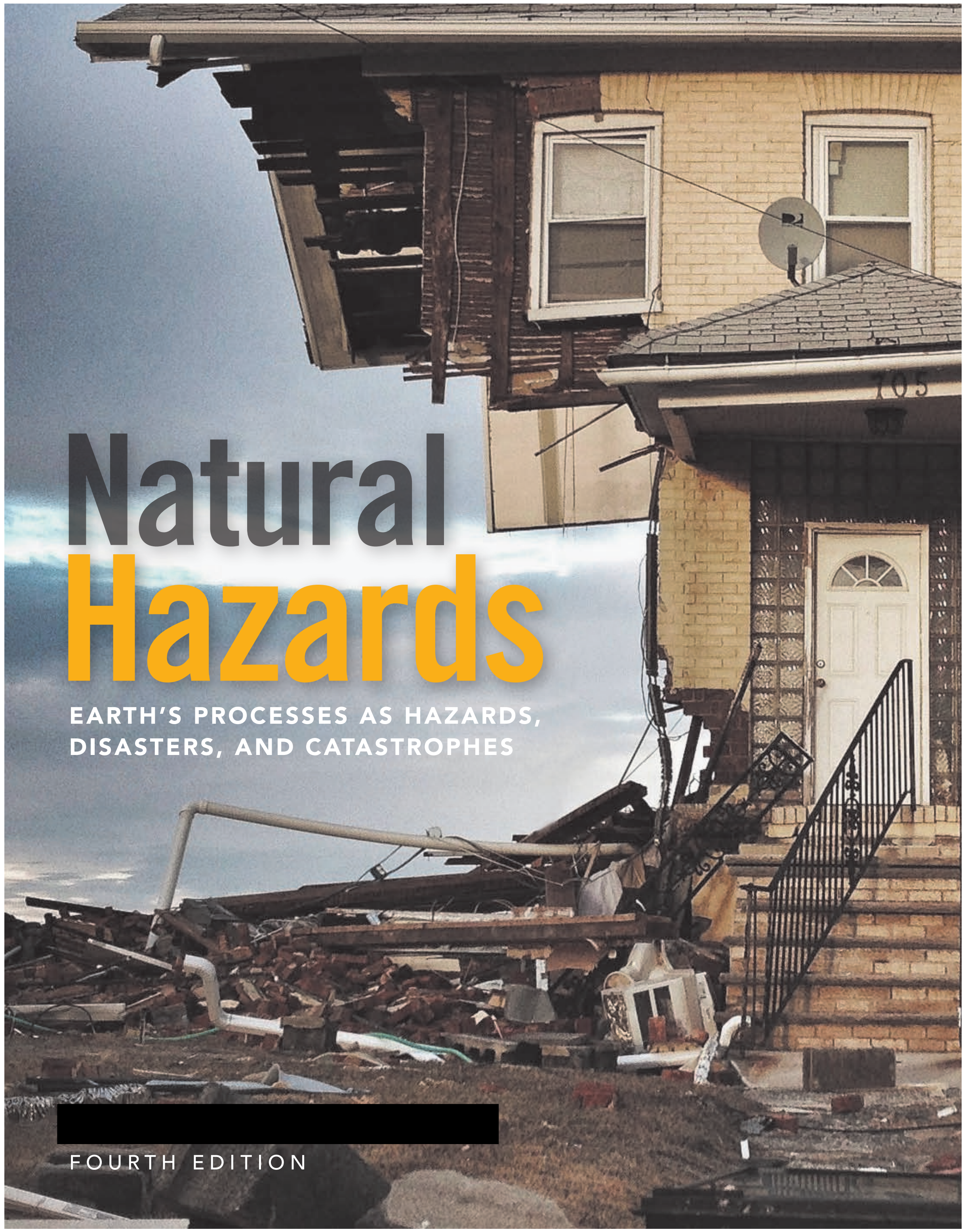
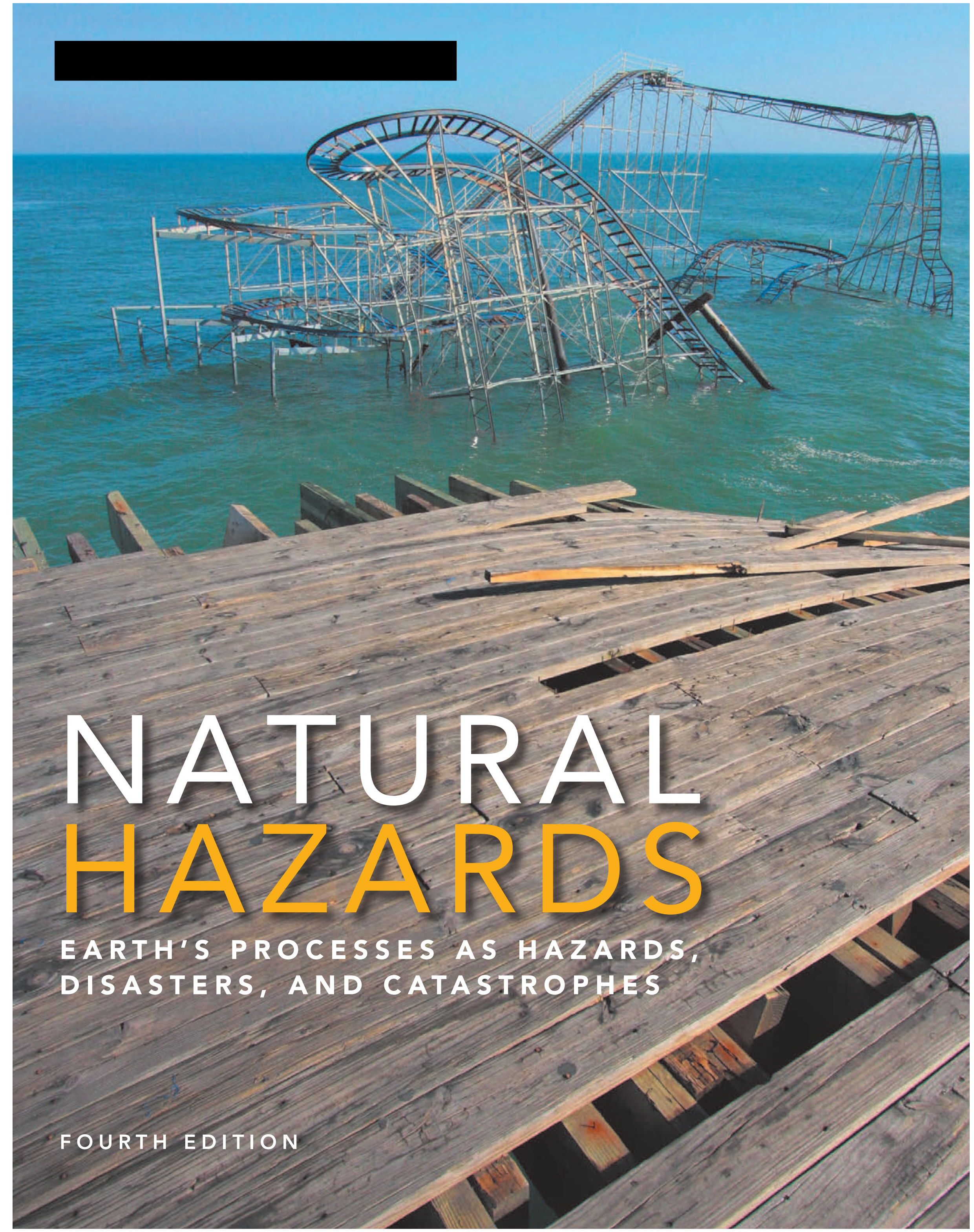
(E) Both B and C

Which textbook cover draws you in more? In other words, which might make you want to enroll in a Natural Hazards course?



a)



b)

Ice Ages are protracted intervals of time lasting millions of years where global temperature is cool enough to sustain ice at the poles.

Glacial intervals are relative short intervals lasting thousands of years during Ice Ages when glaciers are advancing.

Interglacial intervals are relative short intervals last thousands of years during Ice Ages when glaciers are in retreat.

Glacier Classification

Two main types:

Alpine Glaciers - ice is confined within local topography. Subdivided into two types.

—Cirque glaciers

— Valley glaciers

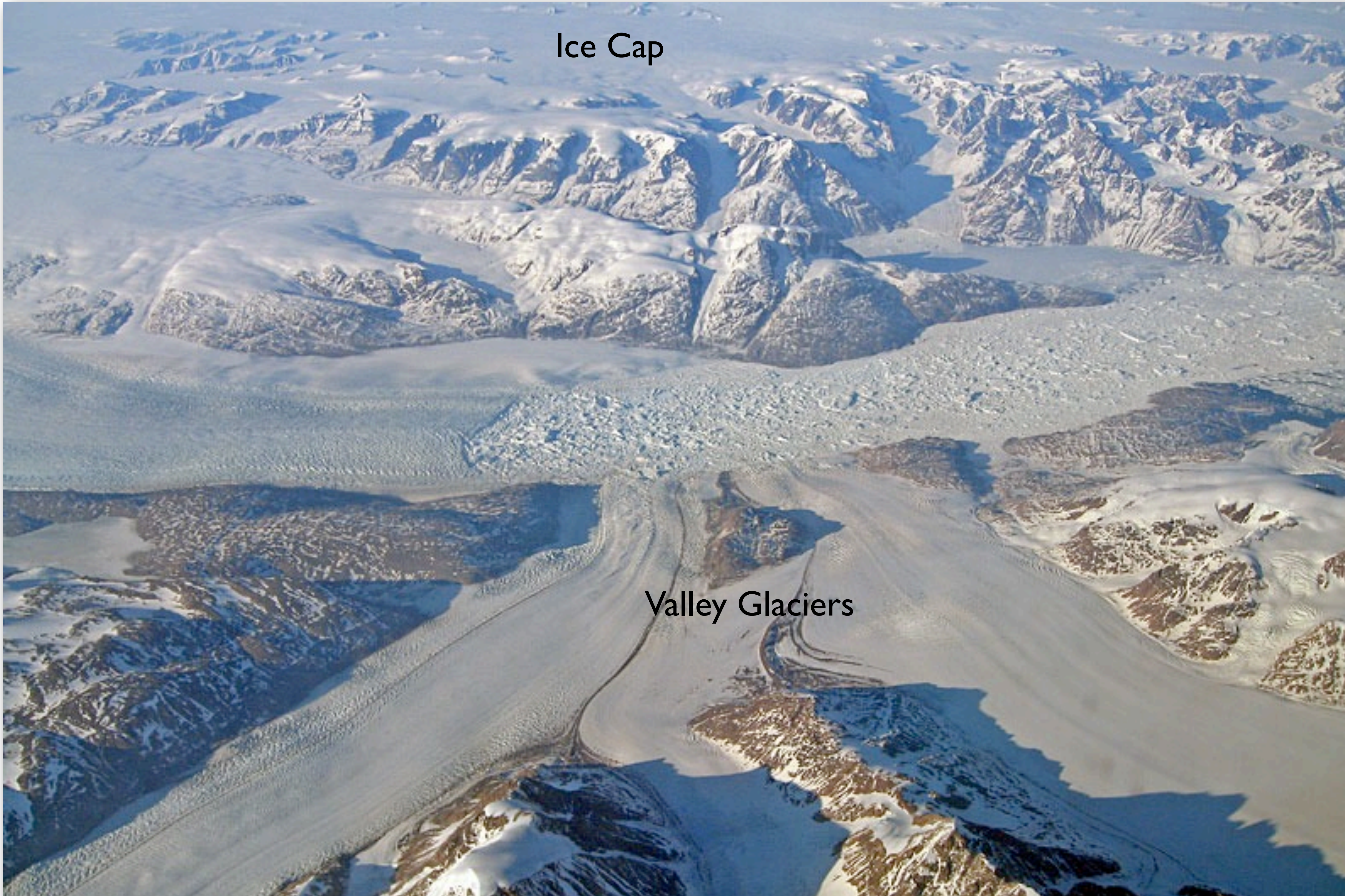
— Ice caps

Continental ice sheets unrestricted by local bedrock topography and typically expand from the poles during glacial intervals.

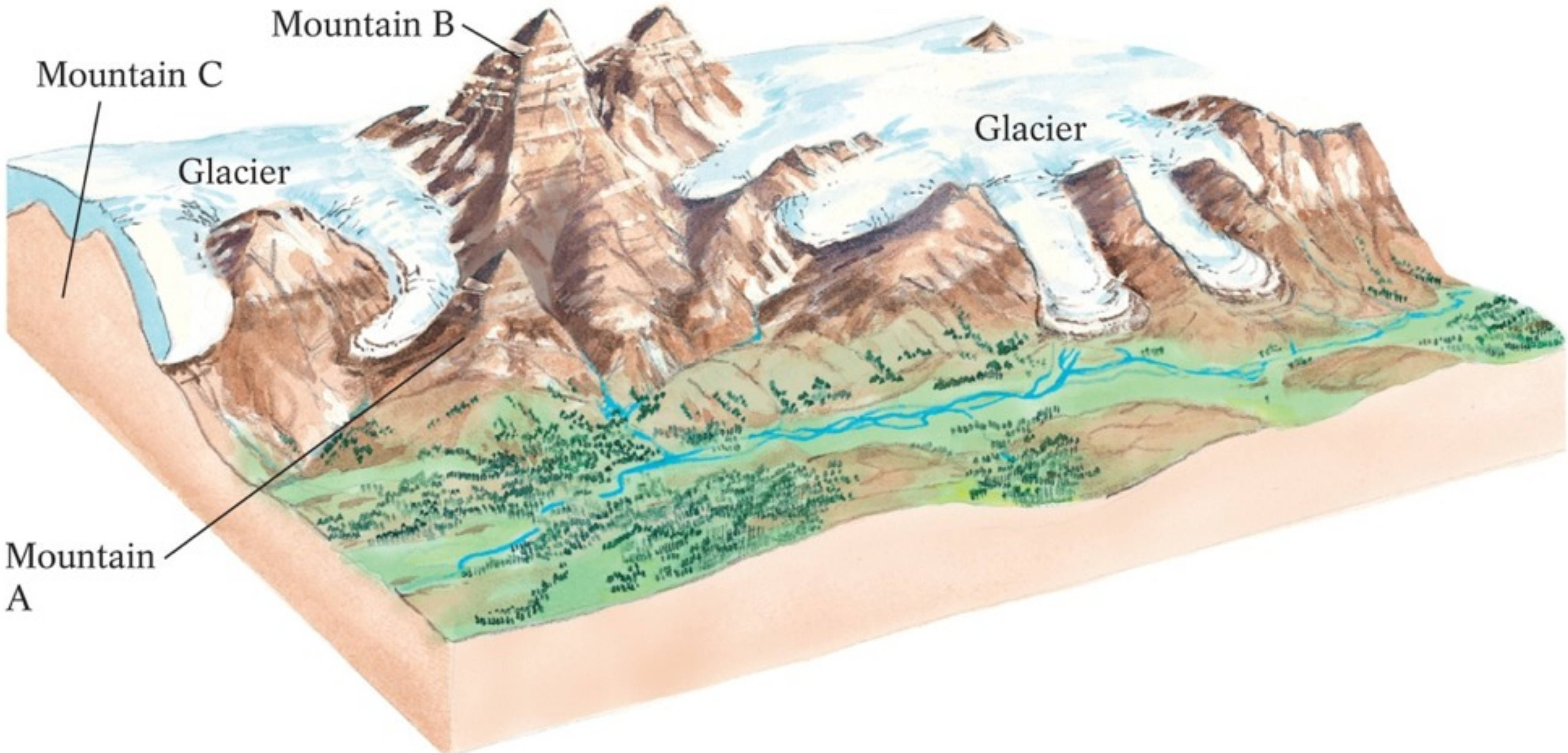
Cirque Glaciers

Valley Glaciers

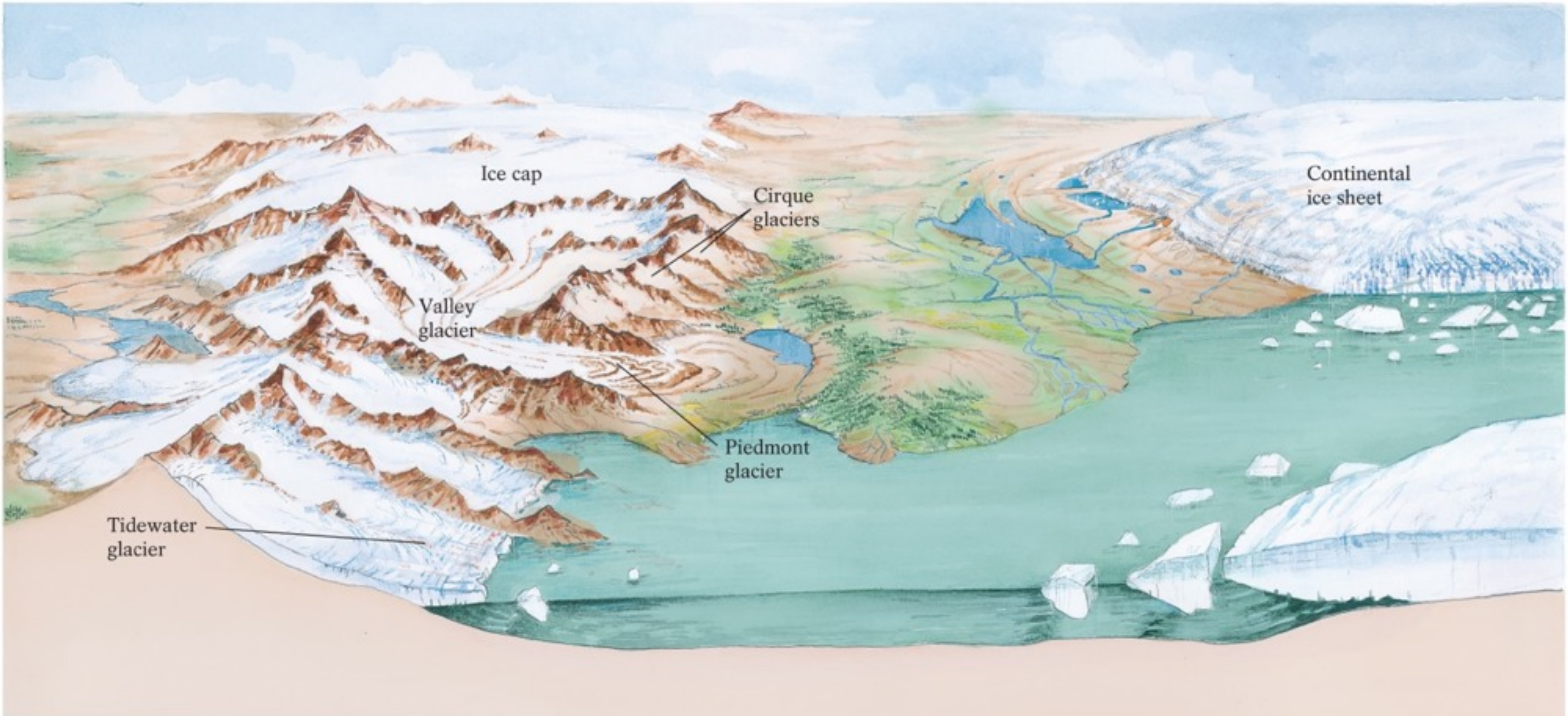
Ice Cap



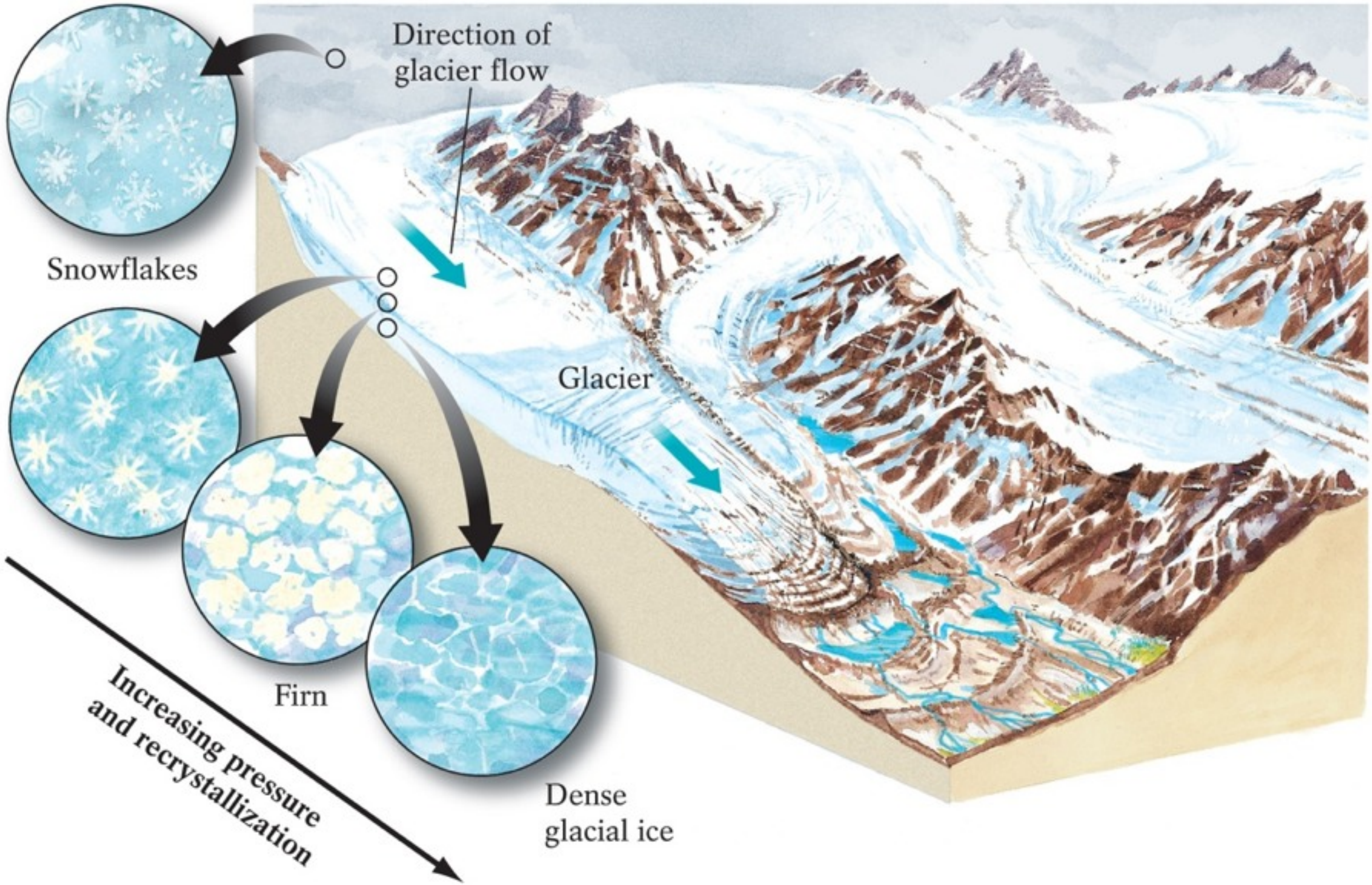
Ice Caps and Glaciers



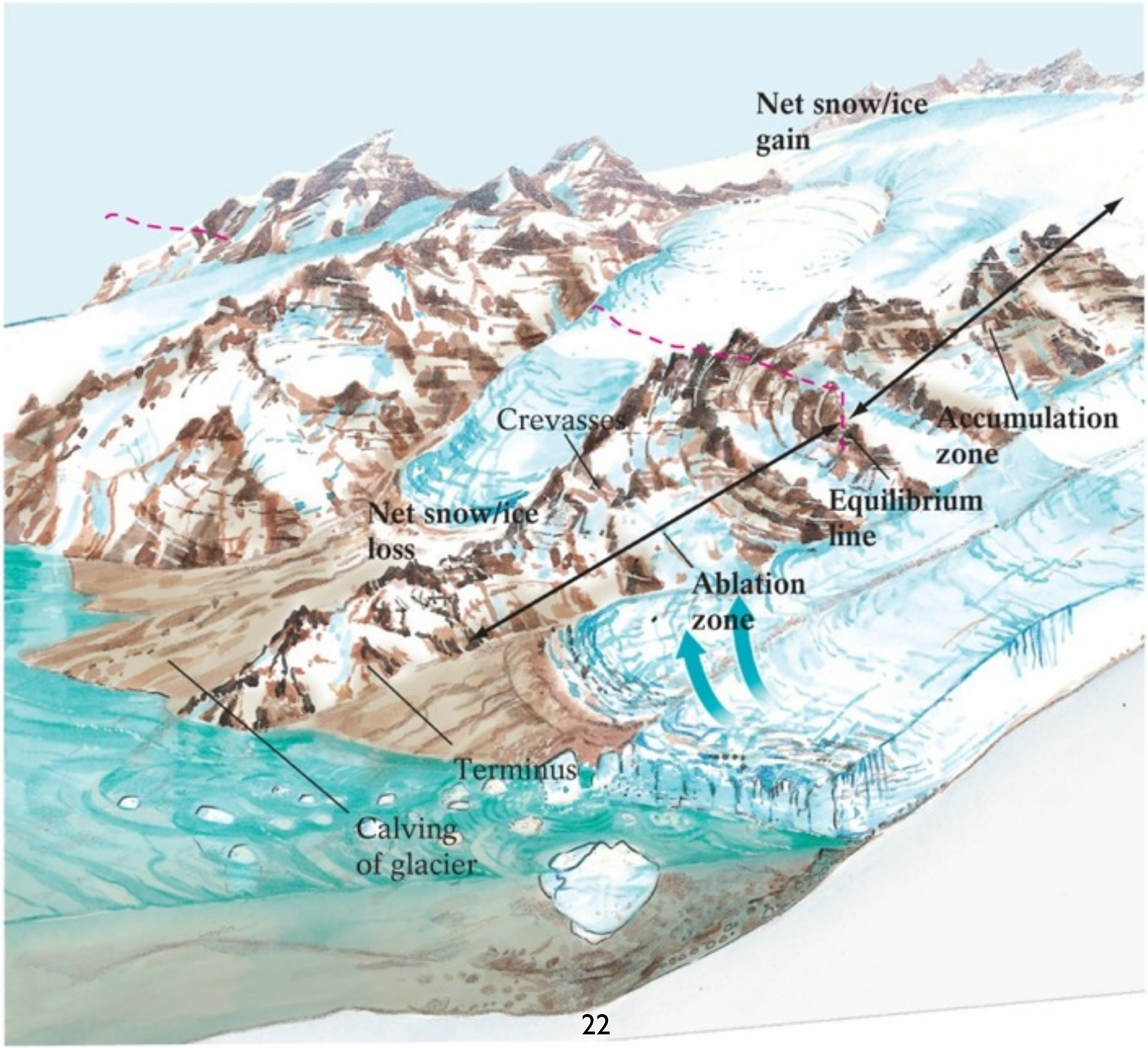
The Ice Team


Ice cap
Cirque glaciers
Continental ice sheet
Valley glacier
Piedmont glacier
Tidewater glacier

