Glacial Processes and Landforms

What is a glacier?

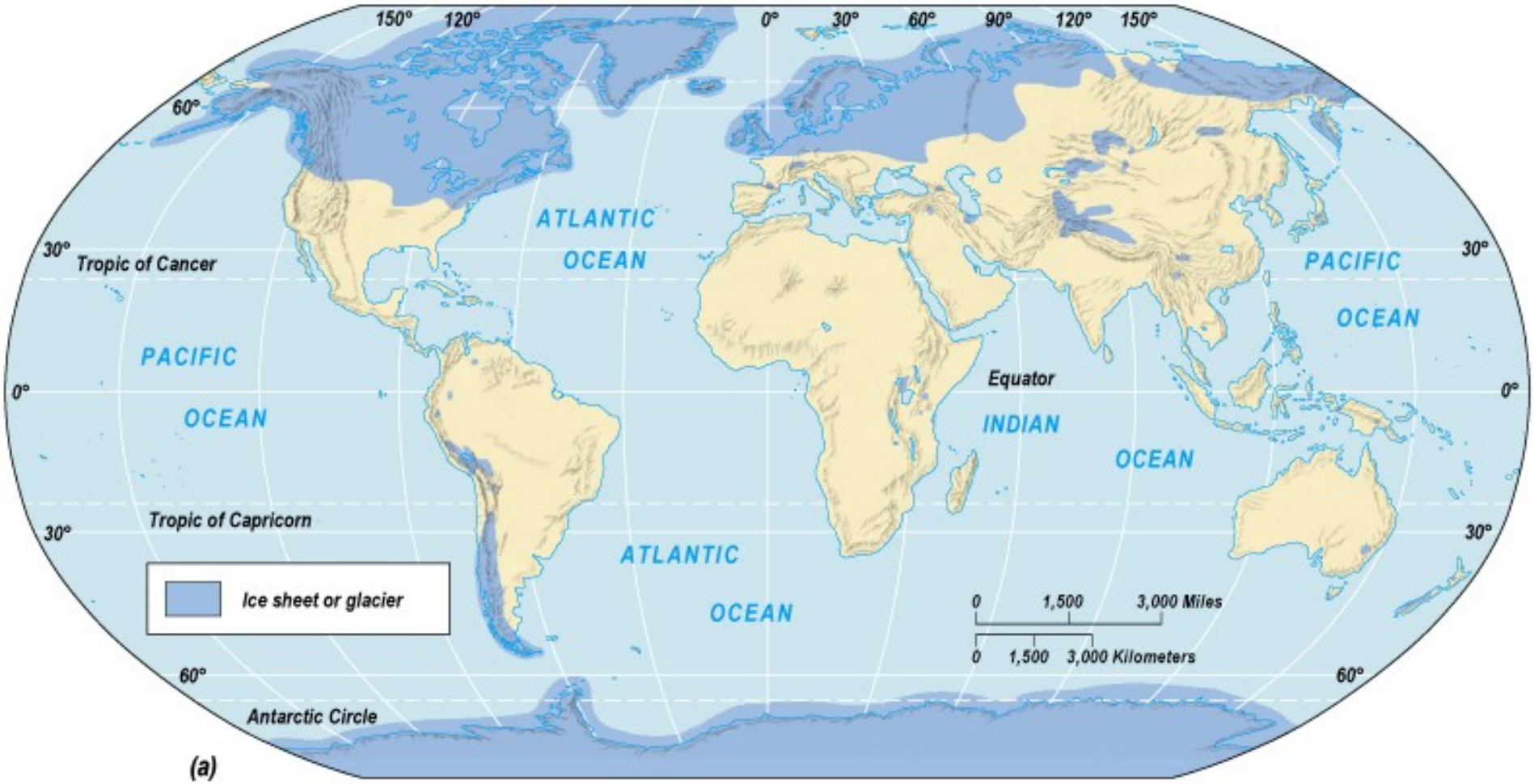
How do glaciers form?

What is a glacier?

- A glacier is simply the existence of year-round ice on the landscape.
- There are two broad types: continental and alpine.

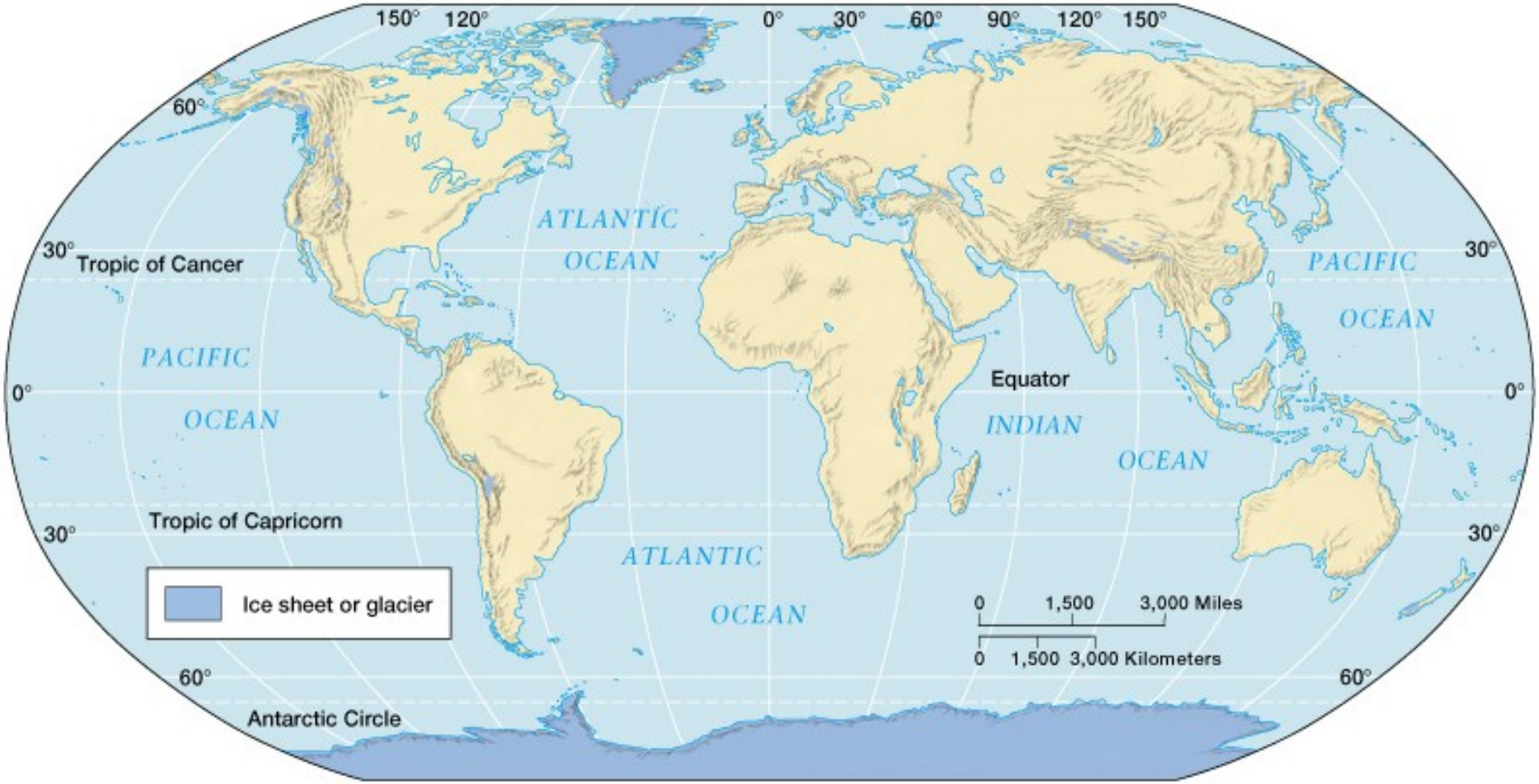
How do glaciers form?

- Glaciers form whenever snowfall exceeds snowmelt year after year. The snow accumulates incrementally, pressure increases, and it is changed into *névé* and then ice by this pressure.



Maximum Extent of Pleistocene Glaciation - 1/3 of land surface

Most recent glacial maximum peaked 18,000 years ago and is considered to have ended 10,000 B.P.



