



**FACULTY OF AGRICULTURAL SCIENCES & ALLIED INDUSTRIES**

## ROCKS

The materials of earth's crust are nothing but rocks and minerals. These are the outcome of the geological forces or processes which operate on the surface and the interior of the earth to bring about changes to produce rocks.

**Rock may be defined as a hard mass of mineral matter comprising two or more rock forming minerals.**

Earth crust - Igneous rocks **95%** and Sedimentary rocks **5%**

Upper 5km of earth crust : Igneous rocks 18%

Sedimentary rocks 74%

Others 8%

**Formation of Rocks:** - The various processes that lead to the formation of rocks are:

- 1 **Cooling and consolidation of Magma:-** Rocks are formed by cooling and consolidation of molten magma within or on the surface of the earth e.g.

**igneous or primary rocks.** (Magma is defined as the complex hot solution of silicates containing water vapour and gases having a temperature ranging from 700 – 1400 °C and originating at great depths in the earth crust)

- 2 **Transportation and Cementation of Fragmentary Material:-**

Disintegration and decomposition lead to the breaking down of pre-existing rocks. The resulting fragmentary material is either compacted *in situ* or transported in solution by the natural agencies of wind, water and ice to low lying areas like oceans. Consolidation of

these materials after their deposition results in the formation of rocks called **sedimentary or secondary rocks**.

- 3 Alteration of Pre-existing rocks:-** The primary and secondary rocks when subjected to earth's movement and to high temperature and pressure are partially or wholly reconstituted or altered to new rocks called **metamorphic rocks**.

**Igneous rocks : These are characterized by non-laminar massive structure and on the whole make up 95% of the earth crust. They are the source of parent material for the others rocks. Igneous rocks can be classified based on the mode of origin and chemical composition Based on the mode of origin they are classified as Extrusive or Volcanic rocks and Intrusive or Plutonic rocks.**

<b>Volcanic rocks</b>	<b>Plutonic Rocks</b>
1. Formed on the surface of earth	1. Formed within earth's crust
2. Cooling of magma is quick	2. Cooling of magma is slow and the time taken for crystallization is quite long
3. Fine size crystals are formed	3. Coarse crystals are formed
4. Mineral grains can be observed only under a microscope or magnifying lenses	4. Mineral grains can be seen with naked eye
5. Rocks have a glassy structure Ex: - Basalt, Andesite	5. Rocks have hard and massive structure eg. Granite & syenite
6. These are called extrusive rocks.	6. These are called intrusive rocks

Igneous rocks are further classified based on the relative amounts of acid and basic components. An acid component is silicic acid or silica.

Basic components are soda, potash, alumina, lime, manganese and iron oxides.

Acid rocks - >65% silica Ex:- Granite, Pitchstone

Sub acid rocks - 60-65% silica Ex:- Syenite, Trachyte

Subbasic rocks - 55-60% silica Ex:-

Deorite, Andesite Basic rocks - 45-55%

silica Ex:- Gabbro, Basalt Ultra basic rocks

- < 45% silica

### **Composition of Igneous Rocks (Crystalline rocks)**

- 1 **Basalt:-** This is the most abundantly formed rock form molten material. It is fine grained and dark colored rock which contains 50% feldspars and 50% Ferro magnesium minerals, including pyroxene and olivine (The coarse grained rock with comparable composition is 'gabbro')
- 2 **Granite:-** A coarse textured and light colored rock that contains 60 - 70% feldspars of which orthoclase 40 -45%, plagioclase 20-25% ferromagnesian minerals 3-10% and quartz 20-30% (The fine grained rock with above composition is 'rhyolite')
- 3 **Pumice:-** A light weight, light colored cellular extrusive rock formed by the escaping of volatile constituents. The cellular structure is due to the lava which has been frothed up to many times its original volume by expansion of its gases. It has a lower specific weight than water. So it floats on water. In composition it is comparable to granite / rhyolite and in texture it is like a sponge.

**Sedimentary rocks:-** The sedimentary rocks are formed from sediments, derived from the breaking down of pre-existing rocks. The sediments are transported to new places and deposited in new arrangements and cemented to form secondary rocks. These rocks are also called as **stratified rocks or aqueous rocks.**

**Formation of Sedimentary rocks:-** Four stages are recognized in the formation of sedimentary rocks.

- o **Weathering:-** The igneous rocks (Primary rocks) disintegrate owing to physical, chemical and biological weathering and provide basic materials for the formation of sedimentary rocks.
- o **Transportation:-** The disintegrated material is transported by the agencies, such as water, wind, glaciers, runoff and gravity. Transportation is a function of speed of water
- o **Deposition or Sedimentation:-** The detrital materials , comprising minerals and rock fragments are deposited when the carrying agent has no longer energy enough to move it further. In this process, coarser particles settle first and the finer particles later. This kind of deposition is called 'graded bedding'
- o **Digeneis:-** It refers to the transformation of unconsolidated sediments to hard rock. It involves compaction and cementation.

