

## Physical Geography II of the United States and Canada

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## Shaping of North America

The **chief shaper** of the landscape of North America is and has been running water.

➤ **GLACIATION** (moving ice) is the **second most potent shaper of the landscape of North America**.

- ❖ A **GLACIER** is a large mass of ice on land that moves in response to pressure and gravity.
  - It stores a tremendous amount of water in its frozen state.

## The Last Ice Age

❖ **PLEISTOCENE EPOCH** began 1.6 million yrs ago.

- During this time period **there were numerous "ice ages"** as the Earth's climates varied and grew colder during periods of global cooling.

❖ The **last advance** of ice in North America was during the **WISCONSINAN STAGE** of the **LAURENTIDE ICE SHEET**.

- It ended 18,000-22,000 yrs. ago.

Maximum extent of the Pleistocene Ice Cap over the North Pole.

Greenland ice sheet  
Hudson Bay Area

## Sea Level and the Coast of North America during the last Ice Age

Sea level is lower because most of the earth's water is frozen, thus more of the continent's perimeter is above water (dry).

Shape of Florida at lowest recorded sea level (dashes).

Shape of Florida at highest recorded sea level.

Changes in the shape of Florida with the level of ice retention.

## Postglacial (isostatic) Rebound

Areas once depressed or deformed by the weight of ice sheets slowly returning to equilibrium ("normal positions").

Change in millimeters (mm)/year

Thickness of last ice sheet in meters

CANADA

## Greenland Ice Sheet Today

Most of Canada looked like this during the Ice Age.

During the Ice Age, the ice sheet in the central areas was 1-2 mi (5,000-10,000 ft) thick.

## Glaciers

- ❖ Glaciers are formed when snowfall exceeds melting.
- ✓ **CONTINENTAL GLACIERS** originate on fairly flat expanses and tend to be very large. They expand from a core area.
- ✓ **ALPINE GLACIERS** originate on mountain tops and flow downhill. They tend to be relatively small.

7

## Glaciers at Work

**Glaciers transform a landscape by ...**

- **Crushing rock** in its path.
- **Scooping soil** and moving it elsewhere.
- **Creating landforms** that are products of both:
  - **erosion** (removal of rock material).
  - **deposition** (laying down and piling up of rock material that was previously eroded elsewhere).


Glacier simulation:  
<http://intern.forskning.no/arnfinn/polarareet/glacier.html>

8

## Glacial Dynamics: How these processes shaped North America

1. **Ice sheets** move away from their **zones of accumulation** and push forward in sections (**lobes**) under the pressure from their weight (called **plastic flow**).
  - Also they move down slope by **slippage**. (As the weight of the ice melts its lowest levels, the water acts as a lubricant.)

\*Get Glacial Dynamics handout from the course home page.\*




The center of the zone of accumulation of the Laurentide Ice Sheet was over present-day Hudson Bay.

9

## Glacial Dynamics (cont'd)

2. The **ice front** (forward edge of the ice sheet) acts as a "bulldozer" or "snow plow". This creates a variety of **erosional glacial features**.
3. All this material is **mixed with the ice** as it moves forward and down slope. Called **debris**.
4. **Moraines** (unsorted glacial debris also called "glacial drift") are created.

Glacial Striations (grooves)  
Central Park, NY




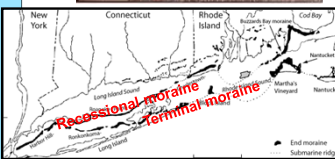
HC GEOL 101 field trip to Central Park

10

## Glacial Dynamics (cont'd)

5. The **furthest advance of the ice** is marked by a **ridge of unsorted glacial material** called the **end moraine** or **terminal moraine**.
6. **Recessional moraine**: a **low ridge** of unsorted glacial material that marks the position of the ice front's furthest forward movement **after** a period of retreat.



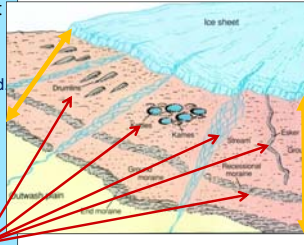


11

## Glacial Dynamics (cont'd)

Area marked by the orange double-headed arrow between the ice sheet and the end moraine melted away. IT DID NOT MOVE BACKWARD.

7. The "**retreat**" of a glacier is the **melting** of the front edge of the ice.
  - >>It creates the **illusion** that the glacier is moving backward (It melts **in place**, NOT backwards.)
8. As the ice melts, the material it picked up is exposed and **dropped in place**. Meltwater may reposition them. This creates a variety of **depositional glacial features**.



12

## The Finger Lakes and Drumlin Fields: NYS

front edge of moving ice is shown here, deepening them into existing river valleys.