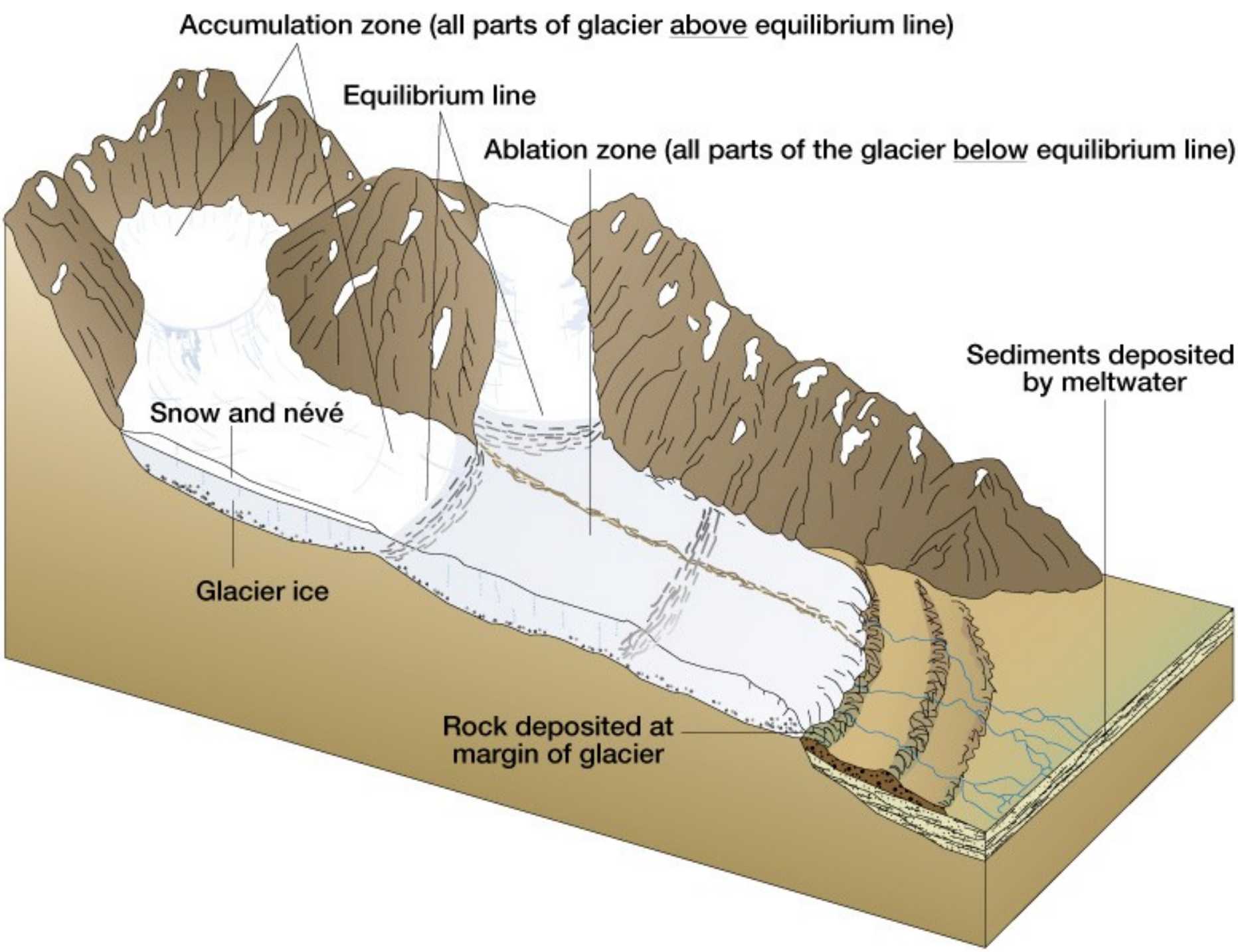
Current Extent of Glaciation -
about 10% of land surface


PACIFIC OCEAN
CANADA
45°N
40°N
UNITED STATES
125°W
35°N
0 200 Miles
0 200 Kilometers
30°N
120°W

(a)

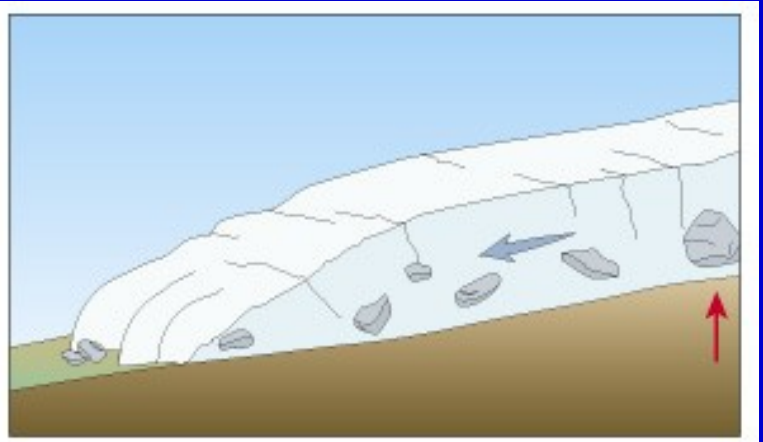

70°N
140°W
160°W
ARCTIC OCEAN
RUSSIA
Alaska
CANADA
PACIFIC OCEAN
0 200 400 Miles
0 200 400 Kilometers
140°W
160°W

(b)

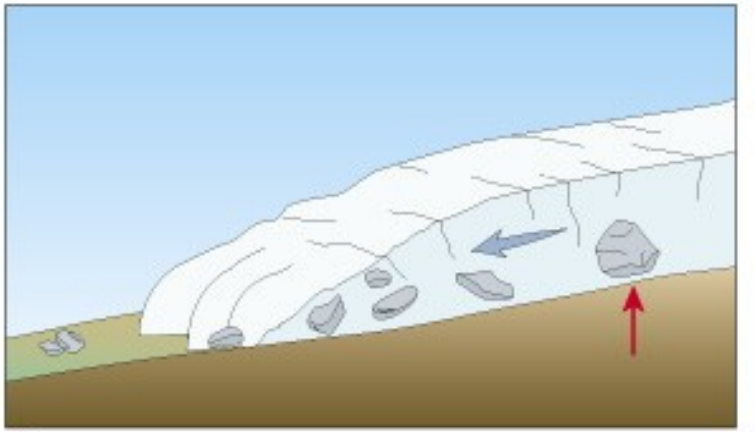

Accumulation zone (all parts of glacier above equilibrium line)
Equilibrium line
Ablation zone (all parts of the glacier below equilibrium line)
Sediments deposited by meltwater
Snow and névé
Glacier ice
Rock deposited at margin of glacier

Franz Joseph Glacier and Outwash Plain, New Zealand

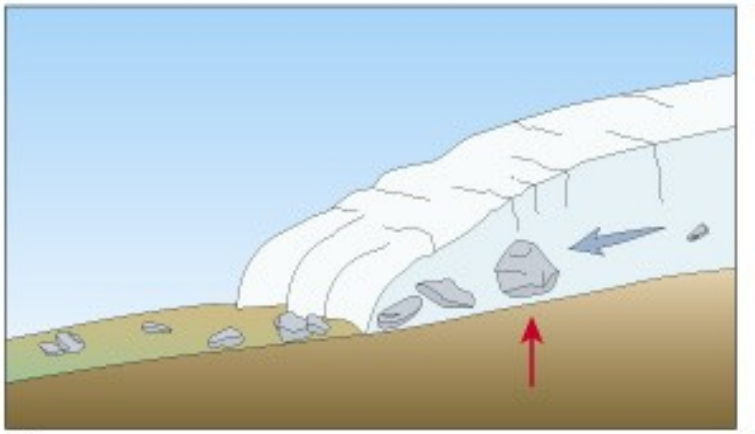
Why is a glacier the only thing that is ever coming and going at the same time?



