Weathering is the disintegration and decomposition of material at or near the surface.

Erosion is the incorporation and transportation of material by a mobile agent, usually water, wind, or ice.

Geologists recognize two categories of weathering processes:

1. ***Mechanical (Physical) Weathering:***

   Disintegration of rocks and minerals by a physical or mechanical process.

2. ***Chemical Weathering:***

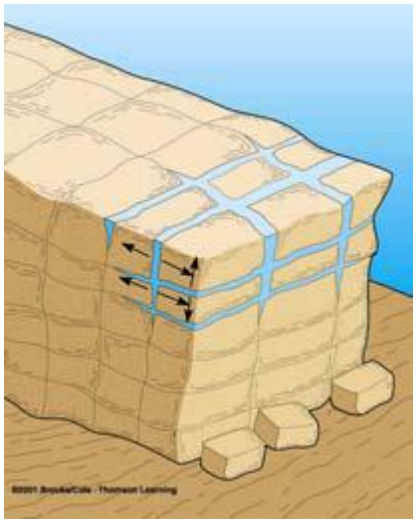
   Chemical alteration or decomposition of rocks and minerals.

Both types are a response to the *low pressure*, *low temperature*, and *water and oxygen rich nature* of the earth's surface.

Mechanical Weathering

The physical (mechanical) forces break rocks into smaller fragments or "detritus" which are classified by size. Breakup or disintegration of rock doesn't change mineral composition.

- Coarse-grained – Boulders, Cobbles, and Pebbles.
- Medium-grained – Sand
- Fine-grained – Silt and clay (mud).



The processes causing mechanical weathering:

1. **Pressure – release fracturing**

   Pressure released from deep below the earth's surface materials.

2. **Thermal expansion and contraction**

   Daily and yearly cycles of heating and cooling.

3. **Frost wedging**

   Water expands when it freezes.

4. **Abrasion**

   Is mechanical weathering and grinding of rock surface by friction and impact.

5. **Organic activity**

   The tree roots growth down into the crack, expand and may eventually break the rock apart.

The processes causing chemical weathering:

1. **Dissolution**

   Dissolving minerals and the ions disperse to form a solution.

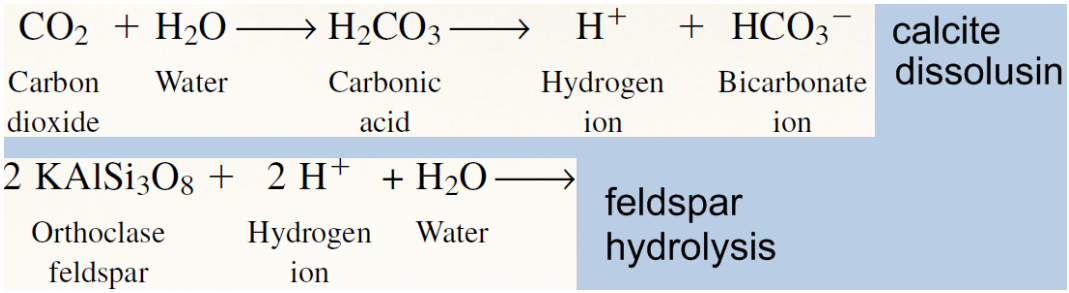
2. **Hydrolysis**

   Water reacts with a mineral to form a new mineral. e.g Feldspar

3. **Oxidation**

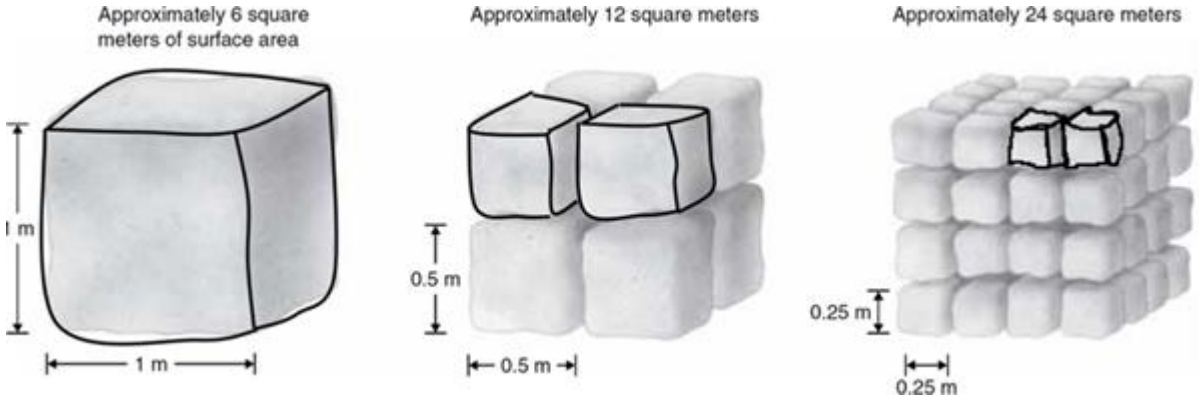
   Reaction with atmospheric oxygen (O_2).

   e.g. ferromagnesium minerals such as Olivine and Hematite



How chemical and mechanical weathering operating together ?

