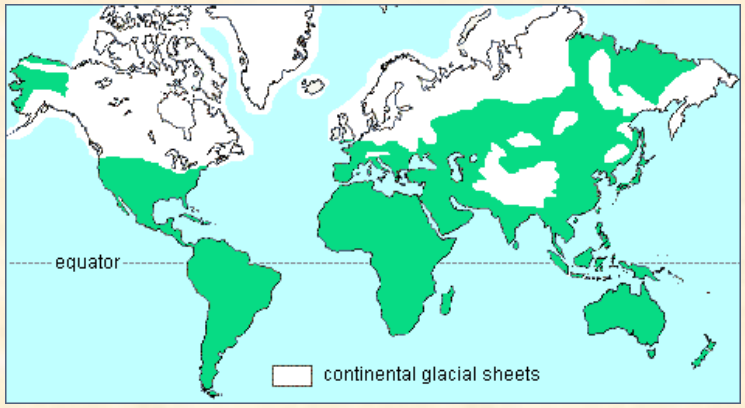
Glacial Landforms

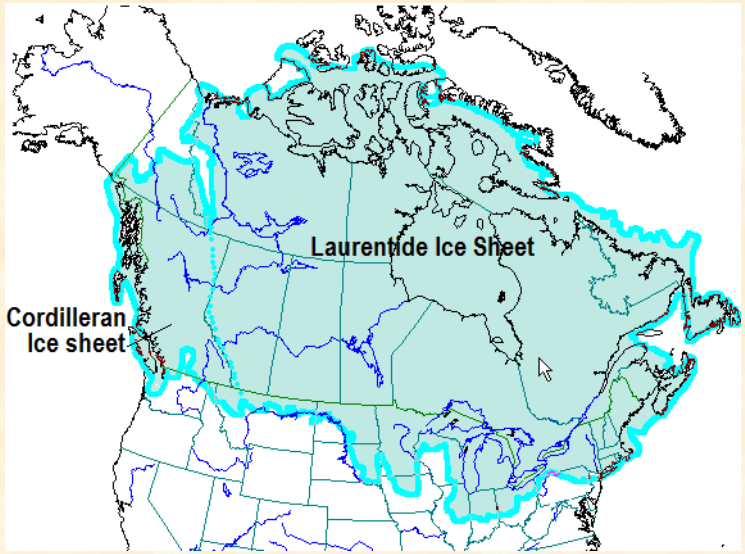
Alpine Valley Glacier in Alaska.

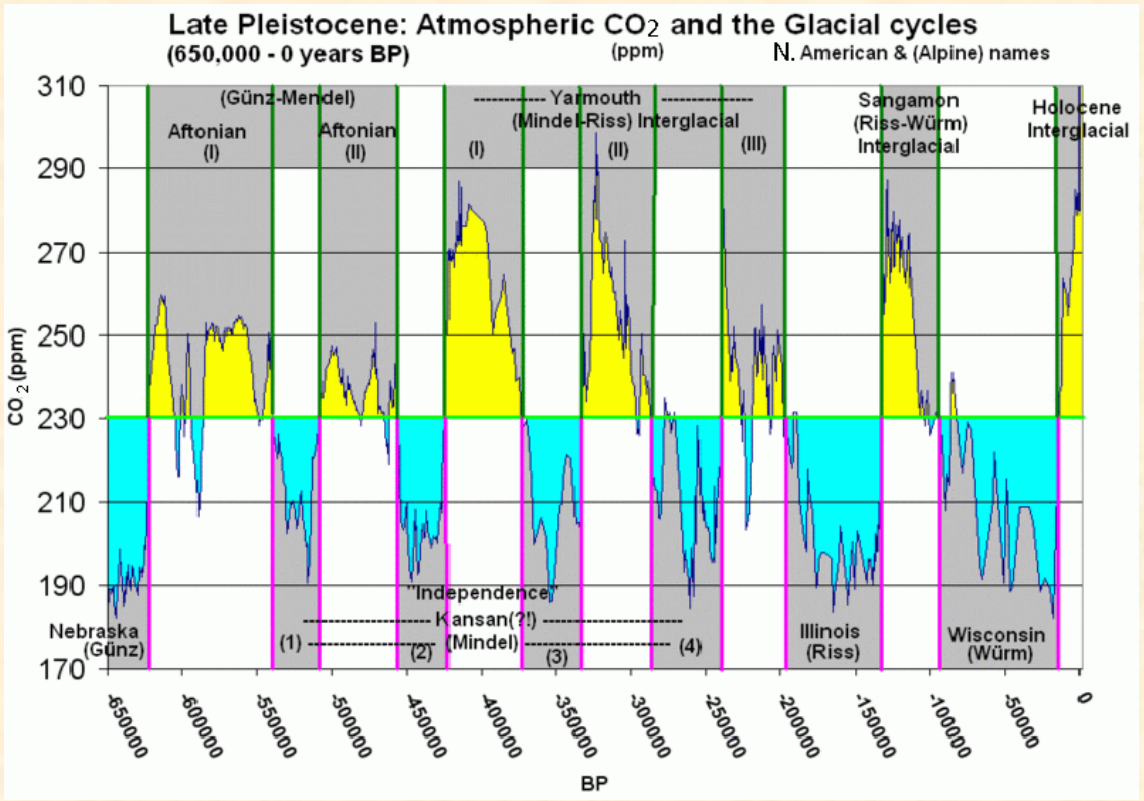
- Ice sheets and Alpine Glaciers
- Ice Field and Ice Caps
- Piedmont Glacier
- Tidal Glaciers and Icebergs
- Glacial U-shaped Valleys
- Fjords
- Hanging Valleys
- Cirques and Cirque Glaciers
- Arêtes, Horns, Cols
- Lateral and Medial Moraines
- End and Terminal Moraines
- Paternoster Lakes
- Kettles
- Erratics
- Drumlins
- Outwash Plain
- Long Island: Glacial Context

Glacial Fundamental

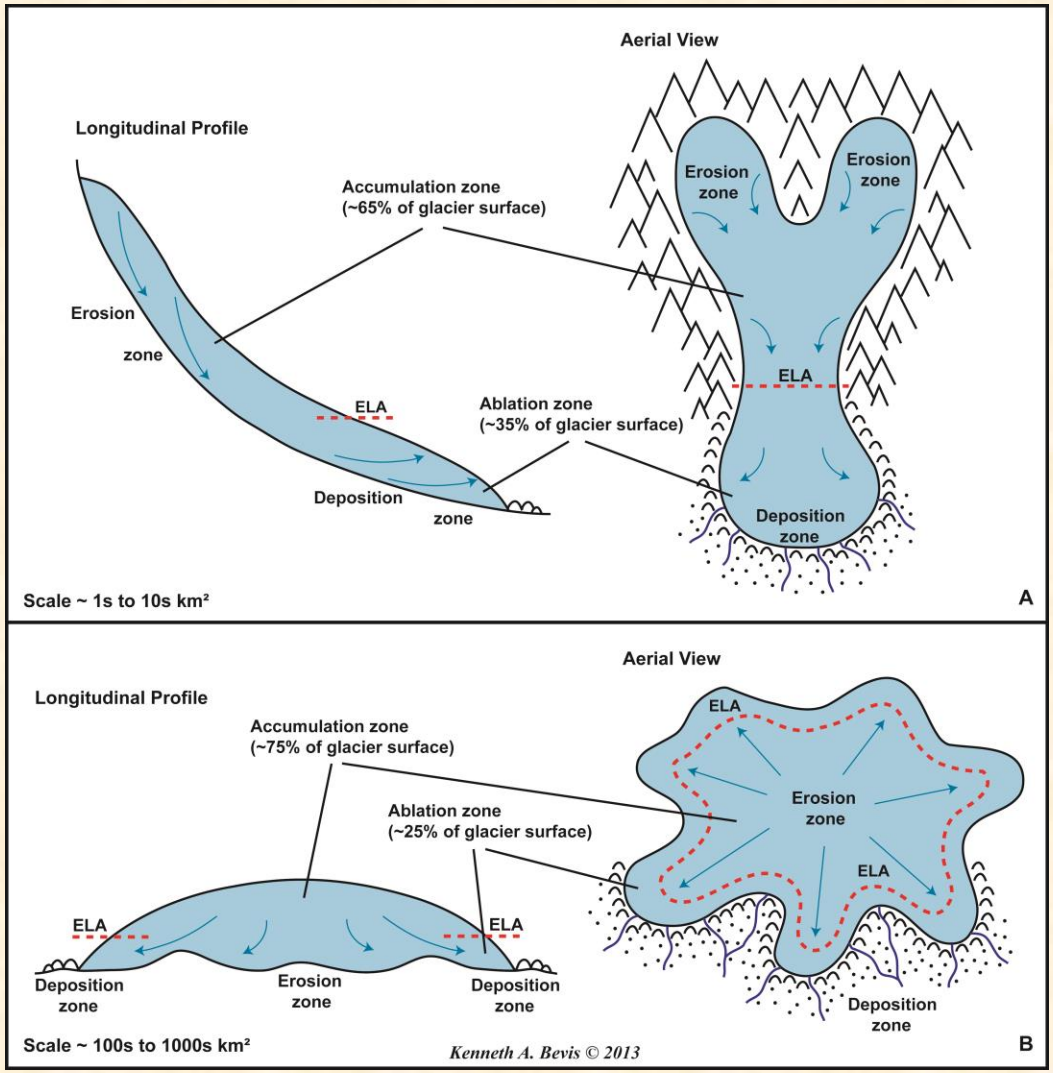
Pleistocene: the epoch forming the earlier half of the Quaternary Period, beginning about 2 mya and ending 10,000 years ago, characterized by widespread glacial ice and the advent of modern humans

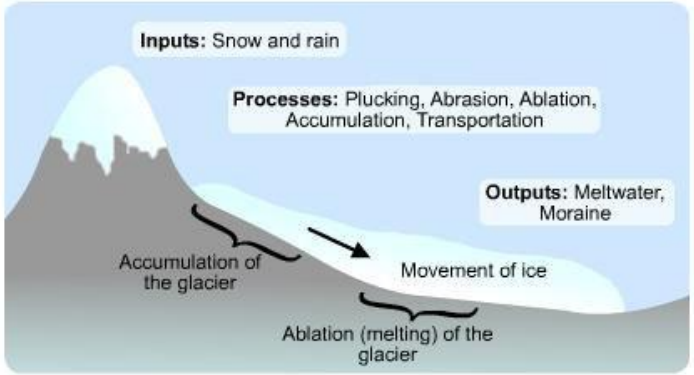






Glacial Fundamental

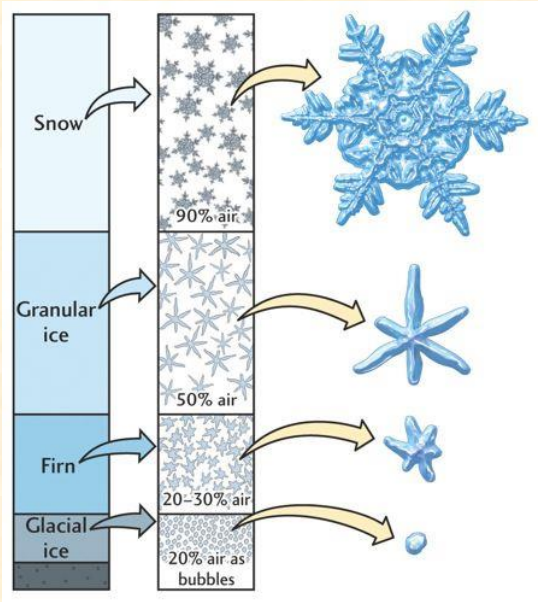




ELA: Equilibrium Line Altitude

accumulation = melting

snow transitions to glacial ice



Glacial Landforms

Glaciers are large masses of moving ice

Glacial Landforms can be found in locations that currently have no active glaciers or glaciation processes

Two distinct geographic regions,

- **High latitude** polar environments
- **High altitude** mountain environments

Chile

Anchorage, Alaska

Glaciers

- Formed by the accumulation and compaction of recrystallized melted snow.
- **High latitude** polar environments
  - **ice sheets** or "**continental glaciers**"
- **High altitude** mountain environments
  - **alpine glaciers** or "**valley glaciers**"
- Glacial processes produce a combination of **constructive** and **destructive** glacial landforms.