(a)



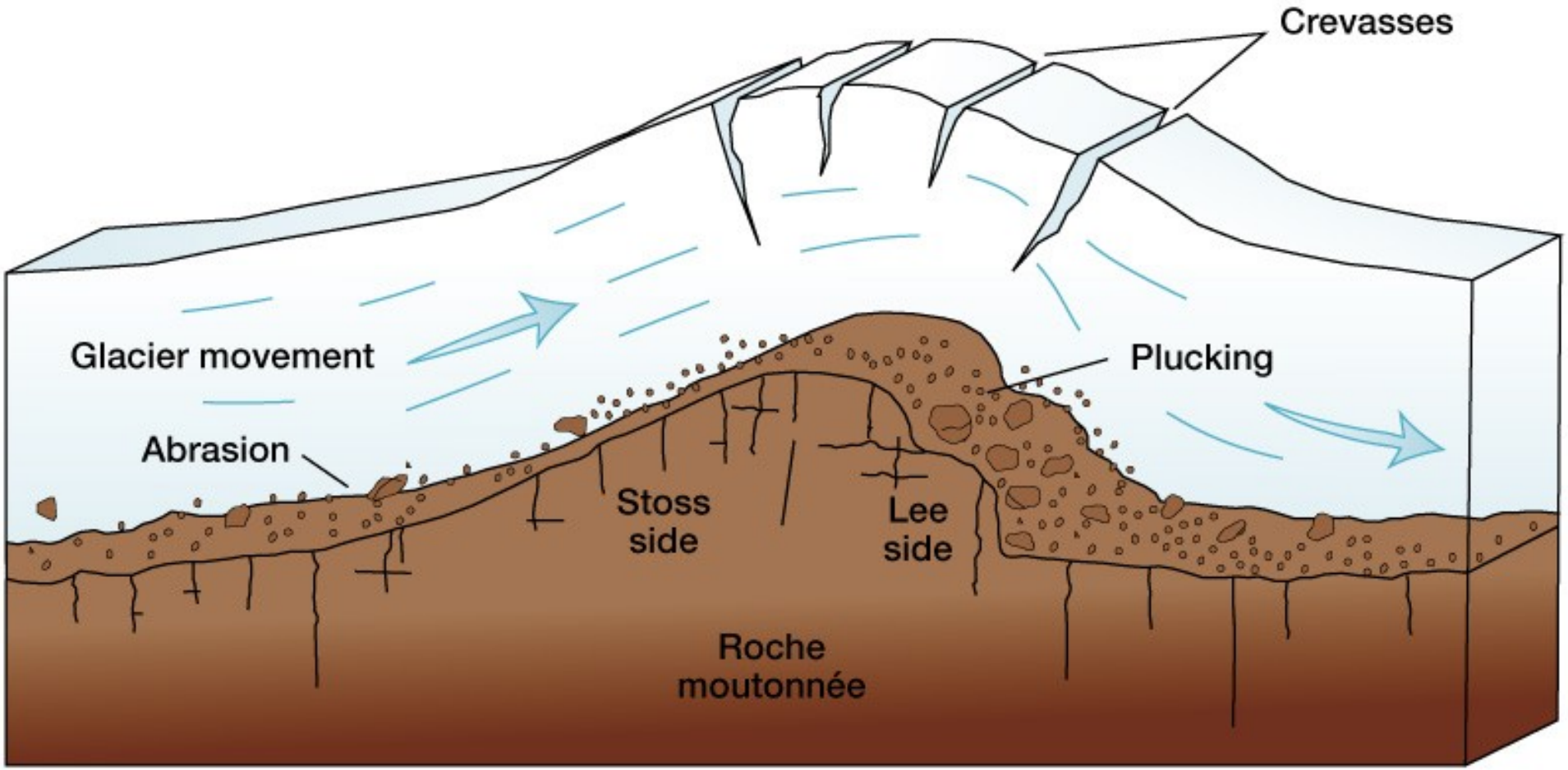
(b)



(c)

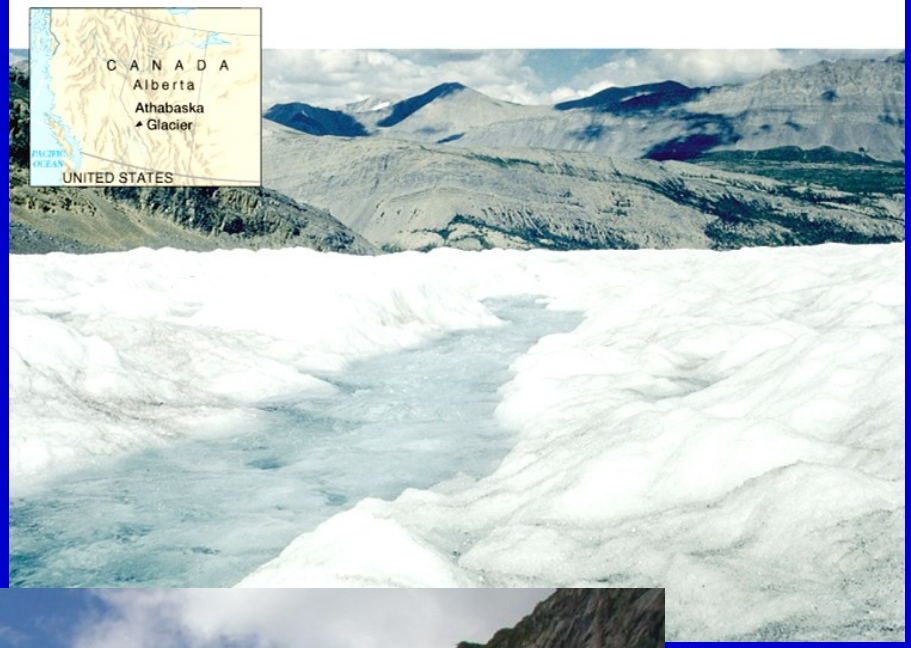
Erosion by Glaciers

- volume and speed determines amount of erosion.
- erodes slightly more effectively than water.
- plucking and abrasion (rock-tipped blade).
- polishing and striations.
- Continental glaciers remove all soil, plants, and small hills.
- Alpine glaciers change V-shaped valleys to U-shaped.


Crevasses
Glacier movement
Plucking
Abrasion
Stoss side
Lee side
Roche moutonnée

Transportation by Glaciers

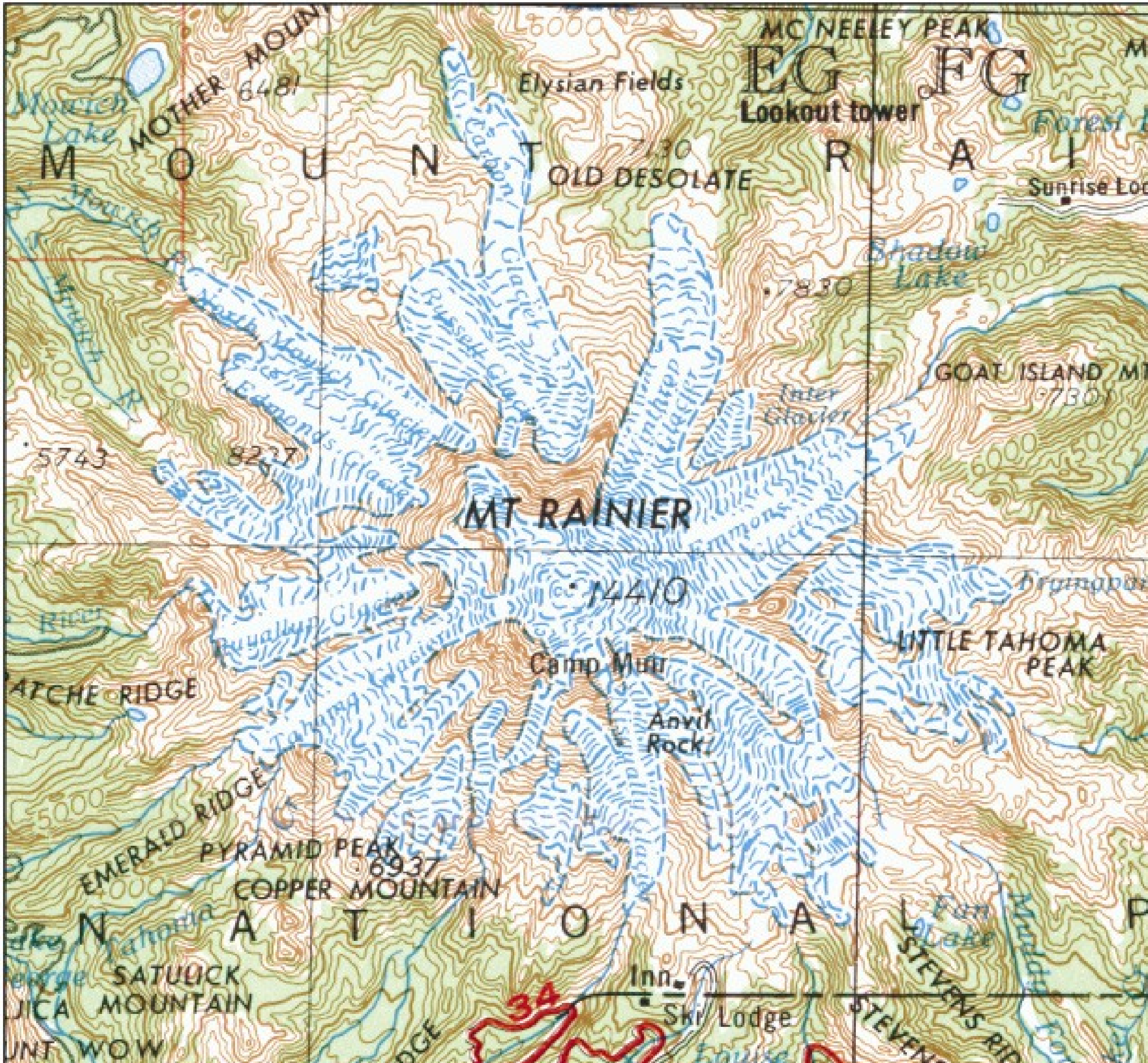
- will move material of all sizes, from *glacial flour* to massive boulders.
- Slow transport.
- Water in, on, and under glaciers (pluvial processes) moves much sediment as well.