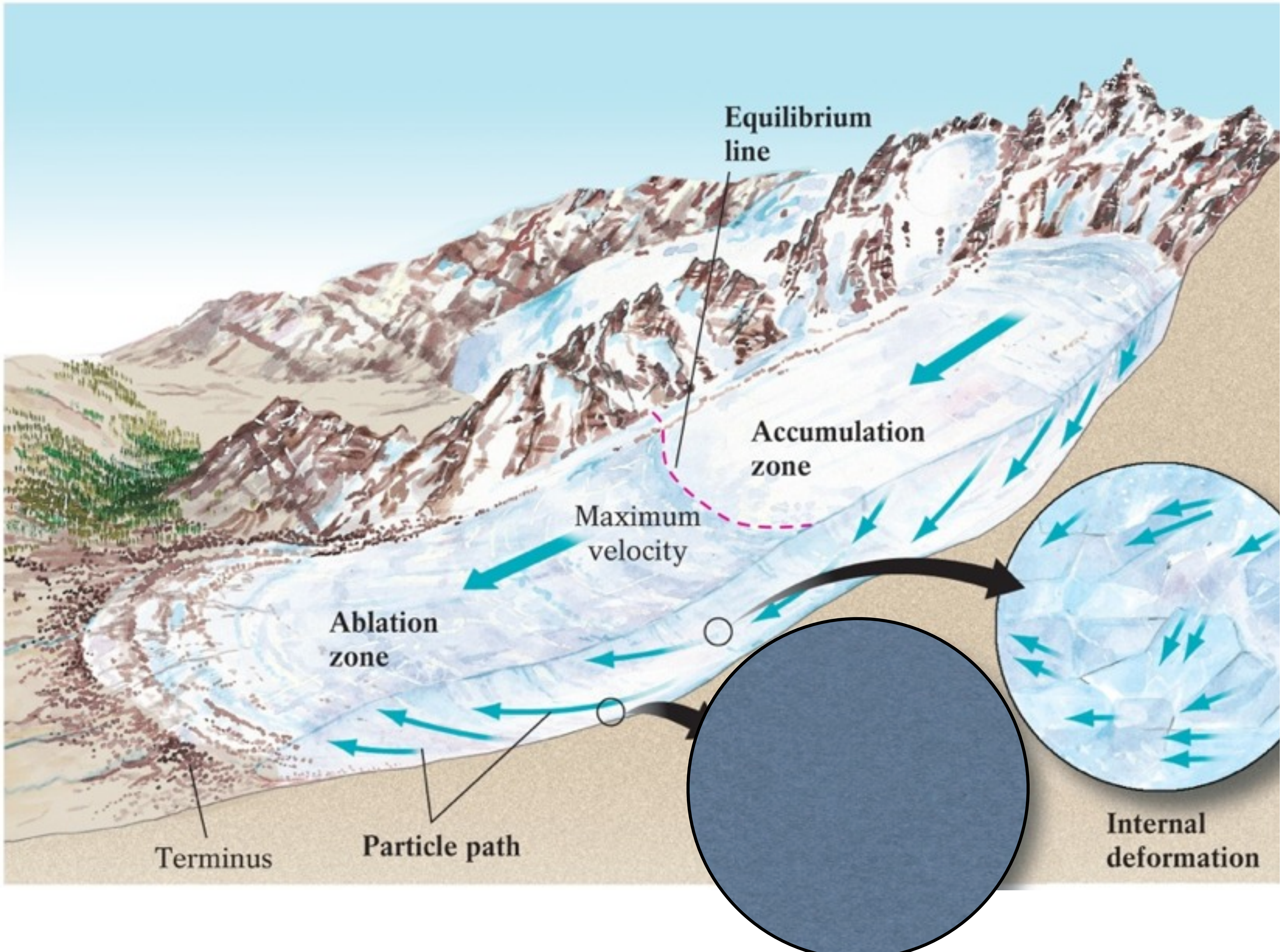
Glacial Ice Formation



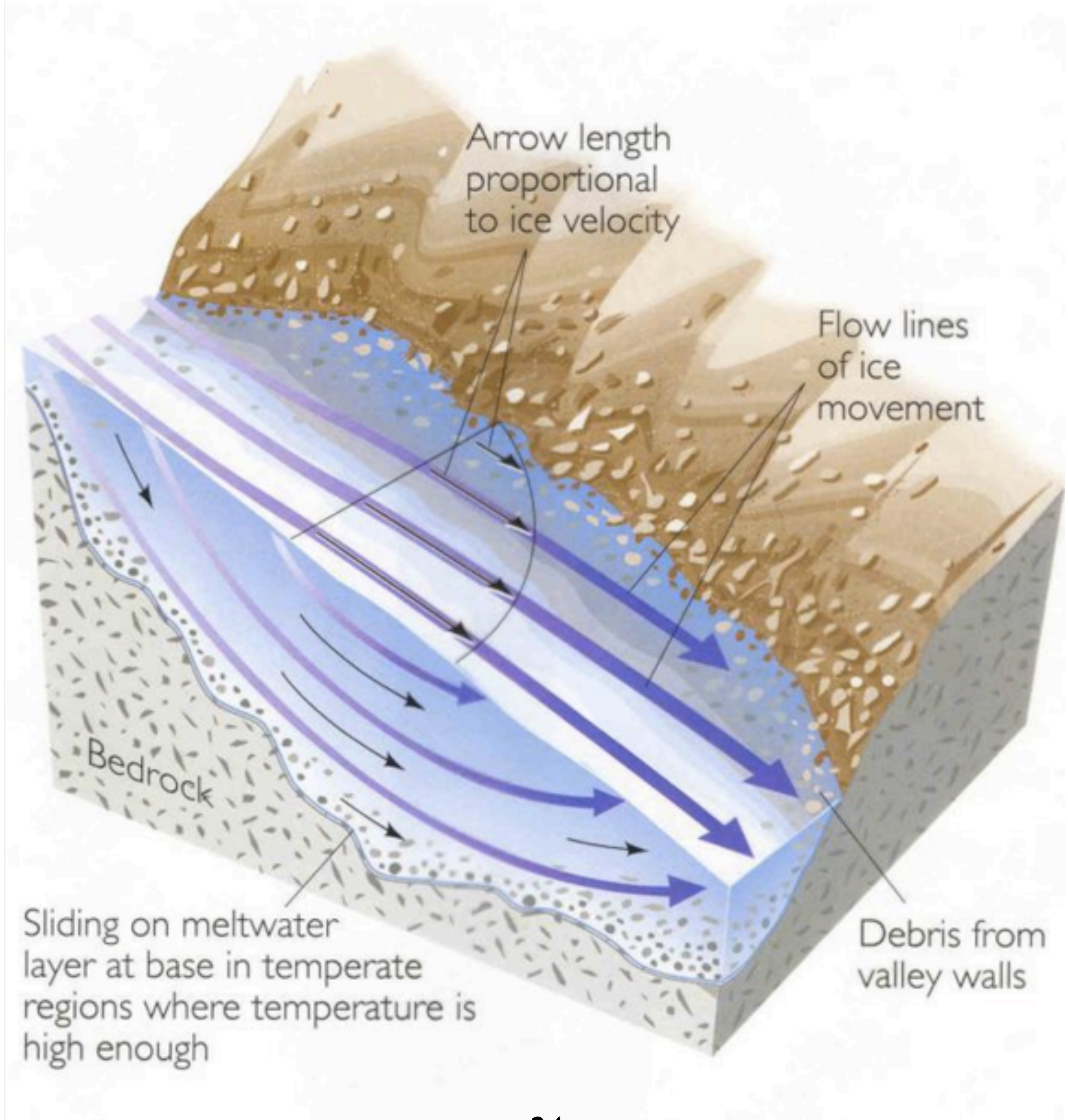
Glacial Ice Formation



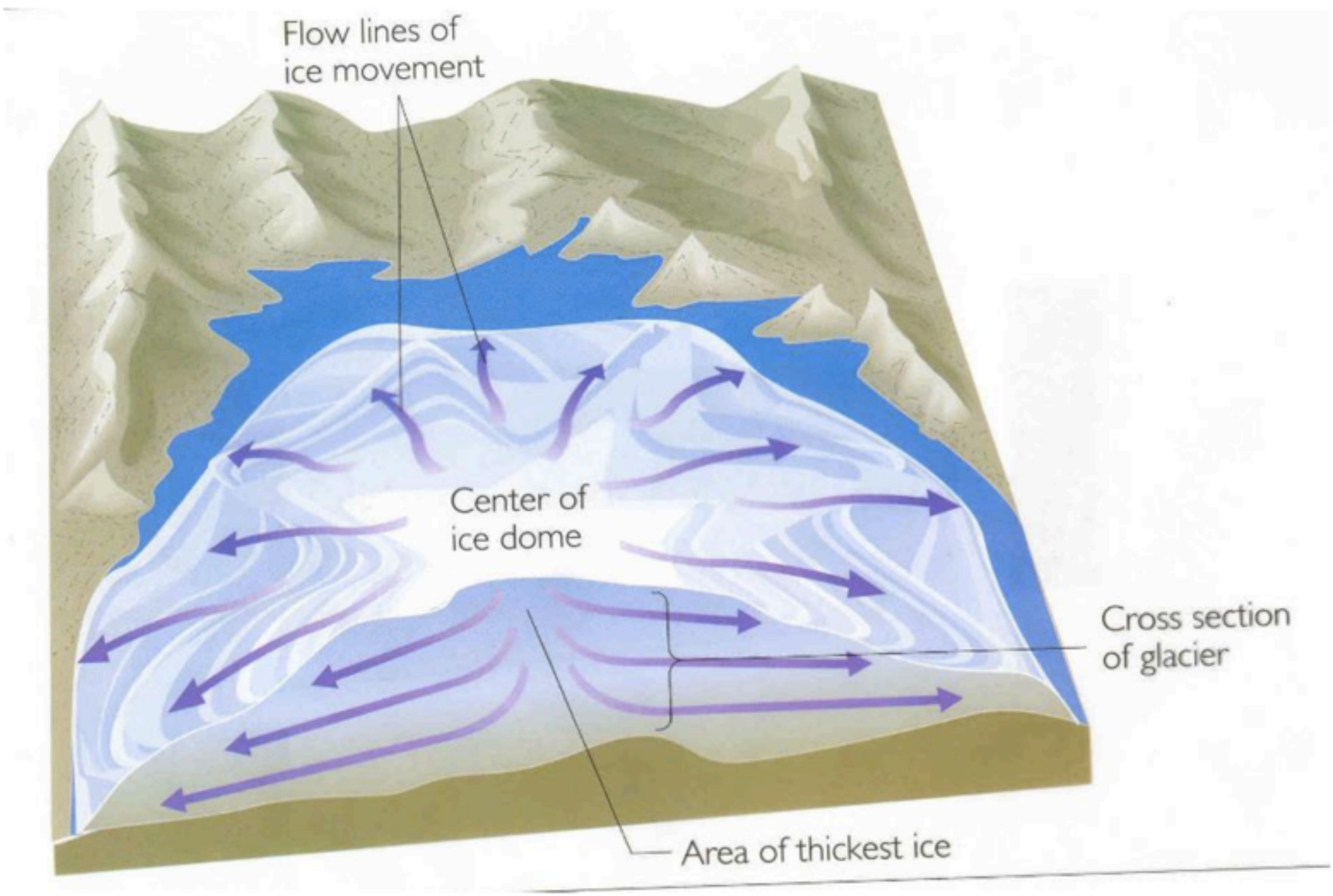
Glacial Ice Dynamics (ice on the move)



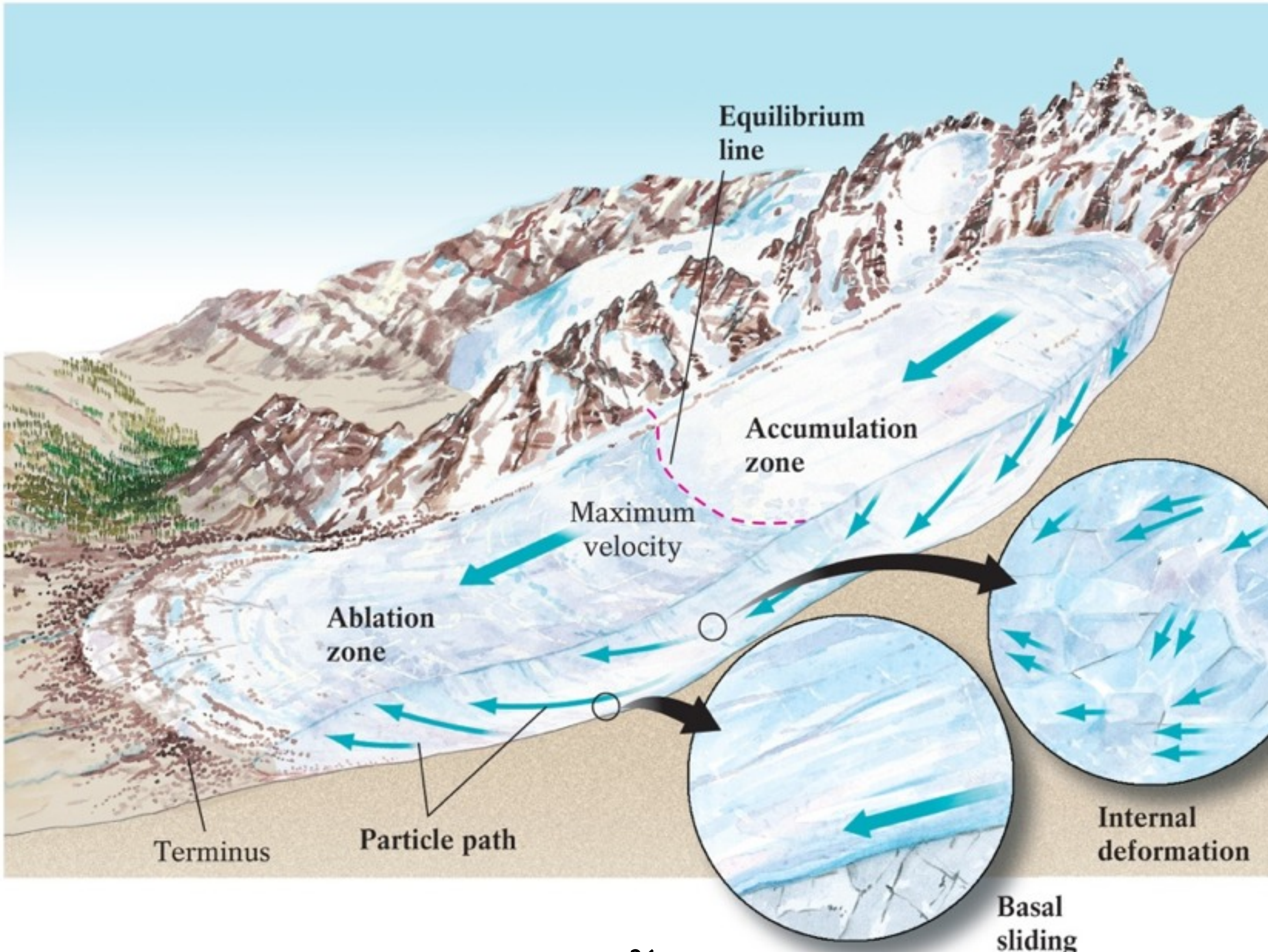
Glacial Ice Dynamics



Glacial Ice Dynamics



Glacial Ice Dynamics



Glacial Ice Dynamics

Glacier V2 Animation

Glacial Ice Dynamics

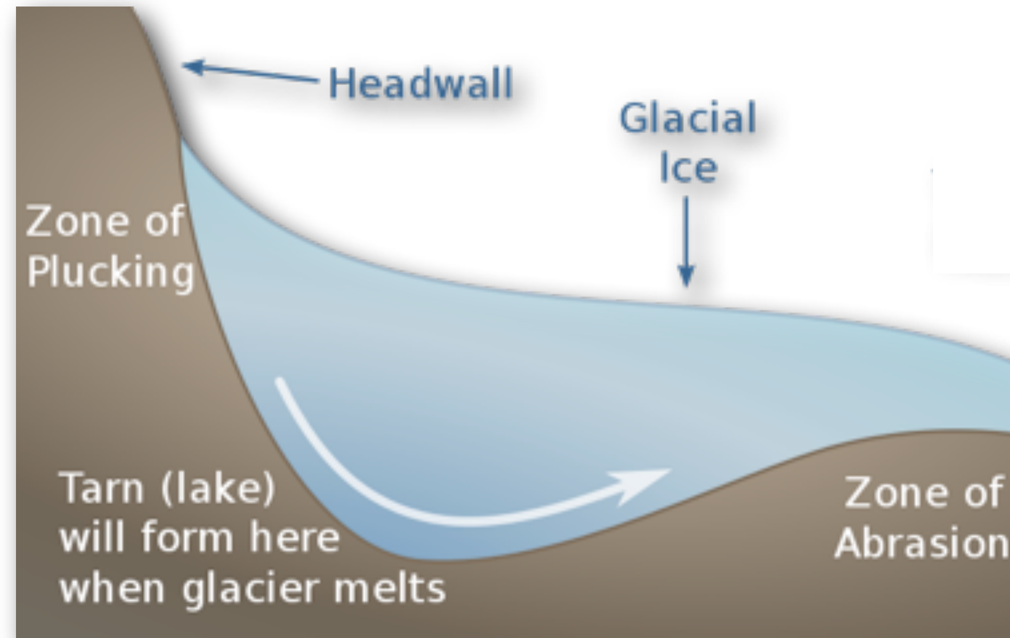
The average speed of *cold-based, nonsliding ice* sheets movement is only a few meters a year.

The average speed of *warm-based, sliding* alpine glaciers on steep slopes is 300 meters or more a year (just less than 1 m/day).

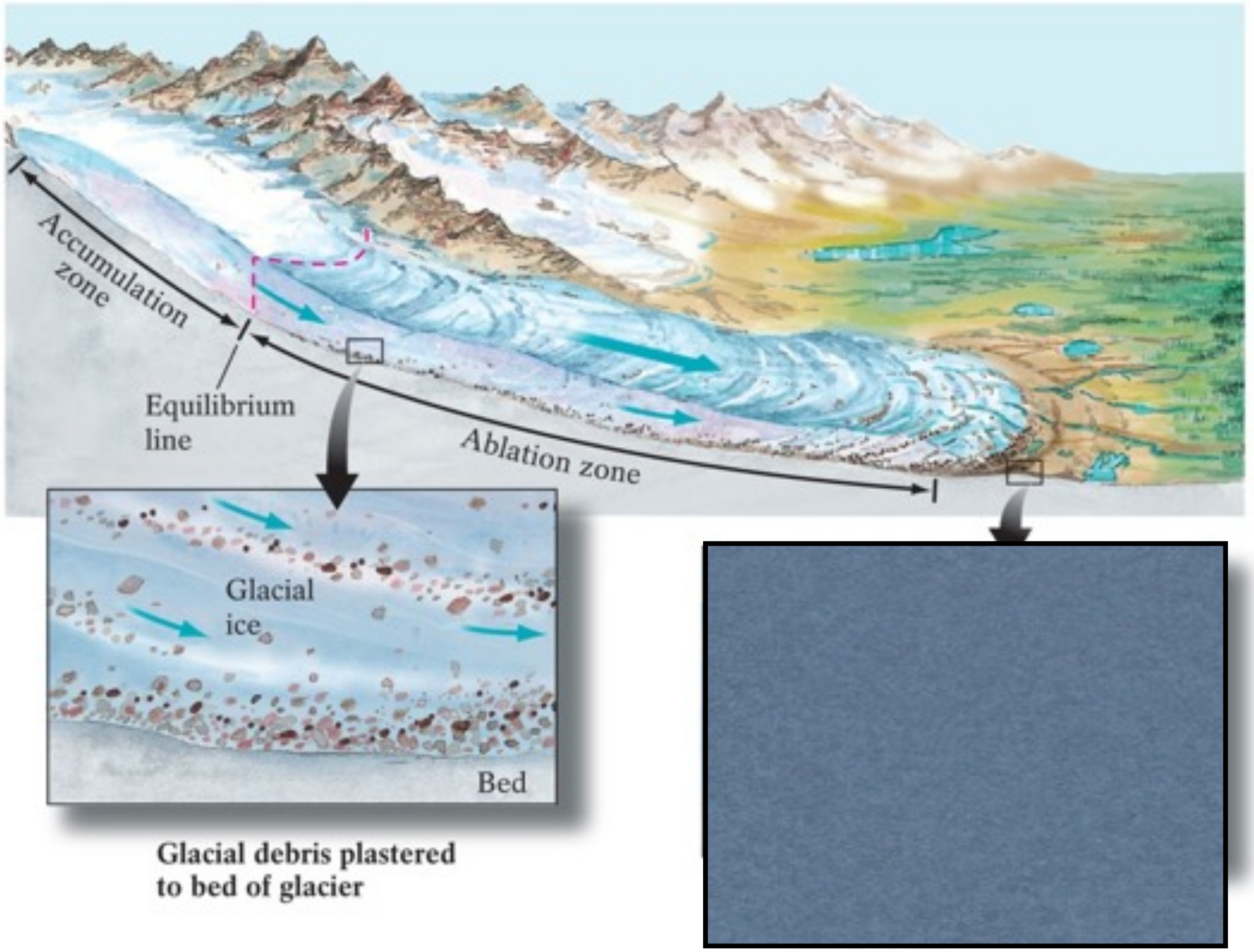
Surging glaciers, however, can move 100x faster than normal for several months to a few years.

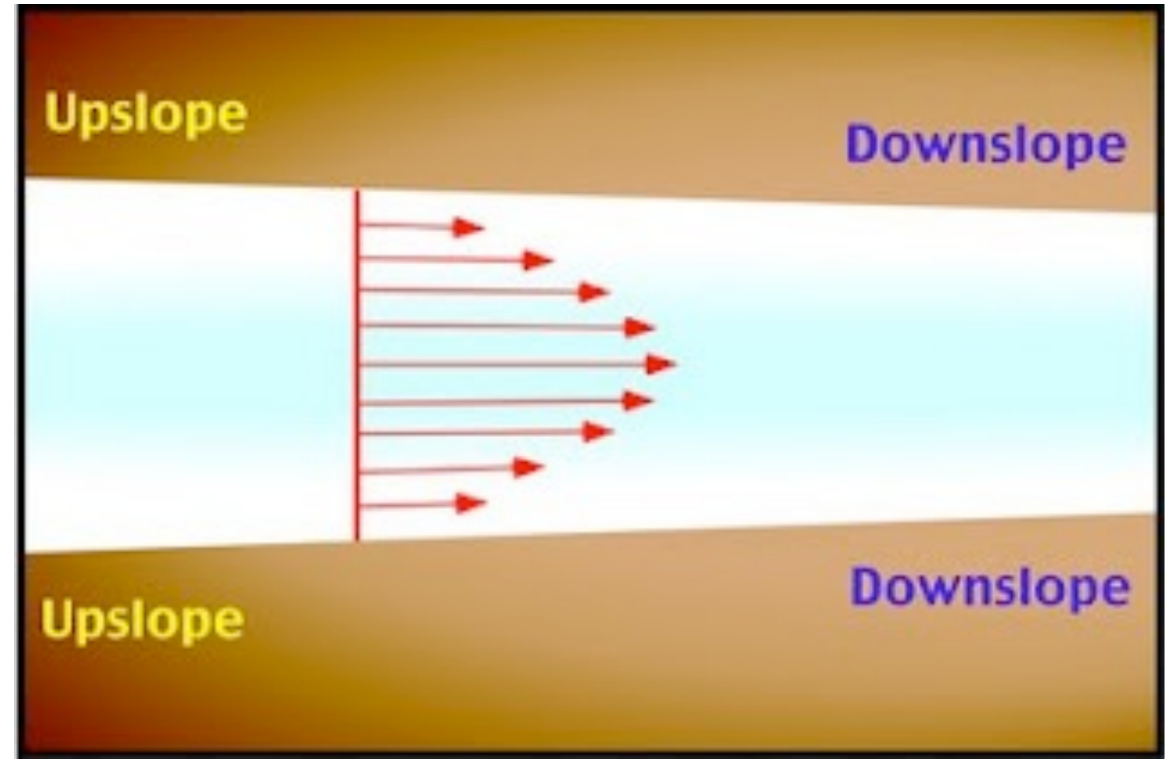
Most rapid surge known was in 1953 in northern Pakistan – 100 meters per day! (~12.5 m/hour or ½ meter a minute!)

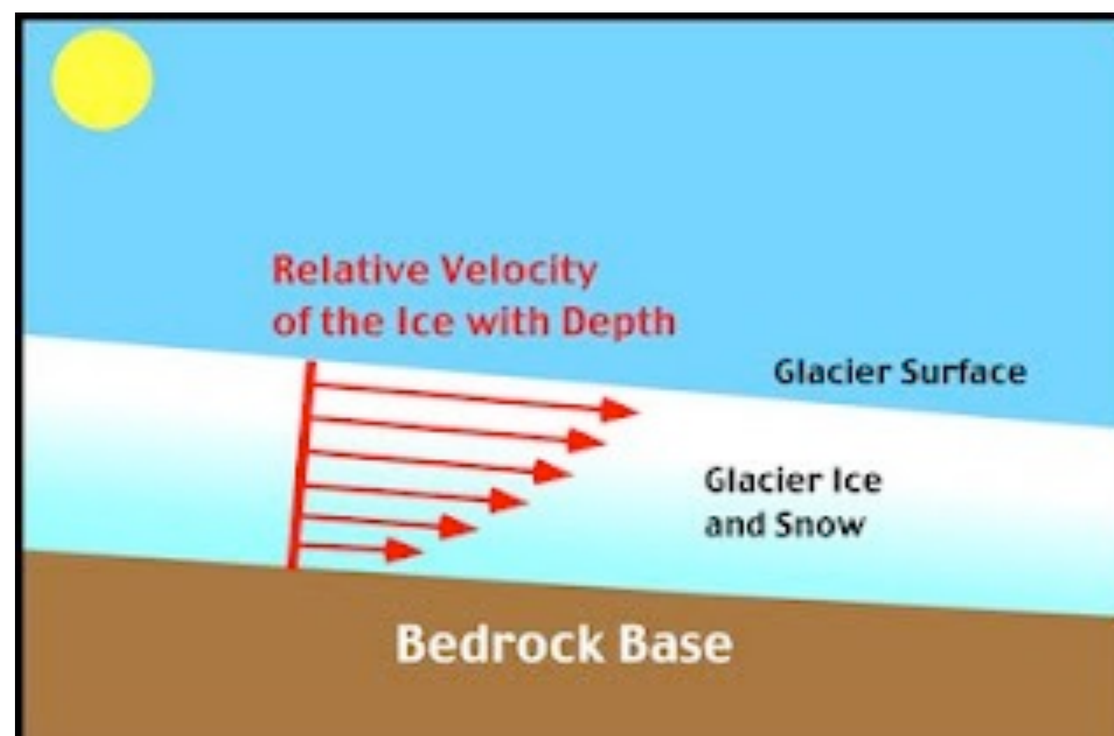
Glacial Ice Erosion
From Top (cirque) to bottom