Greenland, Ice Sheet

Glaciers

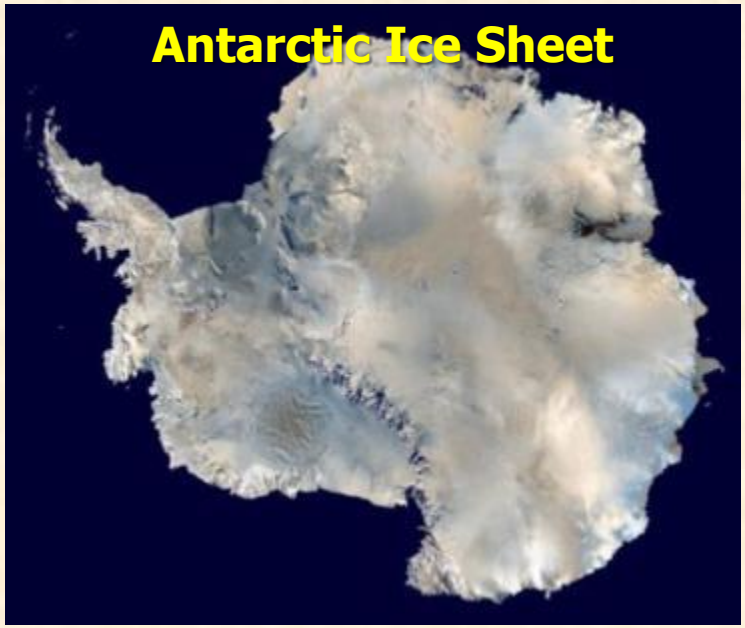
Ice sheets

- Cover extensive areas of continental landmasses
- Long periods of extremely low temperatures
- Antarctica and Greenland almost completely covered by ice sheets.

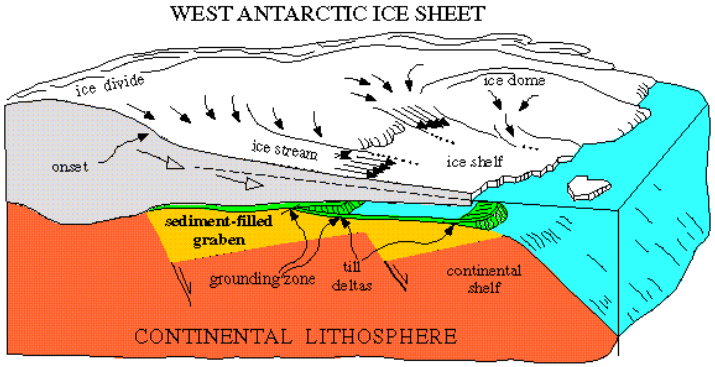
Alpine glaciers

- Long, linear glaciers that occupy high altitude mountain valleys,
- Flow down valley, and increase in size as they accumulate and absorb smaller **tributary glaciers** from the mountainous terrain.
- Found throughout the world: Rockies, Andes, and Himalayas.
- High-latitude, polar or arctic mountains, such as those in Alaska.

Ice Sheets and Alpine Glaciers

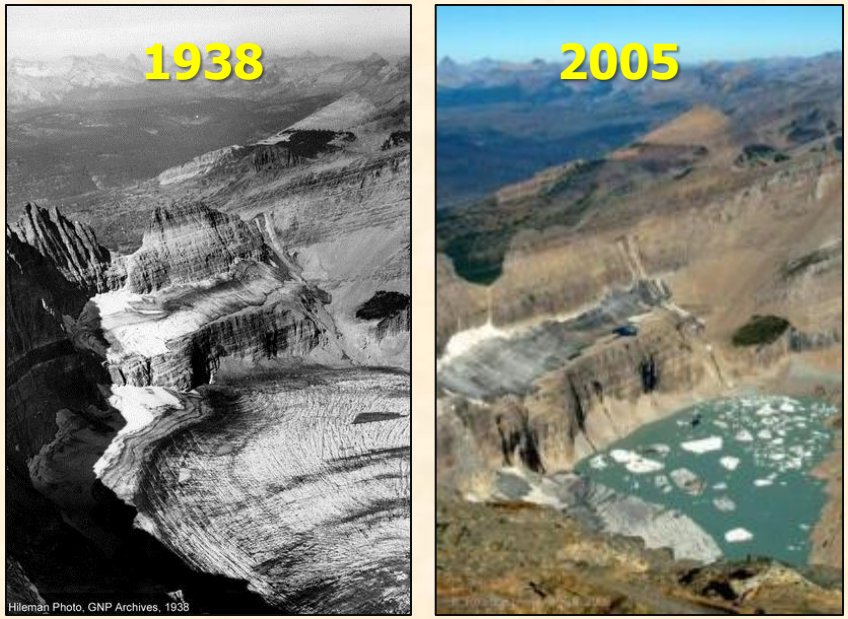


- Antarctica 90% coverage
- Greenland 80% coverage
- Crust is isostatically depressed



Glacier National Park, Montana

- Landscape contains vestiges of past glaciation
- Few active, high elevation alpine glaciers.
- Forecast: by 2030 there may not be any more glaciers in the park



Glacier National Park

Ice Field and Ice Caps

- **Ice fields** are elongate, continuous expanses of glacial ice which follow the topography of mountains. Isolated mountain ridges and peaks often protrude out from the ice field. Ice fields may feed alpine glaciers.

- **Ice caps** are circular shaped masses of glacial ice that cover an area less than 50,000 km^2. Ice caps form in mountain regions and they completely bury the underlying topography. Ice caps are similar to ice sheets, only smaller.

The high altitude environments in Alaska contain large ice fields that feed alpine glaciers.

Source: wikimedia commons, NASA image

Vatnajökull Ice Cap in Iceland has several glaciers flowing outward from the ice cap, indicated by the darker coloring from ash and debris.

Piedmont Glacier

- Piedmont glaciers are formed where multiple valley glaciers flow out from the mountainous terrain and coalesce into a singe large glacier, spreading over the lowland topography.
- Continue to grow as long as they are fed by valley glaciers.
- Often source rivers and streams that form from glacial melt water and till deposits.

Malaspina Glacier, Alaska

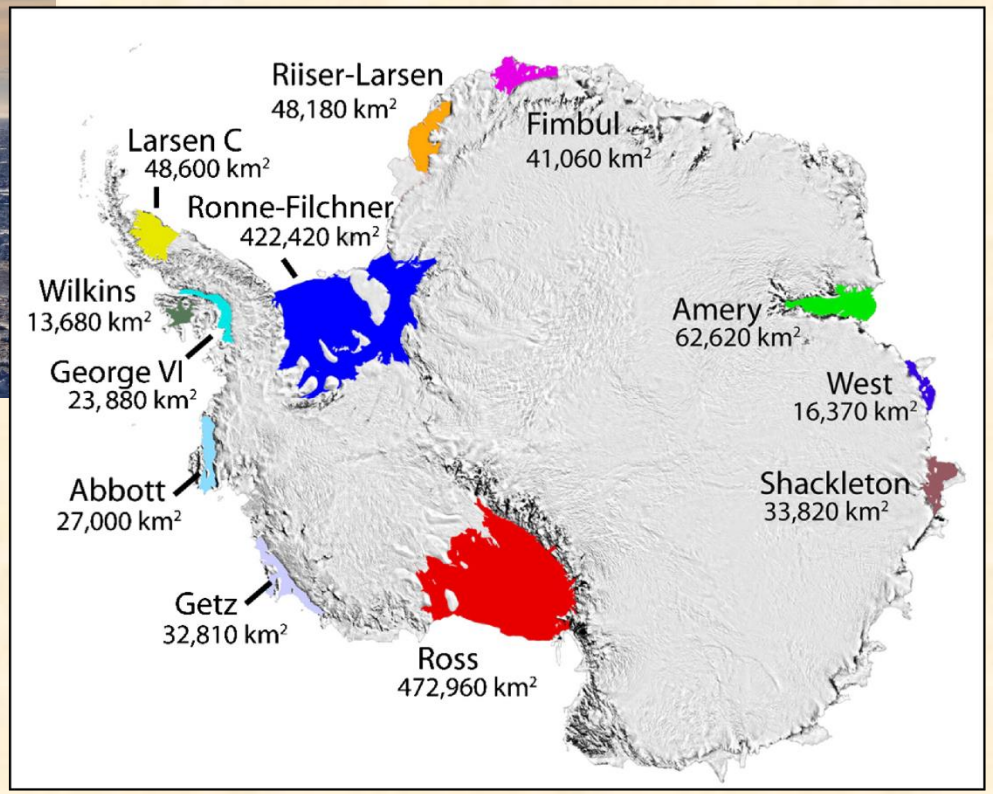
The Mount Saint Elias mountains in the background are the source that feed this piedmont glacier.

The dark bands in the photo mark the lateral and medial moraines where the valley glaciers merged together.