When rocks are broken apart by mechanical weathering, more surface is available for chemical weathering.



Process caused by chemical and mechanical weathering together:

1. **Salt cracking**

   In environments where groundwater is salty, salt water seeps into cracks in bedrock.

2. **Exfoliation**

   Process in which large plates or shells split away like the layers of an onion.

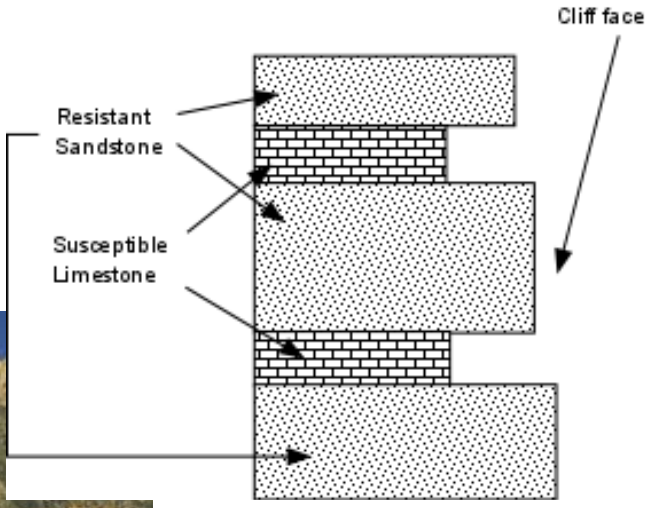
Rates of weathering:

Advanced mechanical weathering aids chemical weathering by increasing the surface area.

Factors that Influence Weathering:

1. Rock Type & Structure

- Different rocks are composed of different minerals, and each mineral has a different susceptibility to weathering.
- Bedding planes, joints, and fractures, all provide pathways for the entry of water.
- Contrasts in the susceptibility to weathering within a large body of rock, the lesser resistant will weather faster than the more resistant portions of the rock. This will result in ***differential weathering.***



2. Slope

- On steep slopes weathering products quickly washed away by rains.
- On gentle slopes the weathering products accumulate.

- Higher weathering rates occur on gentle slope because the water may stay in contact with rock for longer periods of time.

3. Climate

Warm humid climates generally have more highly weathered rock, and rates of weathering are higher than in cold dry climates.

4. Animals

Burrowing organisms like rodents, earthworms, & ants, bring material to the surface were it can be exposed to the agents of weathering.

Soil

Soil is a mixture of weathered rock material and organic matter.

Weathered rock materials include sand, silt, and clay - weathered rock fragments.

Organic materials include that comes from decaying plants and animals.

Humus - carbon rich decayed organic material.

Soils are an important natural resource; represent the interface between the *lithosphere* and the *biosphere* - as soils provide nutrients for plants.

- **Residual soils** - develop on parent rock.
- **Transported soils** - eroded and transported to another location where soil develops.

Controls of soil formation:

• **Parent material**: weathered bedrock.

• **Time**: Approximately 80 – 400 years for soil-forming processes to create 1 cm of topsoil.

• **Climate**

• **Plants and animals**: Organisms influence the soil's physical and chemical properties.

• **Slope angle**: Steep slopes often have poorly developed soils.

Soil types:

There are three very generic types of soil:

