

# **GEOLOGY**

**Notes by-**

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## Geology

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Types of Rocks: Igneous : Cooling & consolidation of molten rock matl.

Sedimentary: Deposition of products of weathering.

Metamorphic: change in composition due to heat & pressure

Petrology: Petrology is the science which deals with the study of natural history of rocks including their origin, present condition & alteration, decay etc.

Petrography: It is the science which deals with systematic description & classification of rocks.

Lithology: It is the branch of science which describes characteristics of rocks, their hand specimen & in occurrence in nature.

Rock forming minerals:-

- \* Rock is defined as the aggregates of minerals.
- \* Mineral is defined as a natural substance having a definite chemical composition & formed by the inorganic processes of nature.
- \* Over 4000 minerals are known.  
But 99.9% earth crust is made up of 20 minerals only.  
As these 20 minerals are mostly available in rocks, these are known as rock forming minerals.

The minerals are mainly belonging to the families of -

- 1) Felspars
  - 2) Felspathoids
  - 3) Micas
  - 4) Amphiboles
  - 5) Pyroxenes
  - 6) Olivine
  - 7) Crystalline & non crystalline (feldspar, carbonate, quartz).
- { silicates formed by combination of silica ( $SiO_2$ ) with bases like potash ( $K_2O$ ), soda ( $Na_2O$ ), lime ( $CaO$ ), magnesia ( $MgO$ ), alumina ( $Al_2O_3$ ) etc.

Common rocks (except carbonate rocks) are silicate rocks containing large amount of silica.

\* Igneous Rock: [Refer "stone" Notes also]

Formation: Cooling of molten lava (magma), which are formed in huge quantities in deeper parts of the earth crust by melting of crustal rocks.

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**Minerals :-**

<b>essential Minerals.</b>	felspar's - 50-85% $\rightarrow$ K <sub>2</sub> O, Na <sub>2</sub> O, CaO (Potash, Soda, lime felspars) Quartz : Crystalline form of silica (SiO <sub>2</sub> ) Felspathoids :- Aluminosilicates of Soda & Potash. (Rare) Mica :- Two types - muscovite, white mica & biotite-the black mica. Amphiboles :- Hornblende $\Rightarrow$ pyroxene augite. - silicates of Fe & Mg Pyroxenes   Dark colour Olivines :- Fainly of iron & magnesium silicates.
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**Primary Minerals:-** Minerals formed when rocks are formed are primary.  
 The minerals formed or derived from primary minerals are formed after the formation of rock, are secondary minerals.

**Texture:-**

Texture is the arrangement of diff. constituents of rock.  
 Physical conditions during cooling affects texture of rock.

**Weathering of Rock :-**

Disintegration of rock due to atmospheric action is known as 'Rock Weathering'. Secondary rocks are formed by weathering of Igneous rock.

### Weathering of Rock

↓  
Decomposition

- Oxidation
- Hydration
- Carbonation
- Solution.

↓  
Disintegration.

- ① Disintegration means breaking of rocks in to small fragment without change in chemical composition.
- ② In higher / drier / cooler region disintegration is predominant.
- ③ Products are same as that of original mineral.
- ④ Coarse grained angular products are formed.

① In decomposition, chemical composition of organic mineral changes.

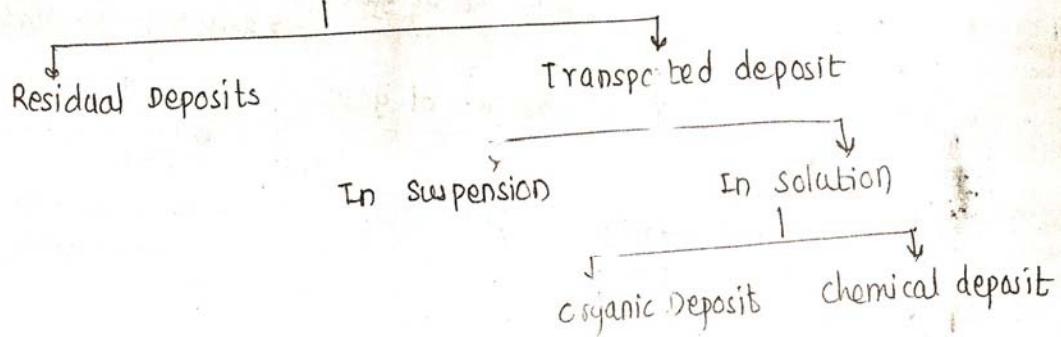
② In moist/warm/low lying region decomposition is predominant.