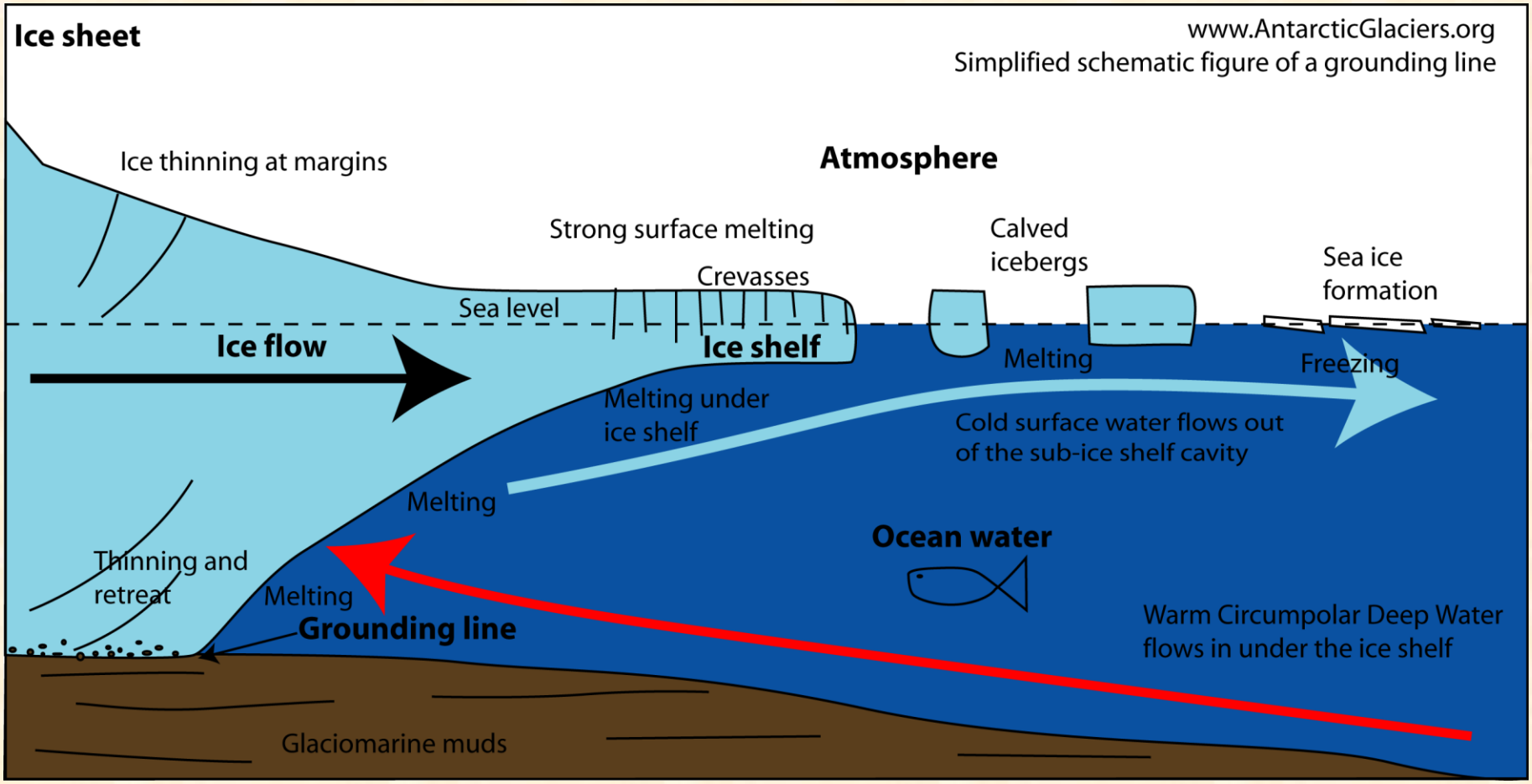
Ice Shelves, Tidal Glaciers

- Tidal glaciers, **Ice Shelves** are the portion of either alpine or continental glaciers which extend out into saltwater.
- **Calving** of glacial ice produces icebergs.
- Calving often occurs along **crevasses** or cracks in the ice, but can also fail from a combination of melting and gravitational pull.
- Melting icebergs will produce **ice rafted sediments**

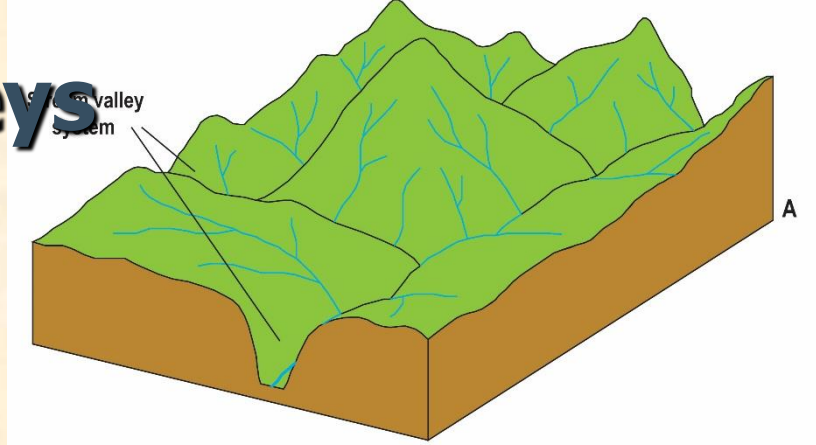
Ice shelf, Weddel Sea

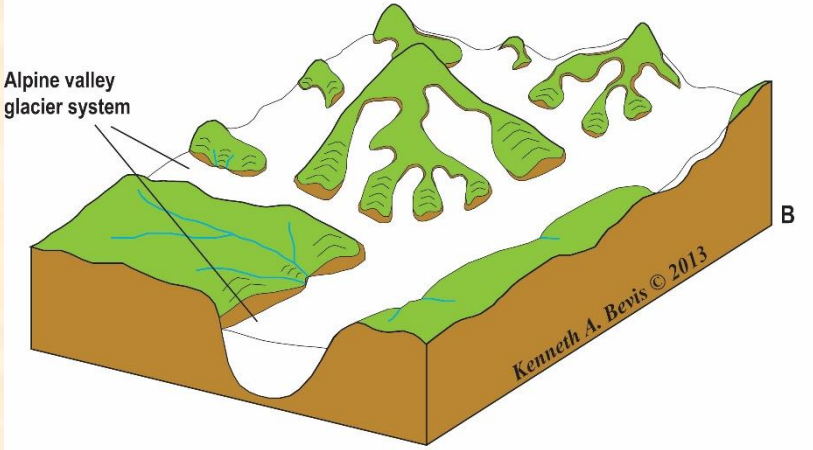


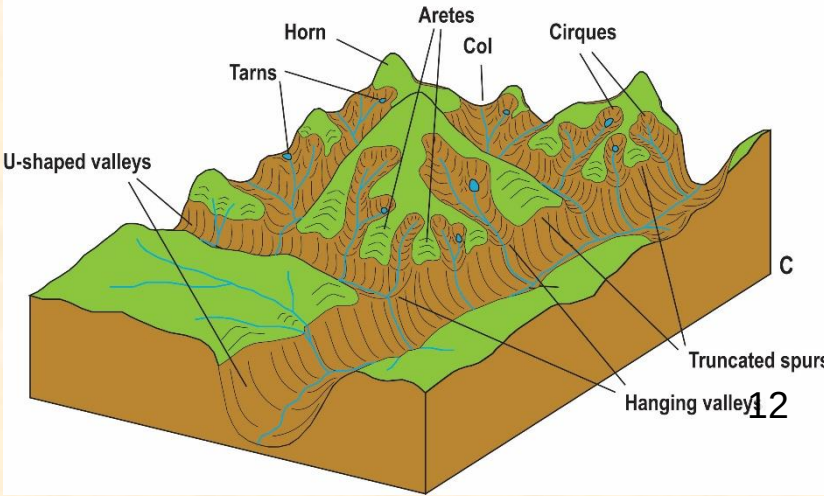
Ice Shelves, Tidal Glaciers



Glacial "U-Shaped" Valleys

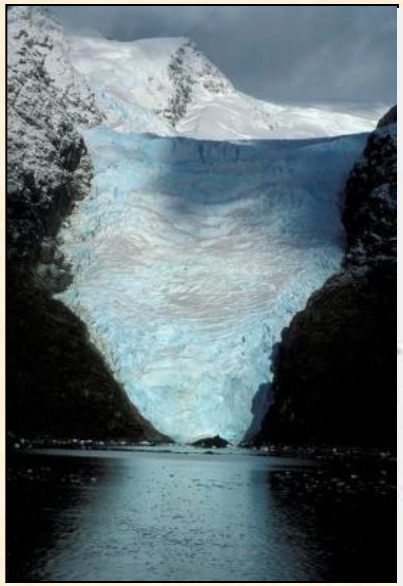


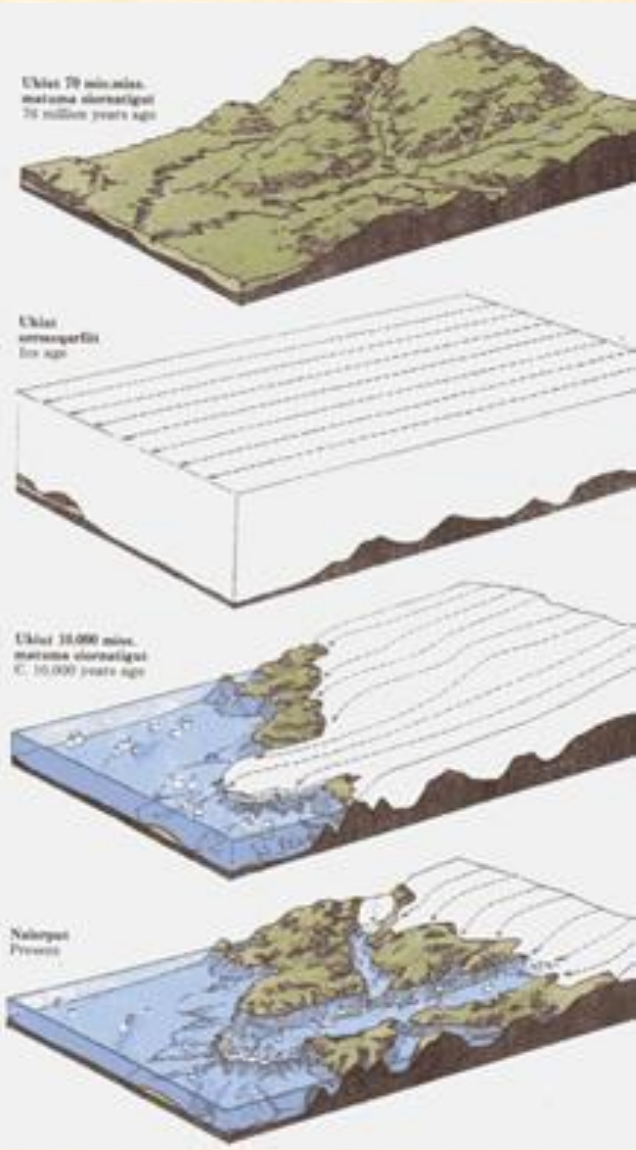




Fjords

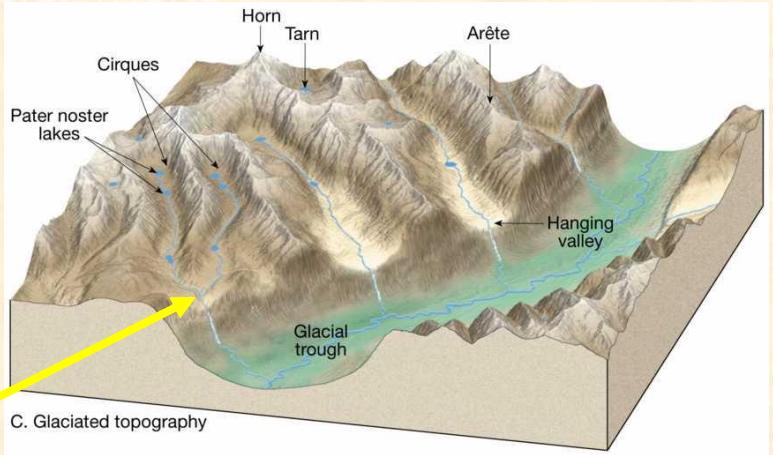
- Created when glacially valleys intersect the ocean and are partially flooded
- Active glaciation or post-glaciation depending on sea-level.





