

## GLACIERS

1. Glacier
  - a. A thick ice mass that originates on land from the accumulation, compaction, and recrystallization of snow.
  - b. Ice mass slowly moves
  - c. Agents of erosion – acquire, transport and deposit sediment
  - d. Occupy ~10% of land area, either as alpine glaciers or continental (ice sheet) glaciers
  - e. Interrupts hydrologic cycle by “locking up” water
2. Glacier Types
  - a. Valley (Alpine)
    - i. Found in mountainous areas
    - ii. Smaller than ice sheets
    - iii. Lengths greater than widths
    - iv. Only cover a small region
    - v. Transform V-shaped valleys into U-shaped valleys
  - b. Ice sheets (Continental glacier)
    - i. Large scale – cover 10% of Earth’s land
    - ii. Found in polar regions
      1. Greenland – 1.7 million km<sup>2</sup>
      2. Antarctica – 13.9 million km<sup>2</sup>
3. Glacier movement
  - a. Gravity primary force
  - b. Entire ice sheet moves – 5 to 50 m/yr
  - c. Plastic flow – flowing solid
  - d. Basal slip – movement over bedrock
  - e. Fastest movement within the center
  - f. Friction Slows down the sides
  - g. Mechanisms of Glacial Movement
    - i. Rotation of Grains
    - ii. Melting and Freezing
    - iii. Internal Slipping
4. Glacier Budget
  - a. In - Zone of accumulation
    - i. Snow accumulates and forms ice
    - ii. Outer limit is the snowline
  - b. Out – Zone of wastage
    - i. Ablation – general term for loss of ice or snow from a glacier
      1. Sublimation
      2. Evaporation
      3. Melting
      4. Calving - icebergs
  - c. If ice formation is greater than ice loss – glacier advances downslope
  - d. If ice formation is less than ice loss – glacier retreats upslope
  - e. If ice formation is = ice loss – glacier position is stationary
5. Glacier Erosion

- a. Plucking – loosen and lift blocks of rock (mechanical weathering)
  - b. Abrasion – sediment in ice acts as giant “sandpaper”
    - i. Creates Rock flour – very fine-grained material
    - ii. Creates Striations – grooves scratched in bedrock that indicate direction of ice movement
6. Causes of Glaciation
- a. Full Reasoning is not known
  - b. Theory of Glaciation needs to include:
    - i. Interglacial periods – periods of warm climate separating periods of glacial advancements.
    - ii. Glacial episodes in the Paleozoic (200-300 mya) and Precambrian time (700 mya).
    - iii. Earth’s average global is 14°C, in the geologic past it was 22°C – Glaciation requires a temp. of about 10°C.
    - iv. Continental glaciers originate in polar or elevated land.
    - v. Sufficient precipitation needs to occur.
7. Earth’s orbital changes controls its climate
8. Milankovitch cycles
- c. Eccentricity
    - i. Measure of the noncircularity of Earth's orbit
    - ii. Cycle is about 100,000 years
  - d. Inclination
    - i. The changes in the axial tilt (22° to 24.5°) of the Earth
    - ii. The greater the tilt the greater the contrast between summer and winter temperatures
    - iii. Cycle is about 41,000 years
  - e. Precession
    - i. The wobble of the Earth as it spins on its axis
    - ii. Cycle is about 26,000 years
  - f. Main effect of cycles is to change the contrast in the temperature of the summer and winter.
  - g. Glaciation would occur when the summer temperature is closer to the winter temperature, but winter temperatures are not colder than usual.
  - h. Rather the mild summers melt less ice than is received in the winter.