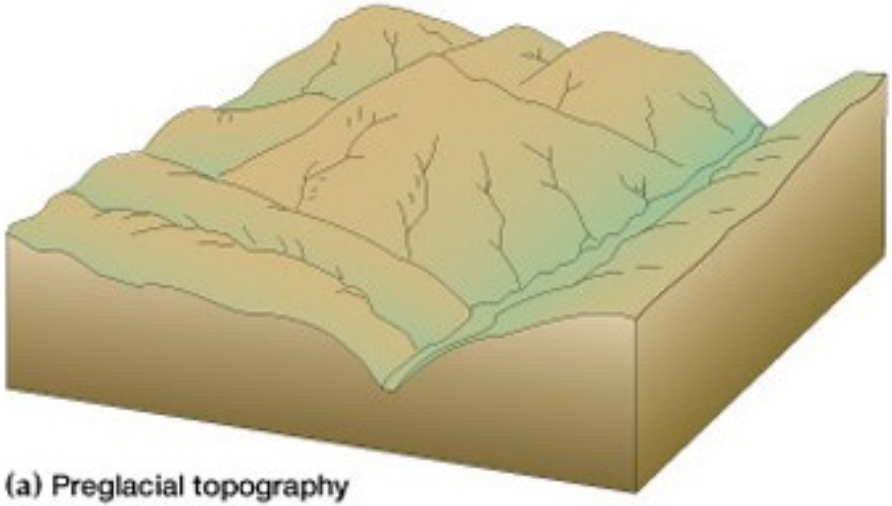
Deposition by Glaciers

- *drift* is any material deposited by glaciers or their meltwater.
- *Till* is that unsorted material that is deposited directly by ice.
- *Moraines* are linear features deposited at bottom or along sides of glaciers.
- *Glacial erratics* are enormous boulders transported and deposited by glaciers, often far from their source region.

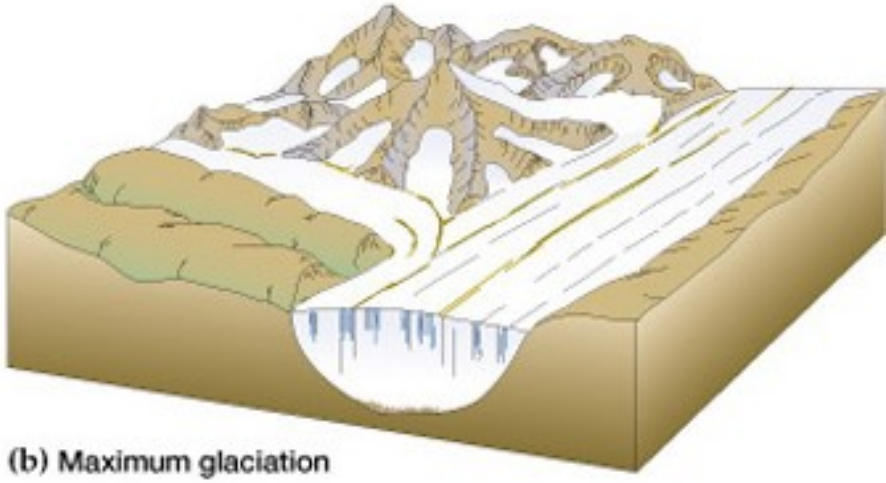
Alpine Glaciers


MC NEELEY PEAK
EG
FG
Elysian Fields
Lookout tower
MOTHER MOUN
6481
Mowich Lake
MOUNT RAINIER NATIONAL PARK
7130
OLD DESOLATE
Sunrise Lodg
Shadow Lake
Forest L
7830
GOAT ISLAND MT
7301
Inter Glacier
Carbon Glacier
Russell Glacier
North Mowich Glacier
Edmonds Glacier
Winthrop Glacier
Emmons Glacier
5743
8237
MT RAINIER
14410
LITTLE TAHOMA PEAK
Camp Muir
Anvil Rock
Puyallup Glacier
Tahoma Glacier
ATCHE RIDGE
EMERALD RIDGE
PYRAMID PEAK
6937
COPPER MOUNTAIN
SATULICK
UICA MOUNTAIN
UNT WOW
Inn
Ski Lodge
34
STEVENS RIDGE
Fan Lake
Louise