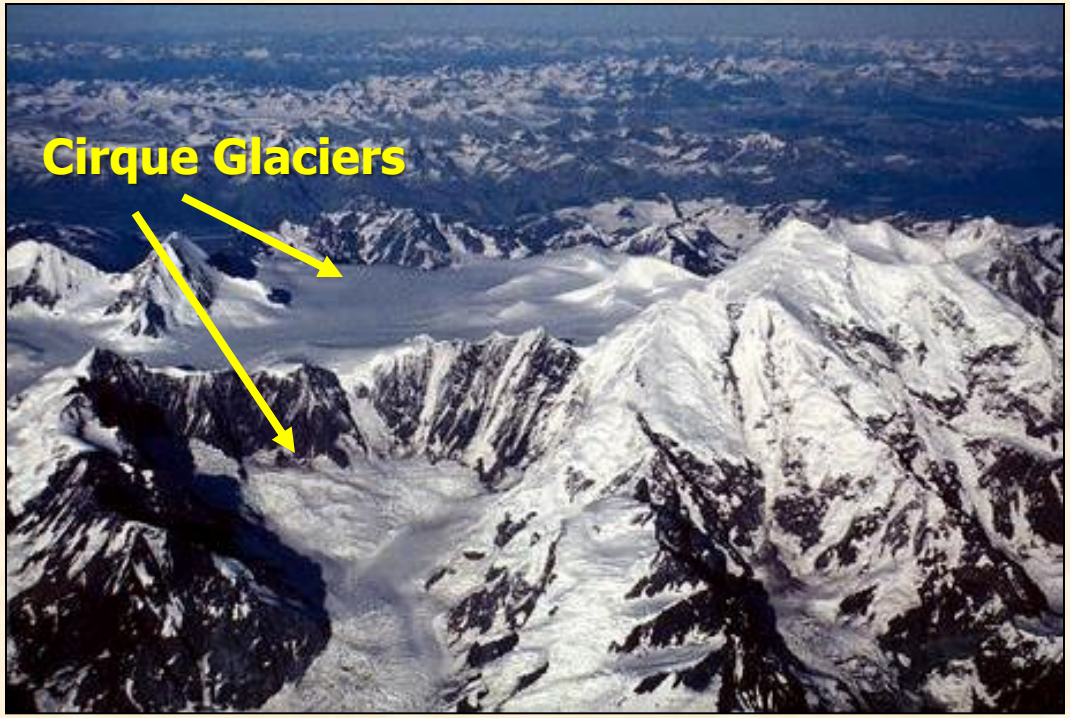
Hanging Valleys

- Abrupt, cliff-like features
- Remnants of a confluence between tributary glaciers and valley glaciers.
- Scour by the valley glacier erodes the original gradient of the tributary confluence.
- Hanging valleys are revealed when the glacier melts

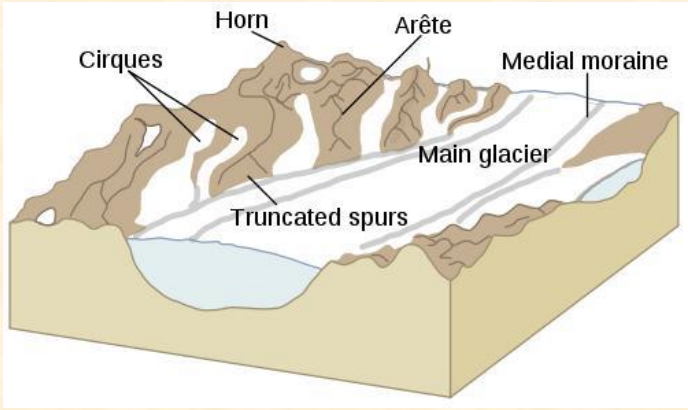


Cirques and Cirque Glaciers

- Bowl-shaped eroded, depressions near-mountain top ridges where snow accumulates and forms the head of an alpine glacier.
- Cirque glaciers: early stage of formation.
- The confluence of multiple cirque glaciers form a valley glacier.
- When glaciers retreat, the cirque is often the last part to melt.

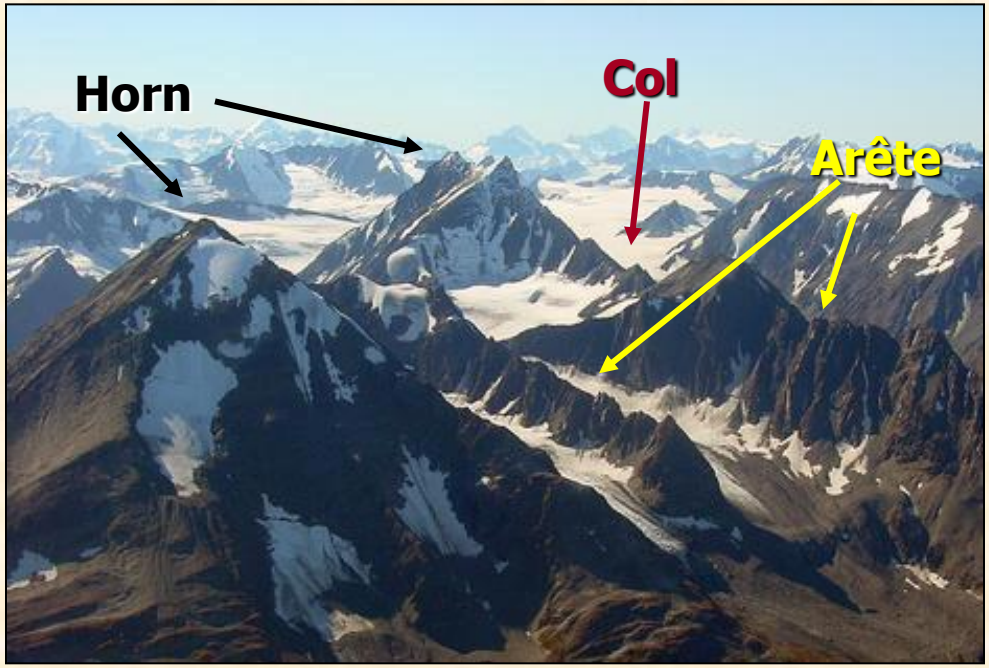


Mount Fairweather, Alaska

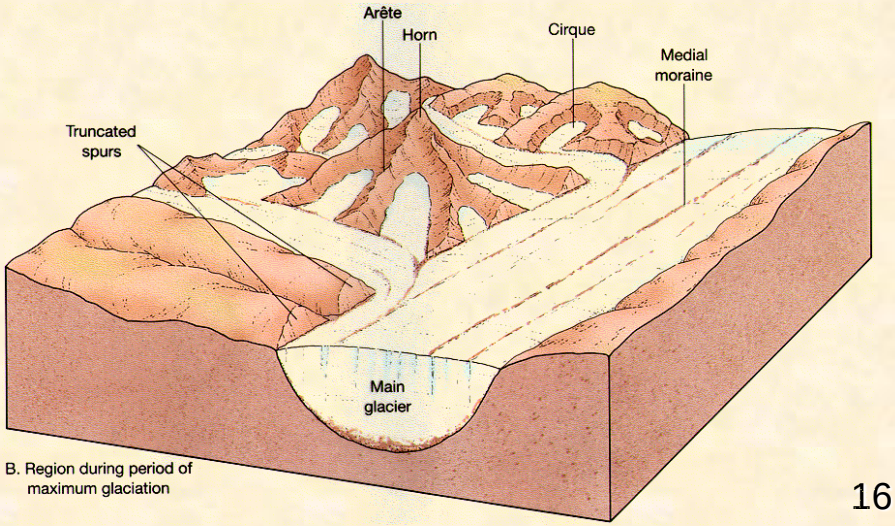


Arêtes Cols and Horns

- **Arêtes** are saw-tooth, serrated ridges in glacial mnts.
  - Separate adjacent cirques and/or adjacent valleys.
- **Cols** form when two cirque basins on opposite sides of the mountain erode the arête dividing them.
  - Cols create saddles or passes over the mountain.
- **Horns** are a single pyramidal peak formed when the summit is eroded by cirque basins on all sides.

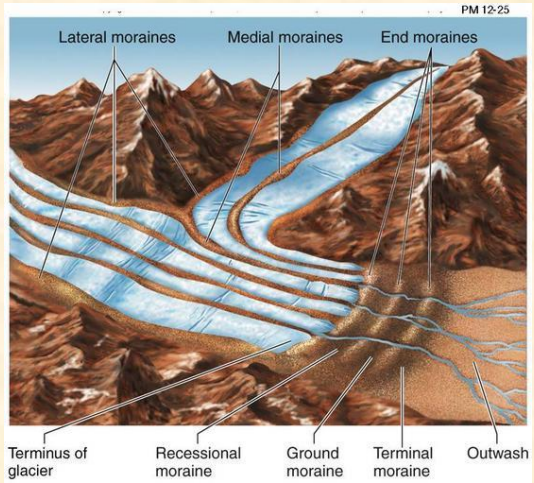


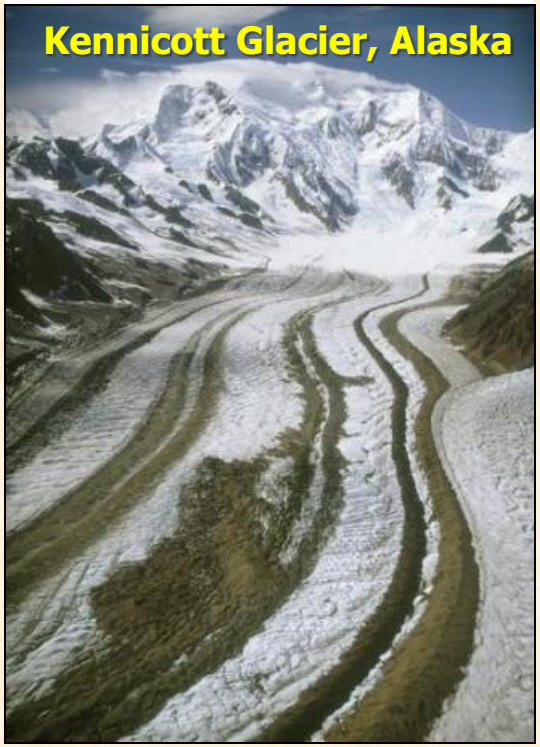
Chugach Mountains, Alaska



Lateral and Medial Moraines

- Moraines are formed by the deposition of glacial till as the glacier melts.
- The four most common moraine types: **lateral**, **medial**, **end**, and **terminal**
- **Lateral moraines:** long linear ridges of glacial till deposited along the side of the glacier parallel to its direction of movement.
- **Medial moraines:** long linear ridges that form along the contact where tributary glaciers with lateral moraines merge to join larger valley glaciers. The till deposits become incorporated as dark ridges of sediment oriented down valley and aligned parallel through the middle of the glacier.

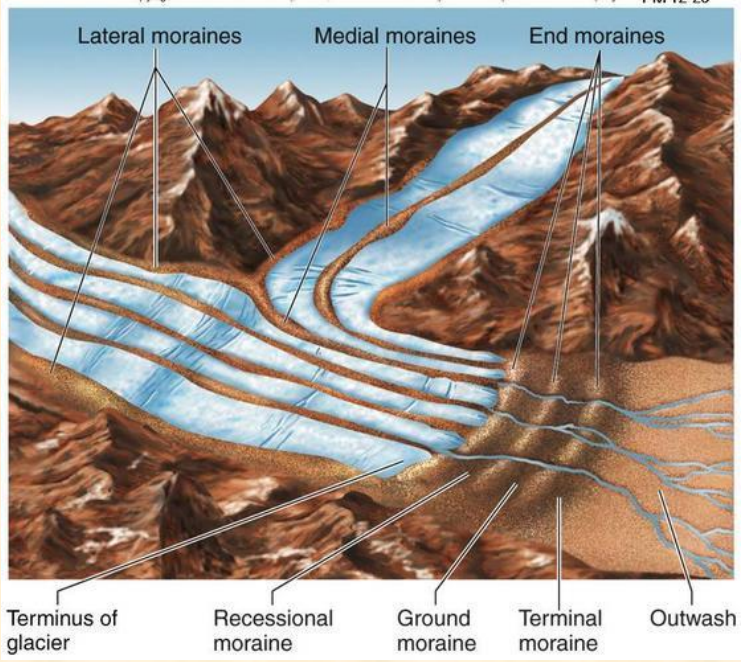




Terminal and End Moraines

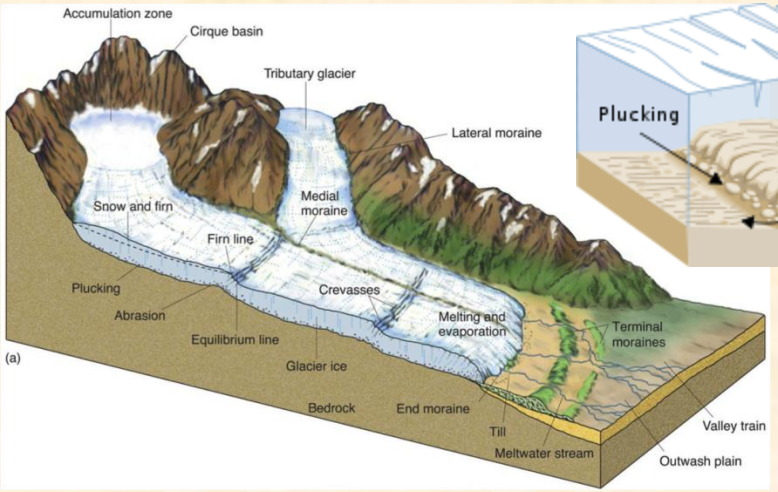
- **Terminal moraines:** linear, concave, arc-shaped depositional ridges that form at the terminus of a glacier. The till deposits mark the outward expanse or limit of glacial movement.

