

1.2 WEATHERING OF ROCKS

- Weathering is defined as a process of decay, disintegration and decomposition of rocks under the influence of certain physical and chemical agencies.
- Weathering, is a natural process of in-situ mechanical disintegration and/or chemical decomposition of the rocks of the crust of the Earth by certain physical and chemical agencies of the atmosphere.
- The most important aspect of this process is that the weathered product remains lying over and above or near to the parent rock unless it is removed from there by some other agency of the nature.

Disintegration:

It may be defined as the process of breaking up of rocks into small pieces by the mechanical agencies of physical agents.

Decomposition:

It may be defined as the process of breaking up of mineral constituents to form new components by the chemical actions of the physical agents.

Denudation:

It is a general term used when the surface of the earth is worn away by the chemical as well as mechanical actions of physical agents and the lower layers are exposed.

The process of weathering depends upon the following three factors:

- ✓ Nature of rocks
- ✓ Length of time
- ✓ Climate

Three types of weathering are commonly distinguished on the basis of type of agency involved in the process and nature of the end product. They are:

- ✓ Physical or mechanical weathering
- ✓ Chemical weathering
- ✓ Biological weathering

Physical weathering:

- ✓ It is the physical breakdown of rock masses under the attack of certain atmospheric agents.
- ✓ A single rock block is broken gradually into smaller irregular fragments and then into particles of still smaller dimensions.
- ✓ It is the most active in cold, dry and higher areas of the earth's surface temperature variations are responsible to a great extent of physical weathering.

Forms of Physical Weathering

1. Abrasion:-

Water carrying suspended rock fragments has a grinding action on surfaces.

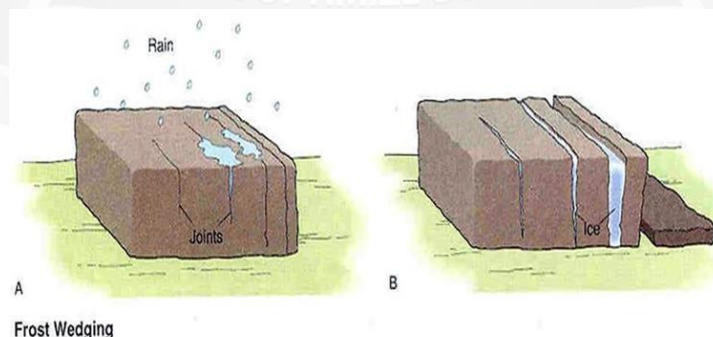
E.g.:- Grinding action of glaciers, gravels, pebbles and boulders with fast flowing streams.

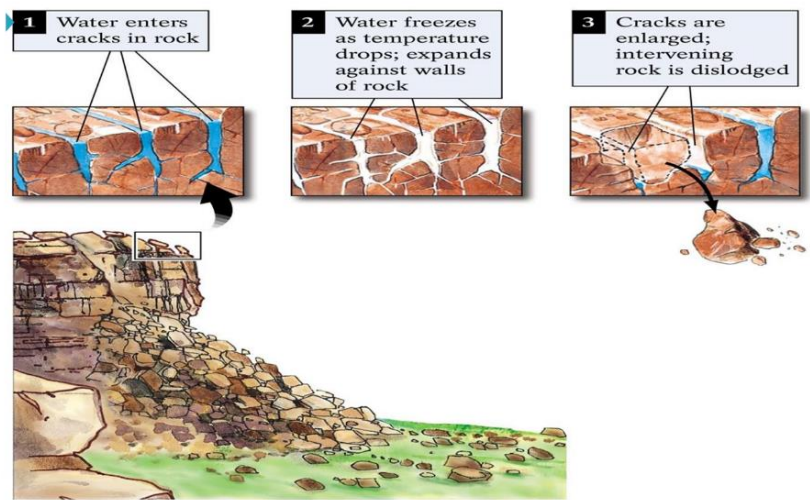
2. Wetting and Drying:-

Water penetrates into rocks and reacts with their constituent material.