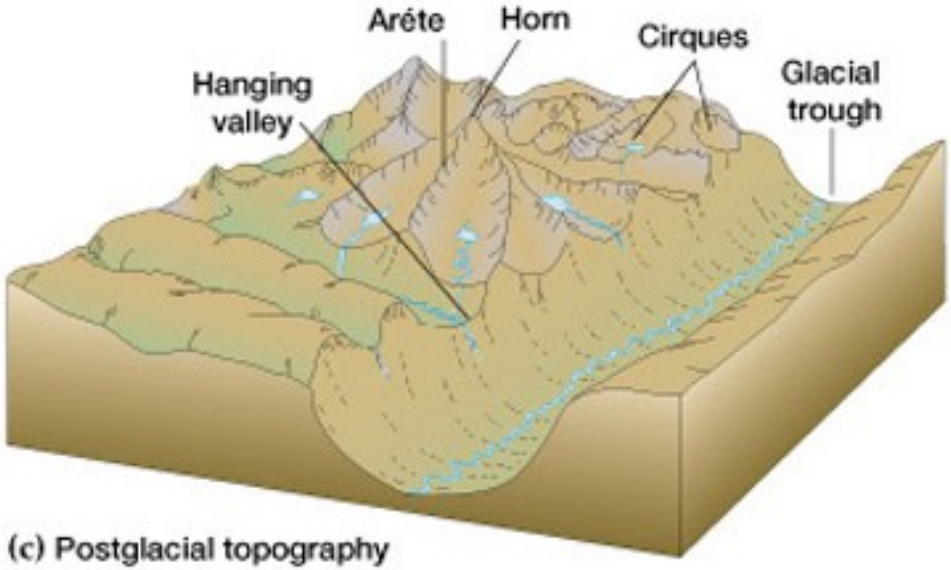

CANADA
Washington
Mt.
Rainier
Oregon



(a) Preglacial topography



(b) Maximum glaciation



(c) Postglacial topography