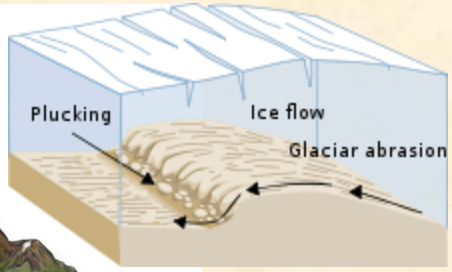
- **End / Recessional moraines:** concave arc-shaped ridges deposited by the melting glacier. Smaller than terminal moraines, and they mark the gradual retreat of the glacial ice after it has already deposited its terminal moraine.

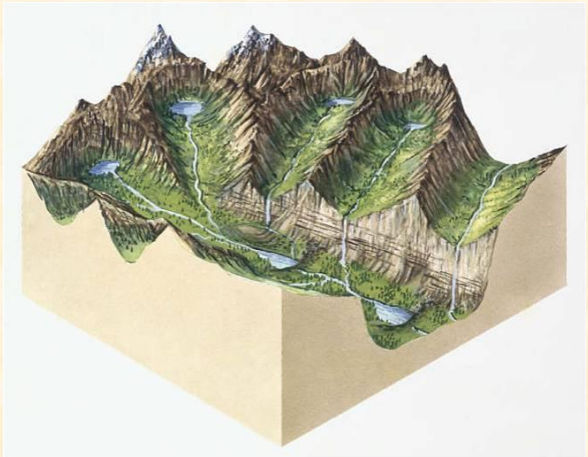


Paternoster Lakes

- Connected string of small, circular lakes that occur in relict glacial valleys.
- Post glacial erosional features filled with rainwater or glacial meltwater.
- Result of either differential erosion of the bedrock, or the creation of small dams formed by glacial till deposits or end moraines.
- Precipitation or springs provide a renewable source of freshwater.

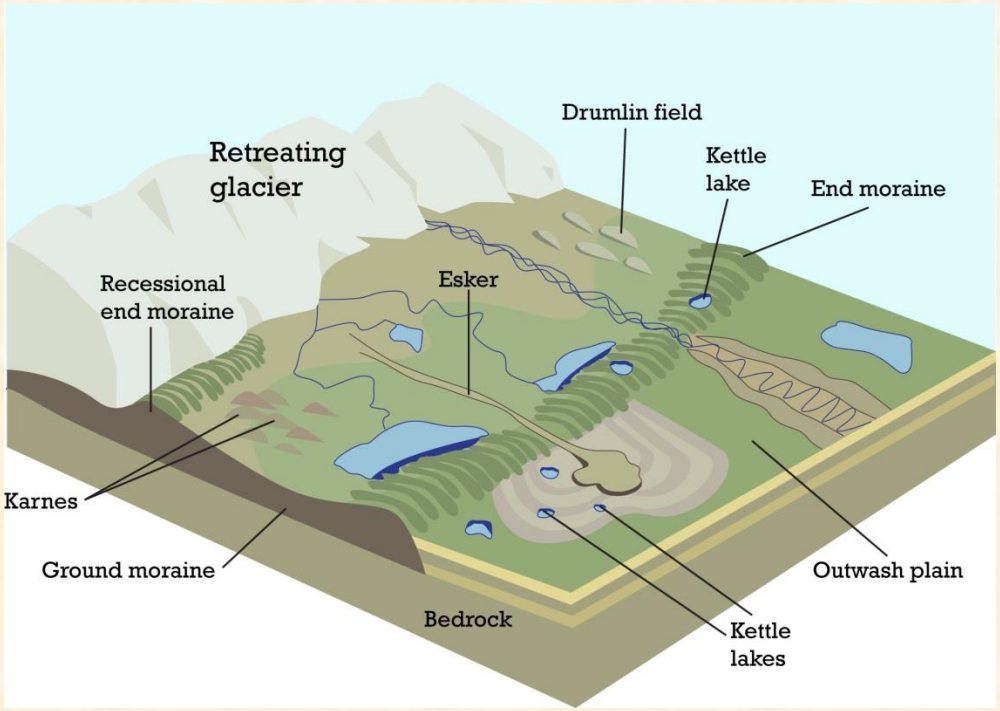


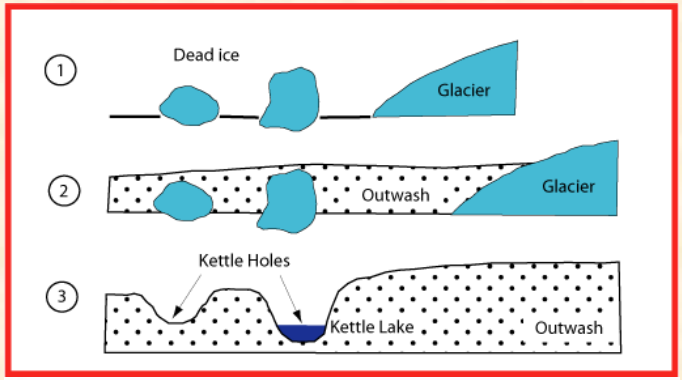




Kettles

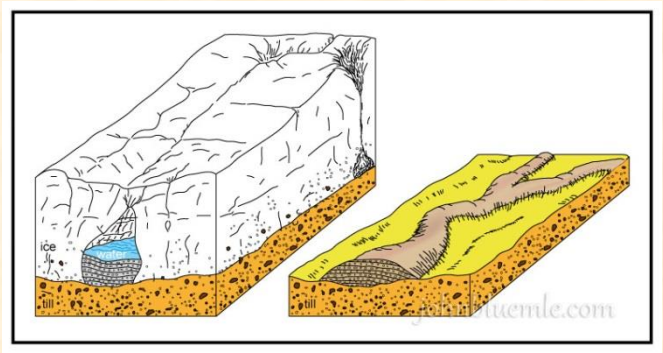
- Small depressions in the landscape, often filled with water post glaciation
- Large blocks of ice are left by a retreating glacier
- Outwash sediments deposited around the blocks, possible burial
- Ice block melts, only a void or kettle remains.
- Subsidence and melting can deepen the kettle.
- Kettles lakes are sourced by rainfall or snowmelt.

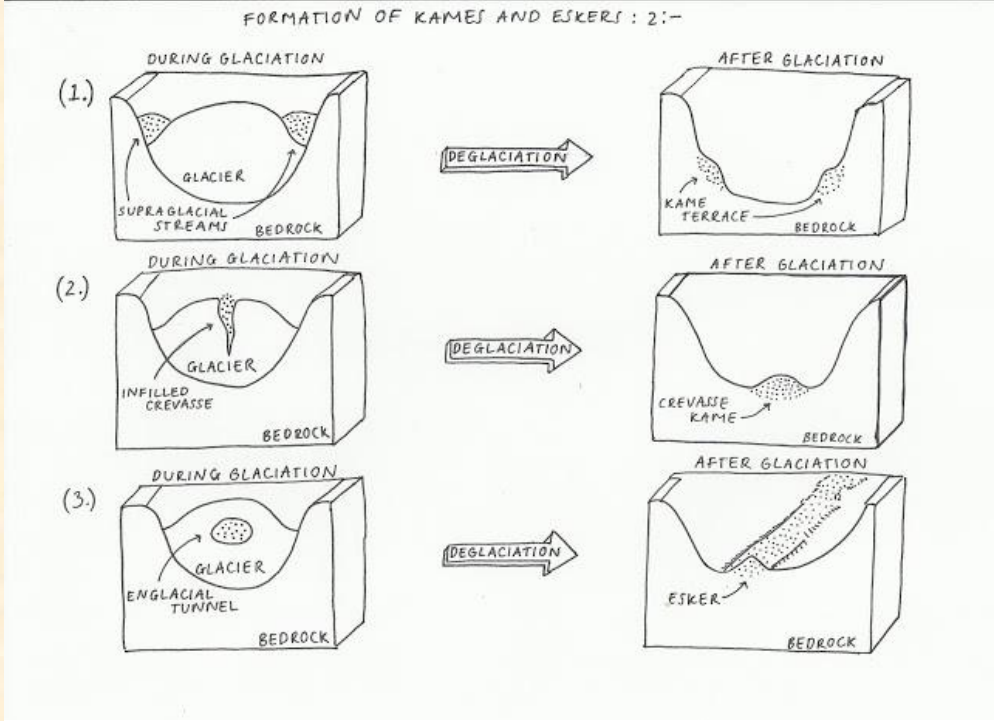


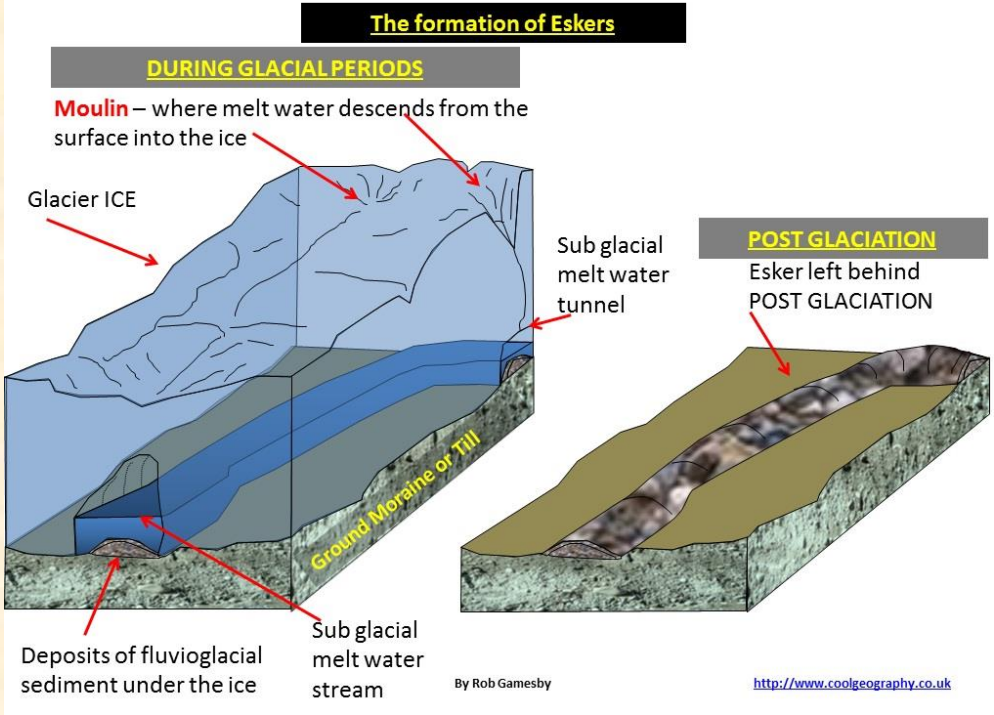


Kames, Eskers

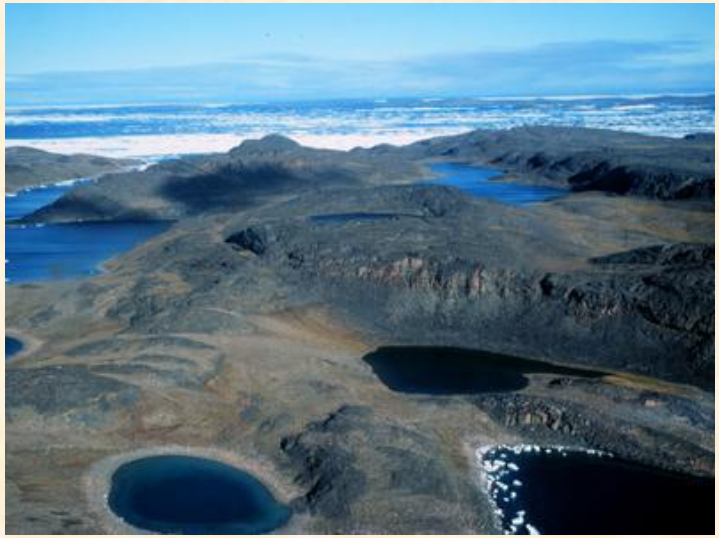
- Kames and Eskers are melt water deposits
- Kames tend to be stratified and associated with surface deposits
- Eskers form along melt water channels that are emerging from tunnels beneath the glacier.
- They are depositional ridges of sands and gravel that mark the "course" of the melting glacier or course of the melt water tunnel.