③ Products of decomposition are different from original mineral & chemical composition changes.

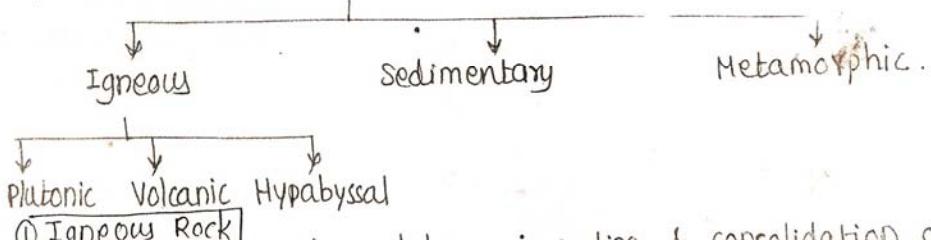
④ Products are fine grained.

During day time rock expands due to heat & during night they cool. Due to this alternate contraction & expansion, due to cooling & heating disintegration took place.

### Products of Weathering



### Classification of Rock:-



① Igneous Rock  
Igneous rocks are formed by cooling & consolidation of magma.

Depending on cooling Igneous rocks are divided as -

② Plutonic Rock (Major Intrusion) : Huge bodies of magma cool at greater depth.

③ Hypabyssal Rock (Minor Intrusion) : Magma cools at intermediate depth.

④ Volcanic (or extrusive rock) :- Magma cools at surface of earth.

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### factors affecting Texture of Rock:-

#### ① Condition of cooling:-

a) If condition of cooling of magma is favorable for crystallization, crystals are formed during cooling of magma.

Rock made up of entirely crystals called "holocrystalline".

b) If condition is not favorable for crystallization, non-crystalline or glassy matl. will form.

Rock made up of entirely non-crystalline matl. called "Glassy".

c) Rock made up of mix. of glass & crystal called as "Hemi-crystalline".

#### ② Absolute Grain Size:-

① If individual crystals are large enough to seen with naked eye, the rock called "phanetic".

② If individual crystals are not seen with naked eye, rock is "ophanitic". & the crystals not visible to naked eye but visible under microscope are "Microcrystalline" & appear as "Homogeneous".

Degree of crystallisation & absolute grain size are controlled by

- ① Rate of cooling of magma.
- ② Pressure
- ③ Presence or absence of the magma bic gases.

- \* Slow cooling, High pre ; presence of gases  $\Rightarrow$  forms large crystals  
 $\Rightarrow$  Rock is holocrystalline.
- \* Rapid cooling, low pre; absence of gases  $\Rightarrow$  forms glassy texture  
 $\Rightarrow$  Rock is "glassy".

### Igneous Rock

#### Intrusive Rock

cooling of magma inside the crust)

Major Intrusion  
(Plutonic Rock).

- \* Cools at greater depth
- \* slow cooling
- \* High pressure
- \* Presence of gas
- \* These cond's are favourable to crystallization.  
 $\Rightarrow$  Holocrystalline.

##### a) Granite Texture

Crystals of plutonic rocks are roughly same sizes that are called equigranular. Equigranular & ~~but~~ holocrystalline texture is called - "Granitic Texture".

##### b) Porphyritic Texture:-

Some times plutonic rock develop inequigranular texture. Such texture is called as "porphyritic texture". This texture results when magma cools slowly first & faster afterward. In this texture, large crystals called phenocrysts are embedded in ground mass of finer grain.

#### Extrusive Rock

cooling of magma on earth surface  
fast cooling

##### Minor Intrusion

(Hypabyssal Rock).

- \* Cools at shallow depth
- \* Moderate cooling
- \* Moderate pressure
- \* Texture is intermediate  
-et? crystalline & glassy  
depending upon "Degree  
of crystallization".

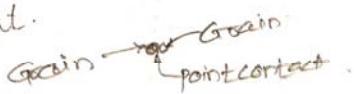
These conditions are favourable to non-crystallization.

Texture of these rock is "glassy".

## Secondary or Sedimentary Rock

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Texture of sedimentary rock is "clastic". Sediments are formed by deposition of individual grains. Grains does not have common boundary. They are separated from each other by empty space. Every grain has only point as contact. Not a plane contact.



## Metamorphic Rock

The texture of metamorphic rock depends on agents of metamorphism.  
i.e. Heat  
& Pressure.