Glacial Ice Erosion



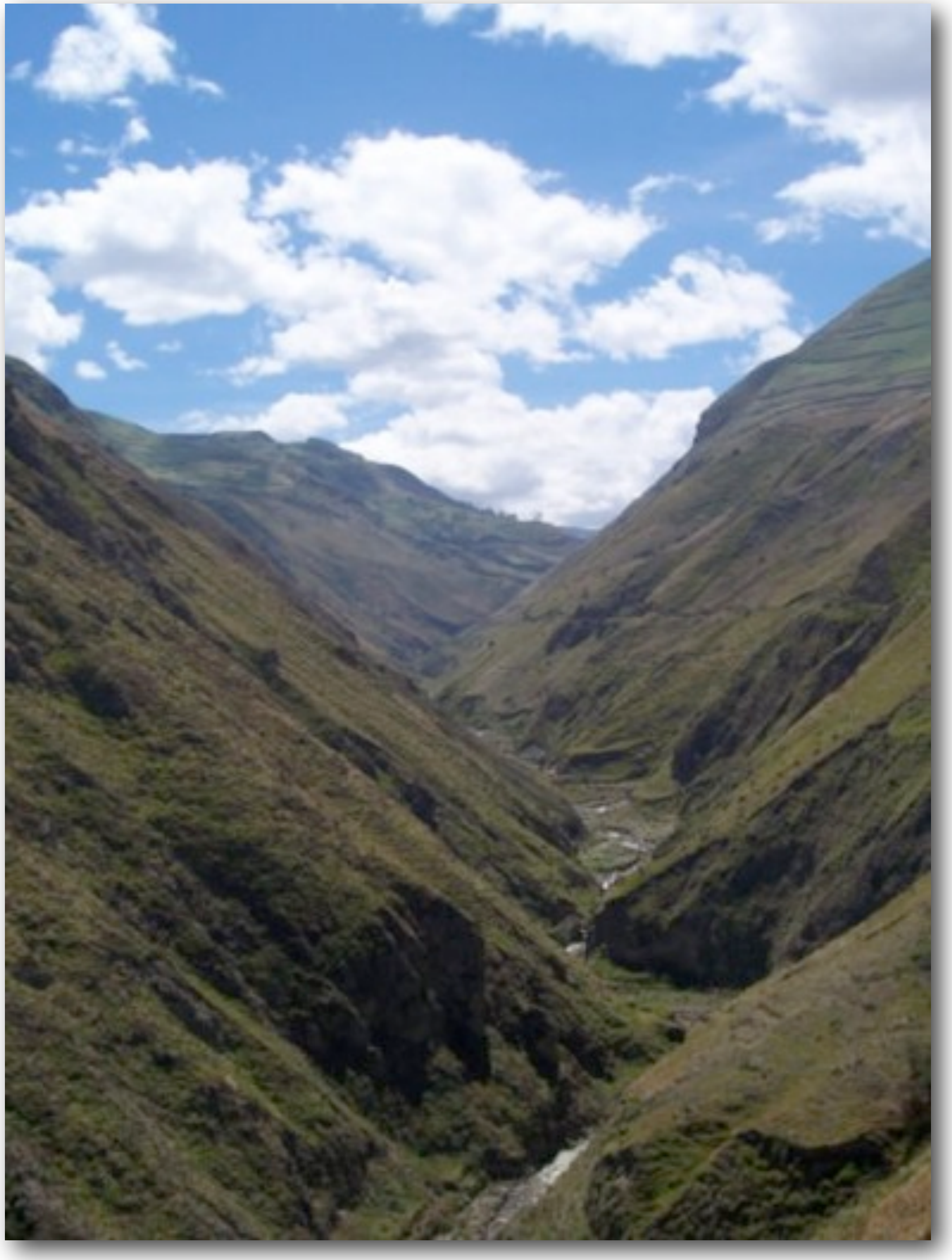




Glacial Erosion vs. River Erosion

Glacial Erosion vs. River Erosion

U-Shaped Glacial Valley



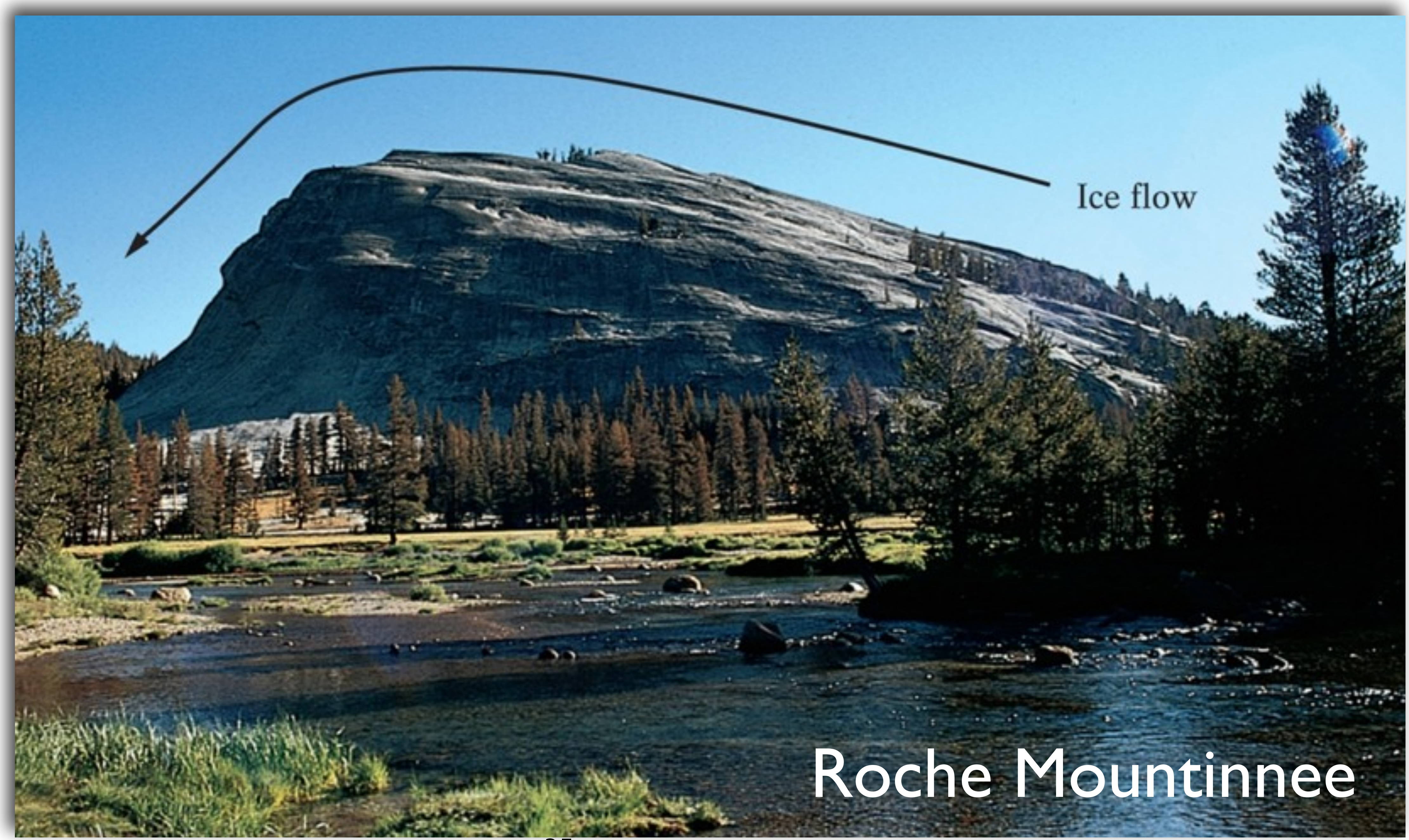
V-Shaped River Valley

Classic Glacial Erosion

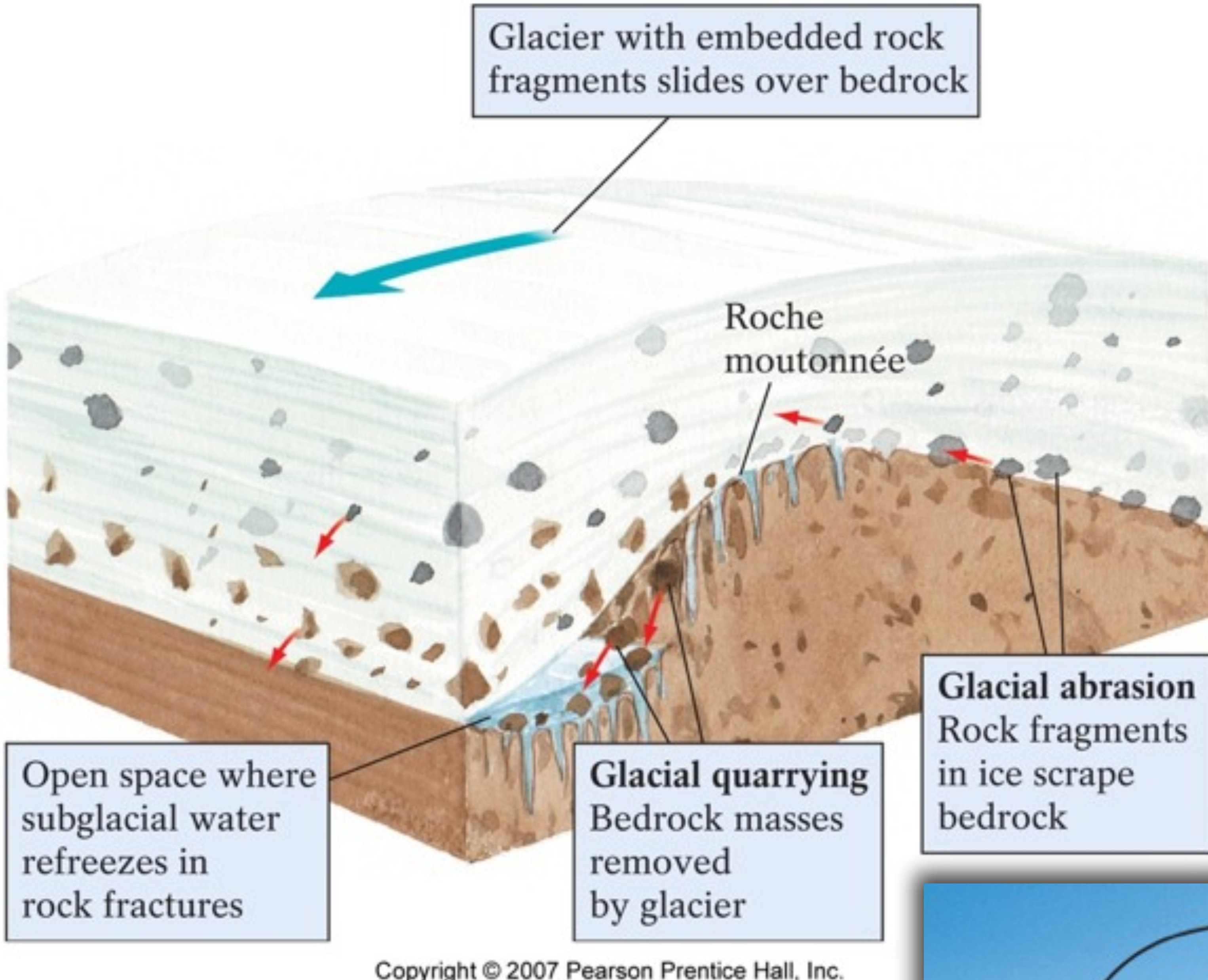
Glacial Erosion (Up-close)

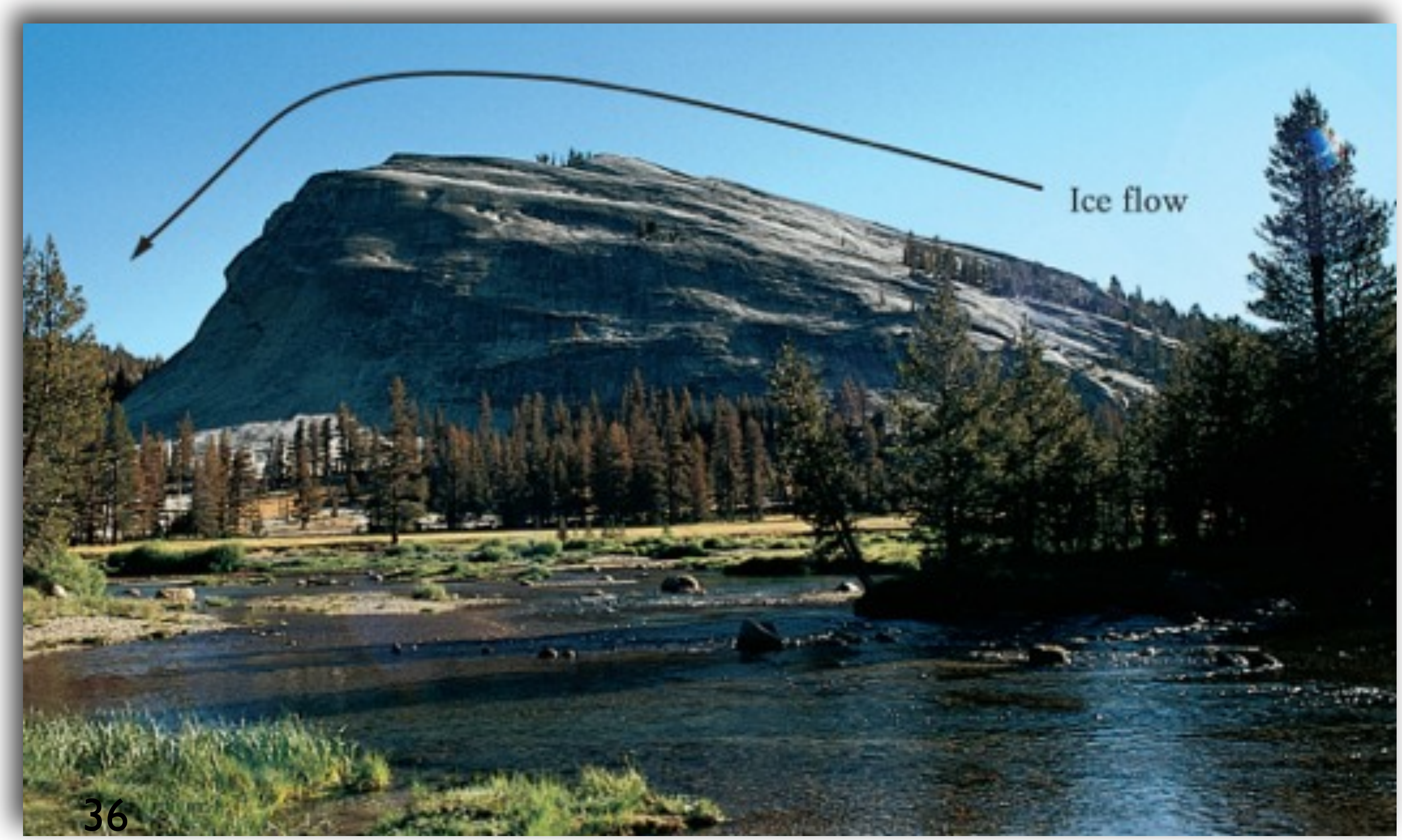
Striated, Grooved, Fluted, and Polished Surfaces

Glacial Erosion (Landforms)



Glacial Quarying
(Roche Mountinnee)



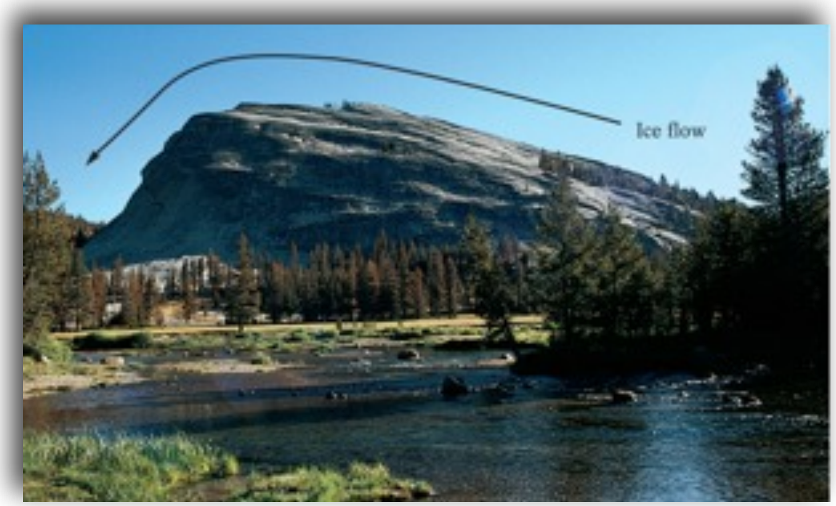


Glacial Erosion (Arete)

Carved by 2 Glaciers

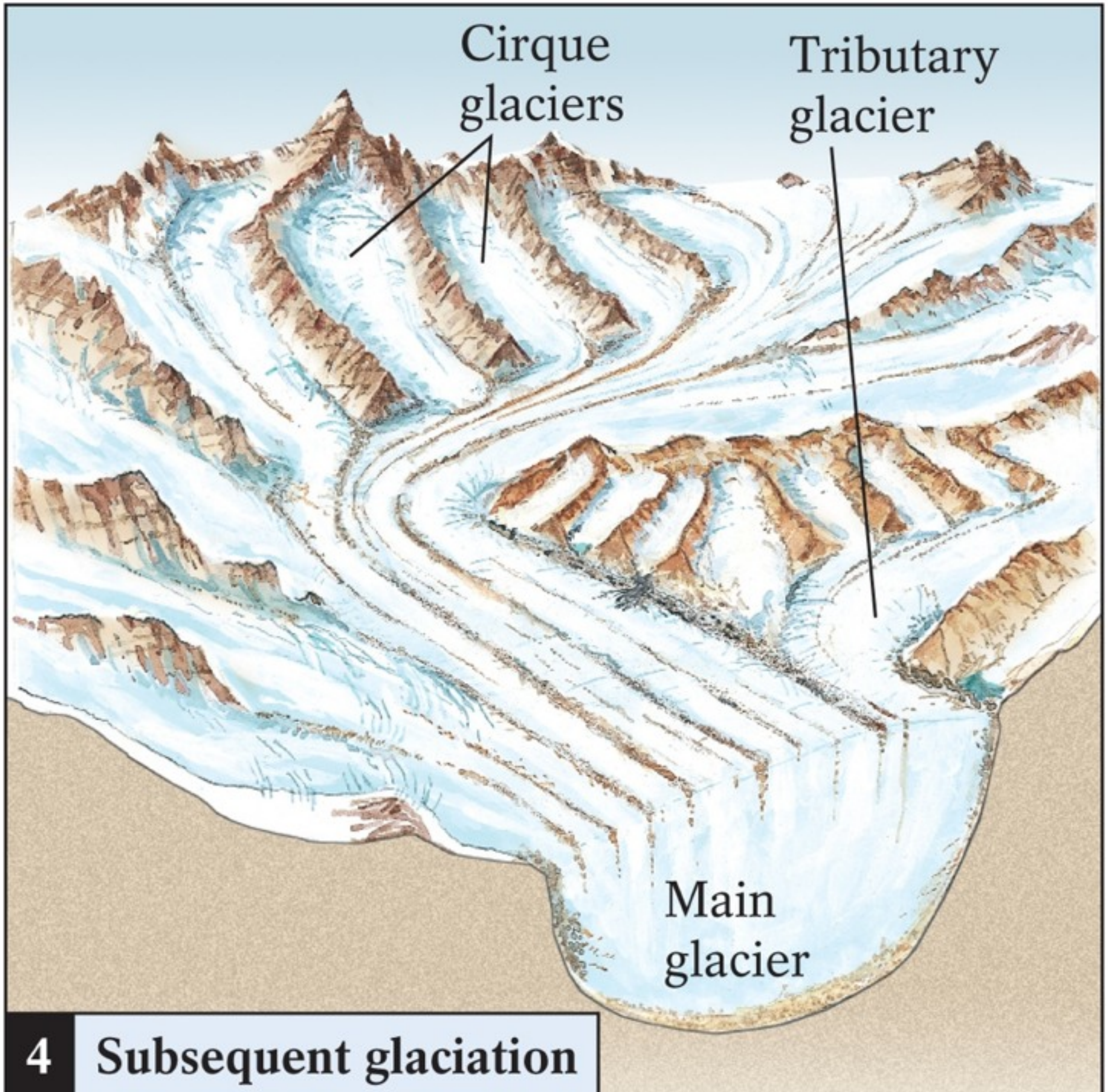
Glacial Erosion (Arete)

Glacial Erosion (Horn)

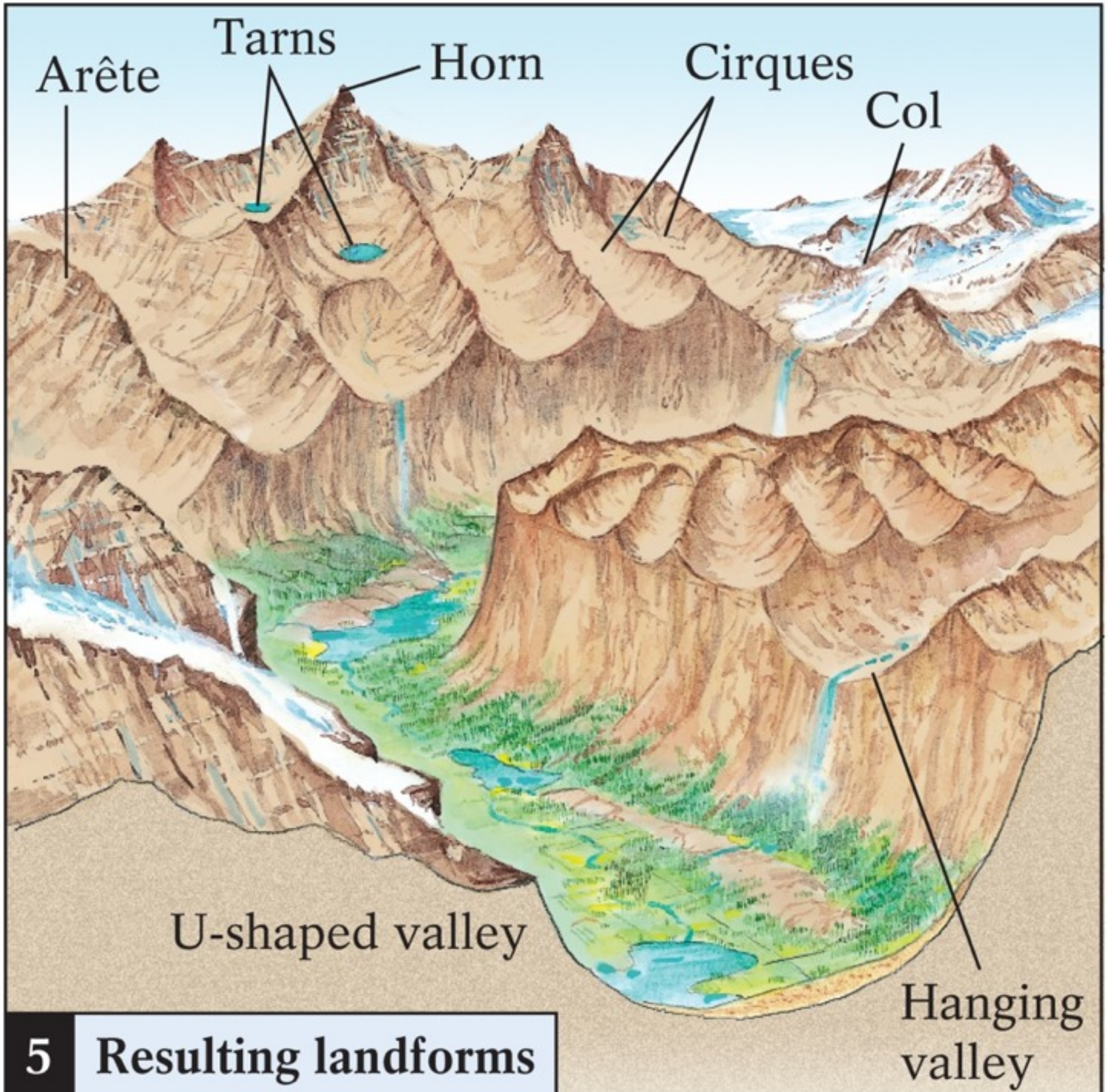


Carved by 3 Glaciers

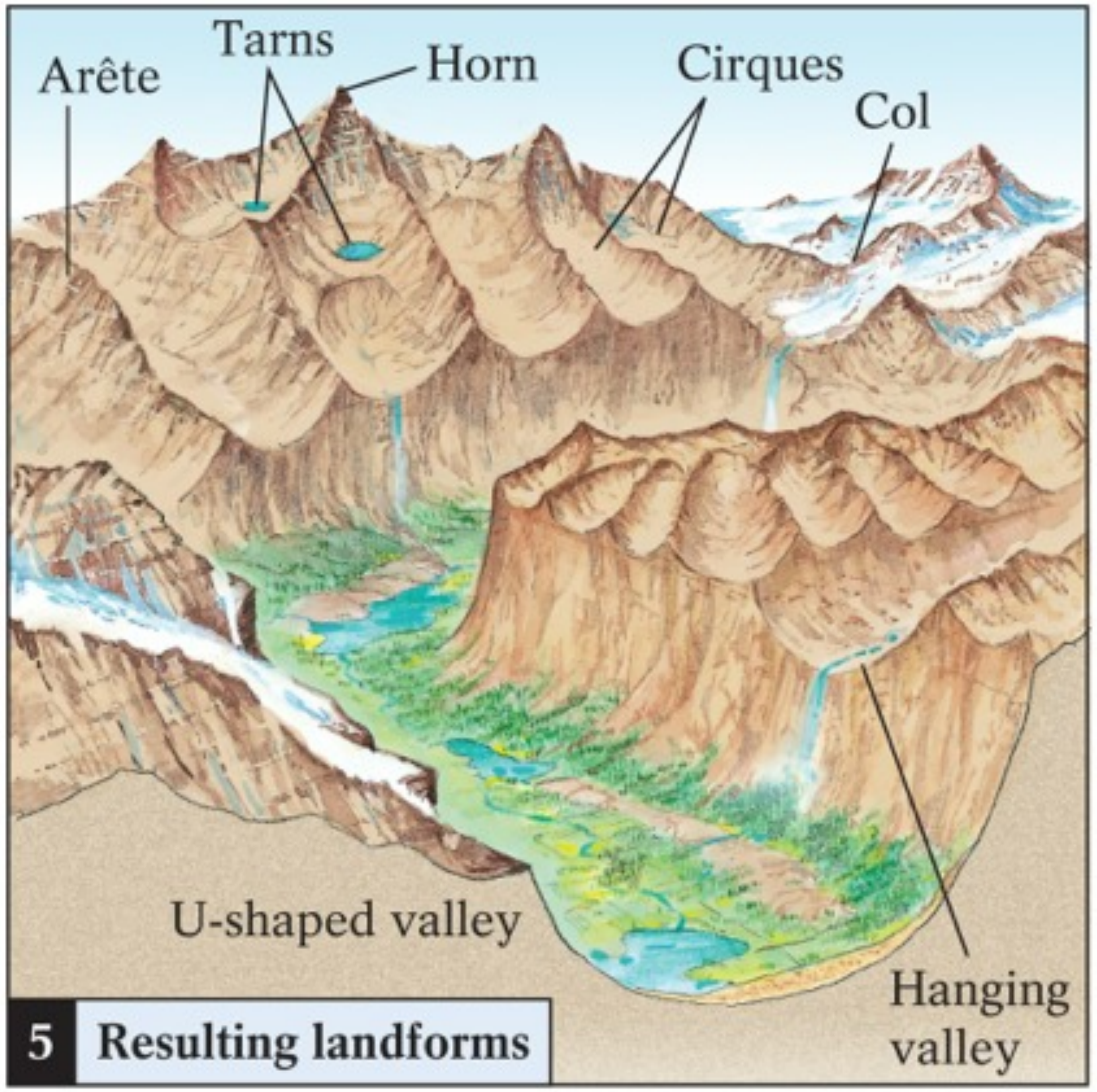
Glacial Erosion



Glacial Erosion



Glacial Erosion (hanging valley)



Glacial Erosion (hanging valley)