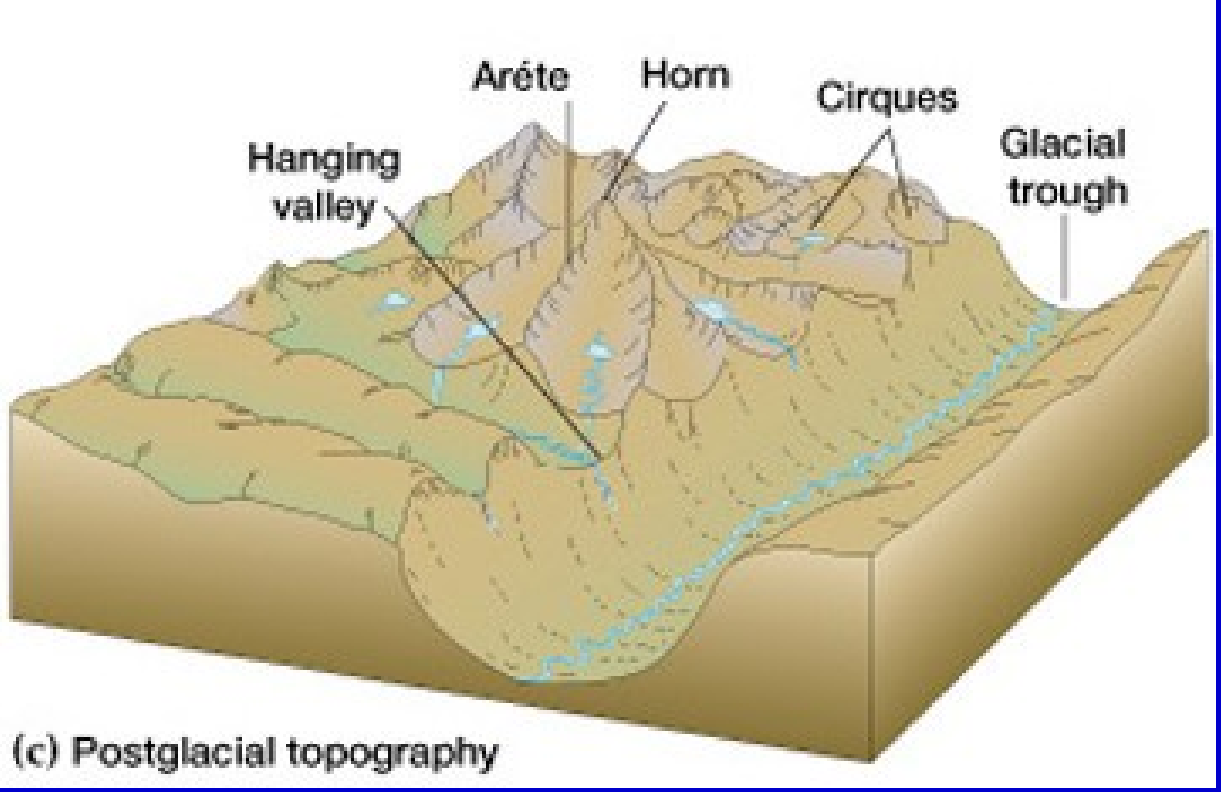
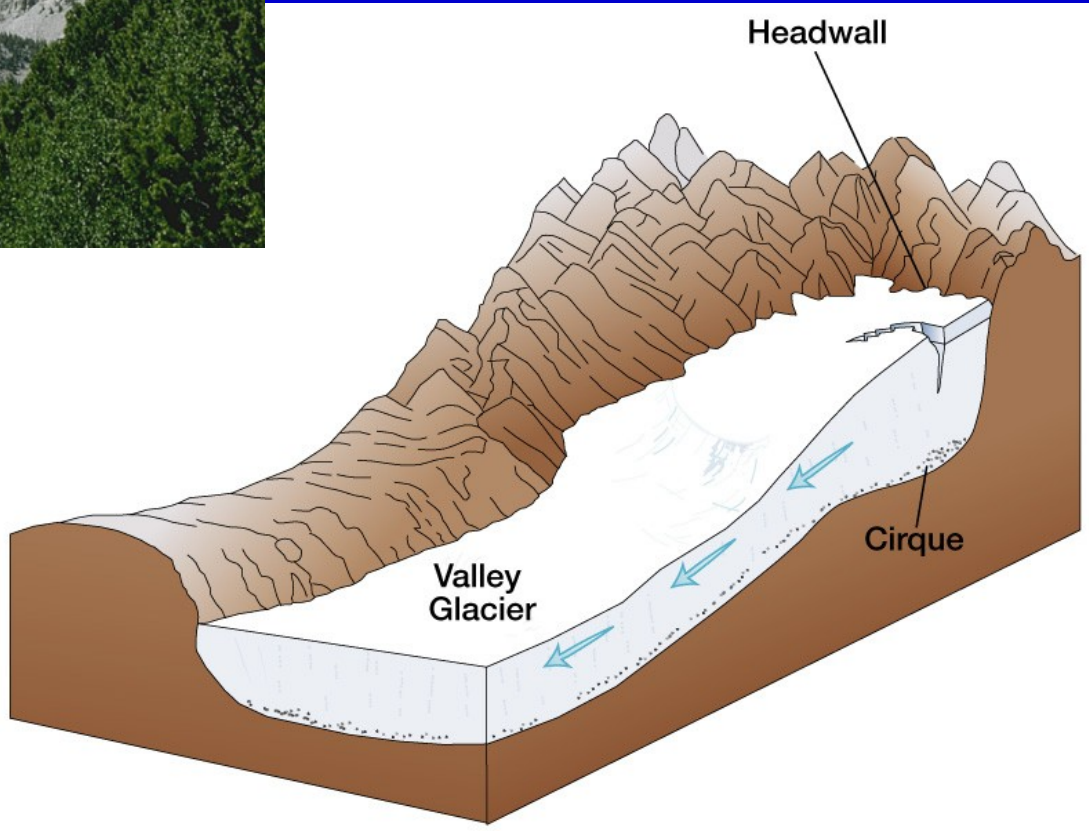
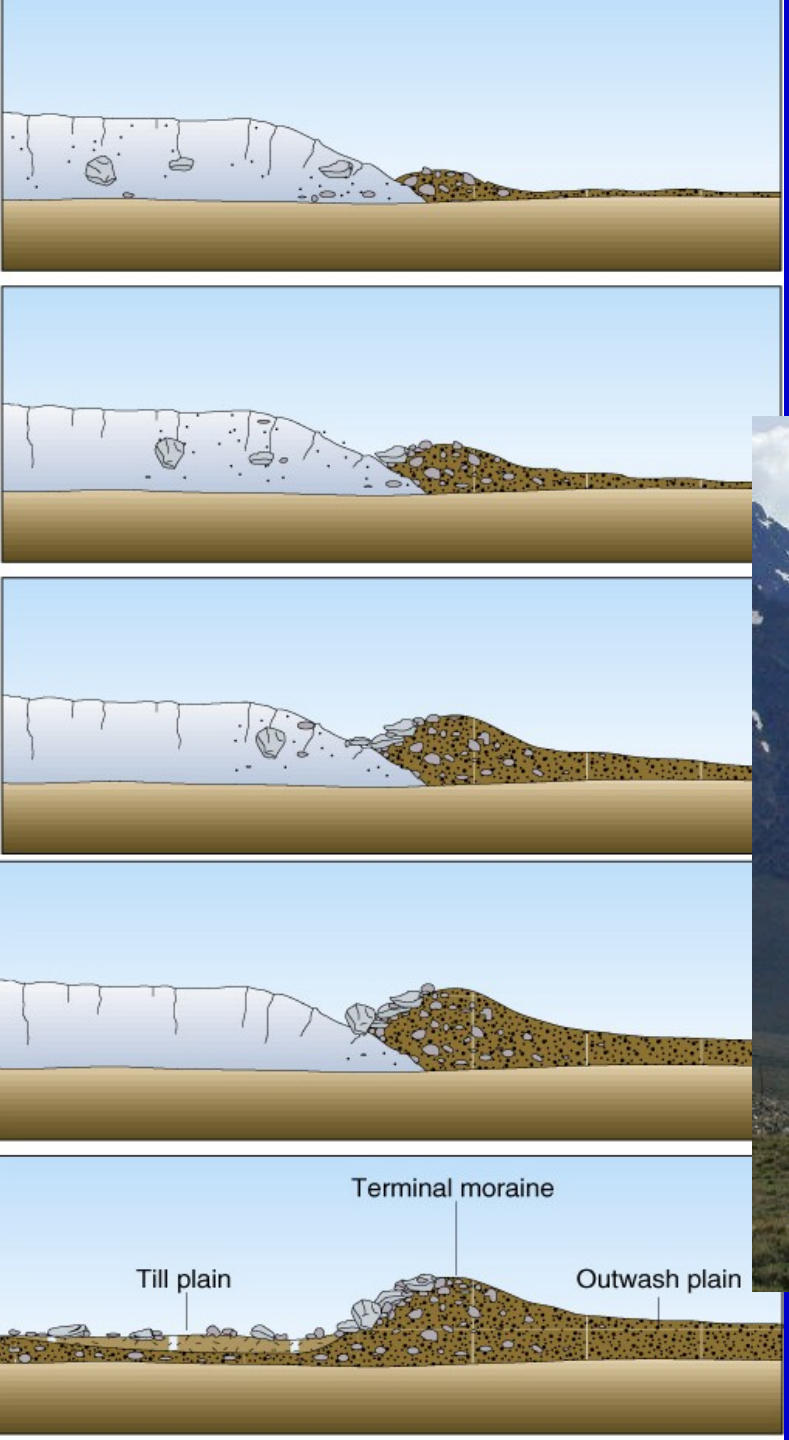
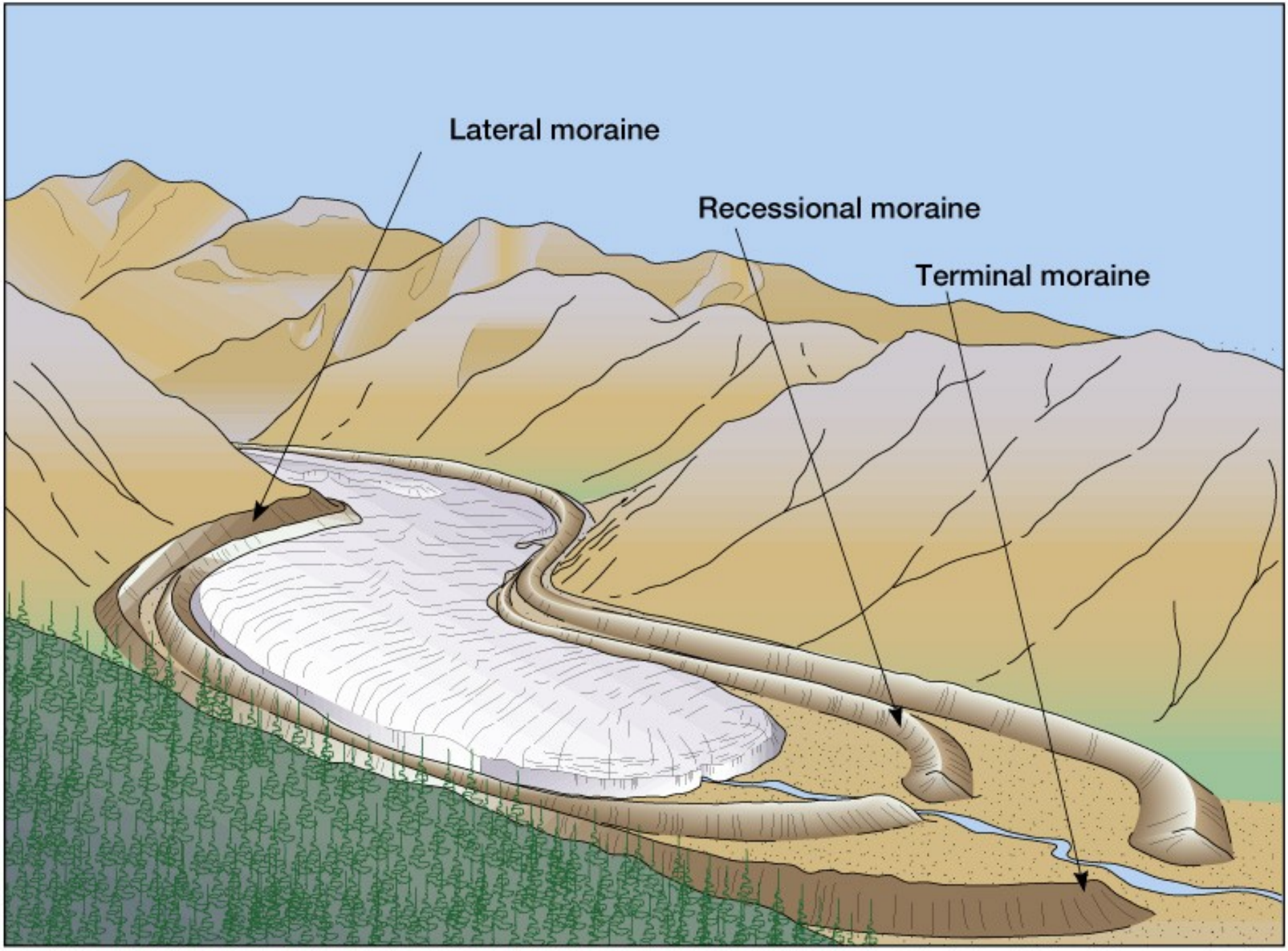