3. Freezing and Thawing:-

When water is trapped into rocks (in cracks) repeatedly freezing and thawing results in forces of expansion and contraction. (When water freezes, the increase in its volume is about 10 %.)





Scree Deposits and Talus Slopes

The result of

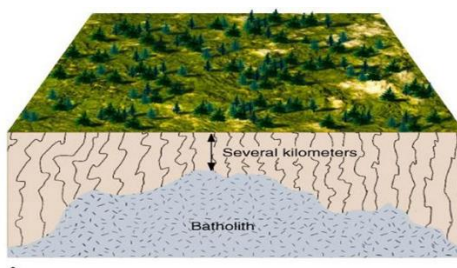
- Mechanical weathering
- Rock falls and slides
- Crushing and abrasion
- Slopes of rock fragments referred as Talus slopes.
- Accumulation of rock fragments referred as Scree deposits

4. Thermal Expansion and Contraction of Minerals:-

Rocks are composed of different kinds of minerals. When heated up by solar radiation each different mineral will expand and contract with surface temperature fluctuations.

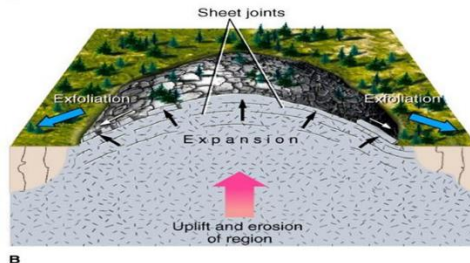
5. Pressure Unloading (or) Pressure Release Jointing:-

There is a reduction in pressure on a rock due to removal of overlying materials. This allows rocks to split along planes of weakness called joints.



6. Crystallization:-

In an arid environment, water evaporates at the surface of rocks and crystals form from dissolved minerals. Over time, the crystals grow (expand their volume) and exert a force great enough to separate mineral grains and break up rocks.



7. Action of Organisms:-

They aid in the physical disintegration of rocks.

8. Thermal Effects:-

The effect of change of temperature on rocks is of considerable importance in arid and semi-arid regions where the difference between daytime and nighttime temperature is often very high. Such temperature fluctuations produce physical disintegration in a normally expected manner.

9. Exfoliation:-

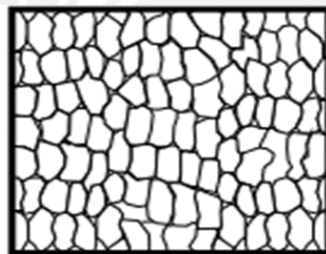
The upper layer of rocks gets affected due to change in temperature. This phenomenon of peeling off layers from rocks under the influence of thermal is called exfoliation.

Expansion on heating followed by contraction on cooling. When the rock mass is layered and of good thickness, additional disturbing stresses may be developed due to unequal expansion and contraction from surface to the lower regions. The rock sometimes is found to break off into concentric shells.



10.Spheroidal weathering:-

Spheroidal weathering is caused due to the combined effect of mechanical and chemical weathering. This complex type of weathering leads to the breaking down of original rock mass into spheroid blocks, due to the development of parallel joints by thermal effects.



Well Sorted Sediment

Chemical weathering:

The chemical decomposition of the rock is called chemical weathering which is nothing but chemical reaction between gases of the atmosphere and minerals of the rocks.

The chemical changes invariably take place in the presence of water generally rainwater in which are dissolved many active gases from the atmosphere like CO₂, nitrogen, Hydrogen etc. These conditions are defined primarily by chemical composition of the rock humidity and the environmental surrounding the rock under attack. Chemical weathering is essentially a process of chemical reactions between gases of the atmosphere and the surface rocks. For example:

Engineering importance of rock weathering:

As an engineer is directly or indirectly interested in rock weathering especially when he has to select a suitable quarry for the extraction of stones for structural and decorative

purposes. The process of weathering always causes a loss in the strength of the rocks or soil. For the construction engineer it is always necessary to see that:

- ✓ To what extent the area under consideration for a proposed project has been affected by weathering and
- ✓ What may be possible effects of weathering processes typical of the area on the construction materials

Types of Chemical Weathering

1. Solution:-

Some rocks contain one or more minerals which are soluble in water to some extent.