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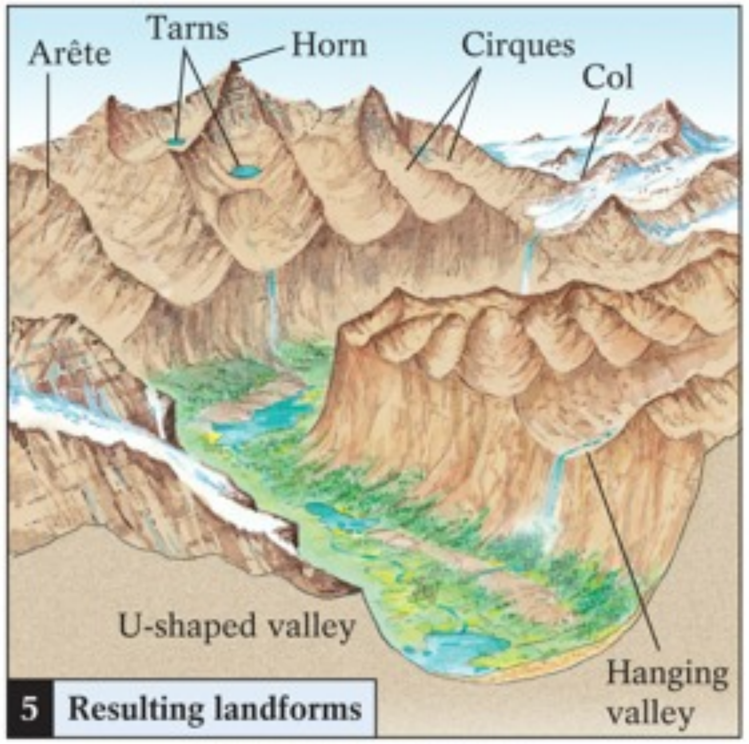
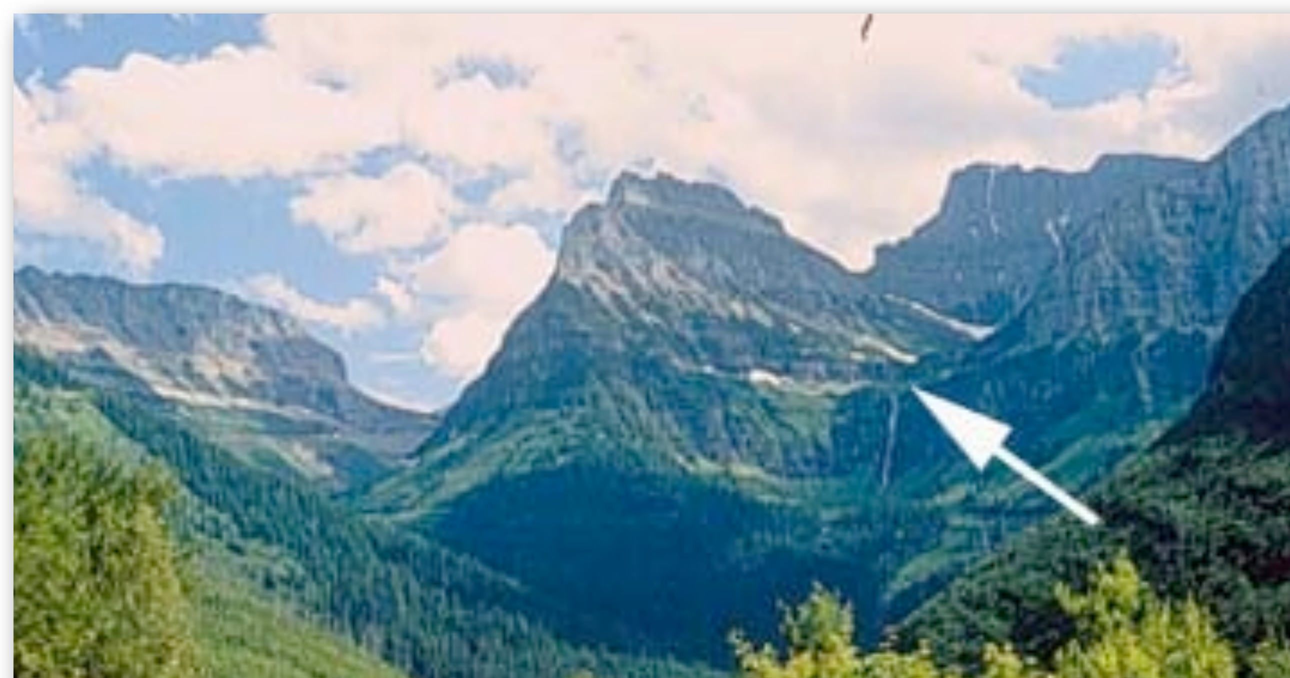
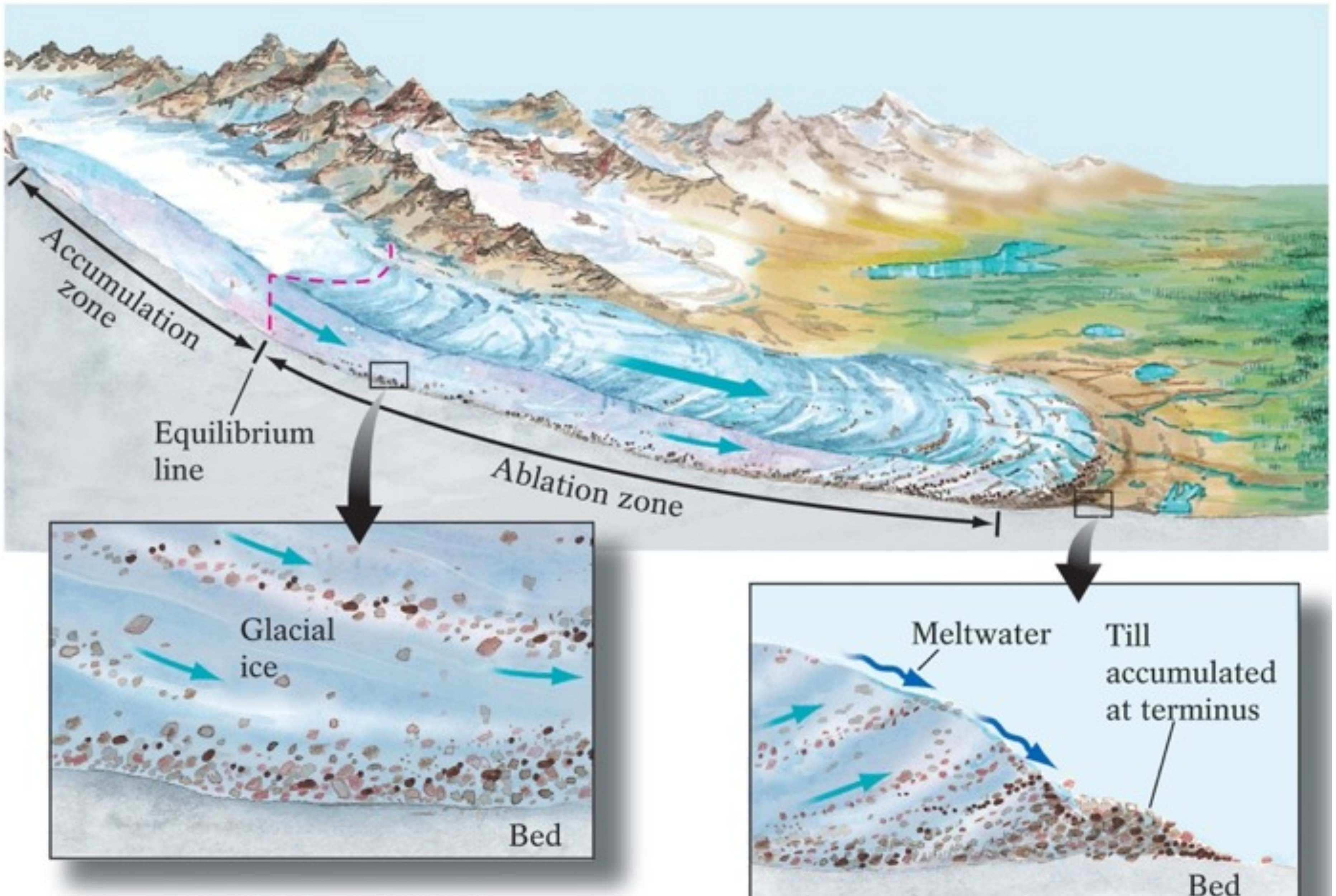




Glacial Deposition



Glacial debris plastered to bed of glacier

Glacial debris "melted out" at terminus

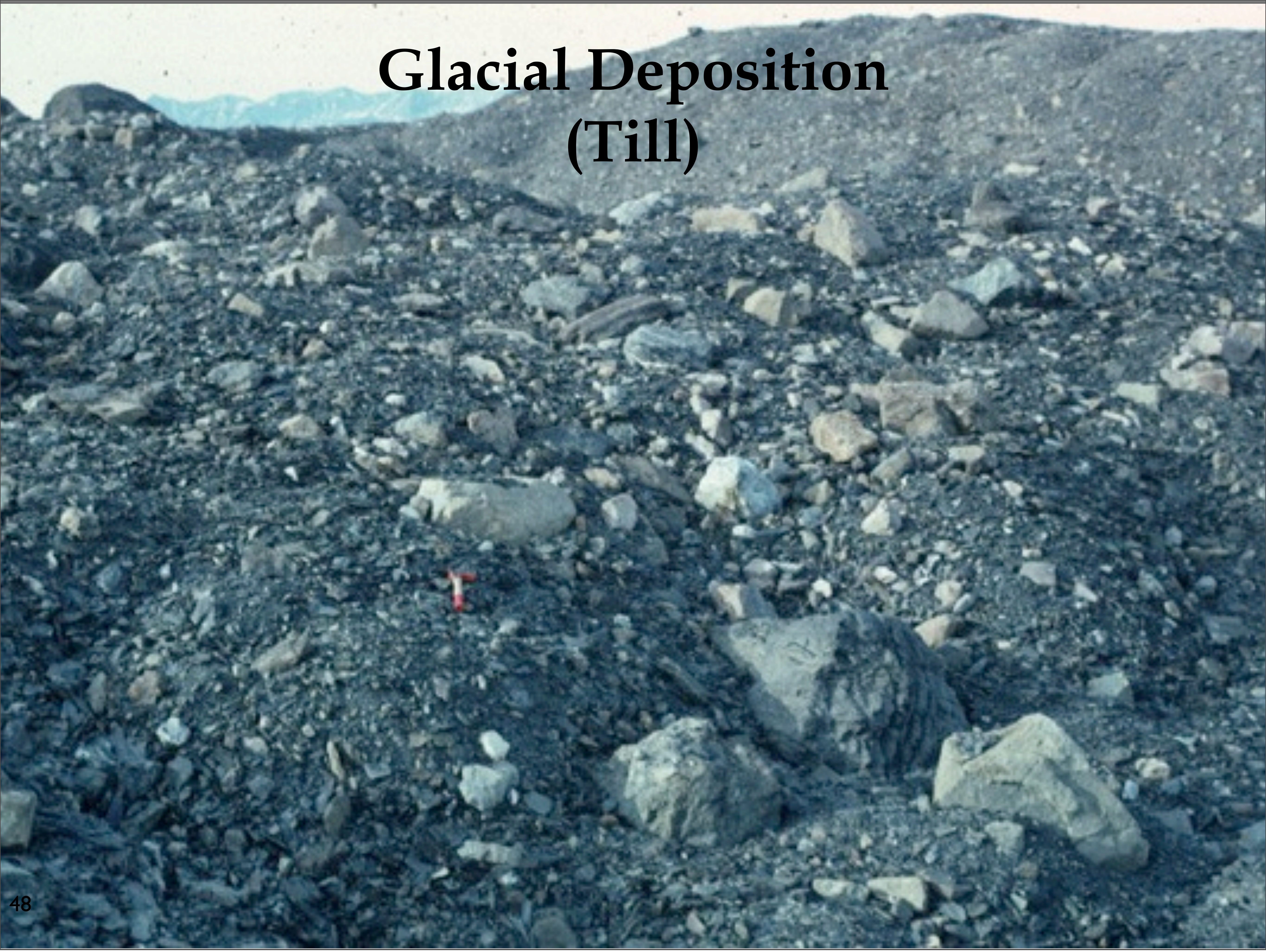
Glacier V3 Animation

Glacial Deposition

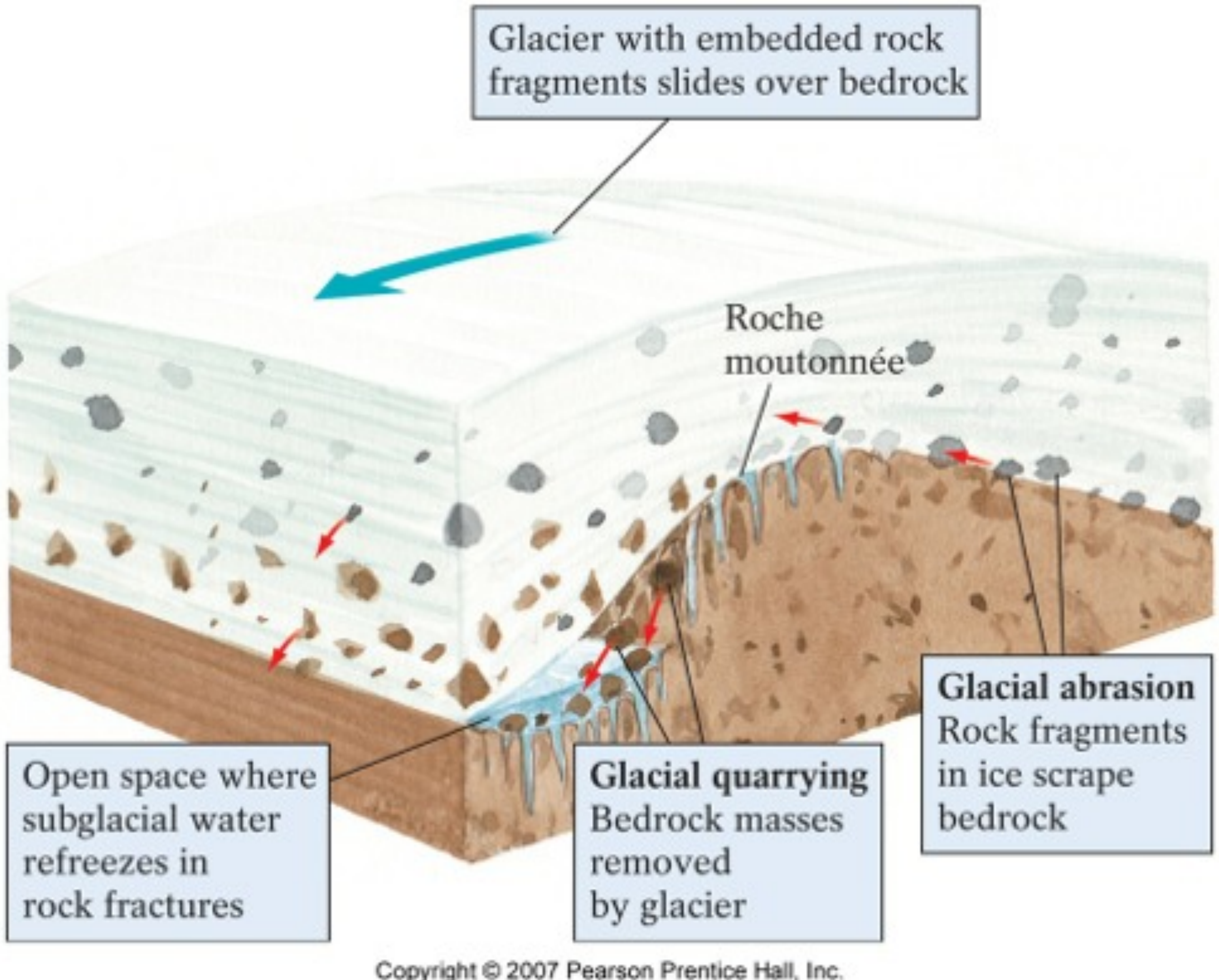
Till - Sediment, clay- to boulder-sized particles deposited directly by glacial ice.

Outwash - Sediment, clay- to boulder-sized particles deposited by water sourced from melting glacial ice.

Glacial Deposition (Till)

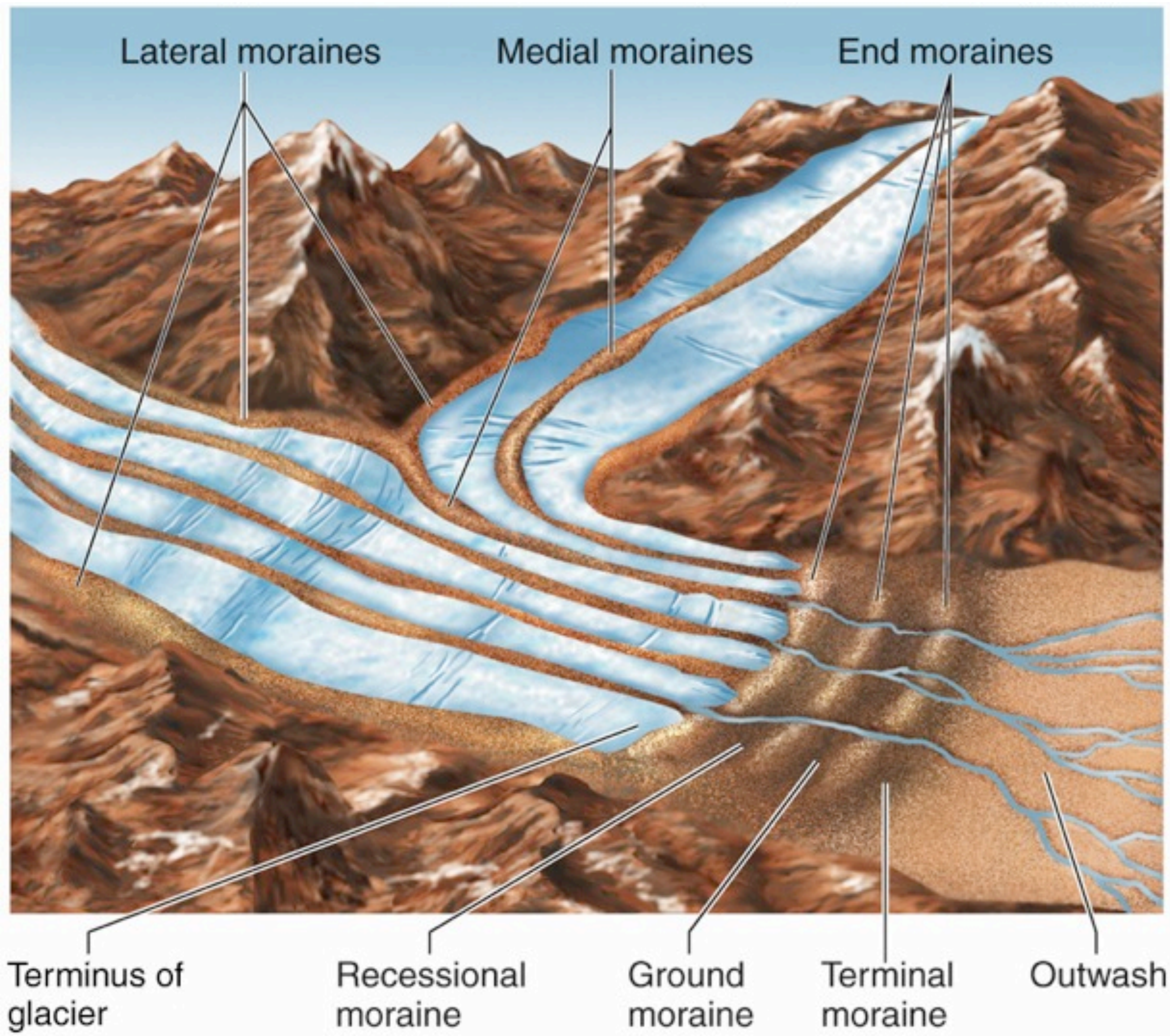


Glacial Deposition



Glacial Deposition (Moraines)

Terminal — Lateral — Medial — Recessional



Glacial Ice Dynamics

Glacier V2 Animation

Glacial Deposition (Moraines)

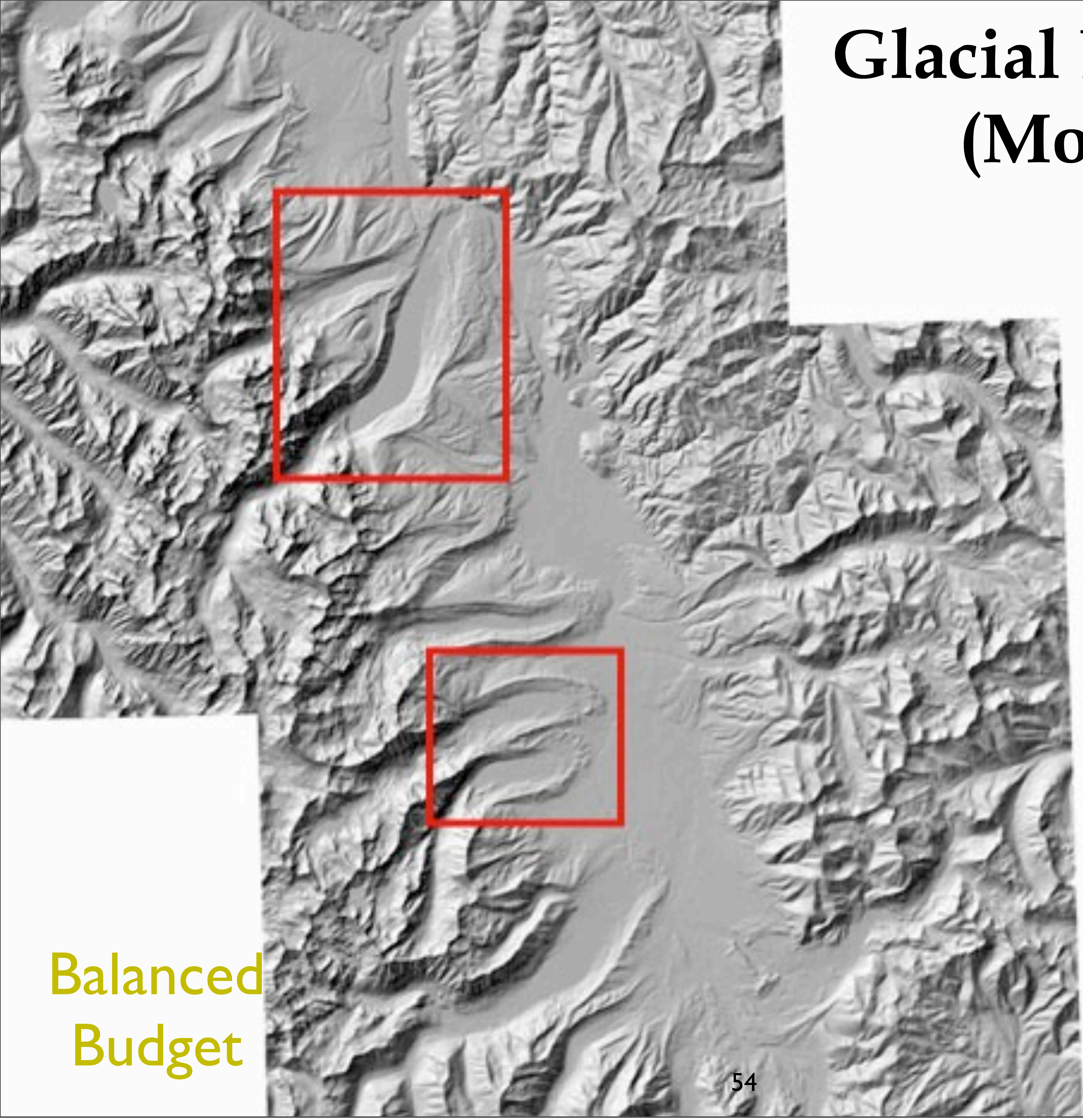
Terminal — Lateral — Medial — Recessional

Glacial Deposition (Moraines)

Terminal — Lateral — Medial — Recessional

Balanced Budget

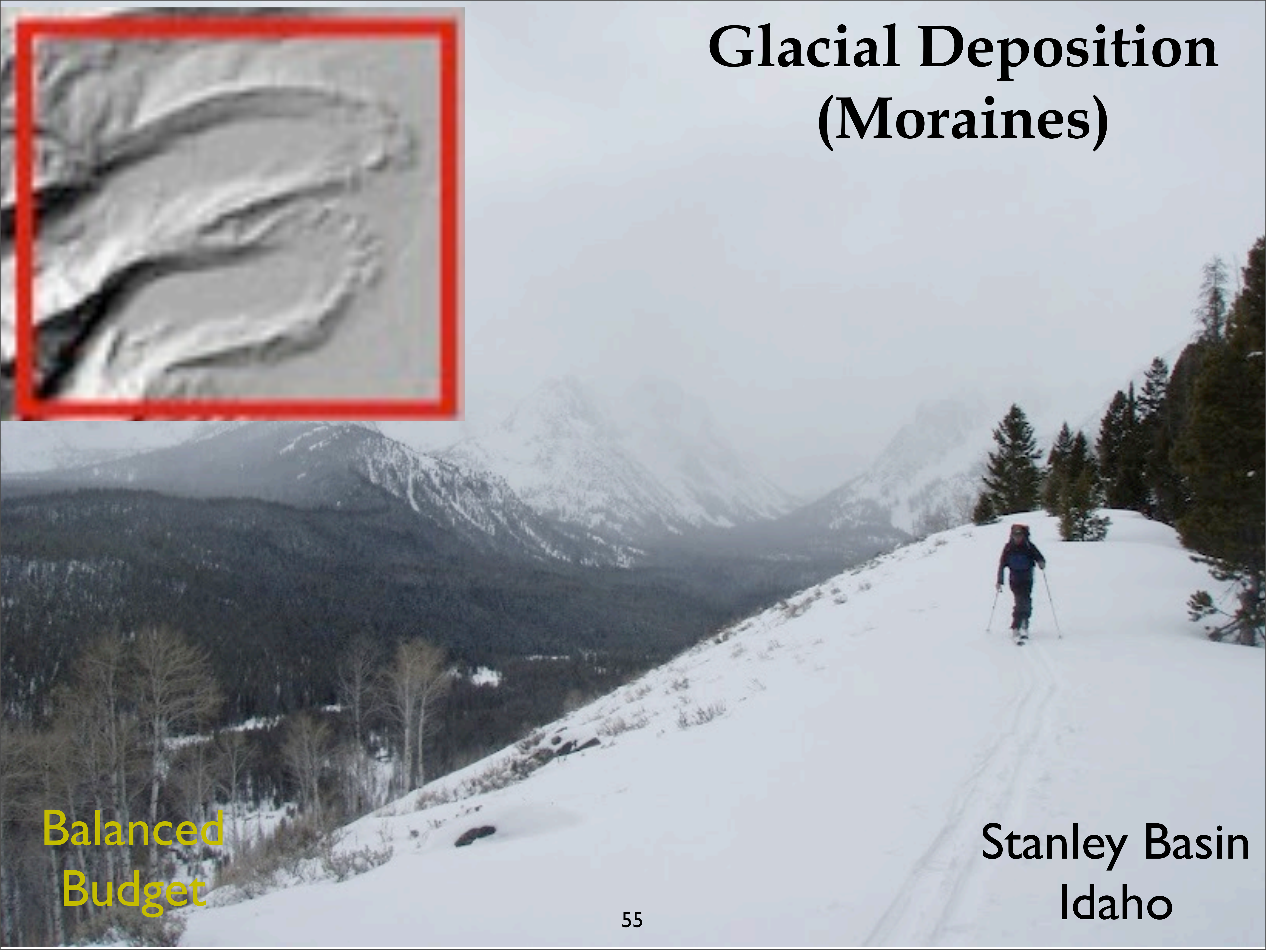
Glacial Deposition (Moraines)



Balanced Budget

Stanley Basin
Idaho

Glacial Deposition (Moraines)



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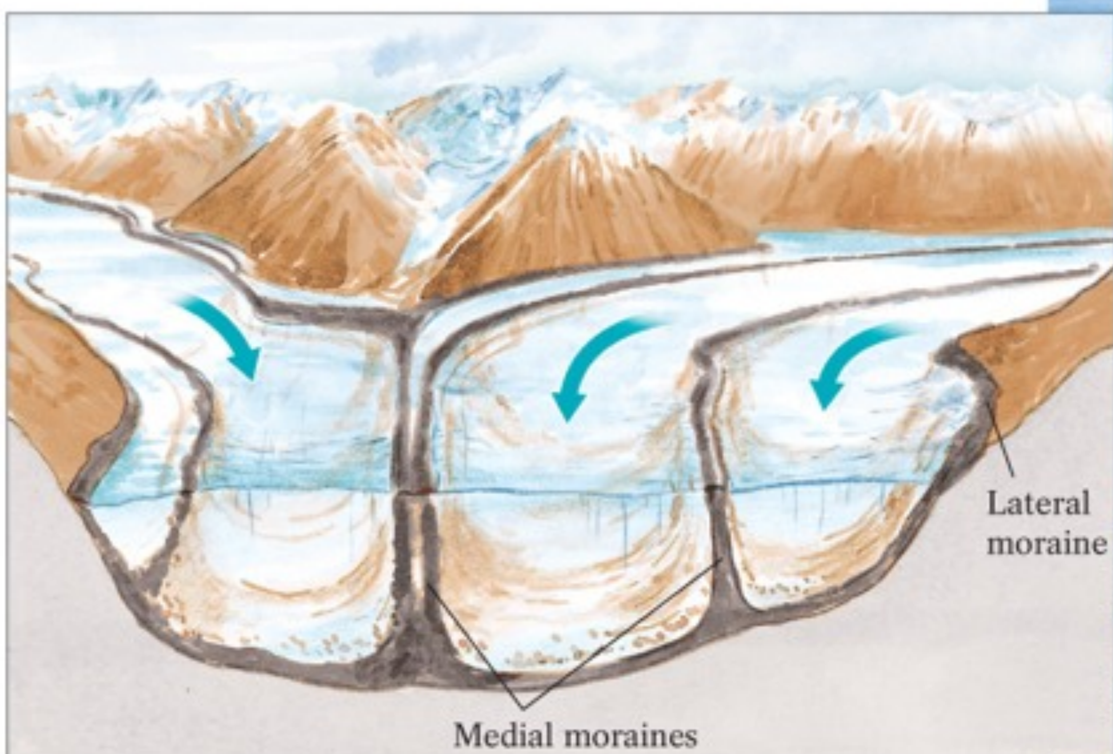