Arête
Horn
Cirques
Hanging valley
Glacial trough
(c) Postglacial topography

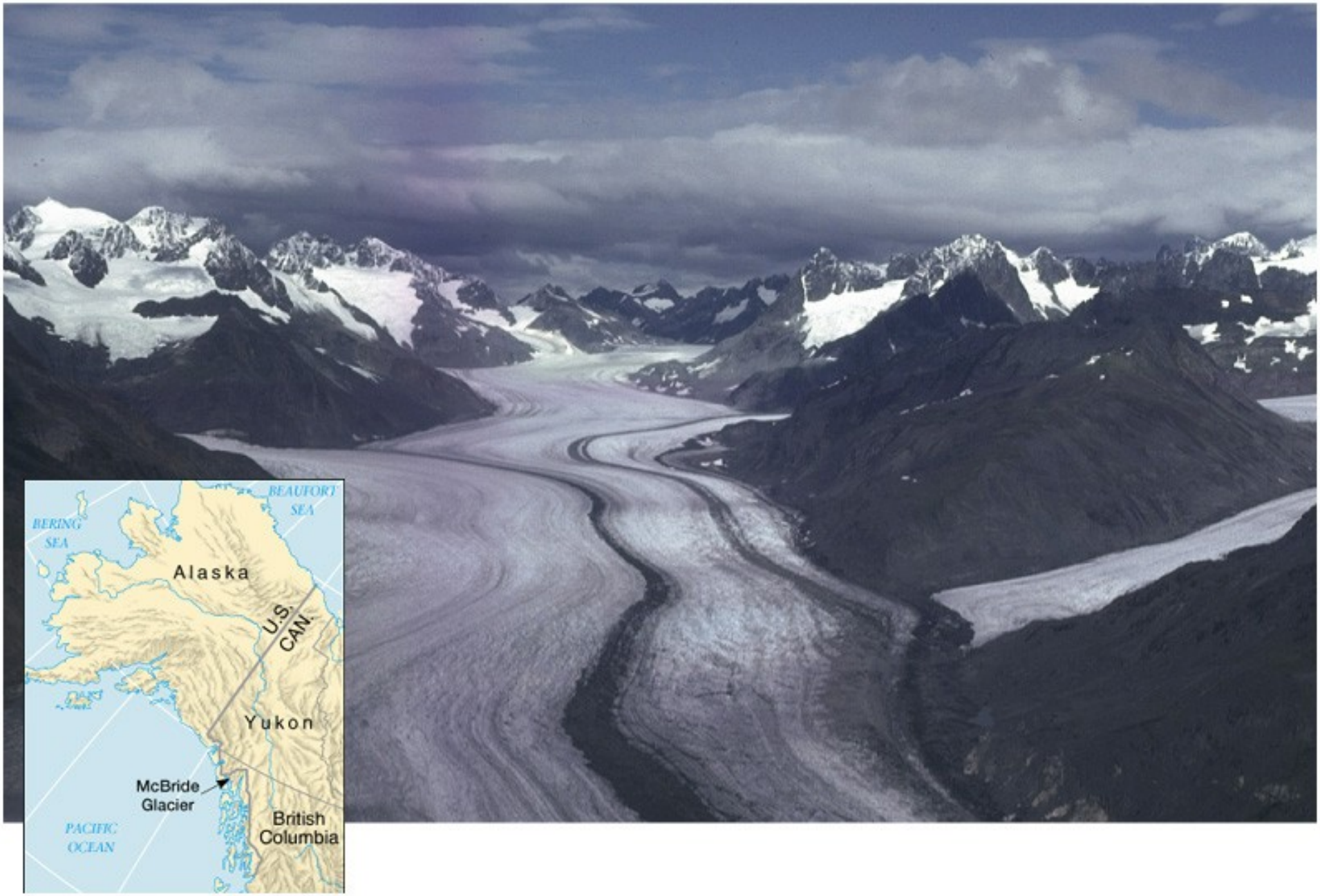

Photo by J.A. Hyatt
Horn
Cirque
Cirque
Arete


Headwall
Cirque
Valley
Glacier

Moraines




Lateral moraine
Recessional moraine
Terminal moraine

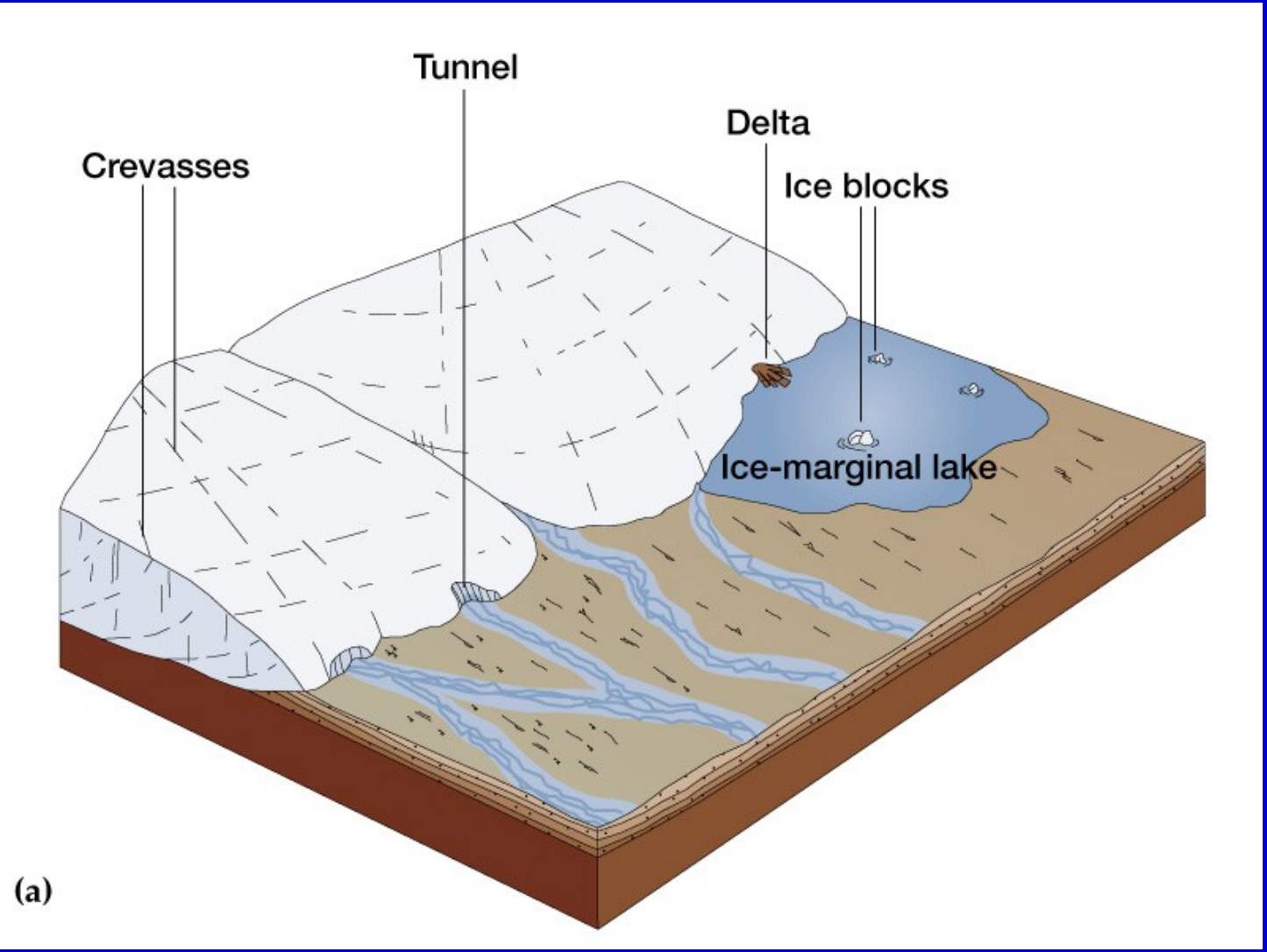

BEAUFORT SEA
BERING SEA
Alaska
U.S.
CAN.
Yukon
McBride Glacier
British Columbia
PACIFIC OCEAN

Continental Glaciers or Ice Sheets

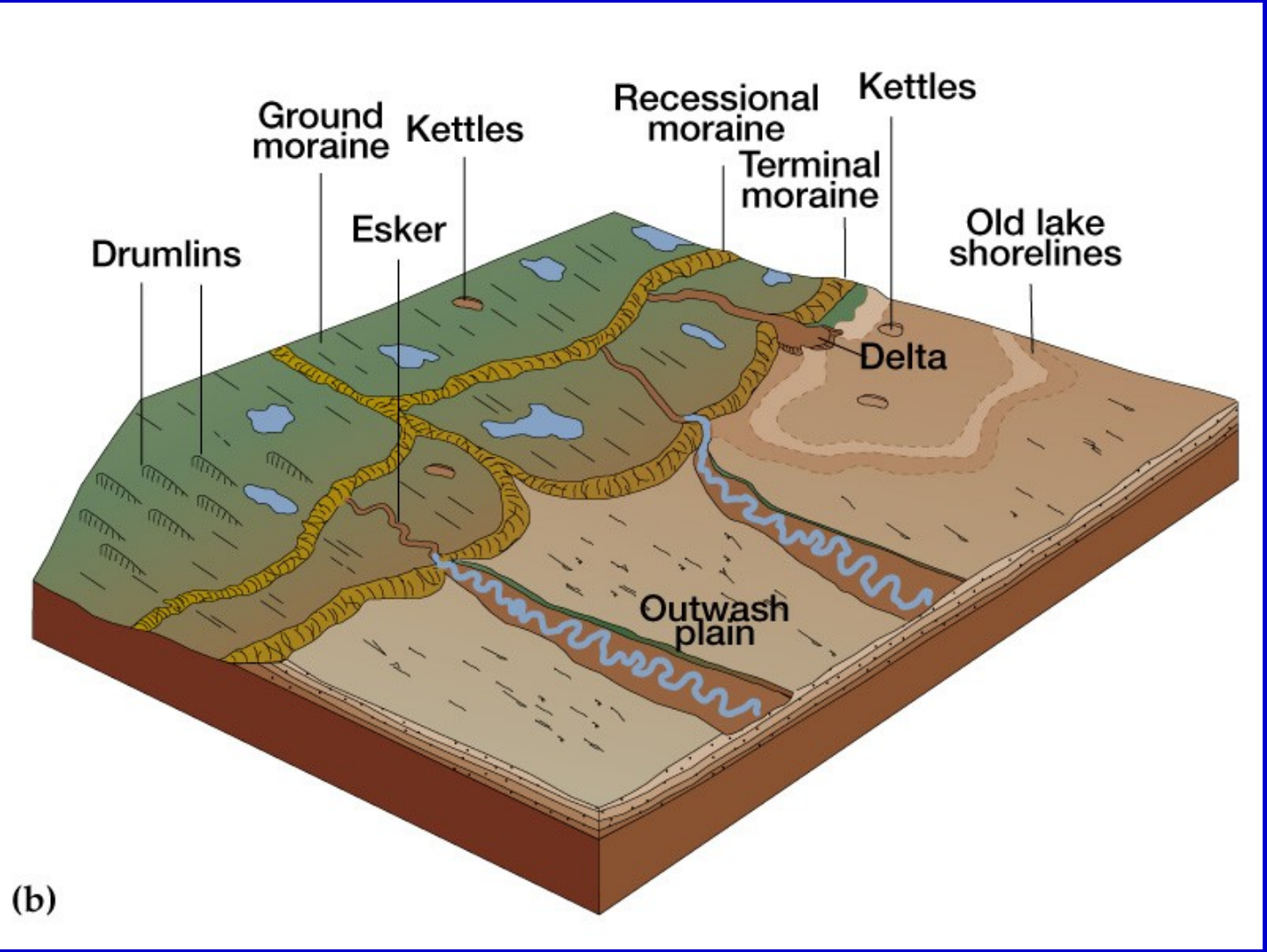
- only two true ice sheets exist today: Greenland and Antarctica
- where they meet the sea they can form ice sheets.
- vary in thickness from hundreds of feet to two miles deep
- scour away all soil and vegetation and dramatically reshape the landscape and ecology of large regions.
- much change occurs in the *periglacial* environment.