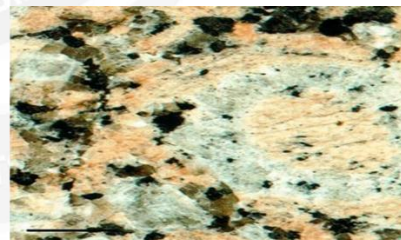
E.g.:- Rock Salt, Gypsum and Calcite

► Hydration:-

Minerals absorb water and chemically change the composition of the material.



Eg. granite contains mica. Mica has a weak chemical composition and absorbs water. Turns into clay



3. Hydrolysis:-

The process of exchange of ions are called hydrolysis. It is very common process of weathering of silicate minerals, quite abundant in rocks.

Orthoclase + Ion from Water = Silicic Acid

4. Oxidation and Reduction:-

The iron bearing minerals of rocks are generally prone to chemical weathering through the process of oxidation and reduction.

Oxidation:-

The process of addition of oxygen or removal of hydrogen is called oxidation.

Ferrous iron of the minerals is oxidized to ferric iron on exposure to air/ moisture. (Iron + oxygen = Rust)



Reduction:-

The process of removal of oxygen or addition of hydrogen is called reduction.

E.g.:- Reduction of iron oxide to iron.

The effects of oxidation by weathering are easily observed from the color changes produced in iron bearing rocks.

5. Carbonation:-

Carbonation is the process of weathering of rocks under the combined action of atmospheric carbon-di-oxide

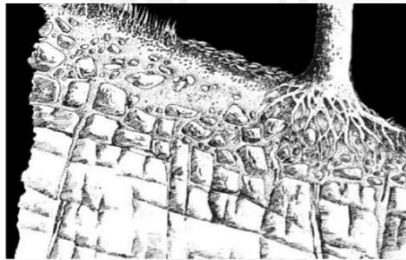
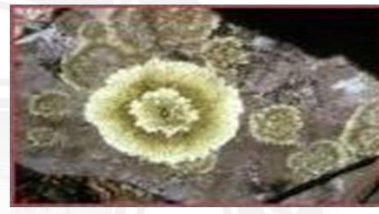
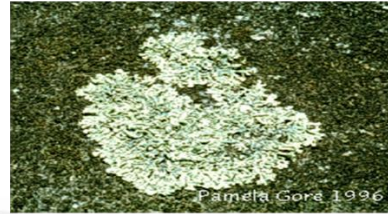
E.g.:-Corrosive action over a number of silicate bearing rocks.

C. Biological Weathering [Organic Weathering]

The weathering process related to the activities, if microorganism such as bacteria as well as plants and animals are termed as organic weathering.

E.g.:-

- Animals moving through cracks can break rocks.
- Roots of plants.



Products of Weathering:-

i. Eluvium:-

The end product that happens to lie over and above the parent rock.

ii. Deluvium:-

The end product has been moved to some distance due to weathering process.

iii. Regolith:-

The term used to express all the material Eluvium and Deluvium that covers a parent rock. It forms huge thickness in the suitable environment.

iv. Minerals and deposits:-

- i. Clay minerals - Montmorillonite, Illite
- ii. Ores of Aluminium – Bauxite and Laterite

1.2.1 SCALE OF WEATHERING

Scale of weathering refers the rate and intensity of weathering.

It may be less intensive, most intensive or moderate, depending upon the following factors.

- 1. Nature of weathering agencies involved.
- 2. Nature and composition of rocks involved.
- 3. Type of weathering takes place.