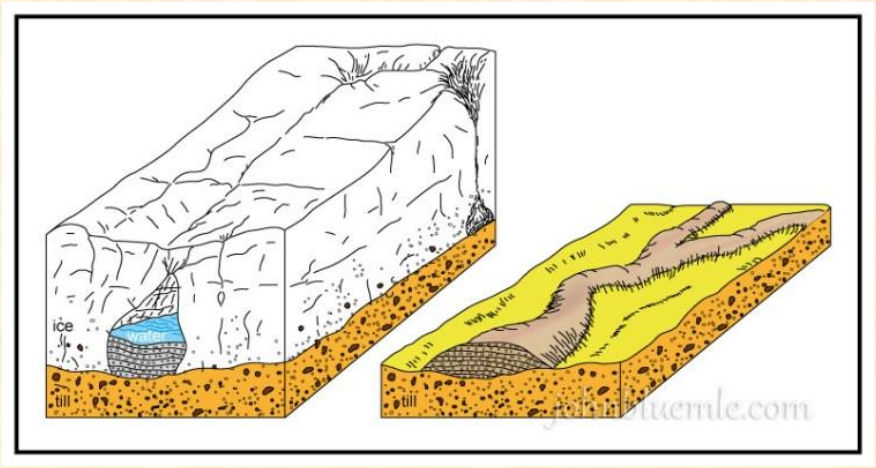






Kames, Eskers

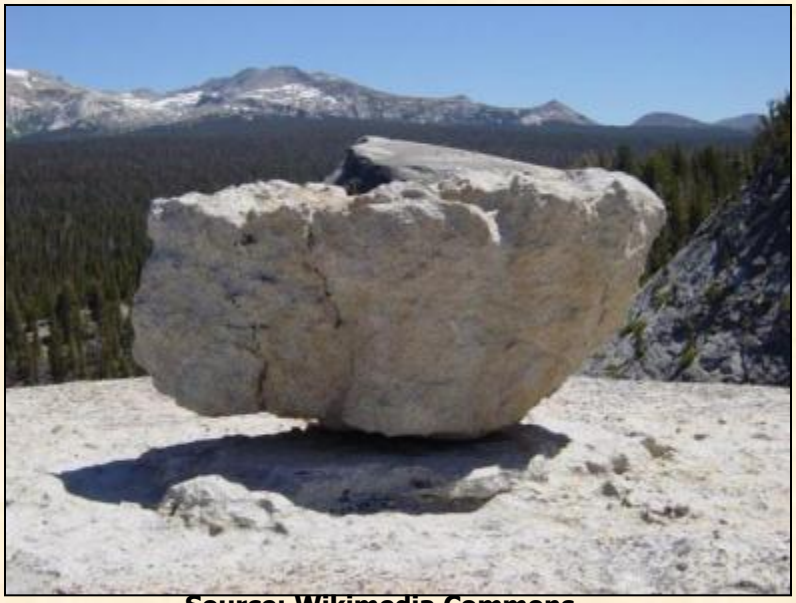




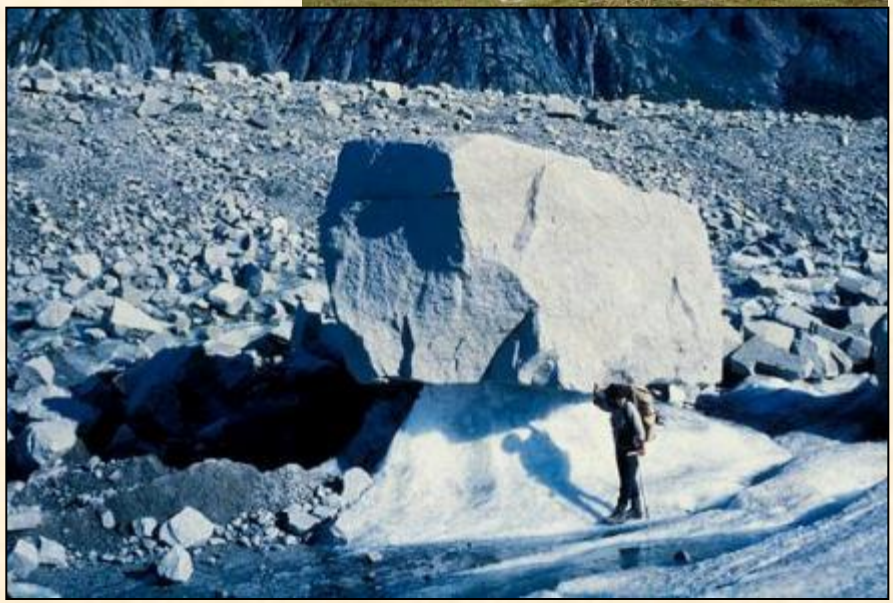
Erratics

- Large, isolated boulders deposited by retreating, melting glaciers.
- Erratics, are generally the largest rocks left behind by the retreating glaciers.
- Generally smooth from glacial abrasion and appear "misplaced" in the landscape.

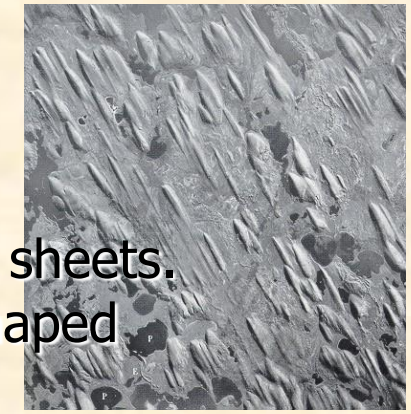
Yosemite Valley.



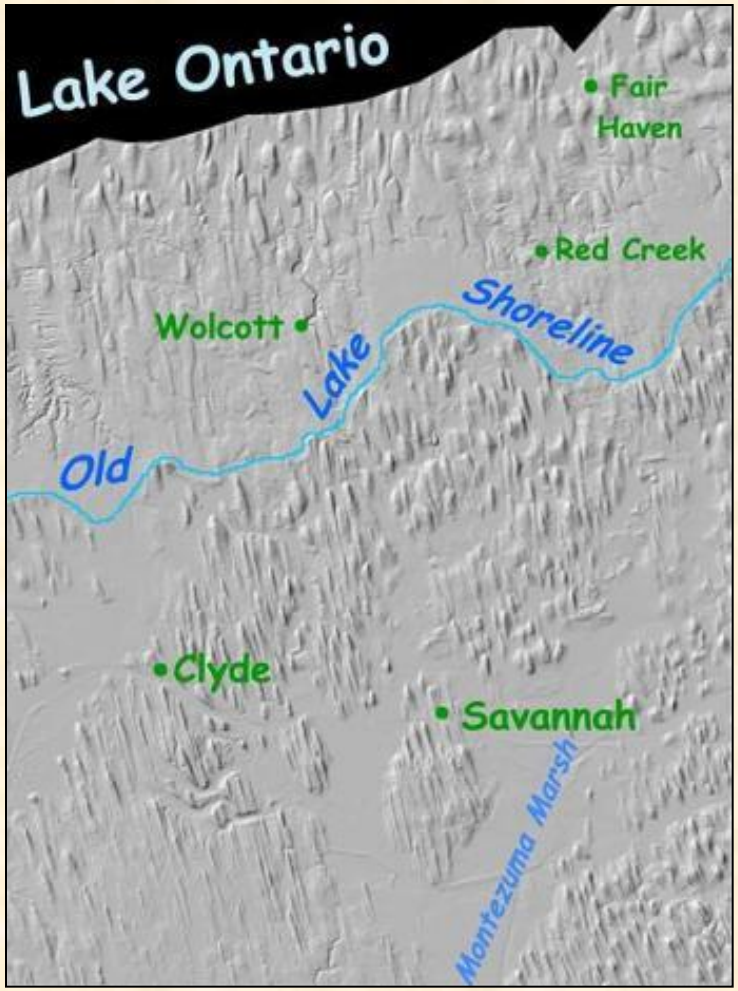
Source: Wikimedia Commons

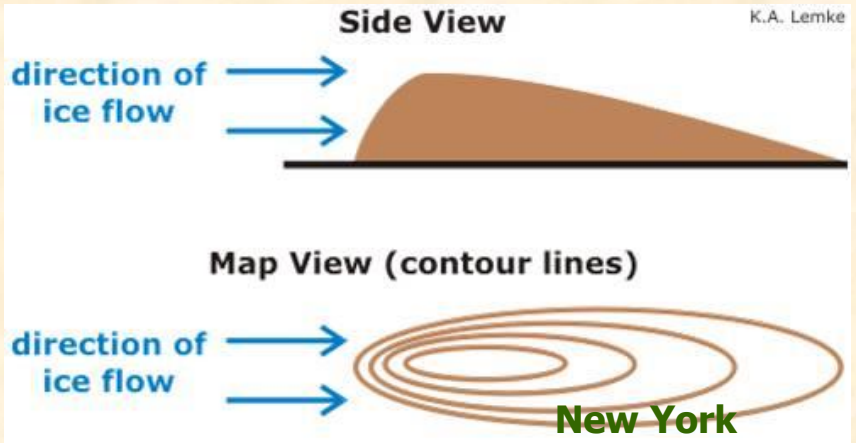


Drumlins



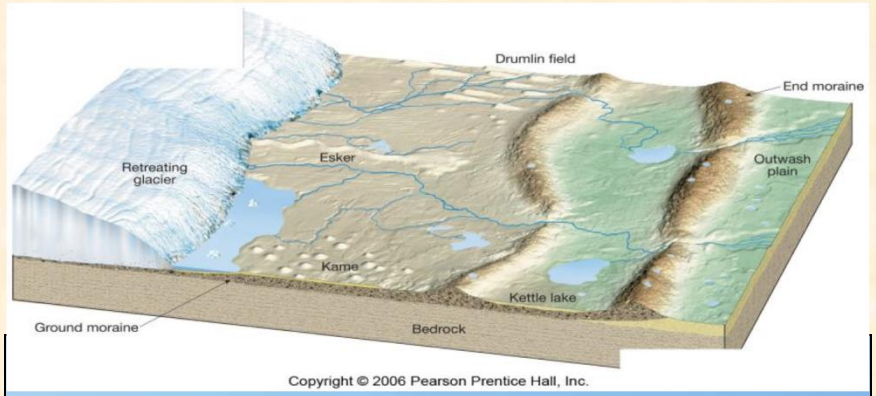
- Drumlins are long, linear hills of glacial till deposited by ice sheets.
- Similar to medial and lateral moraines, smaller, irregular shaped
- Drumlin fields are areas with numerous drumlins.