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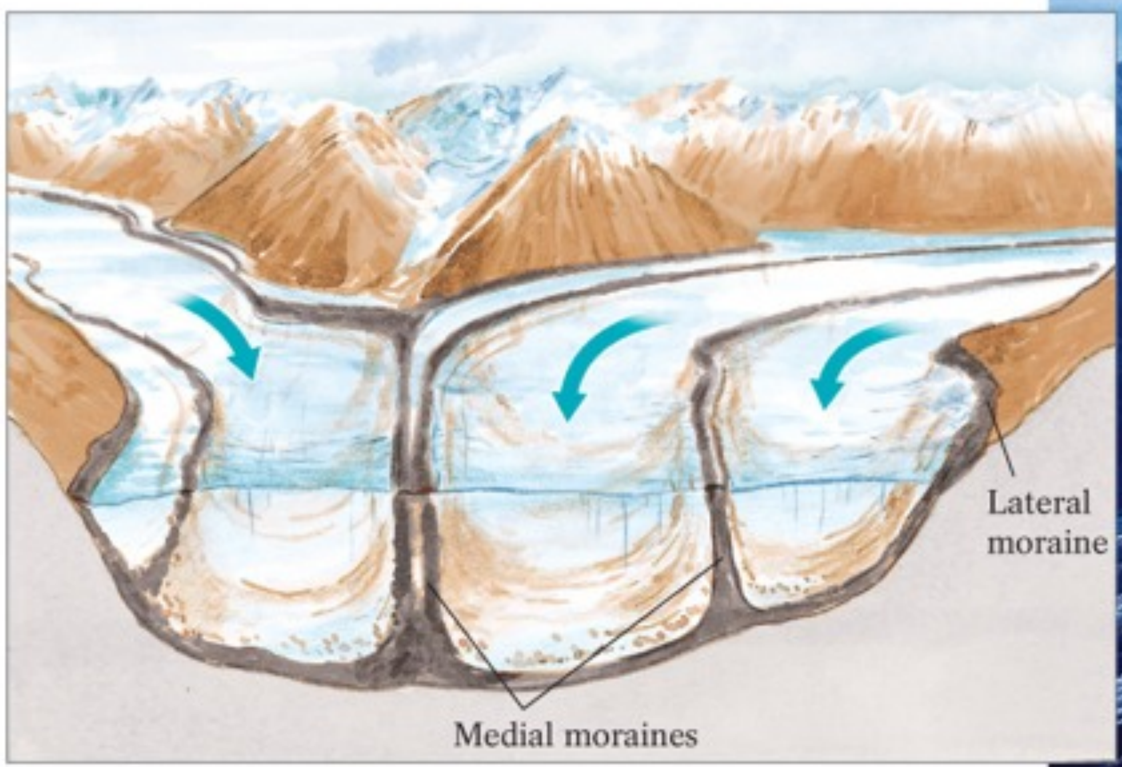
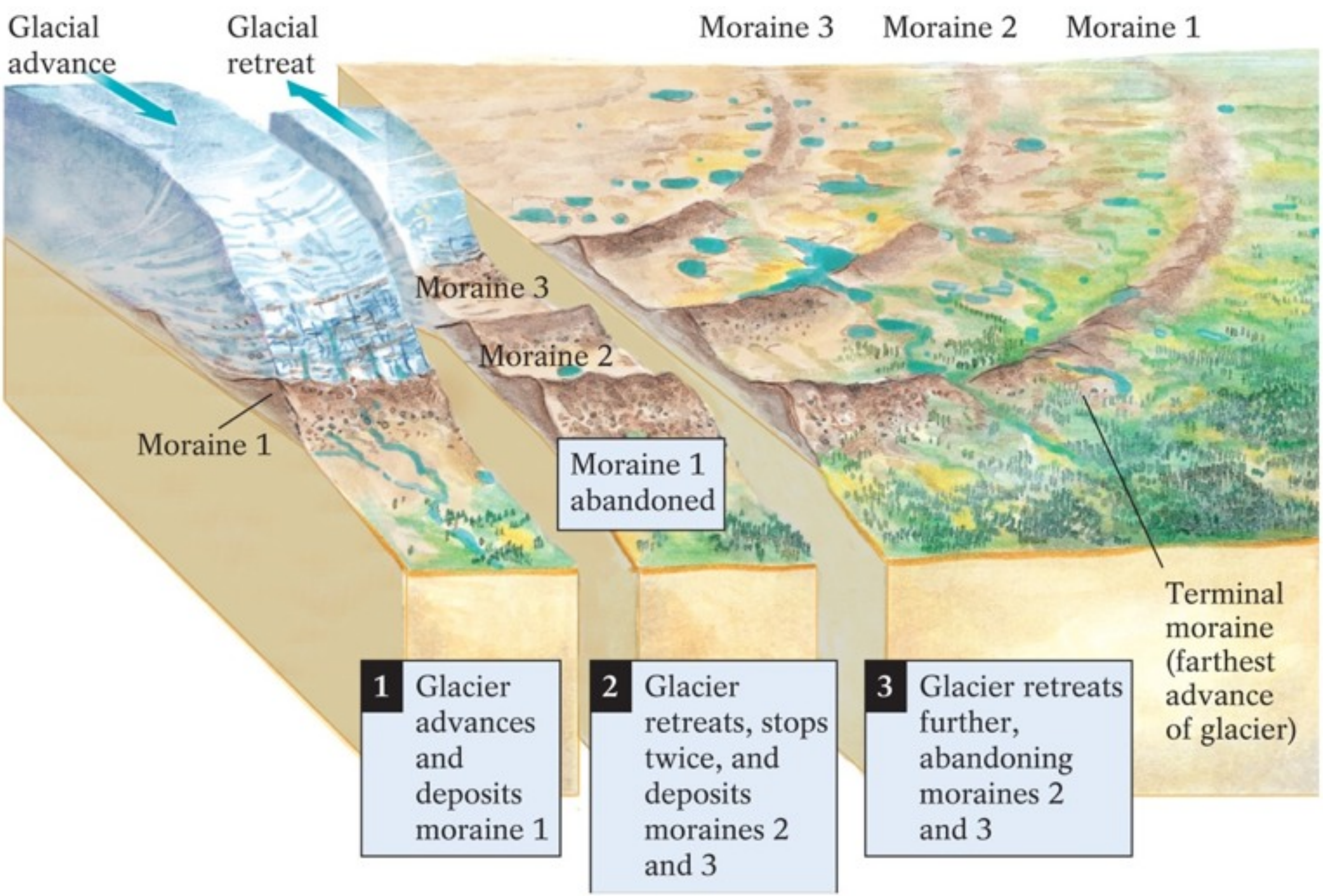


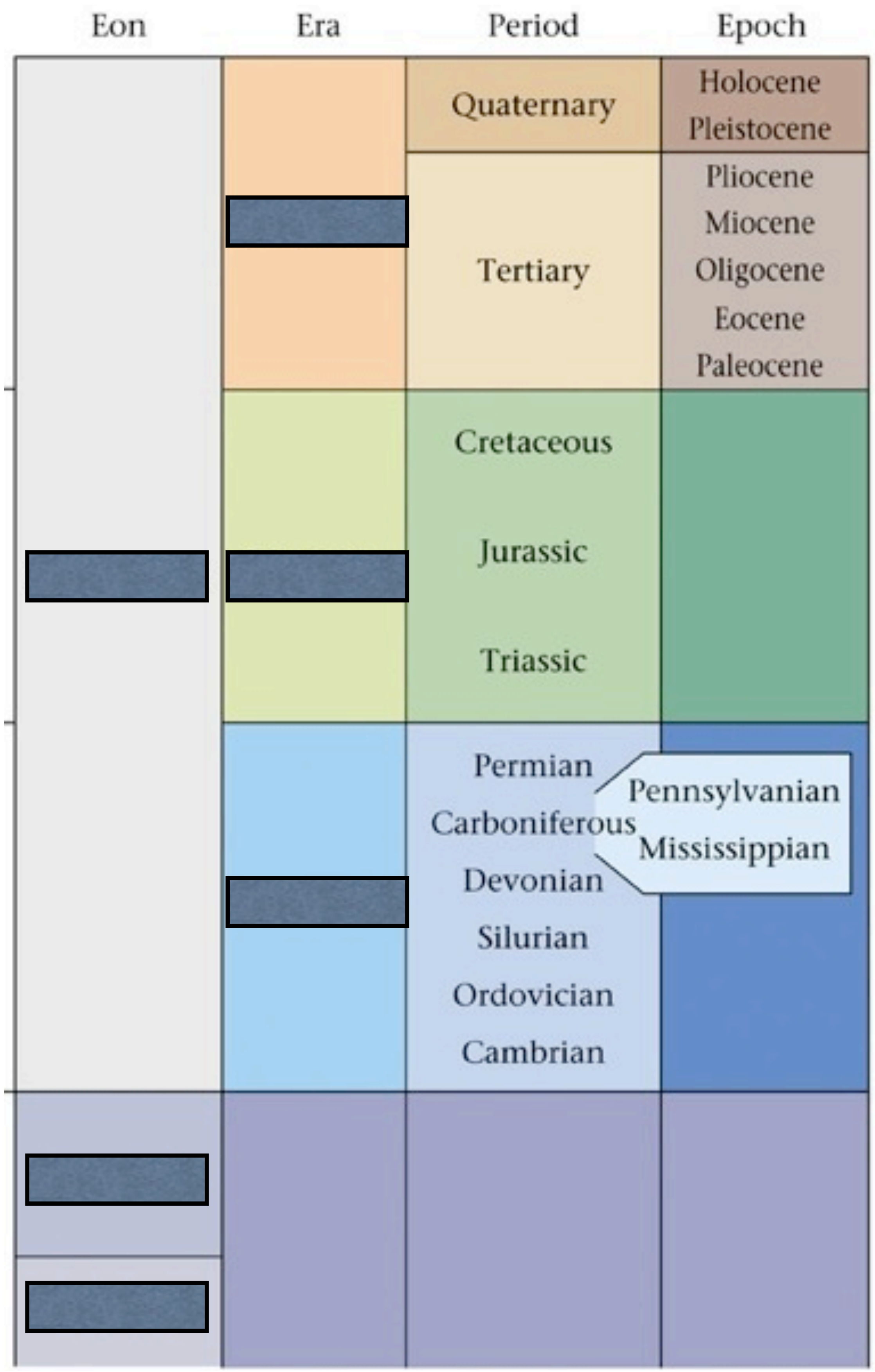
Glacial Deposition (Moraines)

Terminal — Lateral — Medial — Recessional



Glacial Deposition
Outwash Plain

What time is it?



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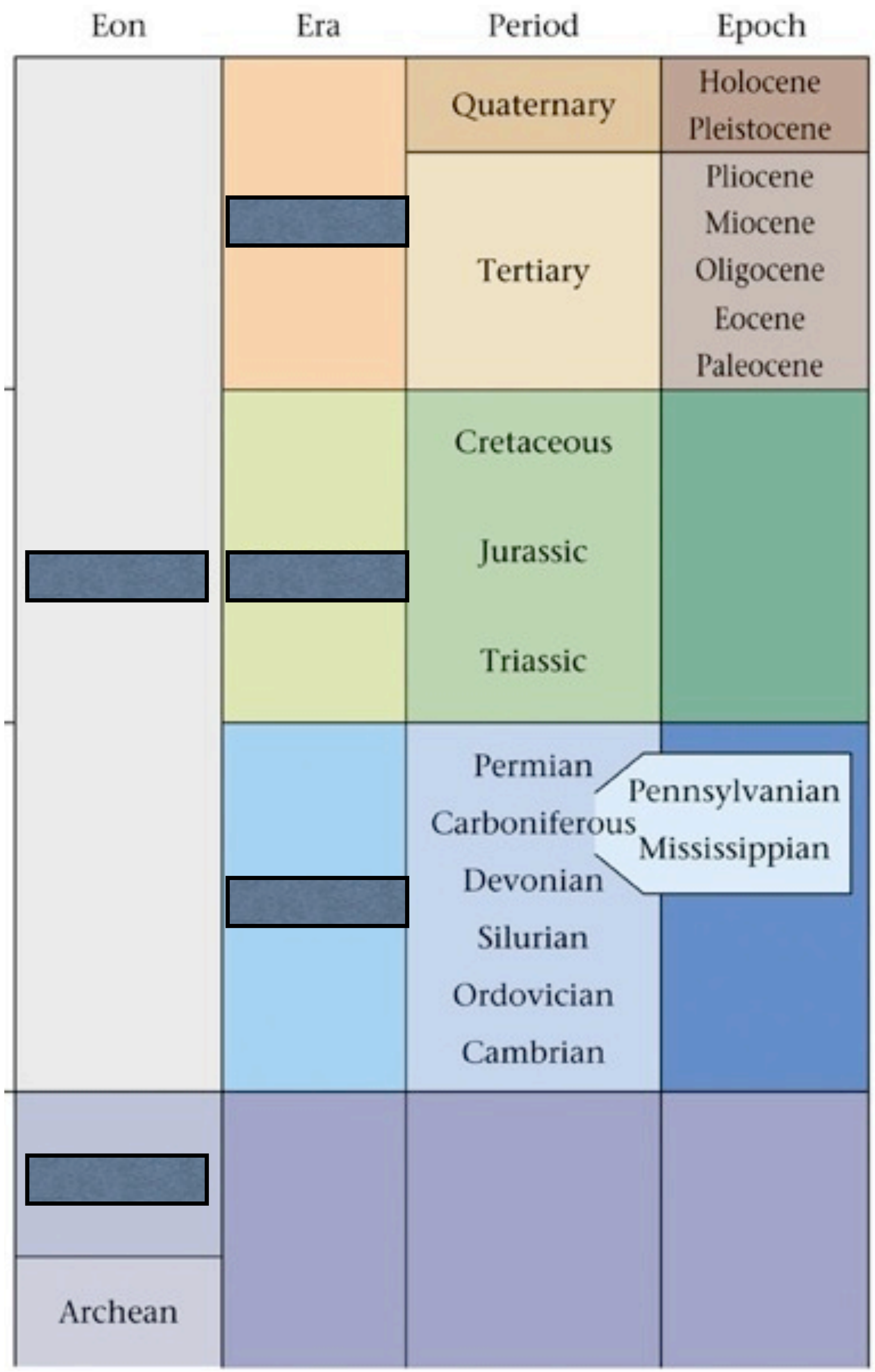

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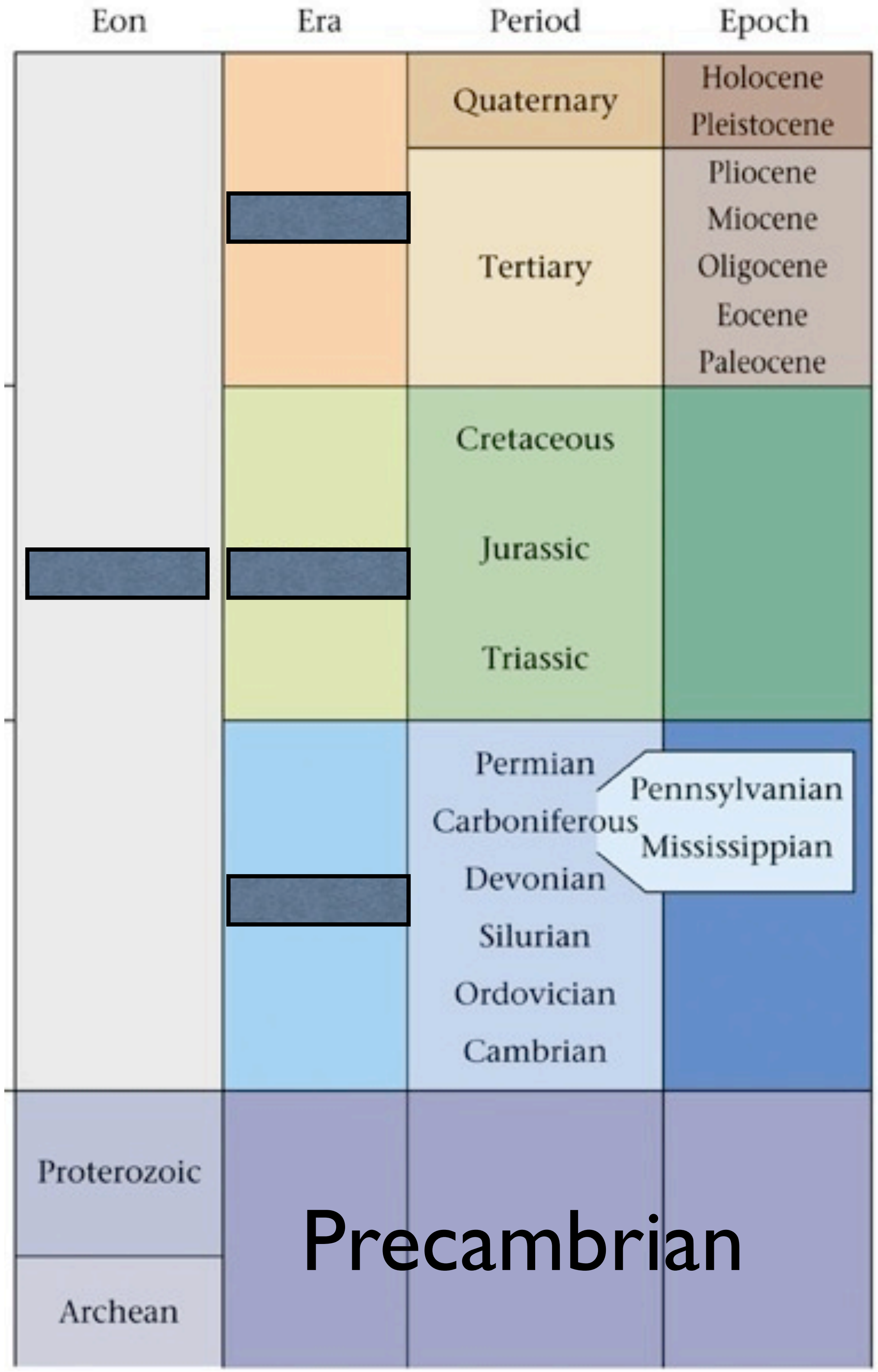

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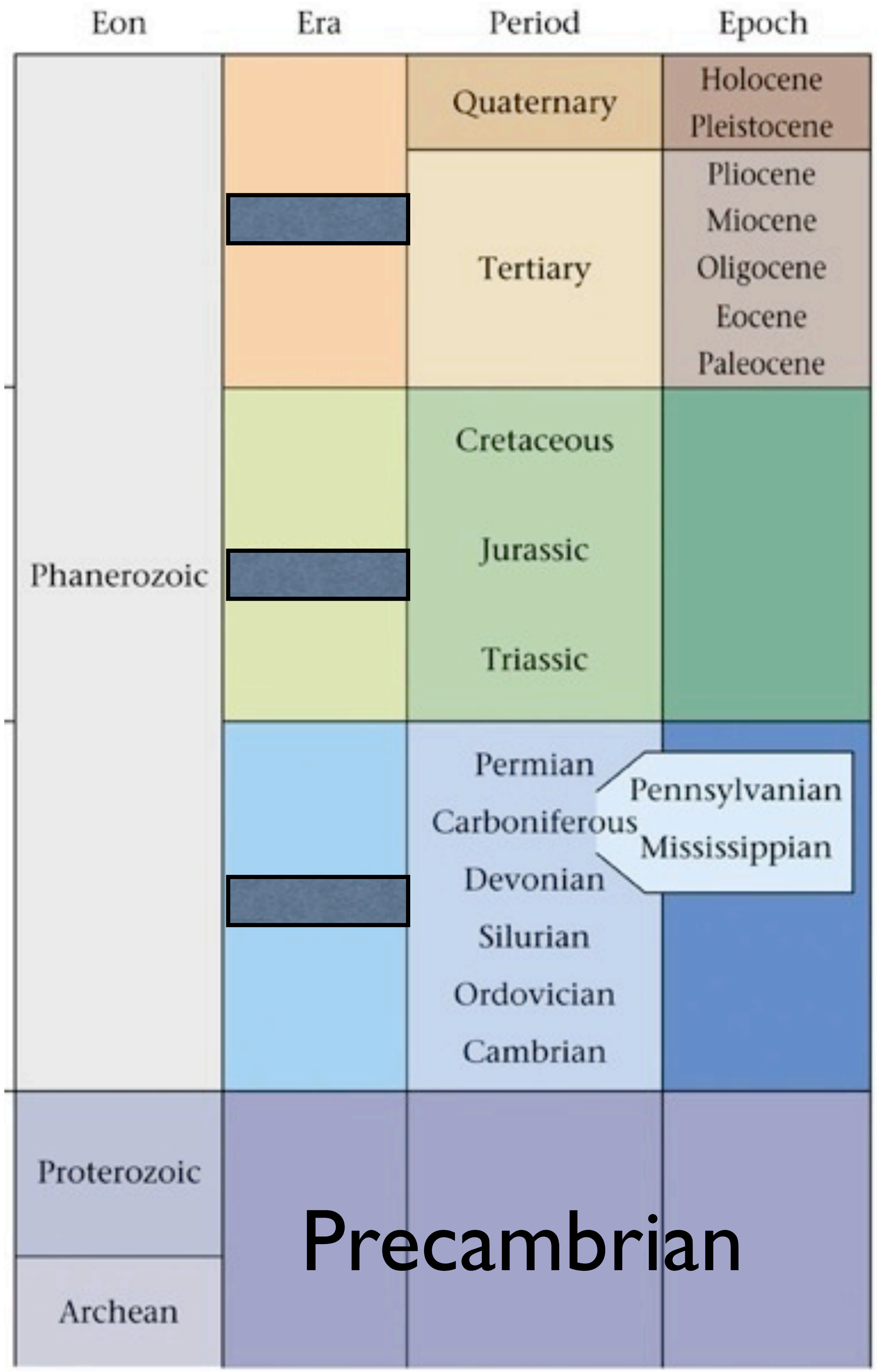

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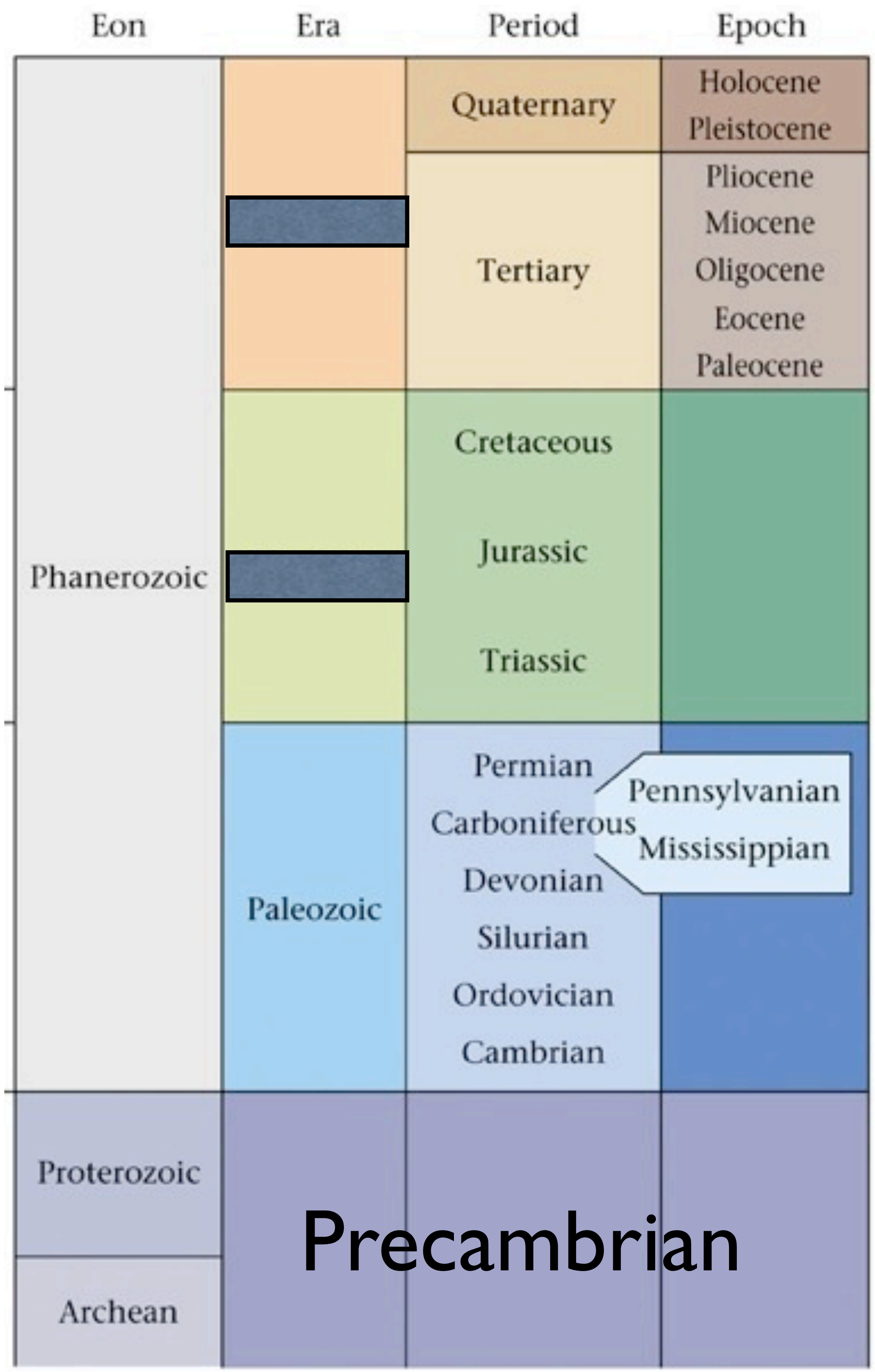

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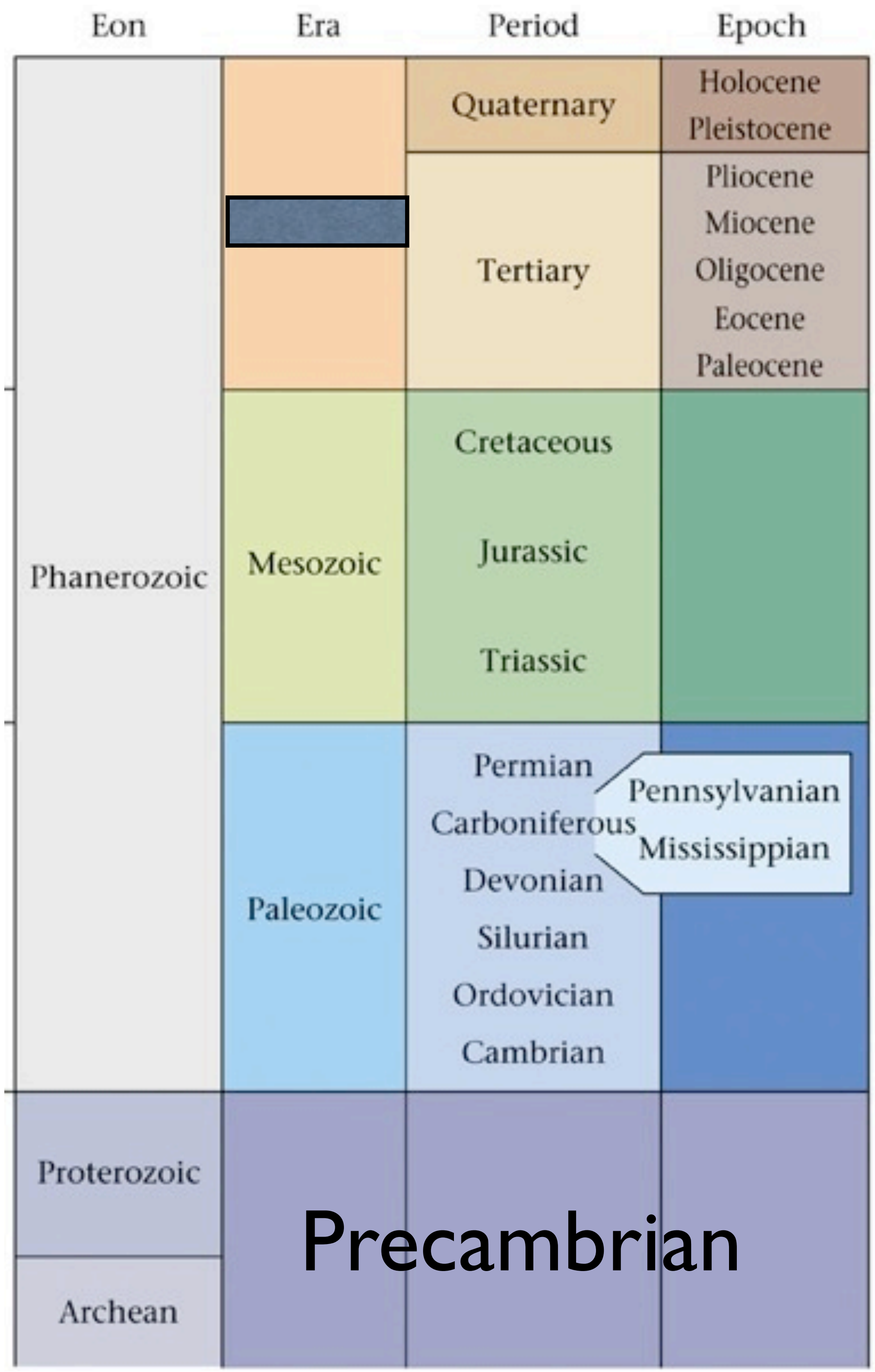