After ice melted a recessional moraine blocked south-flowing drainage. Melt water filled the deepened river valleys to create the lakes.

Orientation indicates ice movement

FINGER LAKES

Recessional Moraine

## Glacial Features near Hudson Bay on the Canadian Shield

**A. Bog, Manitoba**  
(spongy ground with shallow, water-filled depressions)

**B. Kettle lakes, NWT**

**C. Erratic, NWT**

## Glacial Dynamics (cont'd)

**9. Outwash** is melt water that flows from glacier's edge. It carries debris which is **sorted** by the moving water and deposited in front of the moraines.

**10. Outwash Plain:** landform feature created by the material deposited by outwash. It ranges in thickness from several feet to hundreds of feet.

Braided stream and sorted debris created by sediment-filled melt water.

Cross-section of sediment layers deposited by melt water.

## Glacial Features (moraines and outwash) Long Island, NY

1. The twin forks and Shelter Island

2. Central Suffolk County

3. Western Suffolk County

5. JFK airport on the outwash plain

4. Central Nassau County

## Ice Age Alpine Glaciers

❖ Mountains in western North America blocked the movement of the Laurentide Ice Sheet.

- The landscape was covered with overlapping valley glaciers creating a small ice sheet.
- Remnants remain today.
- Other areas -- at lower elevations and located further south -- show the scars of glacial melt water erosion.

Areas covered by Cordilleran Ice Sheet

Areas with active mountain glaciers.

## Alpine Glaciers

**A.** Snow and ice collect at the highest elevations of mountains.

**B.** Pressure of the ice mass moves it down-slope by gravity.

**C.** Valleys funnel the moving ice; erosion occurs.

**D.** Unique features are created by moving ice and meltwater.

(a) (b) (c) (d)


Horn, Arête, Cirque, Truncated spurs, Hanging valley, U-shaped glacial trough

**D. Unique Features**


- Horns
- Cirques
- Arêtes
- Lateral moraines
- Medial moraines
- U-shaped valleys
- Hanging valleys

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## Alpine Glaciers



Lateral moraines




Medial moraine

**Salmon Glacier with lateral moraines, British Columbia**

**Two glaciers join creating a medial moraine in Kluane NP, Yukon Territory.**

19


## Glacier carved U-shaped Valley



20

## Half Dome

Yosemite National Park, CA




U-shaped valley


- **Half Dome** is a granitic structure (dome) that towers above **Yosemite Valley**, a U-shaped valley.
- A glacier sheered away half of the dome during the last Ice Age, creating a north-facing cliff.

21

## Piedmont Glacier

Ellesmere Island, Canada





Ice

Sea water

**Tongue of ice (lobe) coming from a mountain glacier on Ellesmere Island.**

The ice once reached the sea.

22


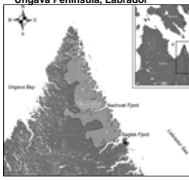
## Fjord

❖ A narrow deep water inlet of the sea flanked by steep slopes.

- It was created by the deepening of a valley by glacial ice to a point where it *could be flooded by the sea*.
- During the post-glacial period, as sea level rose, the valley was flooded.

**Some fjord areas of N. America**

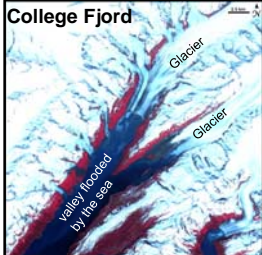
- Coasts of Newfoundland & Labrador
- Inlets along Maine's coast
- The lower Hudson River valley
- Coast of mainland British Columbia
- The west coast of Vancouver Island
- Alaskan Panhandle

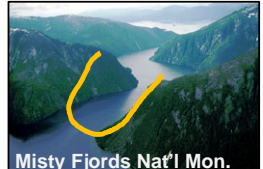
23

## Fjords of Alaska


**College Fjord**



Valley flooded by the sea



Misty Fjords Nat'l Mon.



Tracey Arm Fjord

24

## Ancient Glacial Lakes

As the Ice Age ended, areas of North America beyond the terminal moraine were flooded with glacial melt water.

25

## Formation of Great Lakes

26

## Future N.America in a world without ice

As an ice age ends, glacial melt water is returned to the oceans causing a rise in sea level. The low lying continental margins are flooded by the sea.

**North America**  
 The entire Atlantic seaboard would vanish, along with Florida and the Gulf Coast. In California, San Francisco's hills would become a cluster of islands, and the Central Valley a giant bay. The Gulf of California would stretch north past the latitude of San Diego—no more there'd be a San Diego.

27

## NEXT

# Influence of WEATHER and CLIMATE

28