? **Compaction:-** The weight of the upper incumbent layers with thousands of meters thickness, causes compression of the lower layers or deposits. The sediments consolidate and the interstitial water and air are removed by the pressure of overlying sediments. The fine grained deposits under such environments are transformed to clays, shales etc.

? **Cementation:-** The most common materials that serve as cementing agents are lime, silica, iron oxide. Water that percolates, carries the binding minerals /

materials in solution deposits these in the voids of the loose sediments and binds the sediments together on desiccation. The interior of the earth is sufficiently hot to help in consolidation of the sediments.

### **Classification of sedimentary rocks**

Based on origin, sedimentary rocks are classified into different groups

**Residual:-** When the products of weathering settle at that place where they have been formed, they form into a hard mass Ex: - Bauxite

**Mechanical or Detrital:-** Weathered fragments are transported, deposited in beds of varying thickness and cemented. Ex: Sand Stone, Shale, Conglomerate

**Inorganic or Chemically Formed :-** These are formed by evaporation or precipitation of material in sea or lake water

Formed through evaporation: - Halite (Rock salt), Gypsum

Formed through precipitation and flocculation: - Lime stone, Dolomite

### **Organic Sedimentary rocks or bio-chemically formed rocks**

These are formed by the accumulation and partial decomposition of organic remains under anaerobic conditions. When the plants decompose under restricted air supply in lower layers of earth, a greater portion of their carbon content is retained and the material is slowly converted into coal. Ex: - Peat, Lignite and anthracite (hard coal).

**METAMORPHIC ROCKS:** The word 'metamorphic' means "change in form"

Metamorphism is used as a general term for all those changes that alter more or less completely the original characters of rock.

**FORMATION:** Igneous and sedimentary rocks subjected to tremendous pressures and high temperatures succumb to metamorphism. The changes in

the deeply buried rocks are brought about by the combined action of chemically active fluids, internal heat and pressure. The structure and mineralogical composition of metamorphic rocks depend on the composition of original rock and the kind of metamorphism.

In addition to the minerals, commonly observed in igneous and sedimentary rocks, there are certain minerals such as tremolite, garnet, talc, mica and chlorite, which are the characteristics of metamorphic rocks. The banded or laminated character is the most peculiar feature of metamorphic rocks.

Changes brought about by chemically activated waters - **Hydro-metamorphism**  
Ex: Sandstone to Quartzite; Granite or Basalt to Laterite.

Changes brought about by Heat -- **Thermo-metamorphism** Ex: Limestone to crystalline marble  
Changes brought about by Pressure -- **Dynamo-**

**metamorphism**

Ex: Granite - Granite-gneiss (Partial foliation)

Gneiss - Schist (Complete foliation); Shale - Slate

Changes brought about by Heat & Pressure - **Dynamo-thermal**

Pre-Existing or Original Rock		Metamorphic Rock
Granite or Syenite	→	Gneiss? Mica-schist
Conglomerate	→	Gneiss
Sandstone	?	Quartzite ? Quartz-schist
Clayey Sandstone	→	Quartzite ? Mica-schist
Shale	→	Slate? Phyllite ? Mica-schist
Limestone	→	Marble
Dolomite	→	Dolomite marble? Soapstone or serpentine

Iron ores	→	Haematite – Schists
Coal	→	Graphite

**metamorphism.** Many crystalline gneisses, schists and marbles are formed.

### **Classification of Metamorphic Rocks**

: Based on the texture and structure of minerals, the metamorphic rocks are divided into three groups i.e. foliated, unfoliated and granulated.

**Foliated** (Parallel structure) (Leaved or leafy): These rocks contain micas and ferro-magnesian minerals and show foliation as the minerals are flattened and arranged in parallel layers. Ex: Gneiss, Schist (Coarse grained); Phyllite (medium grained); Slate (Very fine grained)

**Unfoliated** (massive structure): These rocks contain quartz and feldspars and do not show foliation even under pressure because of large sized crystals. EX; Talc-schist, amphibolite and graphite.

**Granular:** These consisting of mostly equidimensional grains. Ex: Quartzite, Marble

**Weatherability of rocks:** Rocks made up of ferromagnesian minerals like olivines, pyroxenes etc., are more weatherable than rocks with non ferromagnesian minerals.