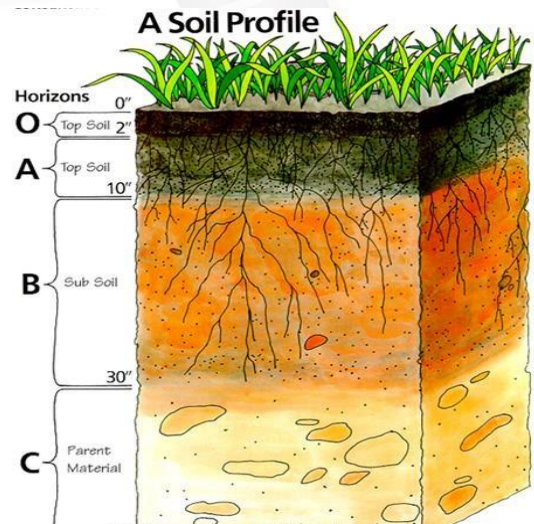
Weather and climate condition of the region

1.2.2 SOILS

- Soils are the products of disintegrated and decomposed rocks.
- Weathering is the key process of the formation of soil.
- Soils are unconsolidated fragments ranging in size 60 micron - 2mm.

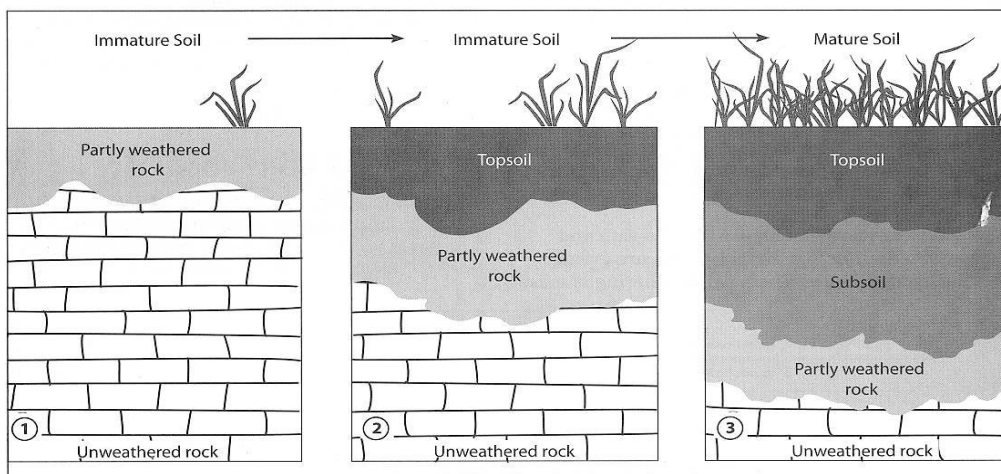
Soil Profile

- ✓ Top layer (consists of loose particles)
- ✓ Second layer (not compacted much)
- ✓ Third layer (compact layer)
- ✓ Last layer (rocky)

