DENUDATION:

Erosion

and

Weathering
DENUDATION refers to the wearing down, stripping and leveling of the earth's surface.

- This is caused by rivers, glaciers, waves and wind!
- 2 processes: weathering and erosion.

Weathering is the breakdown of rock and minerals.

Erosion is the movement of these weathered materials.
Weathering

- Weathering is the breakdown of rocks and minerals by physical pressures and chemical reactions.

- There are two types: physical and chemical.
Physical Weathering

- Physical weathering is the breakdown of rock and minerals by mechanical stresses.

- Physical weathering prevails in:
  - cold and wet climates
  - high altitudes and high latitudes
  - hot/dry regions
Environmental affects on Physical Weathering

- Fast temperature changes, like those that occur in the desert, increases the amount of physical weathering due to heat expansion.

- Conversely, in regions like the tropics where there is little temperature change, the amount of physical weathering due to heat expansion is minimal.
Environmental affects on Physical Weathering

- Abundant precipitation combined with alternating freezing/thawing temperatures increases the amount of frost fracture. Conversely, the absence of those climatic conditions reduces the amount of frost fracture.

- Running water increases physical erosion as friction occurs between water and rock.

- Ocean waves cause hydraulic pressure and abrasion on the shore leading to physical weathering.
1. Physical Weathering - Frost fracture
water gets into the cracks of rocks, freezes and expands causing rocks to crack.
Water collects in rock crack.

Water freezes and expands, forcing crack to widen.

Ice thaws, contracts and water gets deeper into cracks again.

Repeated expansion and contraction causes further cracks till rock splits.
2. Physical Weathering – Heat or Thermal Expansion

- Repeated daily heating and cooling of rock results in **expansion** during heating and **contraction** during cooling.

- Different materials expand and contract at different rates, resulting in stresses along mineral boundaries.
Heat or Thermal Expansion
3. Physical Weathering - Exfoliation

- Some types of rocks, such as coarse grained igneous rocks, weather by breaking along curved surfaces – breaking apart in rounded sheets.

- Associated with release of internal pressure within rock.

- Outer layers of rock “peel away” like layers of an onion.
Exfoliation
rock surface heats up and expands

rock surface cools and contracts

joints form in the outer part of the rock

original rock surface

broken rocks
4. **Physical Weathering** – Plants and animals

- **ROOTS grown into the rock**
  - Expansion due to root growth.
- **Animals that burrow in the ground.**
  - Could be considered Biological weathering!!!!
Chemical Weathering

- Chemical weathering is the breakdown of rocks and minerals by chemical reactions.

- It usually involves the action of rainwater.

- This involves three processes:
1. Chemical Weathering – Solution or Carbonation

- Rainwater absorbs CO$_2$, SO$_2$, and other chemicals from the atmosphere and combines with organic acids from the soil.
- Which then reacts with rock and minerals causing some to dissolve and move away.
- Often results in caves, sink holes and underground rivers.
1. Carbonic acid in groundwater dissolves limestone.
2. Carbonic acid in groundwater dissolves limestone.
3. Water table is lowered.
4. Limestone dissolved from rocks above the caves is deposited as stalactites and stalagmites.
2. Chemical Weathering – Hydrolysis

- Hydrolysis like the first process involves the minerals in solution.

- In this case, carbonic acid reacts with silicates in some rocks leaving a soft clay from which potassium, sodium and magnesium are subsequently leached.
3. Chemical Weathering – Oxidation

- Oxygen in water reacts with metallic materials in rock.

- This results in the formation of oxides, which tend to be softer than the original mineral.

- For example, rust on iron.
Relate environmental conditions & rate of physical & chemical weathering

• Freezing temperatures and moisture?
  • Frost Fractures
• Variation/fluctuations in H/C temperatures?
  • Thermal Expansion
• Presence of vegetation?
  • Roots expanding cracks
• Heavy precipitation?
  • Accelerates dissolving of rocks/minerals
Relate environmental conditions & rate of physical & chemical weathering

- CO2 and SO2 in the humid air?
  - Creates solutions that dissolve some rock and minerals
- O2, Moisture and metallic minerals?
  - Chemical reaction-oxidation, ie. rust
- Carbonic Acid?
  - Hydrolysis, transform rock into soft clay-like..leach away
- High Temperatures?
  - Accelerates oxidation
- Oceans and Salt?
  - Accelerates oxidation
Erosion

- The **removal** of weathered sediment or rock by the forces of **wind, water and ice**.

- This is a two-fold process:
  - **Transportation** which is the movement of sediment or weathered material away from its source to another location.
  - **Deposition** which is dropping or settling of sediments.