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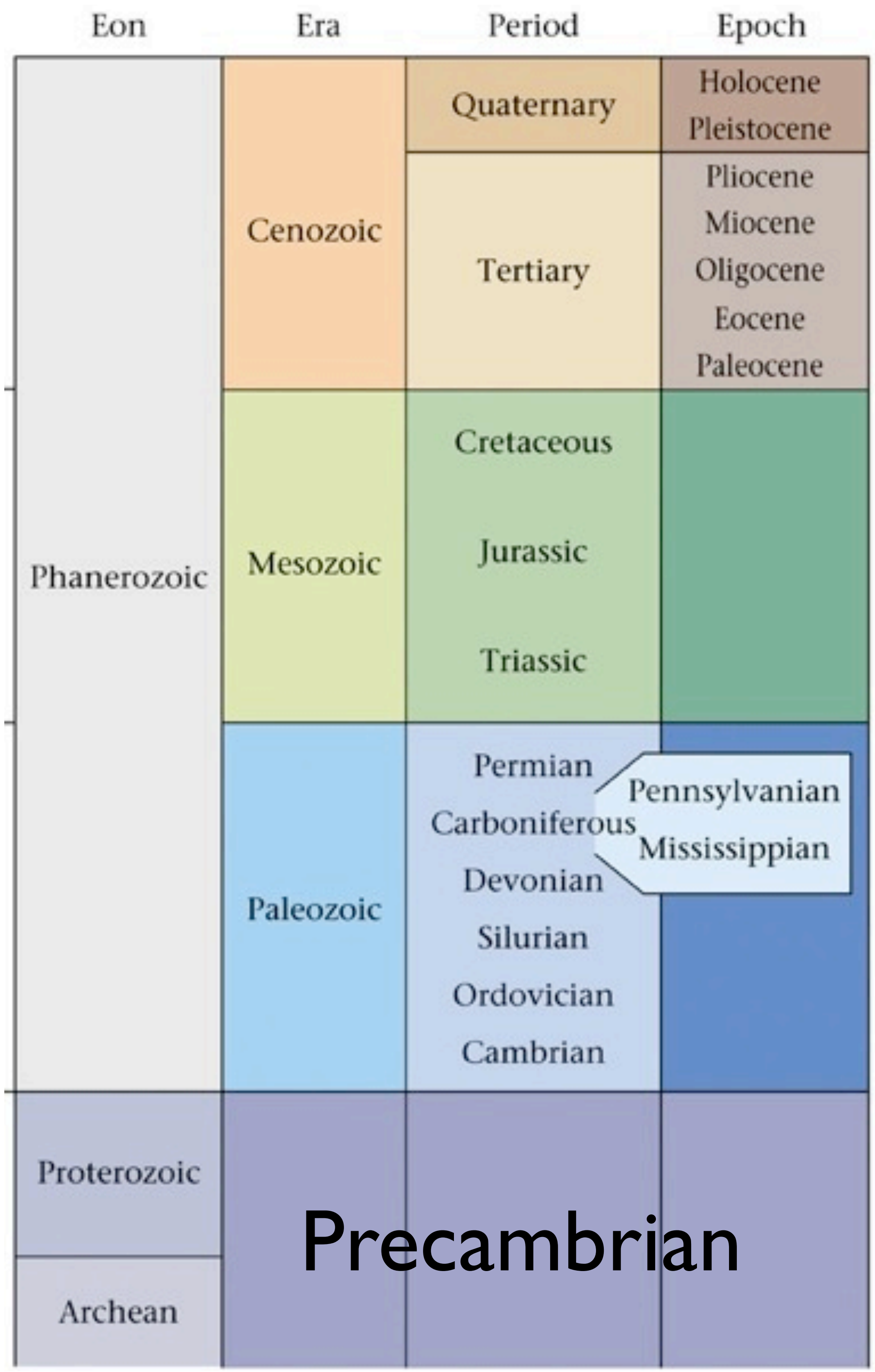

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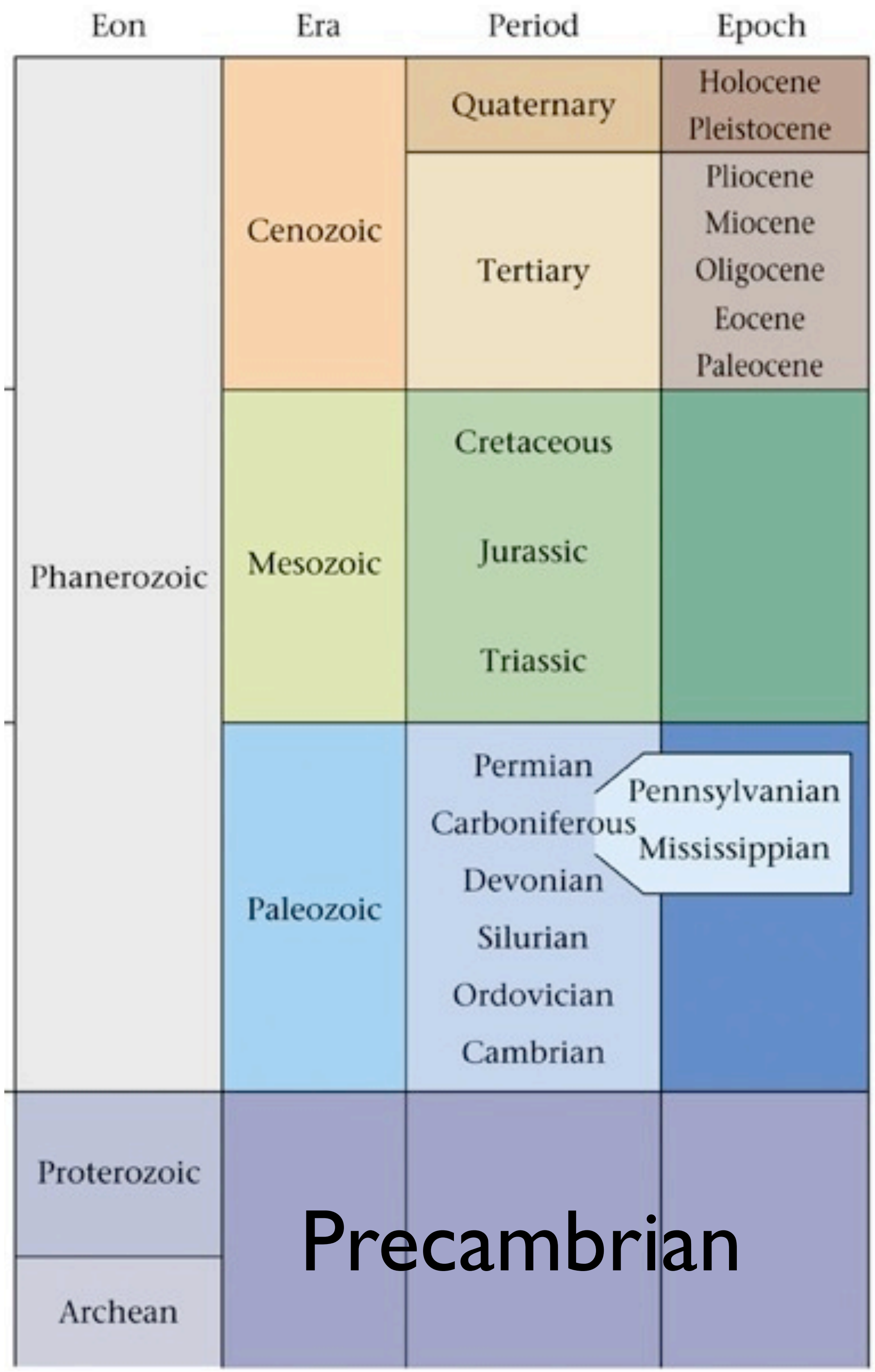
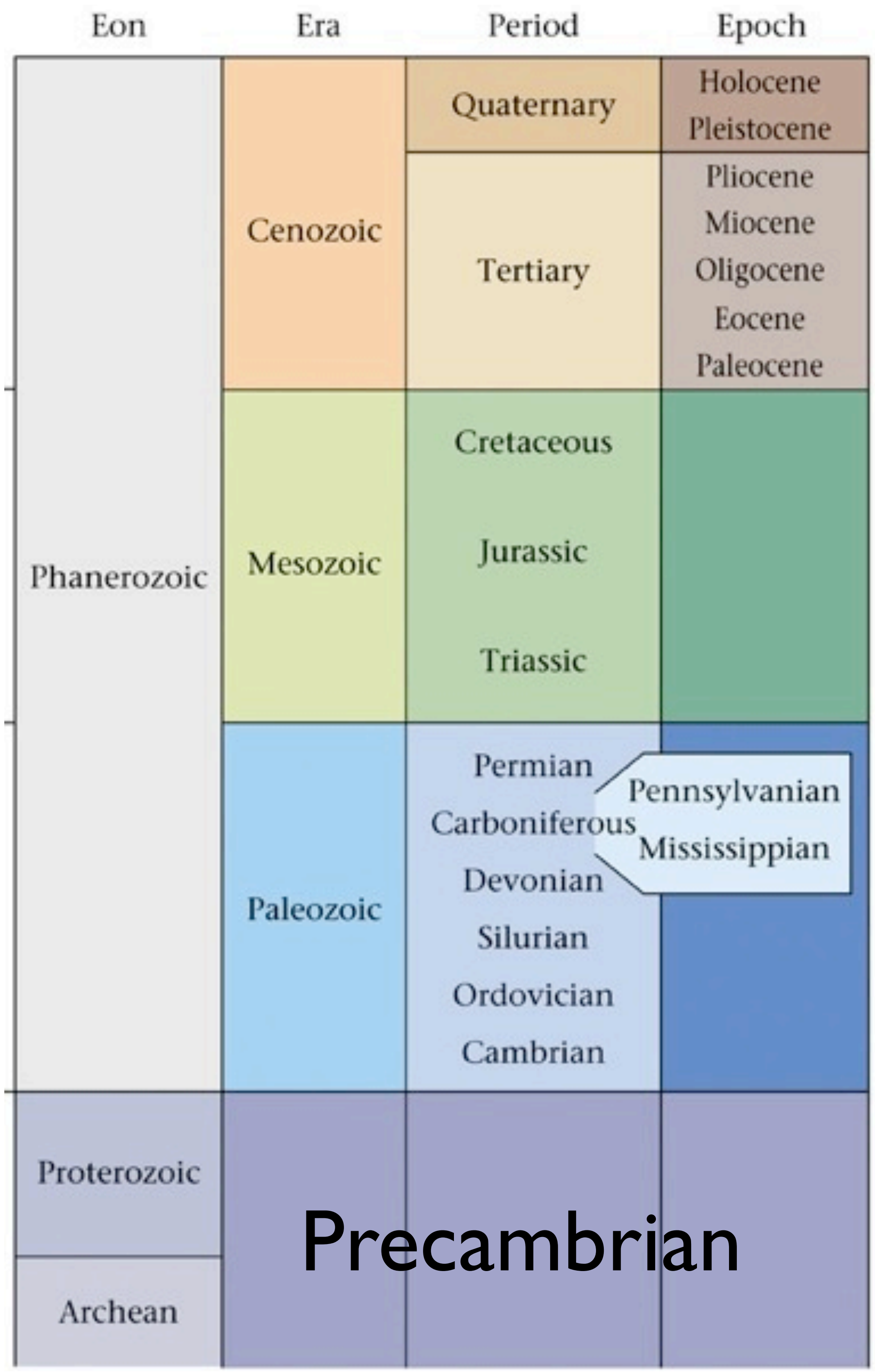


4.6 Ga

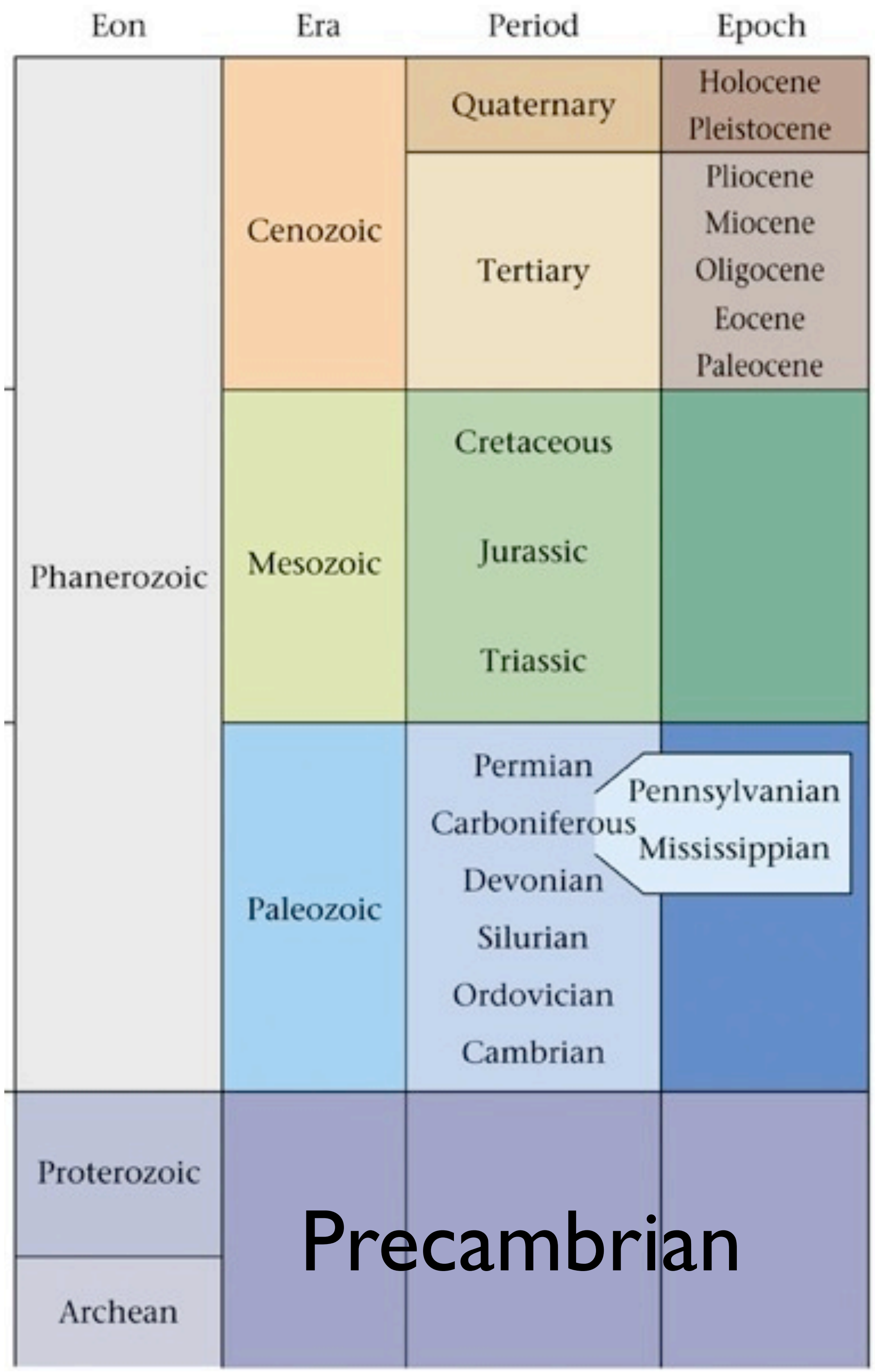
What time is it?



~545 Ma

4.6 Ga

What time is it?

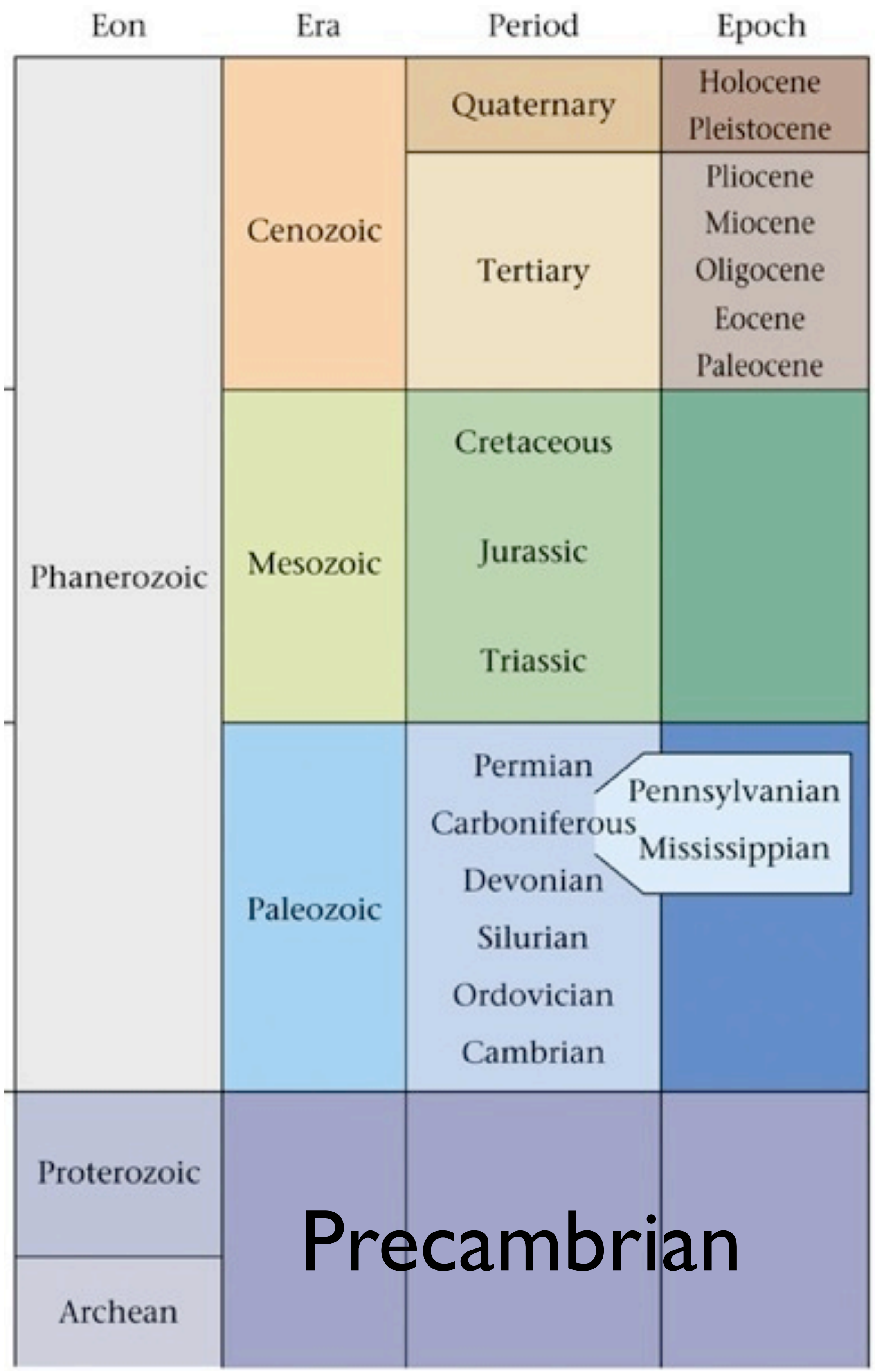


~245 Ma

~545 Ma

4.6 Ga

What time is it?



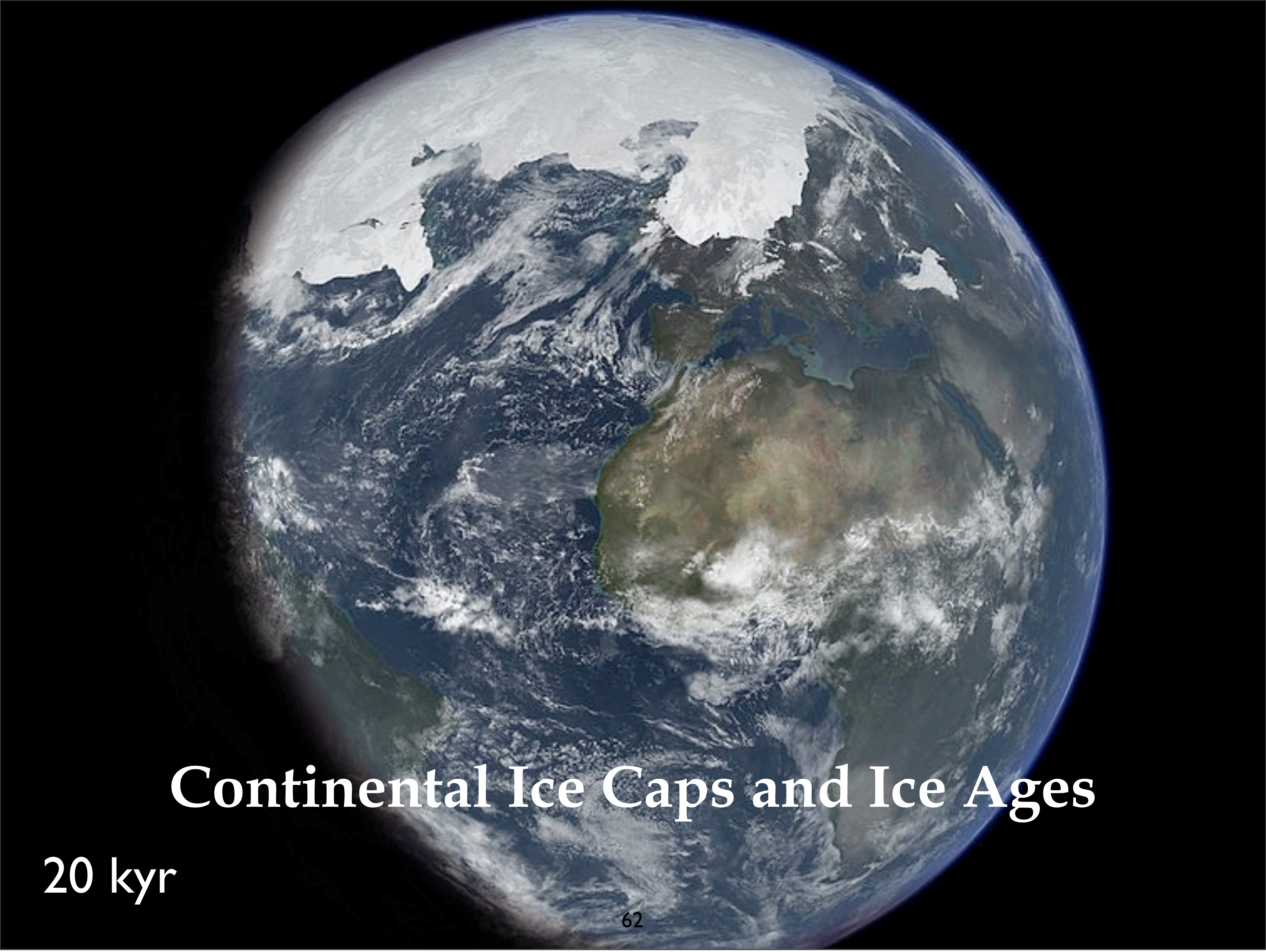
~65 Ma

~245 Ma

~545 Ma

4.6 Ga

Continental Ice Caps and Ice Ages



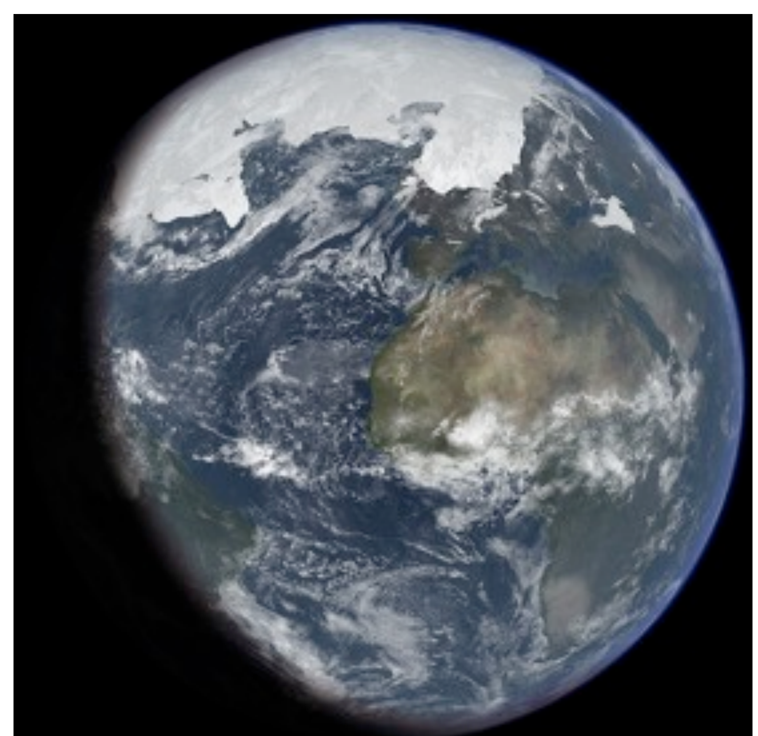
20 kyr

Continental Ice Caps and Ice Ages

20 kyr
(-5-7 C)

Continental Ice Caps and Ice Ages

Neanderthal

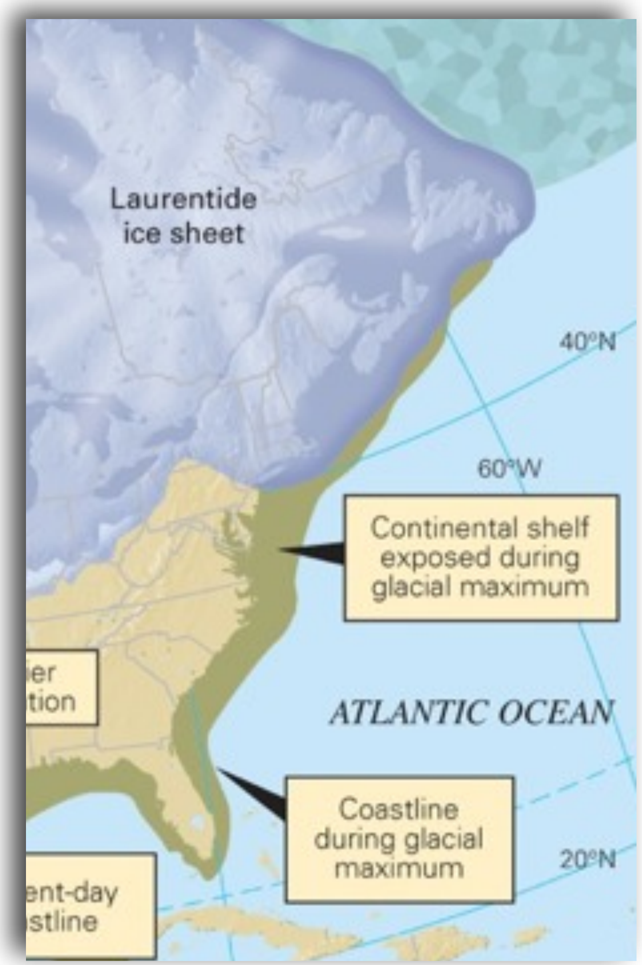


20 kyr
(-5-7 C)