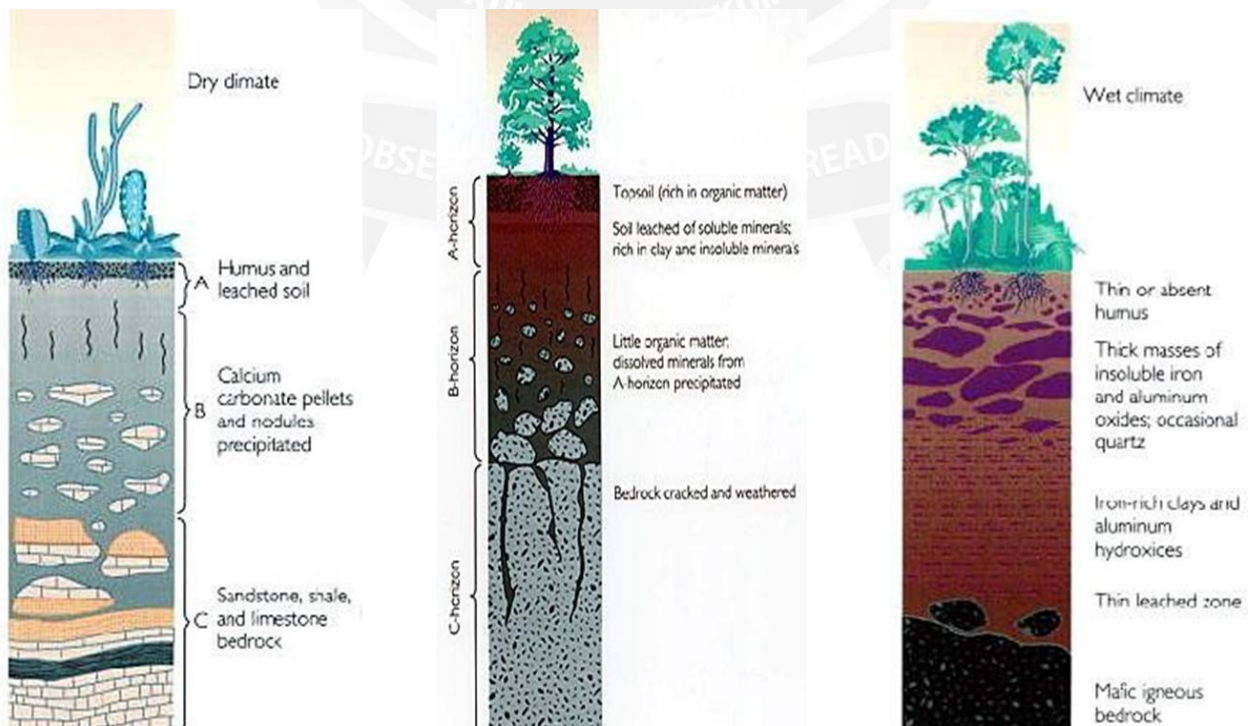


Soil Development

- ▶ Soil development from local bedrock.
- ▶ Stage 1 Mostly un-weathered bedrock
- ▶ Stage 2 Development of top soil by biologic activity Stage 3 Mature thick and well developed soil horizons



Different climates produce different soil types



Formation of soil

- Weathering
 - i. Physical
 - ii. Chemical
 - iii. Biological
- Erosion
- Transportation
- Deposition
- Sedimentation

Weathering:-

It is the natural process of disintegration and decay of rocks, due to the impact of various natural agencies like atmospheric gases moisture, sun's heat, wind, running water, glaciers and other organisms and human beings.

Erosion:-

The process of the removal of weathered product by wind, river or any other agents are called erosions.

Transportation:-

It refers movement of eroded particles from one place to another.

Deposition and sedimentation:-

Deposition of particles will take place whenever the velocity of transporting agents like wind is arrested.

Sedimentation is the process of deposition of sediments.

Classification of Soils

Major classifications:-

1. **Cohesive Soil:** Soil particles held under cohesion. E.g.: -Clay soil
2. **Non-Cohesive Soil:** No cohesion involved b/n soil particle. E.g.: -sand
3. **Transported Soil:** The soil particles are transported from the point of origin and deposited somewhere away from their source. E.g.: -River sand
4. **Residual Soil:** They are also called in-situ-soils. They are formed at their source point itself. E.g.: -Pit sand, Lateritic Soil

Based on their composition:-

1. **Clayey Soil** – Rich in clay
2. **Sandy Soil** – Rich in sand
3. **Gravelly Sand** – Gravel mixed sandy soil
4. **Clayey Sand** – Clay rich sand
5. **Sandy Clay** – Sand rich in clay
6. **Lateritic Soil** – Rich in laterite
7. **Black Cotton Soil** – Black soil rich in most Montmorillonite clay
8. **Red Soil** – Red in color rich in iron
9. **Loamy Soil** – Mixture of sand, silt and clay

Based on their places of origins:-

1. **Desert soil:** Light brown soil contains nitrogen and favorable for vegetation if there is water content.
2. **Alluvial Soil:** Formed along river bed.
3. **Coastal sand:** Formed in coastal plains having Saline in character due to the presents of chlorides.
4. **Mountainous soil:** Found in Himalayas.

5. **Peat soil:** Formed due to decaying of vegetable matter, derived from Marshy land.