1. Pedalfer

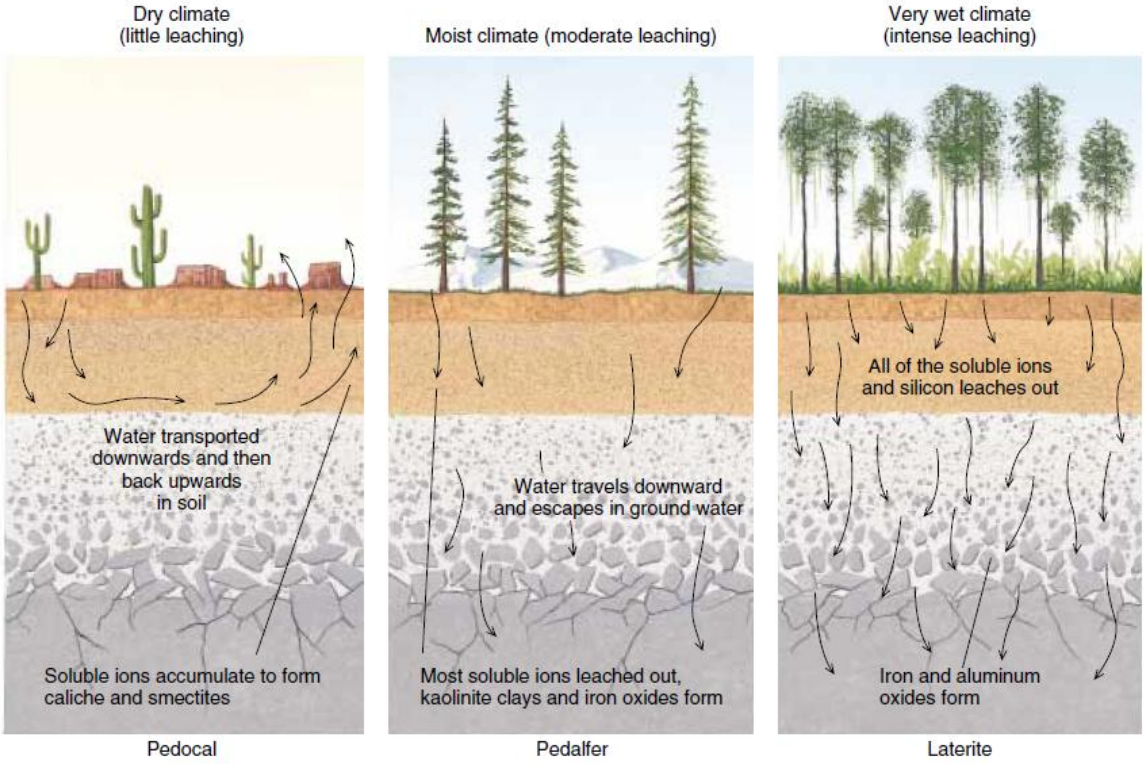
- Accumulation of iron oxides and Al-rich clays in the B-horizon.
- Best developed under forest vegetation.
- Best occur in humid climates.

2. Pedocal

- Accumulate calcium carbonate.
- Associated with drier grasslands.
- Best occur in arid climates.

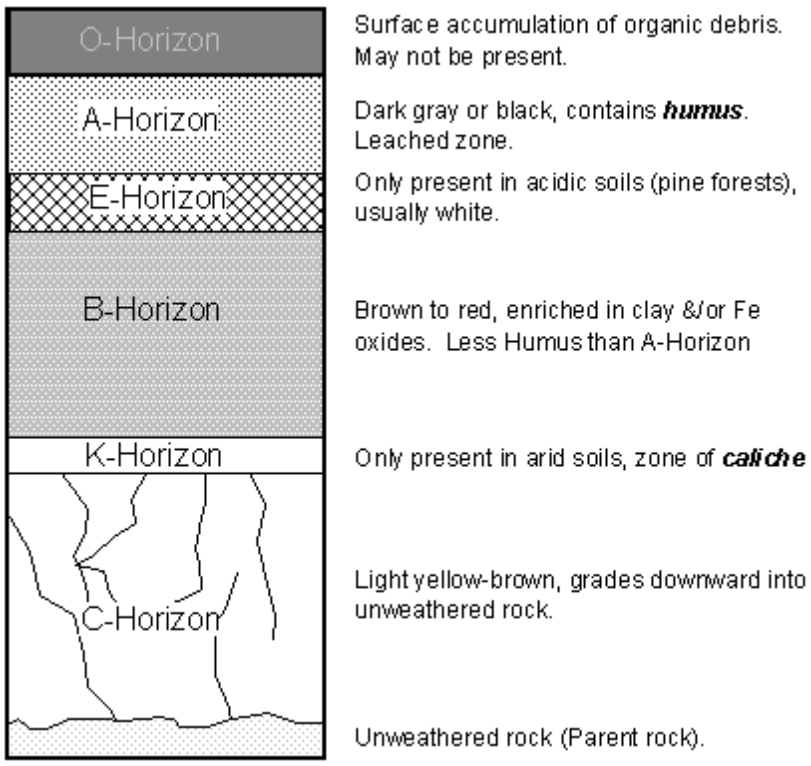
3. Laterite

- Hot, wet, tropical climates.
- Intense chemical weathering.
- Best occur in tropical climates.



Soil Profile

Soil forming processes operate from the surface downward. When a soil develops on rock, an idealized soil profile develops as shown below:



Caliche: Calcium Carbonate (Calcite) that forms in arid soils in the K-horizon by chemical precipitation of calcite

The general Soil Profile consists of:

1. **O horizon**: organic matter
2. **A horizon**: top soil, intense biological activity
3. **B horizon**: subsoil, zone of accumulation
4. **C horizon**: little organic matter, partially altered parent rock

O and **A** together called **topsoil .**

O, A, E, and **B** together called **solum**, or "**true soil**" .

Soil Erosion:

In most climates it takes between 80 and 400 years to form about one centimeter of topsoil (an organic and nutrient rich soil suitable for agriculture). Thus soil that is eroded by poor farming practices is essentially lost and cannot be replaced in a reasonable amount of time. This could become a critical factor in controlling world population.

Soil Texture Triangle