Continental Ice Caps and Ice Ages

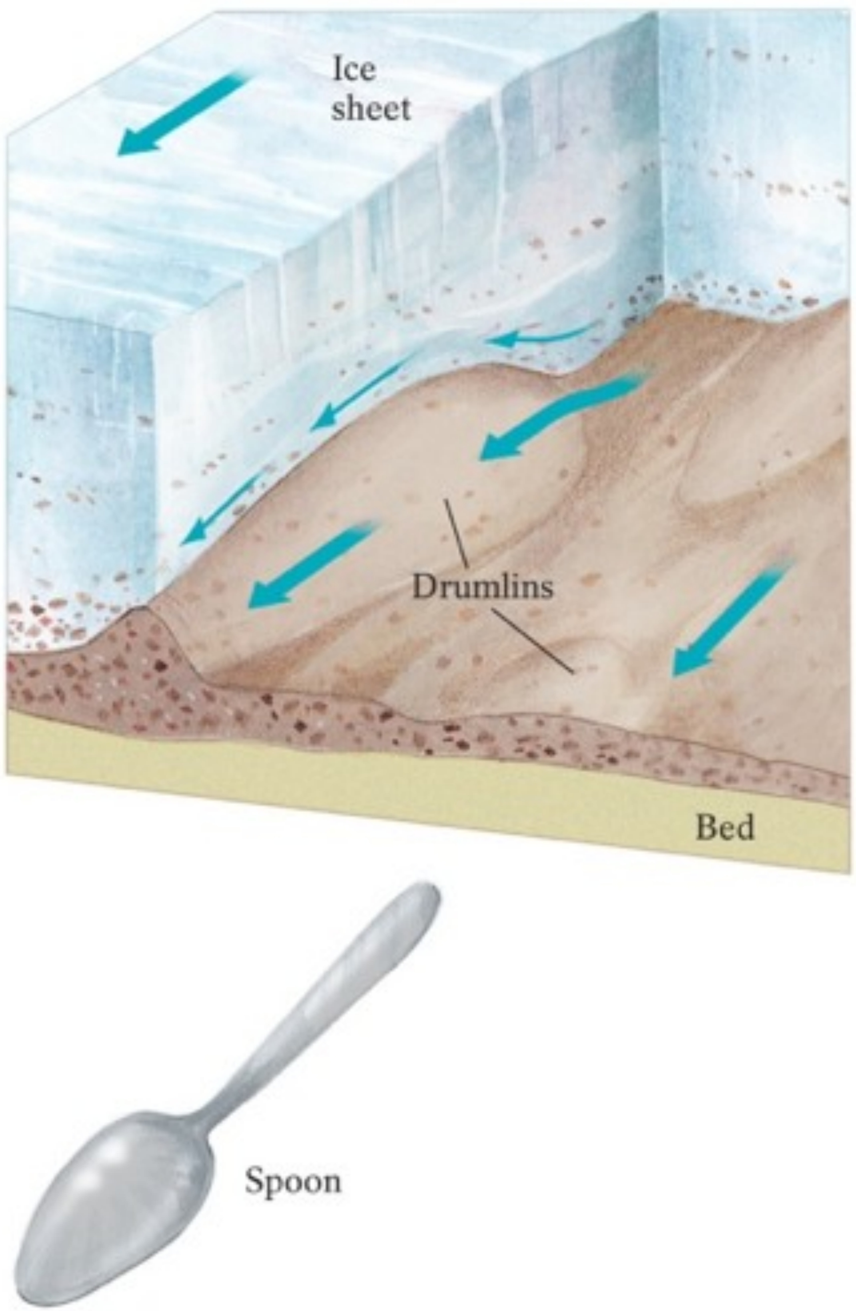
1) -20 k.y.
2) ~-10 F cooler
3) 30% of Earth

Continental Ice Caps and Ice Ages
Depositional feature: Ground Moraine

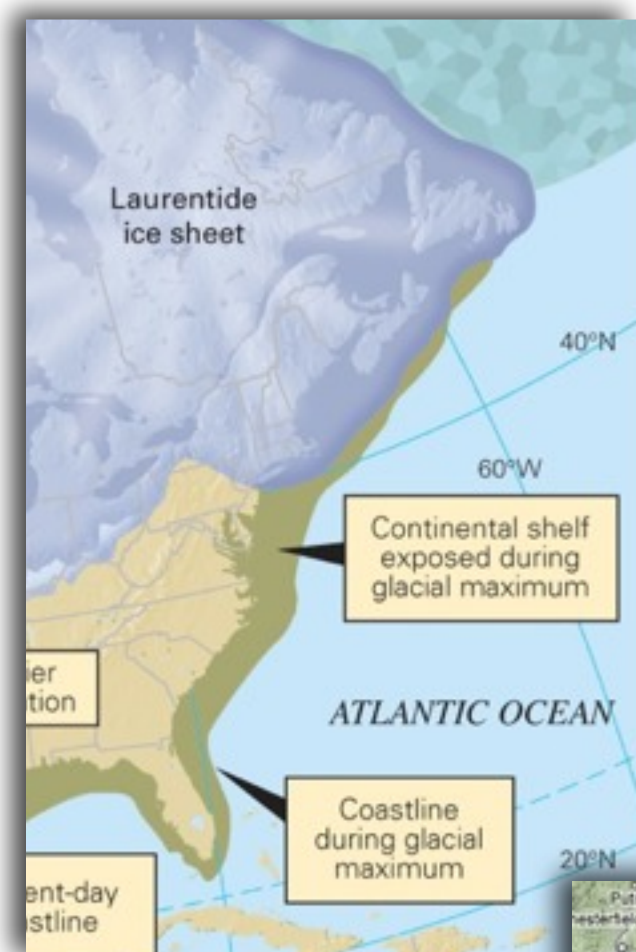


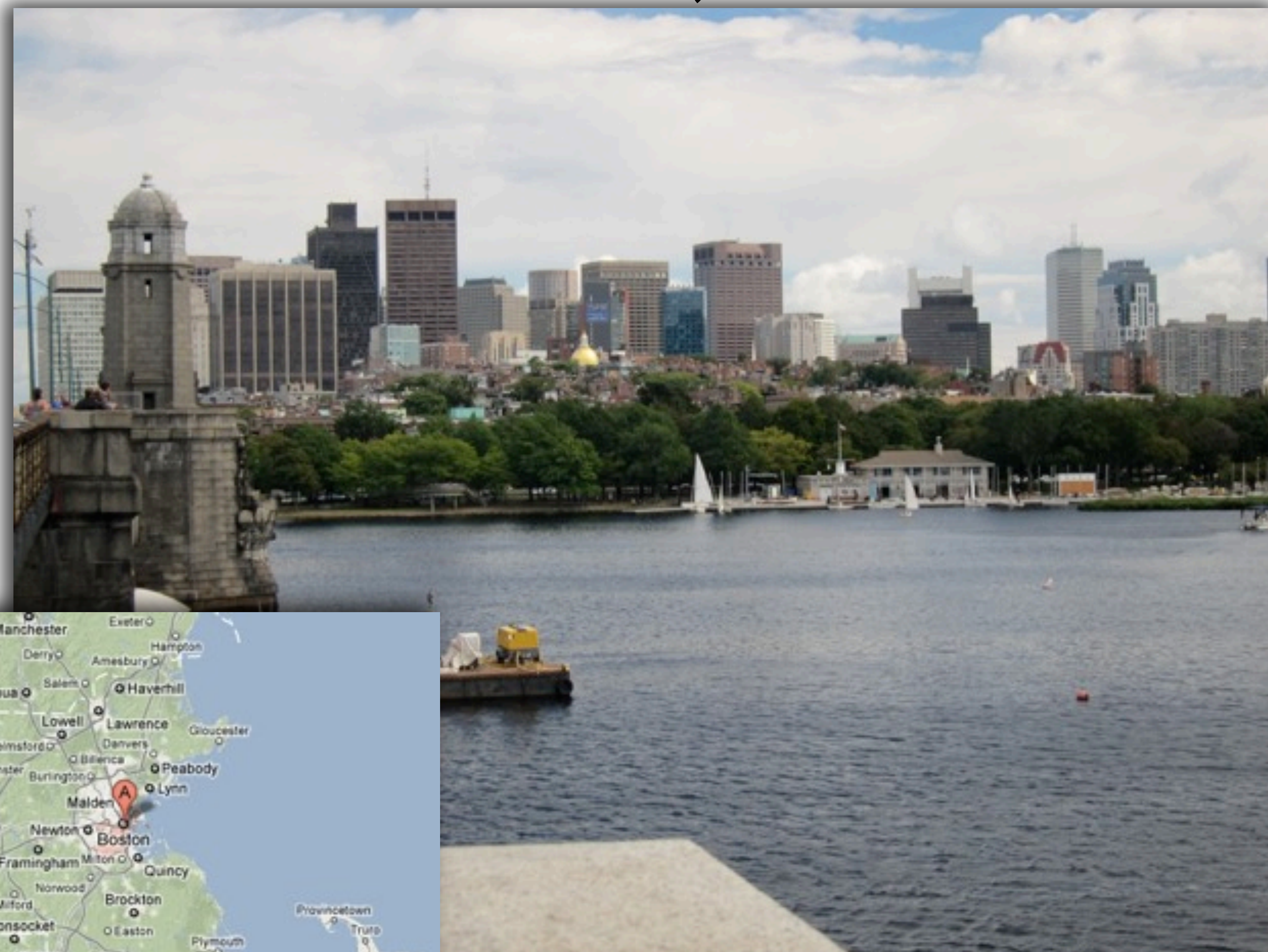
20 kyr
(-5-7 C)

Continental Ice Caps and Ice Ages
Drumlins



Continental Ice Caps and Ice Ages (How do we know?)

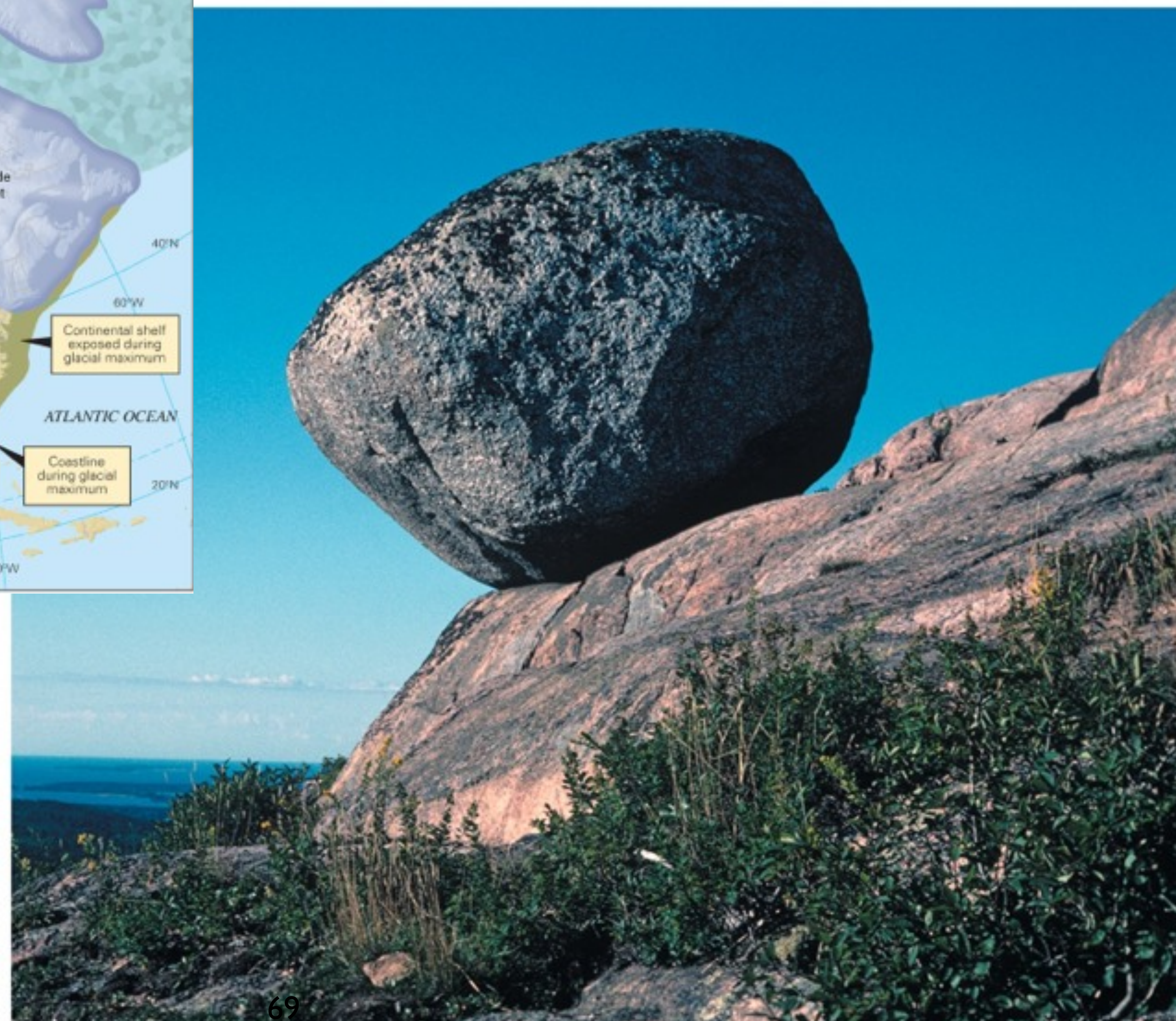




20 kyr
(-5-7 C)

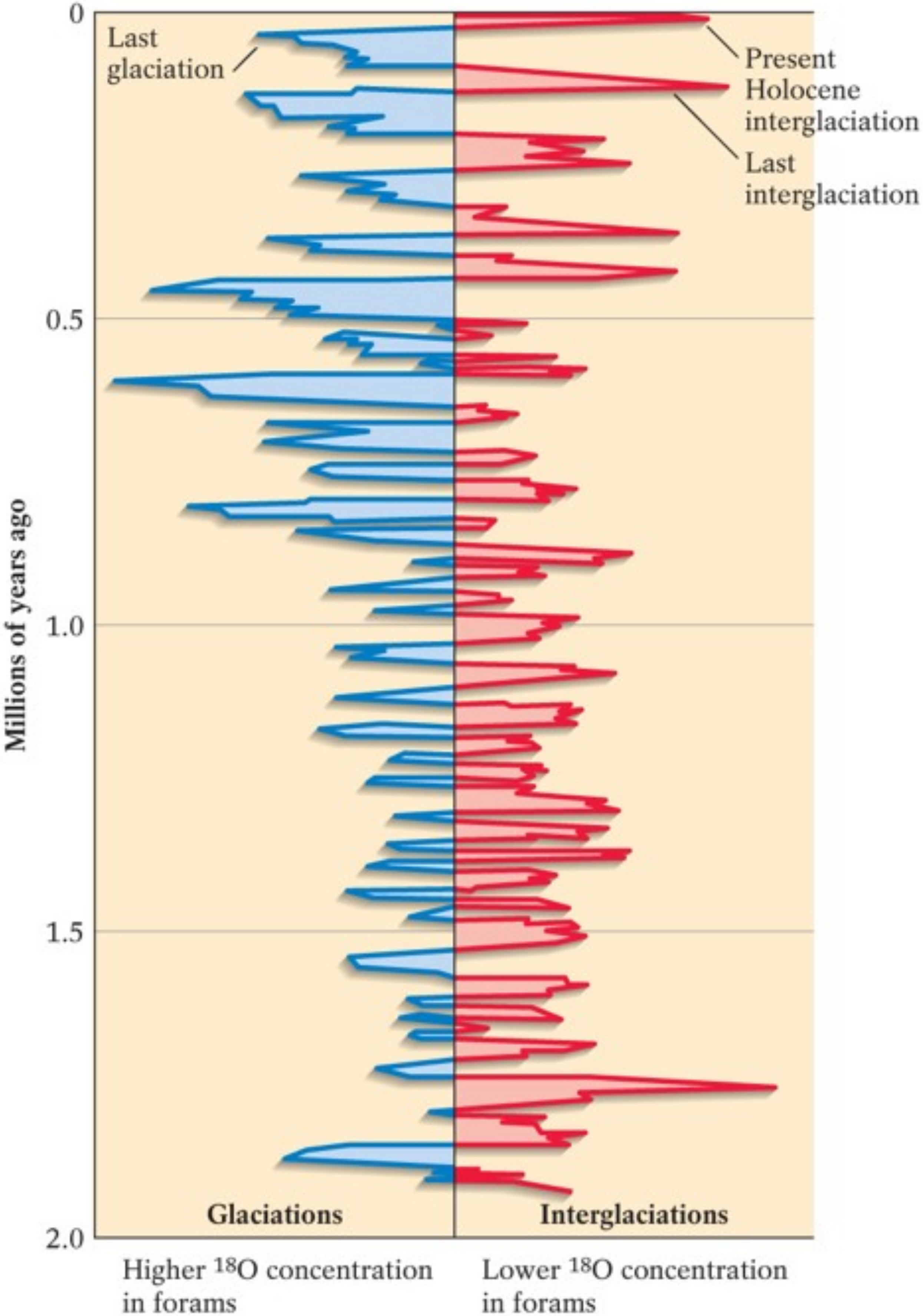
Continental Ice Caps and Ice Ages

Glacial Erratic

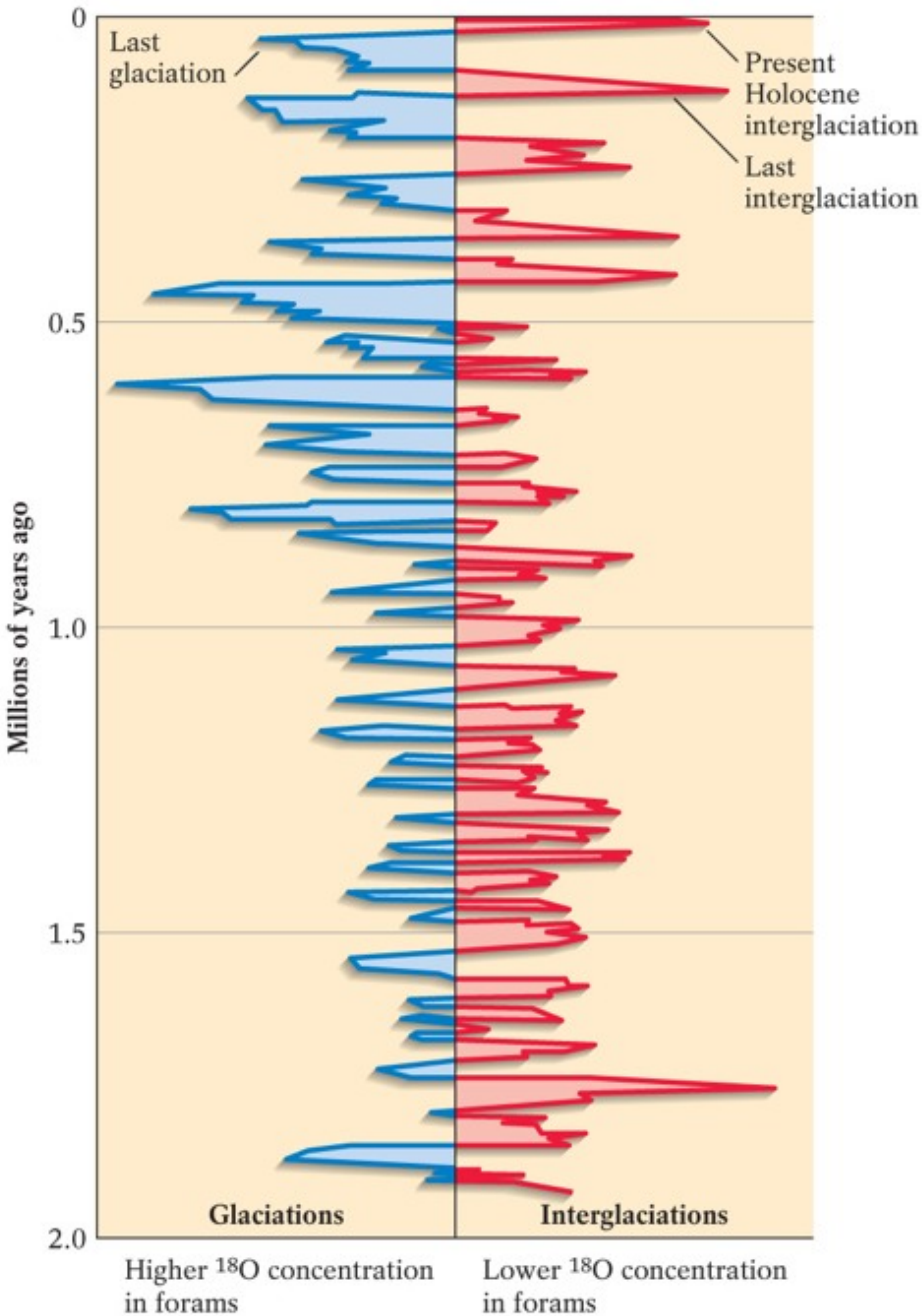


20 kyr
(-5-7 C)

Glacial and Interglacial cycles



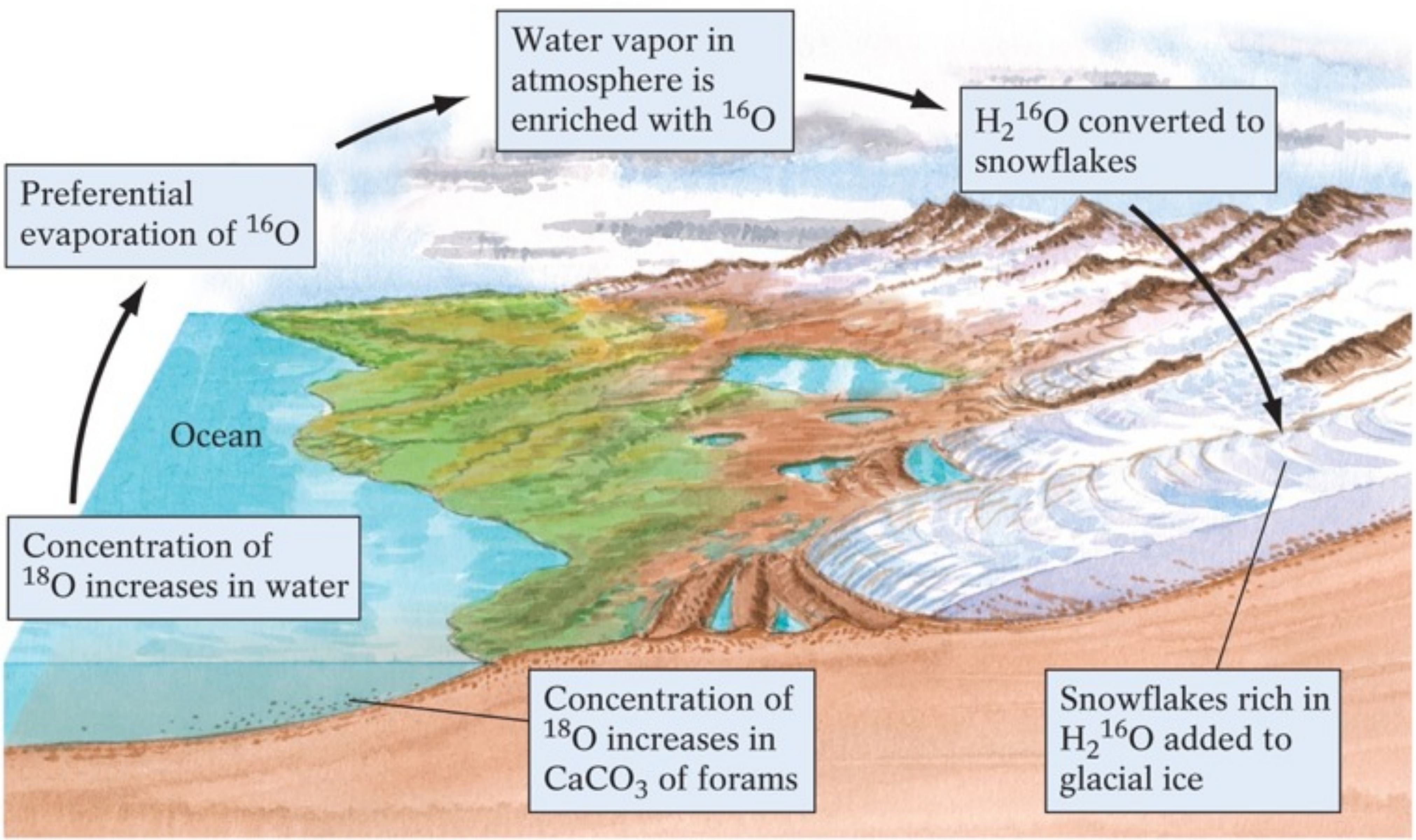
Glacial and Interglacial cycles



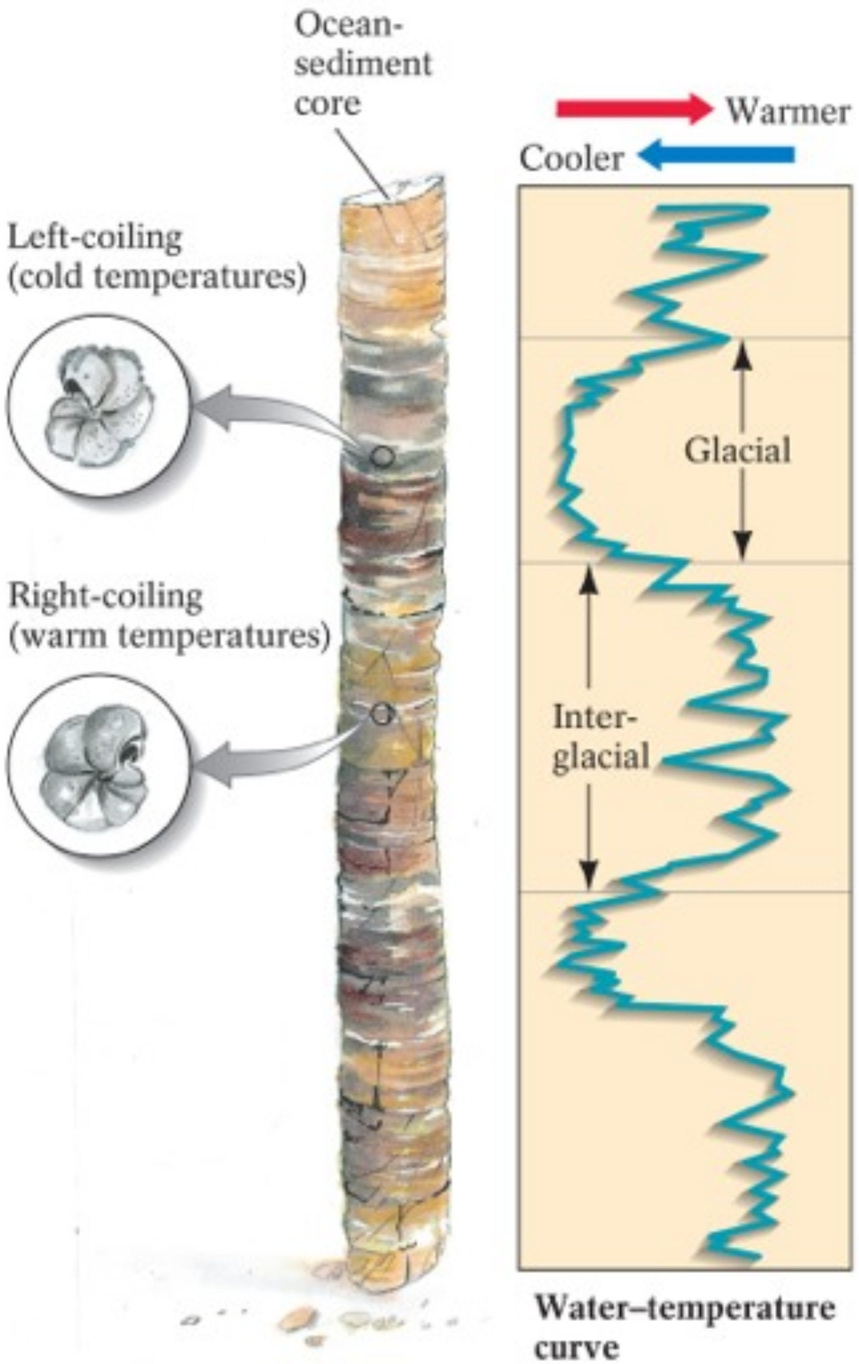
(How do we know?)