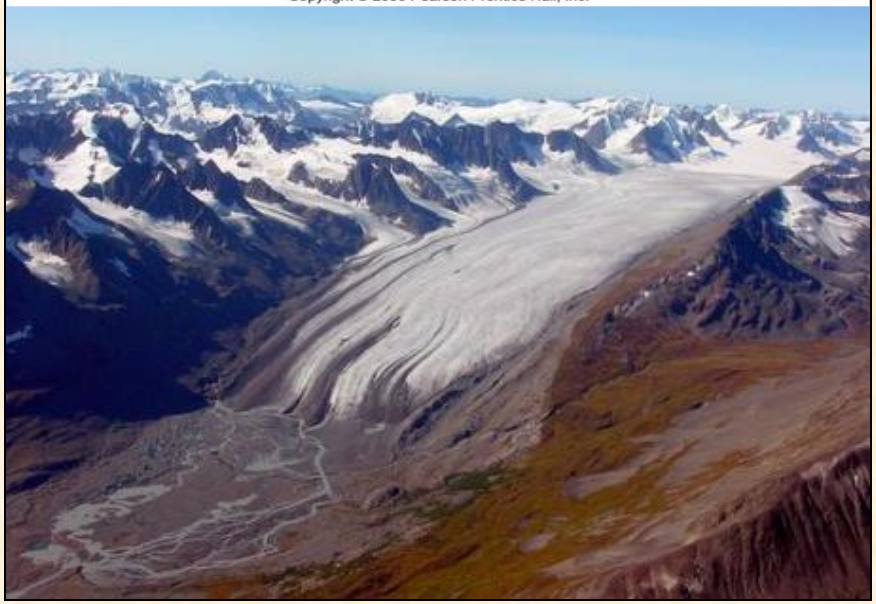




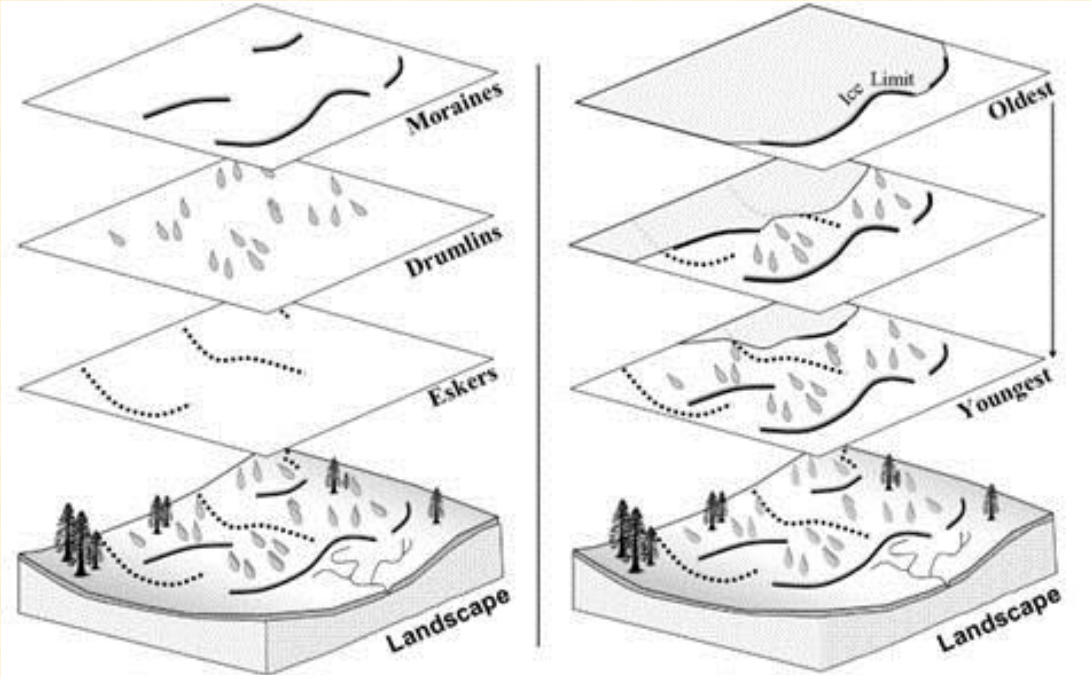
Outwash Plains

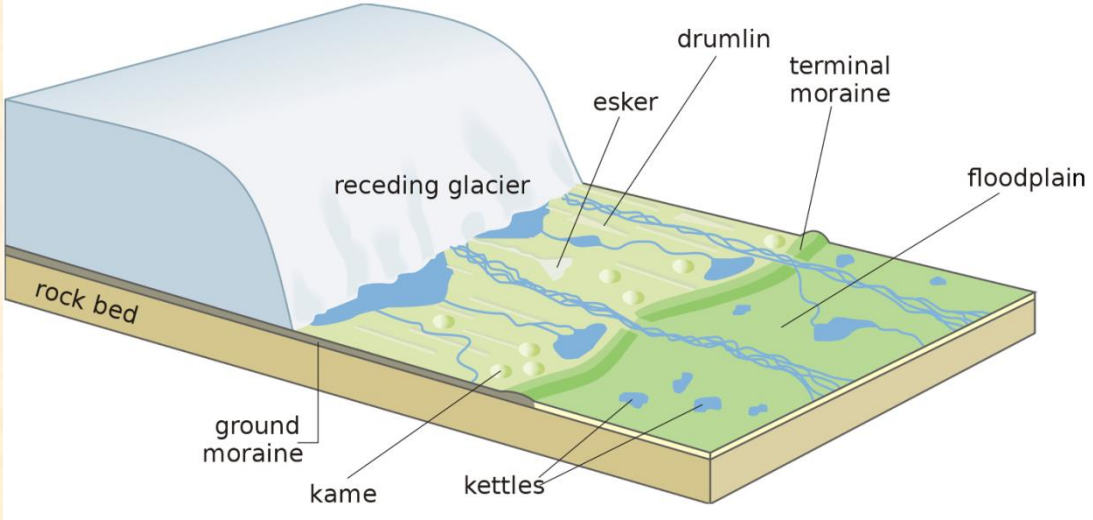
- Extensive stratified deposits of glacial till below a glacier.
- Choked with glacial till and are fed by melt-water flowing from the base of the glacier often creating a braided stream environment.
- Sorting does occur finer materials transported downstream.