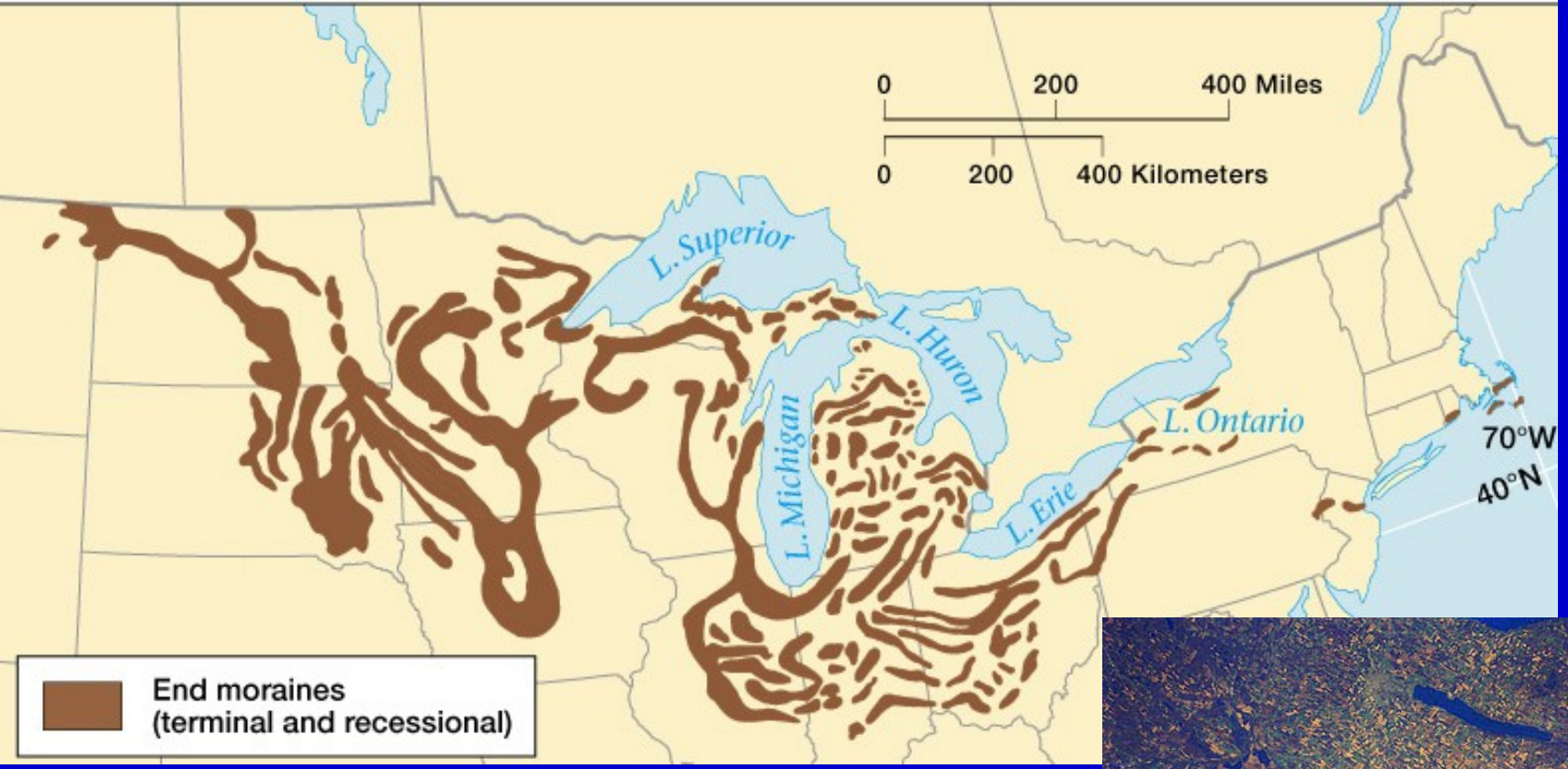
Ellesmere Island, Canada

Continental Glaciers or Ice Sheets

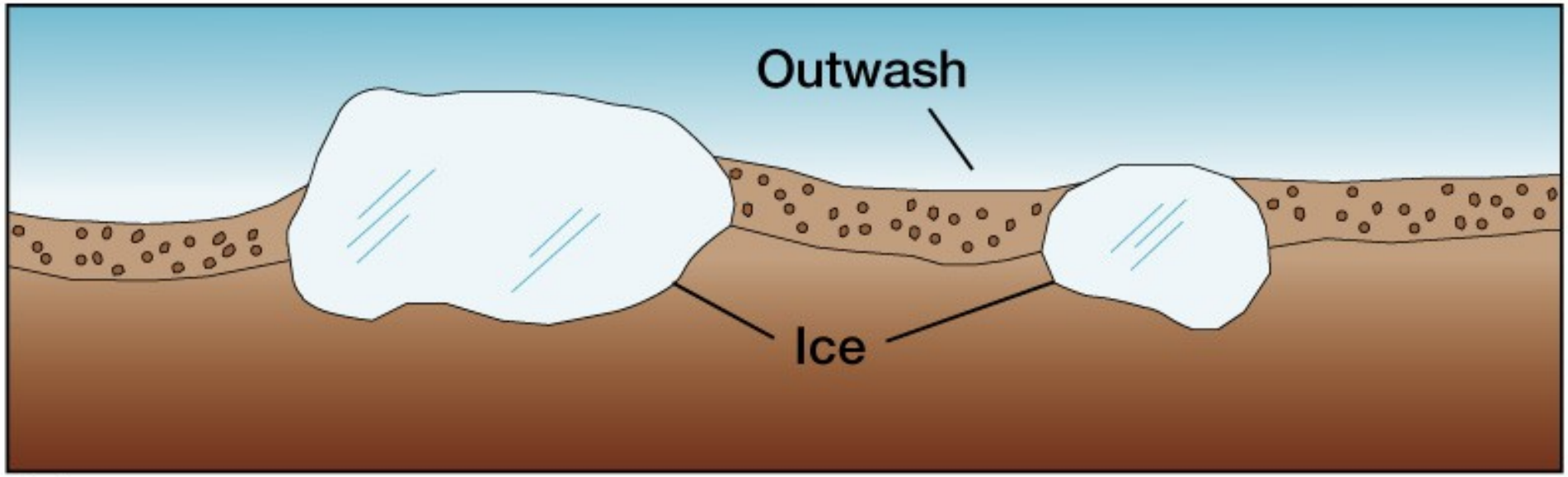


Continental Glaciers or Ice Sheets

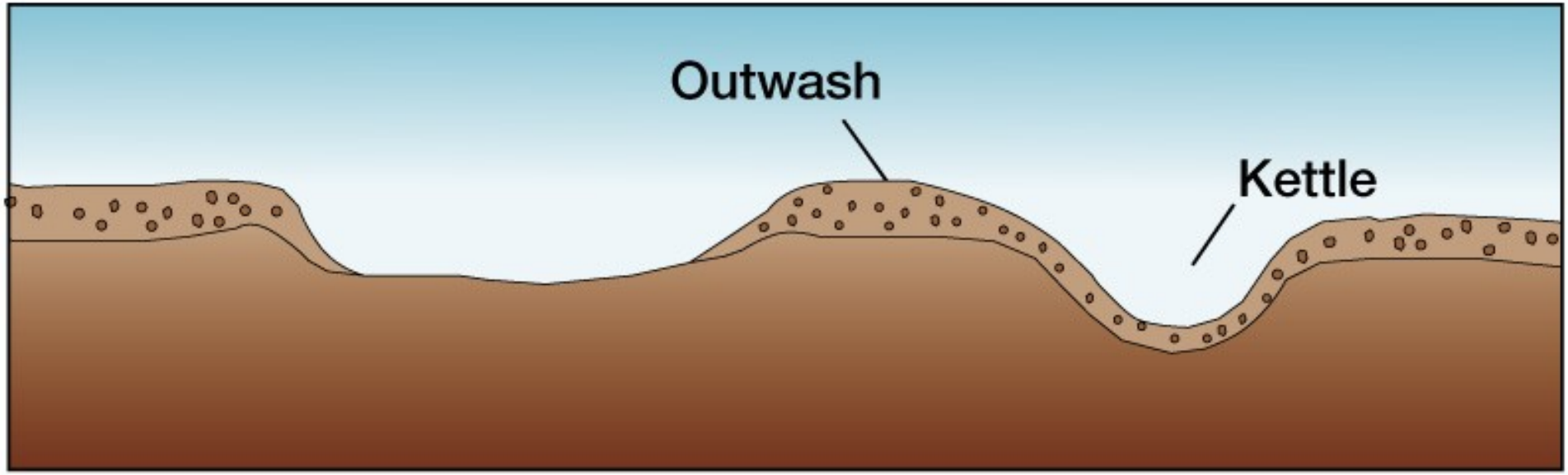




Finger Lakes Region, New York



(a)



(b)

Fjords


BLÅSJØ
SVARTEVT.
TIL RØLDAL
NESFLATEN
SULDALSVT.
SAUDA
SULDAL
SAND
ROPEID
FØRRE
HÅLANDSOSEN
JØSENFJORDEN
HJELMELAND
ÅRDAL
LYSEBØTN
FLØYRLI
SONGESAND
BRATTELI
PREIKESTOLEN
BYRKJEDAL
LYSEFJORDSENTERET
FORSAND
LAUVVIK
JØRPELAND
KOBBASTEINEN
SKIPAVIK
OMBO
BOGSUND
FØRENESET
JELSA
MARVIK
HEBNES
FOLDØY
VORMESTRAND
VIKEDAL
SANDEID
ØLEN
NEDSTRAND
VATS
YRKJE
NOTBØTERIET
KARSTØ
AKSDAL
FØRDESFJORD
BERGEN
SVEIO
VESTRE BOKN
FØRESVIK
ARSVÅGEN
BOKNAFJORDEN
NORTEVIKA
FINNØY
FOGN
TAU
FLOR & FJÆRE
SØRHOLE
ØSTHUSVIK
MOSTERØY
UTSTEIN KLOSTER
HOMMERSÅK
STAVANGER
RANDABERG
TANANGER
KVITSØY MARITIM