### a) When Heat is Predominant:-

Heat brings recrystallization of minerals. Resulting texture is "Recrystallisation Texture".

### b) When Pressure is predominant:-

Under application of direct pressure, cracks get developed in the rock. Hence Rock shows uncrushed pebbles surrounded by powder of crushed rock. This texture is called as "Porphyroclastic".

### c) When pressure & heat is predominant (dynamothermal metamorphism)

Recrystallisation takes place under pressure due to this flaky crystal minerals like micas or rod like crystals of mineral like hornblende grow in the direction of right angles to the direction of greatest pressure.

When parallel arranged directional minerals are predominate structure is called "Schistose str." It is rich in mica & amphiboles & poor in quartz & feldspat. Gneissose structure observed in rock made of quartz, felspars and poor in directional minerals. Such rocks are called "Gneisses". Gneisses are light in colour & do not split like schists.

Parallel arrangement of minerals

### d) Heat & uniform pre. is predominant:-

Evenly granular directionless str. called "granulose" is formed

~~Nature of Charnier~~

Classification of Rock / Texture of Rock / Modes of formation		Rock	
Igneous Rock		Sedimentary Rock	
Formation: Cooling of magma.		Formation: Deposition of particles of weathered soil & existing rock.	
Intrusive Rock		Extrusive Rock	
Major Intrusion [Plutonic]	Minor Intrusion [Hypabyssal]		
Depth of cooling: Deeper	Shallow	As the grains are	
Rate of cooling: Slow	Moderate	gets deposited, they	
Pressure: High	Moderate	have only point contact	Heat predominant $\Rightarrow$ Contact Meta.
presence of Gases: Yes	Yes	such. texture = "Clastic".	Pressure predominant $\Rightarrow$ Cataclastic
Favourable cond: crystallized	non-crystallized	* As the sedimentary	Porphyroblastic Texture
		rock has layers having	Porphyroblasts pre. both predominant
		thick. few mm to many m.	Dynamothermal metamop.
		this rock is also called	Schistose texture
		as "Stratified Rock".	
Texture: Holocrystalline	Crystalline-Glassy	No.	Heat: Uniform Pressure
Types of Texture:	Glassy	Non-crystallization.	Pressure: Plutonic meta.
① Granitic			Temperature: Isomeric
② Porphyritic			
Factors affecting texture:-			
① condition of cooling			
② absolute grain size.			
③ Pressure.			
④ presence of gases.			
⑤ Depth of rock from surface			
⑥ Temp.			

## Kinds/ Types of metamorphism:-

- ① Heat is Predominant  $\Rightarrow$  Contact
- ② Pressure  $\Rightarrow$  cata-classic
- ③ Heat & Pre. both  $\Rightarrow$  Dynamothermal
- ④ Heat & Uniform pre  $\Rightarrow$  Plutonic

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Rock Weathering:- The rock weathering may be defined as "change in physical & chemical properties of rock" due to action of atmospheric agent's.

physical change  $\Rightarrow$  disintegration  $\Rightarrow$  No change in chemical composition.  
chemical change  $\Rightarrow$  decomposition.  $\Rightarrow$  change in chemical composition.

disintegration & decomposition are simultaneous process but if,  
warm, moist, low lying region  $\Rightarrow$  Decomposition predominant.  
cooler, drier, Higher region  $\Rightarrow$  Disintegration predominant.

### Dis Decomposition:-

- ① Oxidation
- ② Hydration
- ③ Carbonation
- ④ Chemical Reactn.

### Disintegration:-

- ① Cooling & heating of rock.  
i.e. contraction & expansion.
- ② Freezing the water.  
ice  $\Rightarrow$  Increased vol.
- ③ Wind.

## STRUCTURAL GEOLOGY

Structural Geology deals with the large scale features of rock masses such as their size, shape, their attitude in space, their relationship with each other as seen in the field in their outcrops i.e. portion of rock formations which are exposed at the surface.

Sedimentary rocks are deposited in beds, lying one over other, which can be distinguished from each other because of diff. in their physical properties. Two successive beds are separated from each other by a plane surface which is called as bedding plane.

\* Horizontal bedding Plane:- Sedimentary rocks are deposited in horizontal layers. If uplift force acts such that their horizontal altitude does not disturb, & bedding planes are horizontal.

\* Dip:- The bedding plane in case of sedimentary rock may be inclined due to uplift pressur. such beds are said to be "dipping".

The position of dipping plane is accurately described as-

- ① direction in which planes are inclined.
- ② Angle with which plane make with horizontal.