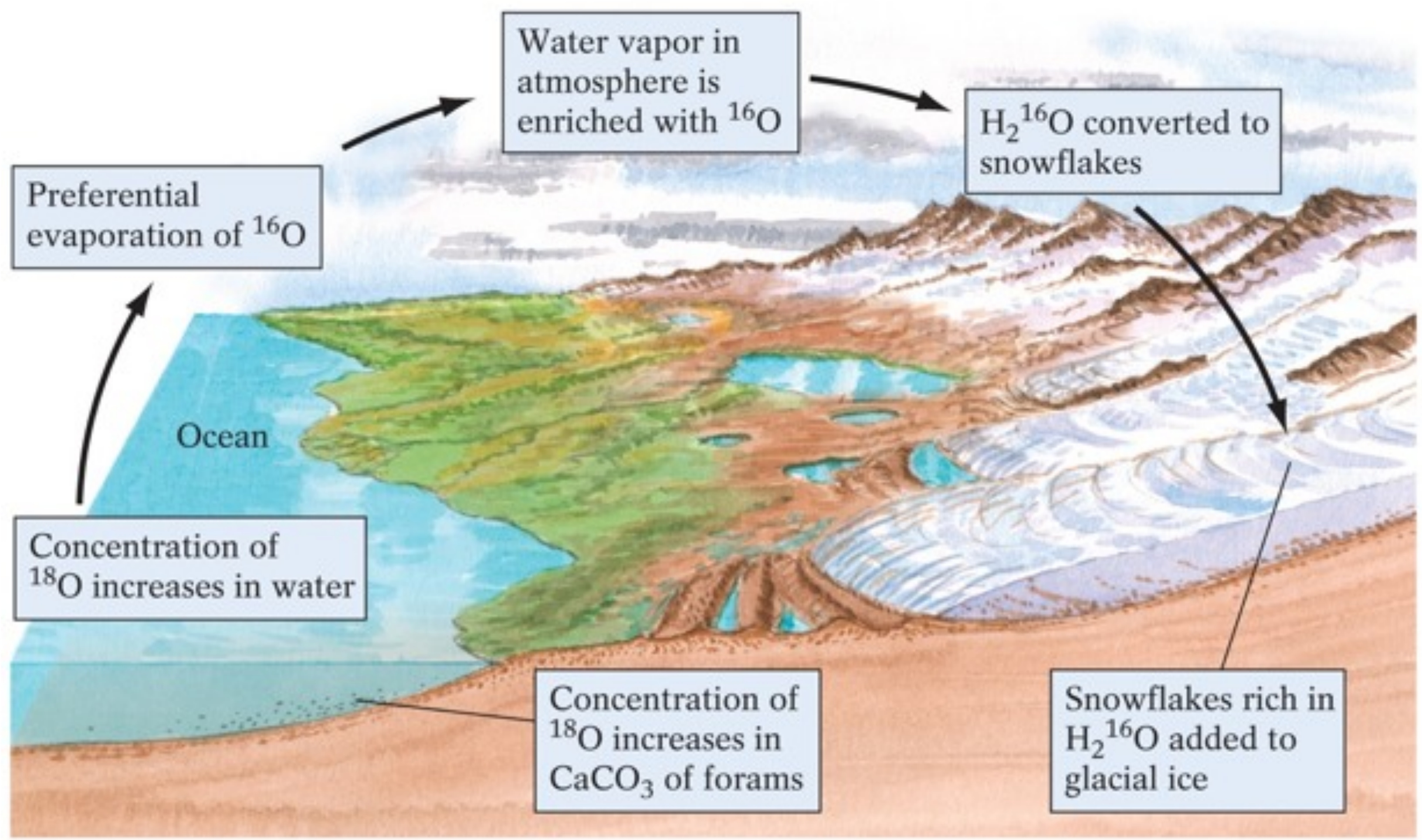
Continental Ice Caps and Ice Ages (How do we know?)

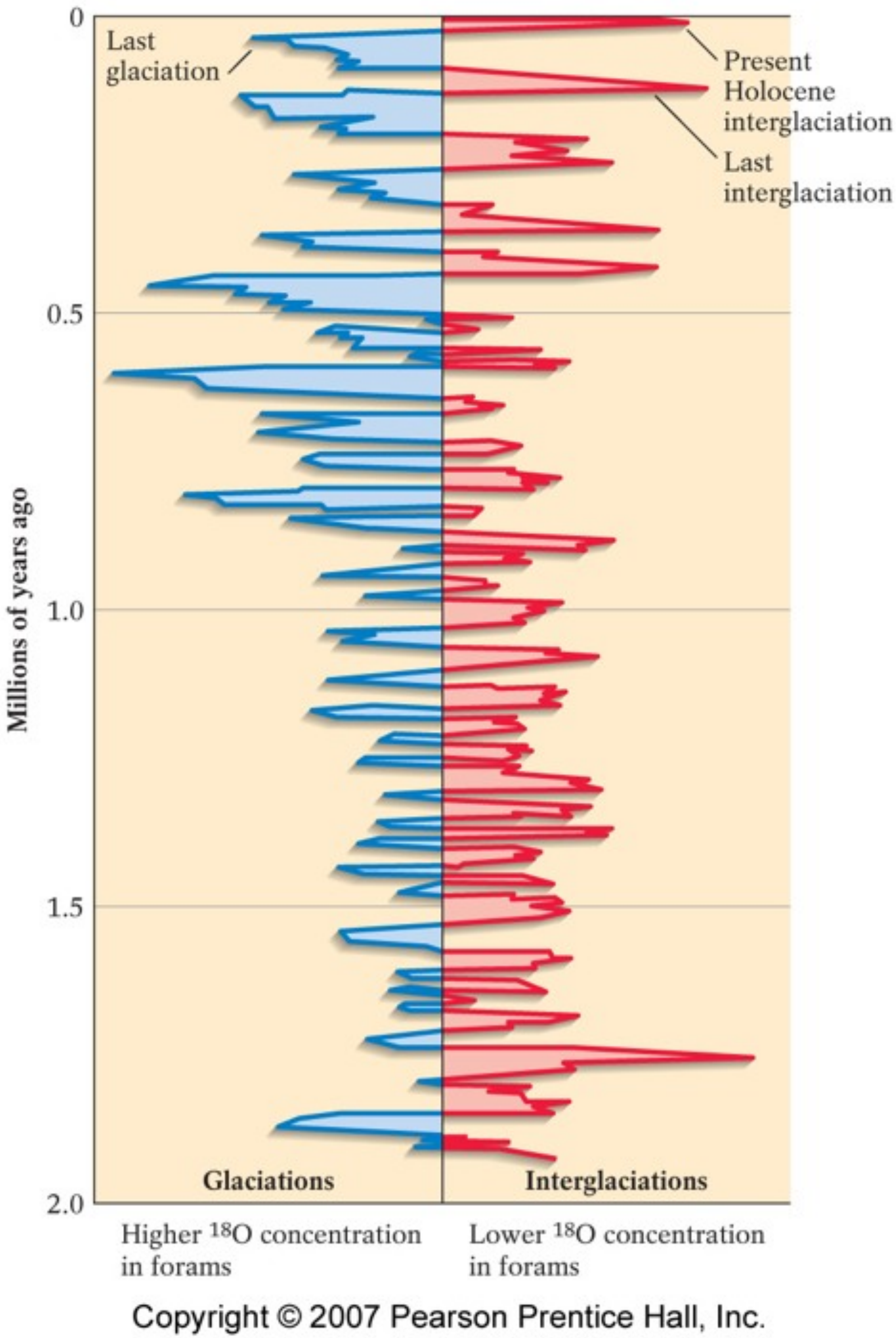
Stable Isotopes of Oxygen16 and Oxygen 18



Continental Ice Caps and Ice Ages (How do we know?)







Glacial and Interglacial cycles

~100,000 year cyclicity separated by brief intervals (10,000yr)

Continental Ice Caps and Ice Ages (What are the Driving forces?)

There is consensus among scientists that three main factors must be present in order for an Ice Age to occur

1) Sizable landmass at or near the poles; 2) land surfaces with relatively high elevations; 3) and nearby oceans to provide moisture

Continental Ice Caps and Ice Ages (What are the Driving forces?)

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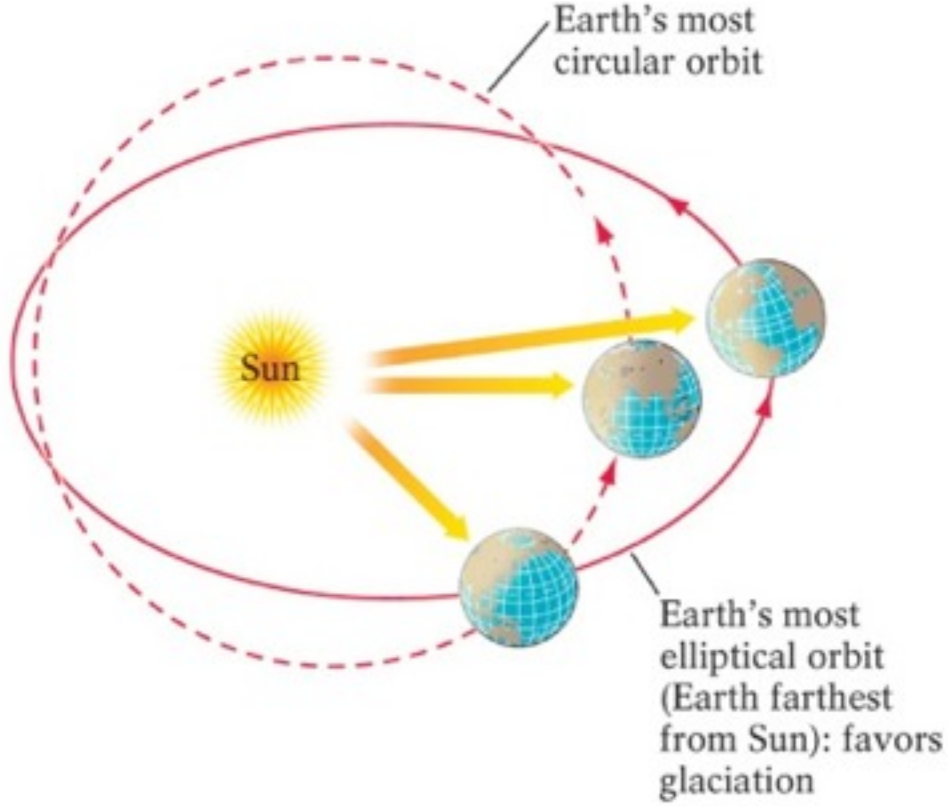
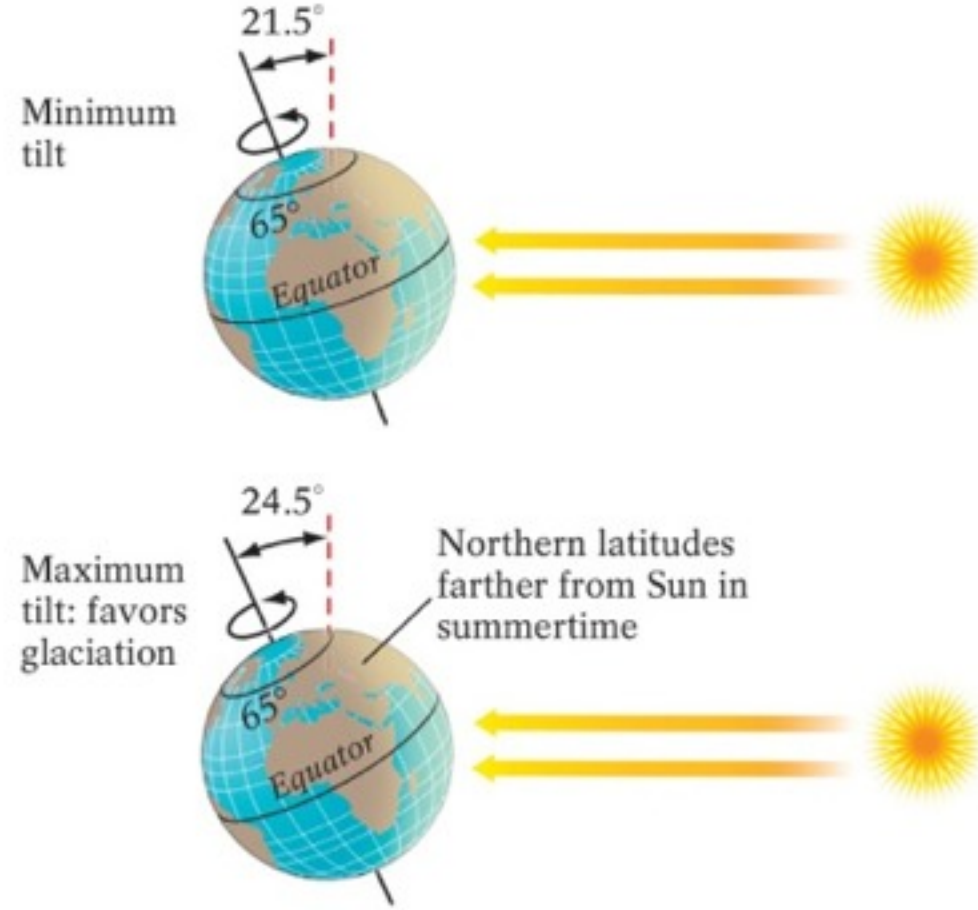
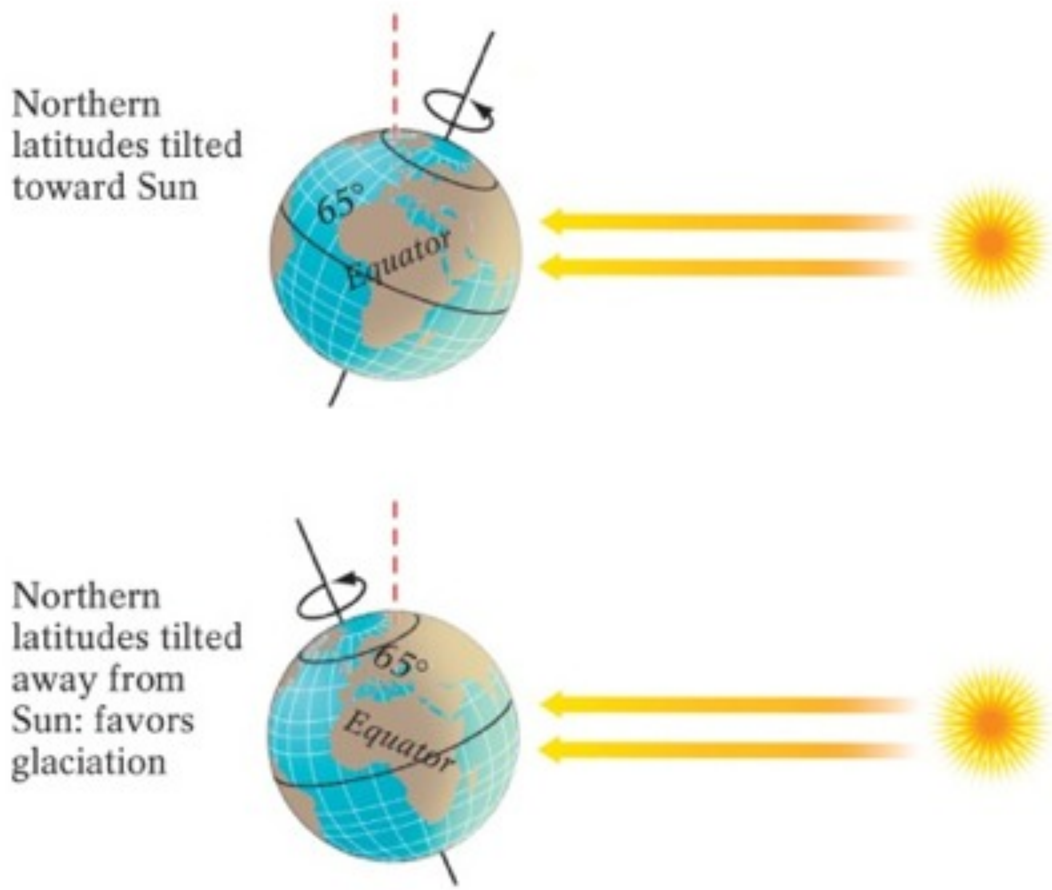
Why cannot plate tectonics be the driving force?



(a) Orbital effects

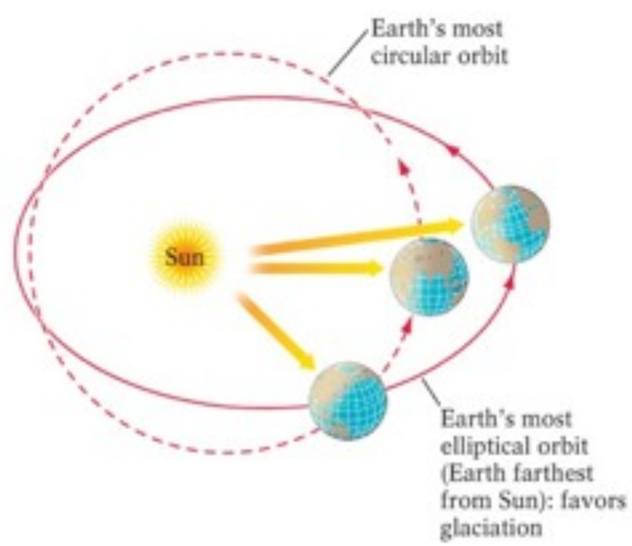


(b) Tilt of Earth's axis of rotation



Milutin Milankovitch suggested Orbital forcing was the dominate mechanism

Milonkovitch Cycles



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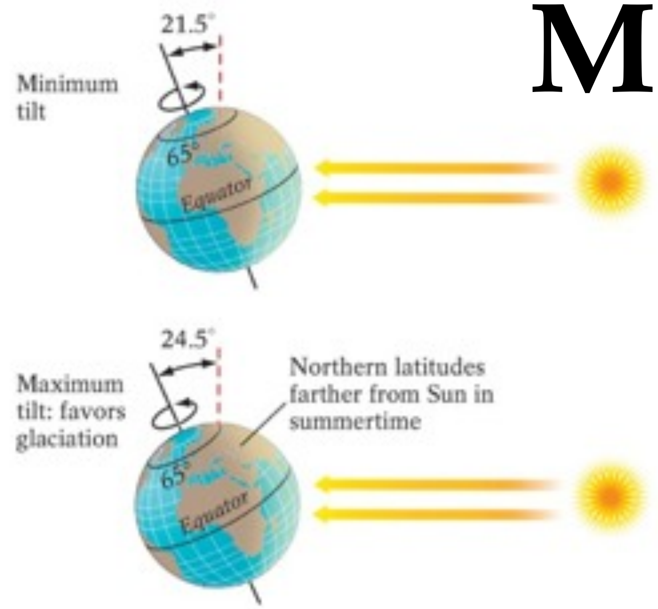

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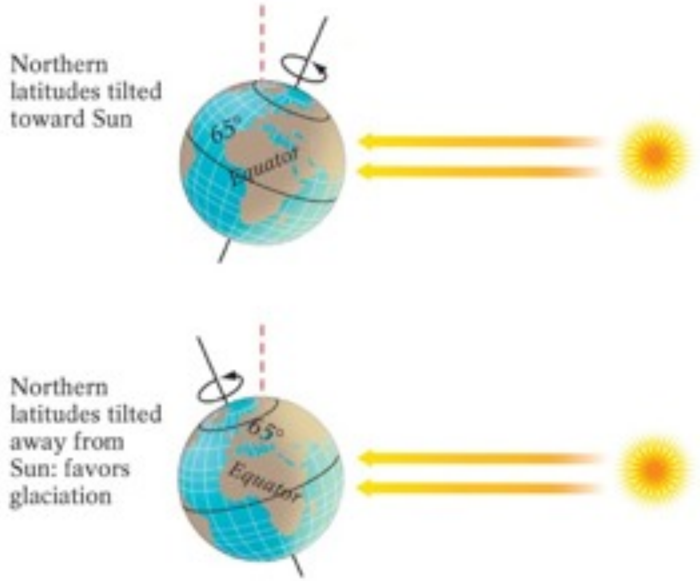
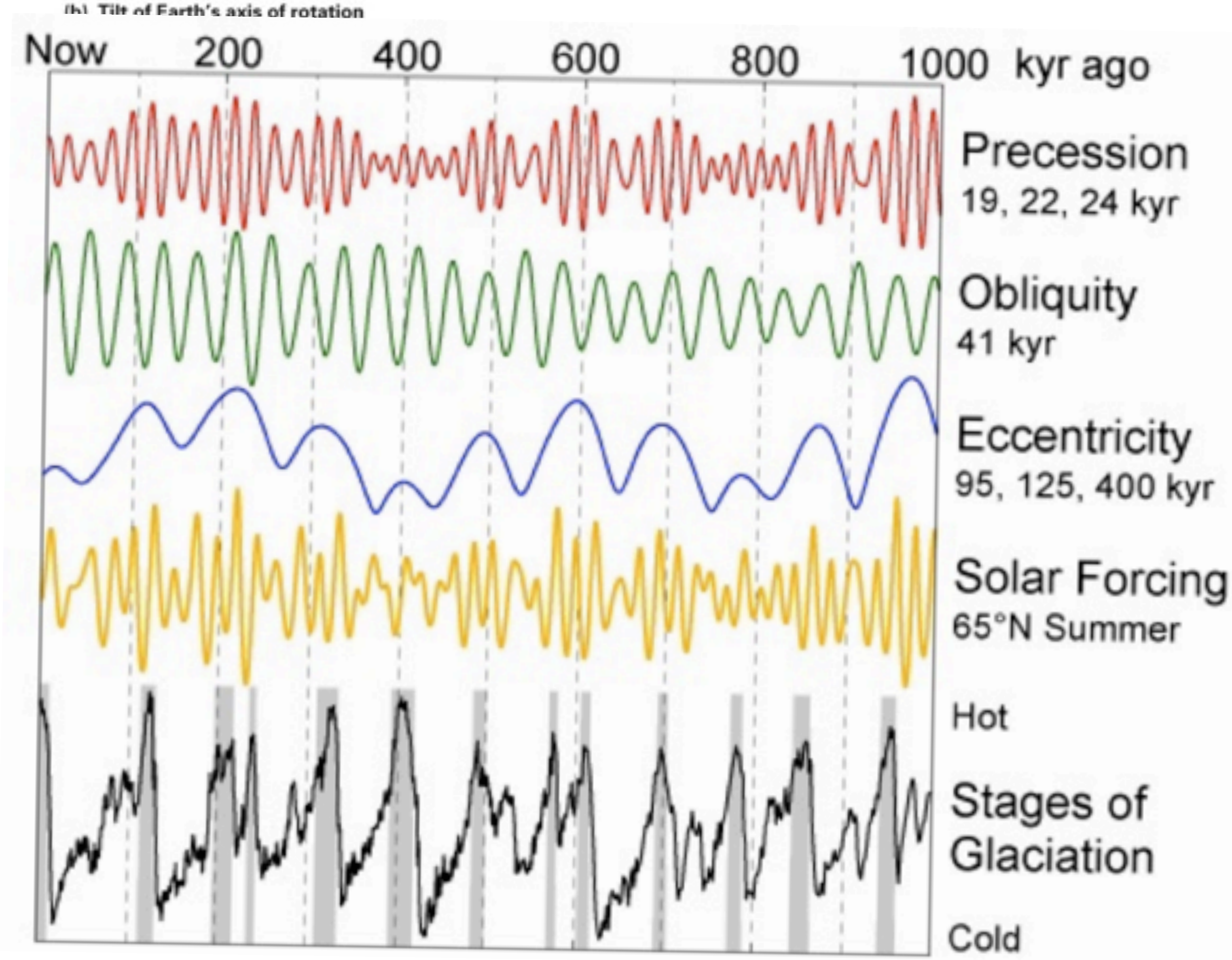
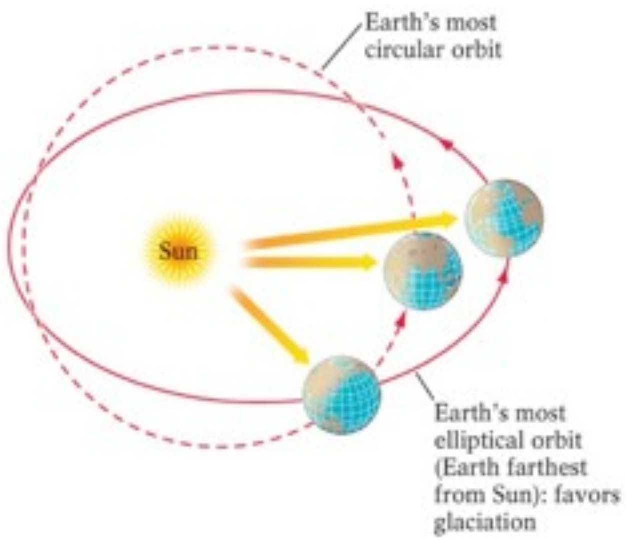


(c) Wobble of Earth's axis of rotation (precession)



Milonkovitch Cycles



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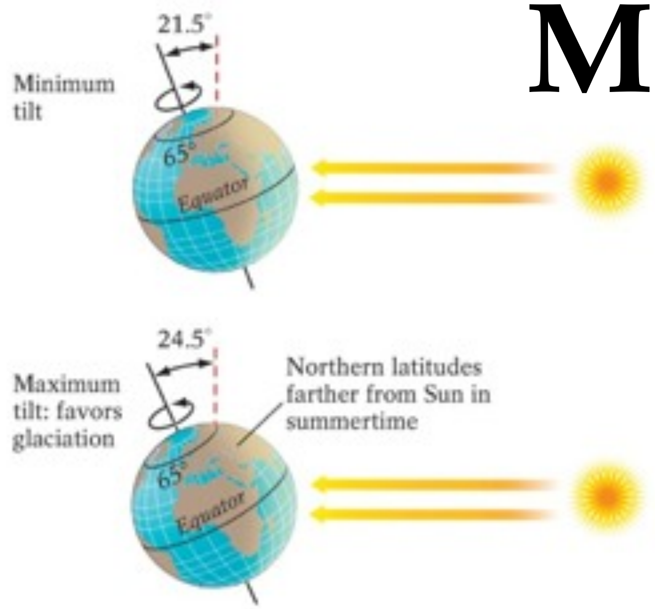
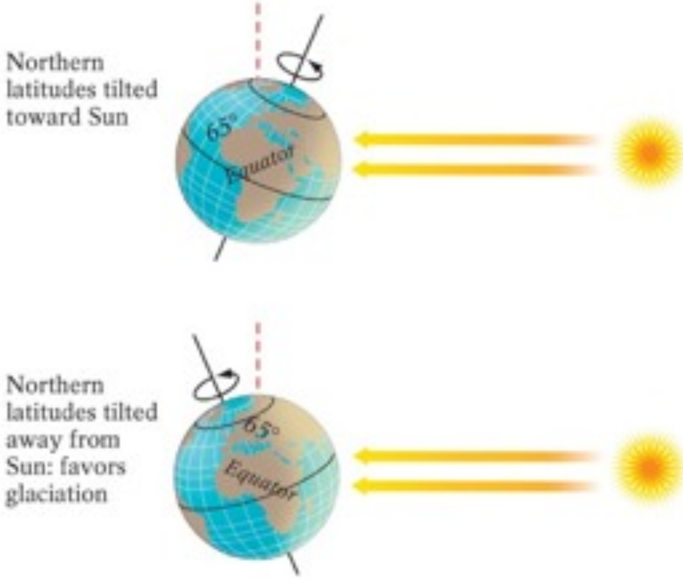


(b) Tilt of Earth's axis of rotation



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