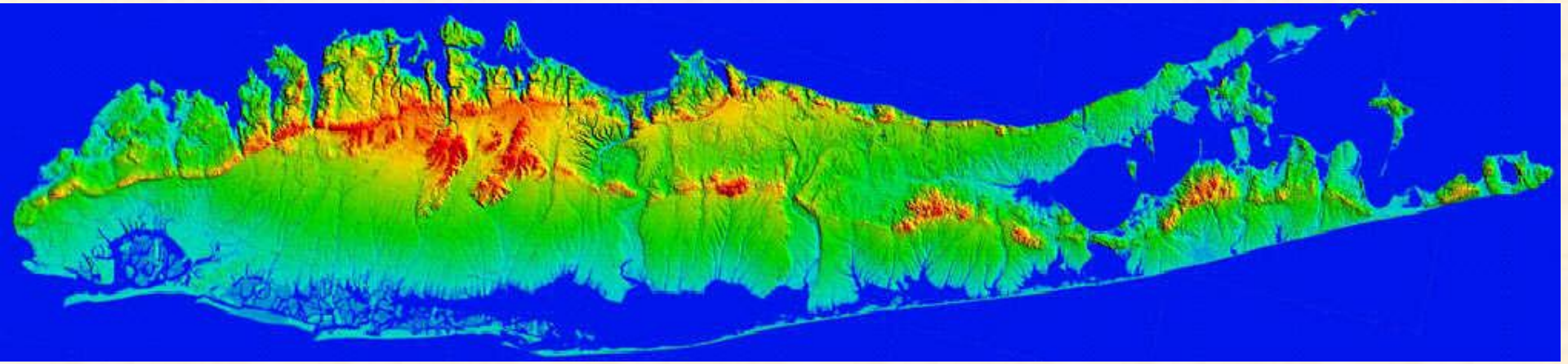


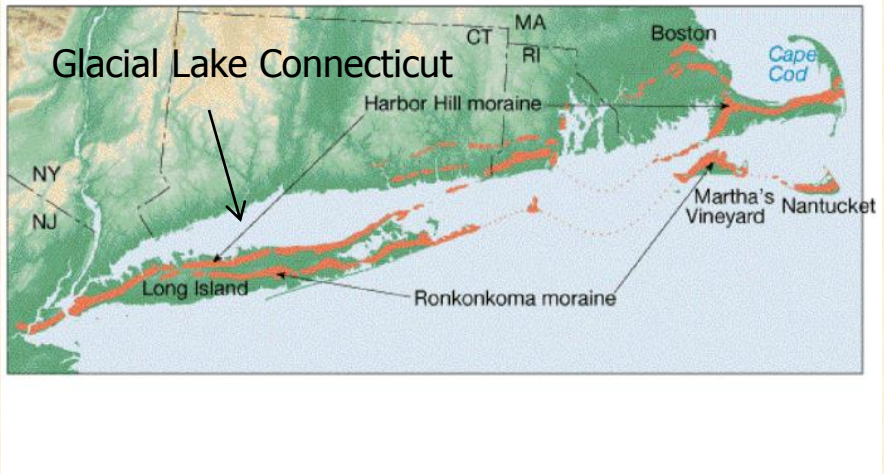
Glacial Landscape Evolution

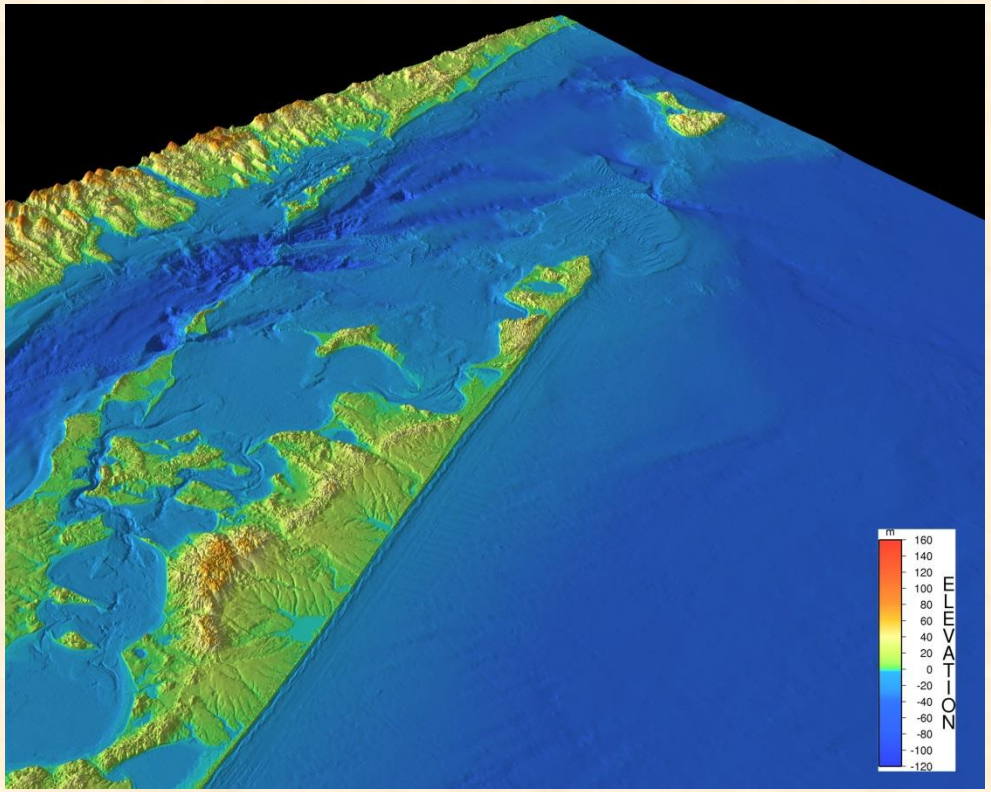


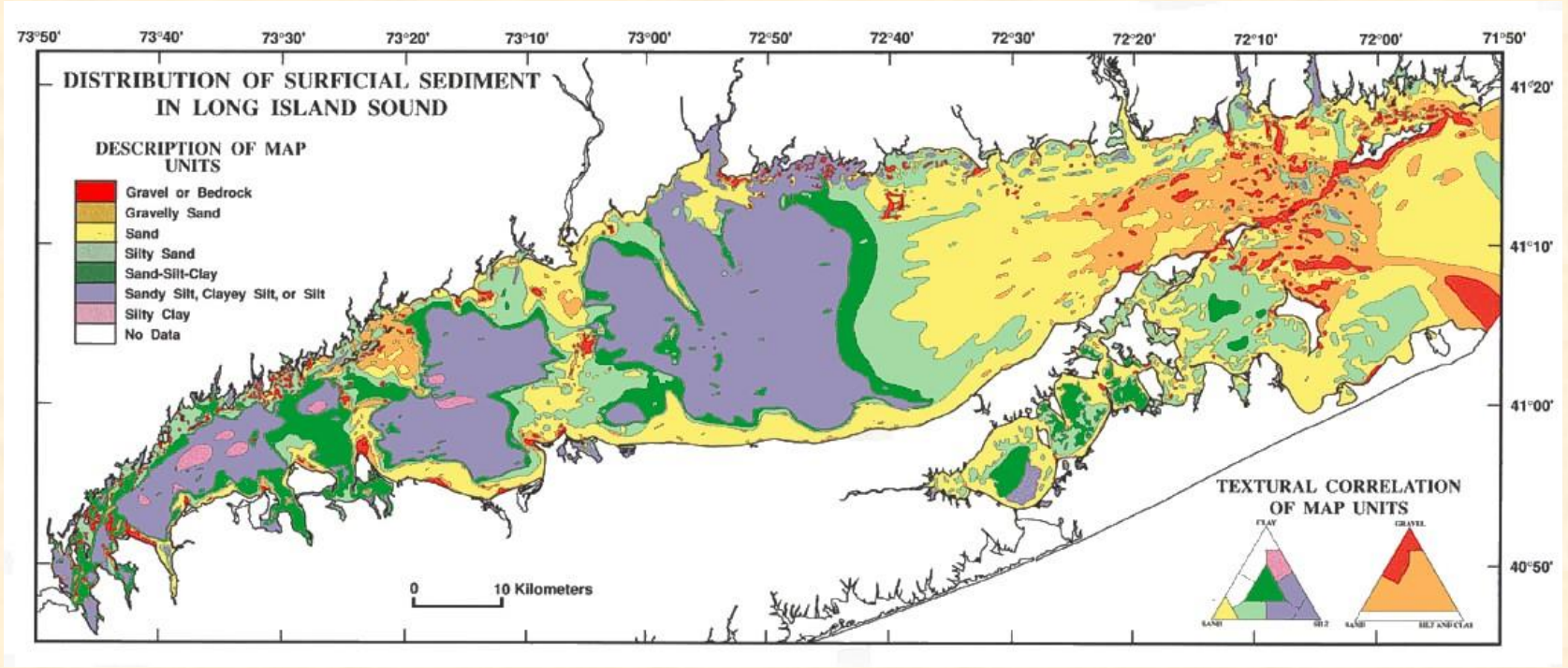


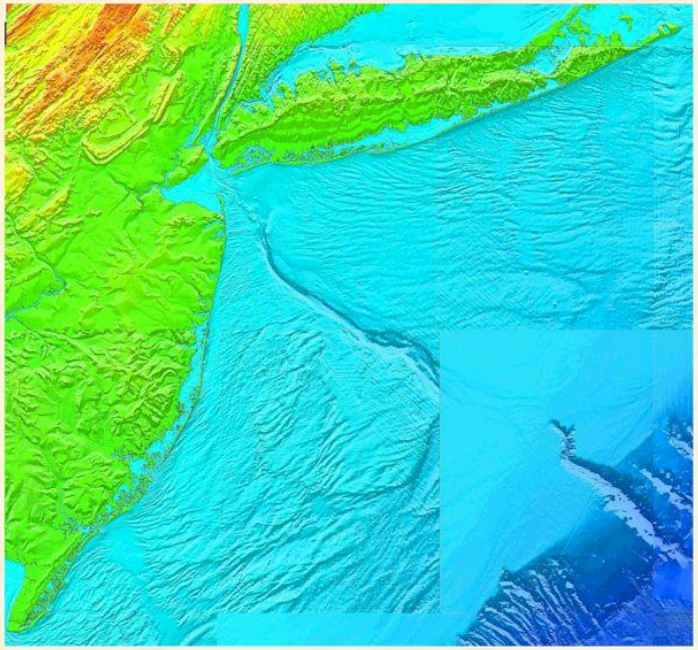
Long Island in Context











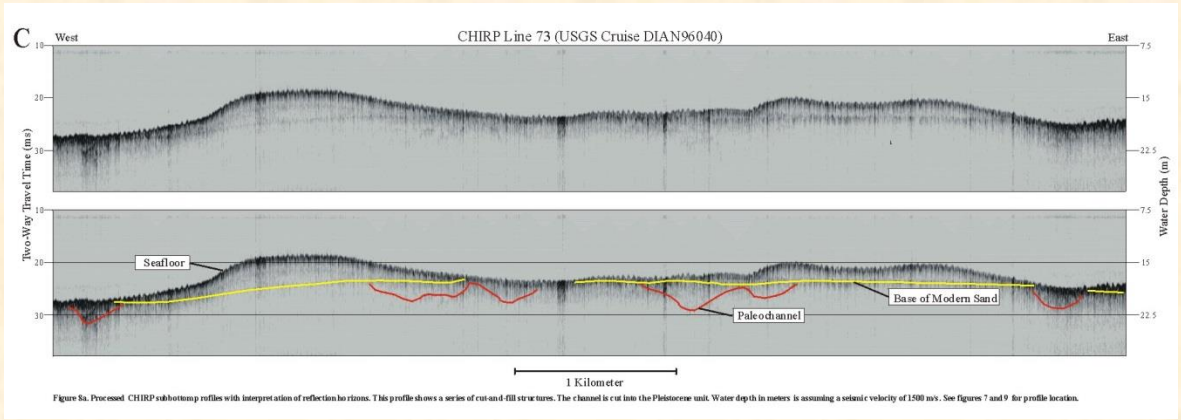
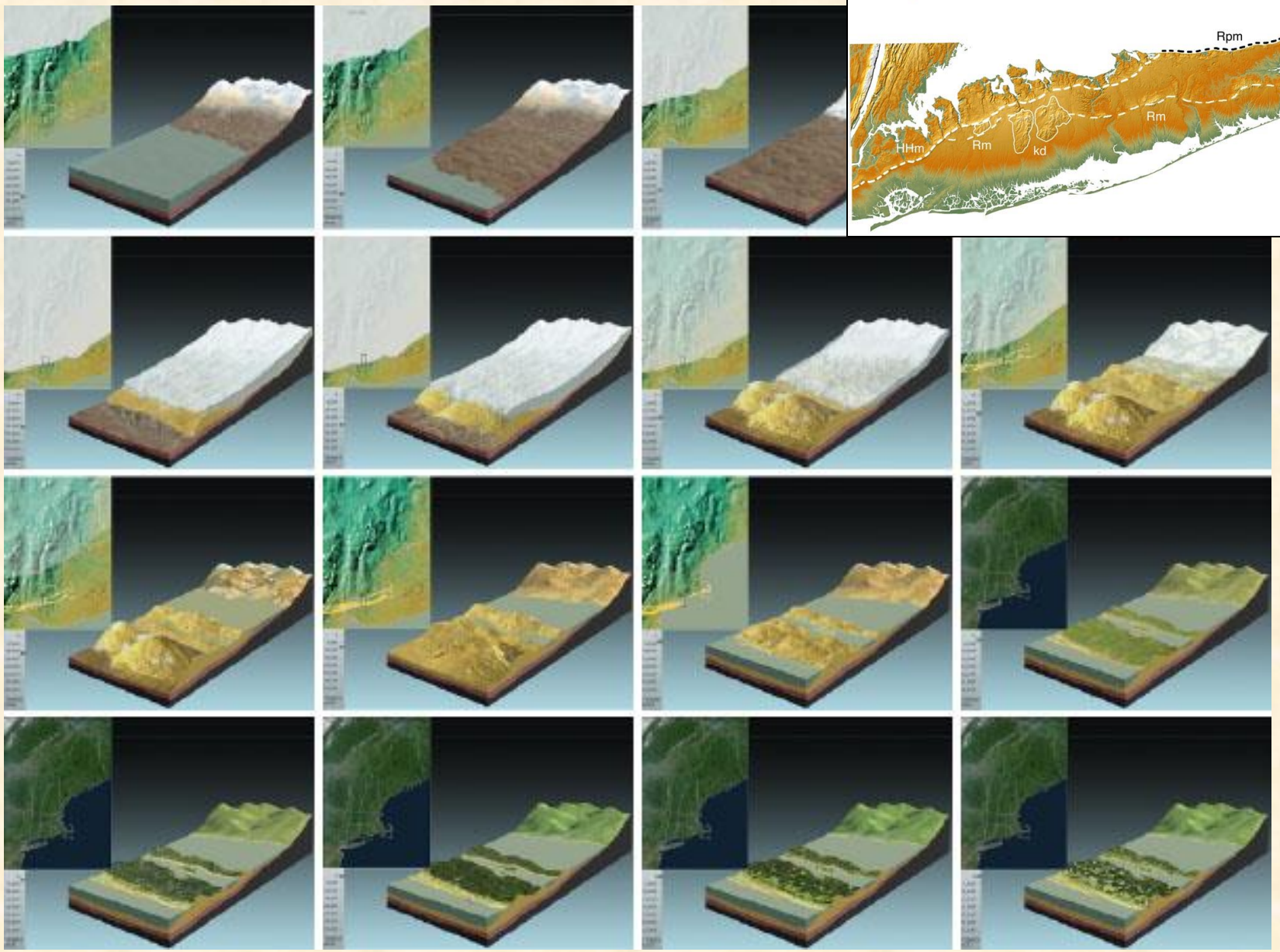


Figure 8a. Processed CHIRP subbottom profiles with interpretation of reflection horizons. This profile shows a series of cut-and-fill structures. The channel is cut into the Pleistocene unit. Water depth in meters is assuming a seismic velocity of 1500 m/s. See figures 7 and 9 for profile location.


DEM - Long Island, NY
Rpm
Rm
Rm
HHm
kd
>400
275
110
56
28
0
elevation (ft)