

UNIT III

PETROLOGY

3.1 CLASSIFICATION OF ROCKS

SYLLABUS

Classification of rocks, distinction between Igneous, Sedimentary and Metamorphic rocks. Engineering properties of rocks. Description, occurrence, engineering properties, distribution and uses of Granite, Dolerite, Basalt, Sandstone, Limestone, Laterite, Shale, Quartzite, Marble, Slate, Gneiss and Schist.

Introduction:

Petrology: Petrology is the branch of geology, dealing with study of rocks in respect of their origin, mode of formation, occurrence, distribution, their engineering properties and uses.

Rock : A rock is defined as an assemblage of minerals.

Mineral : A mineral is an assemblage of elements.

Element : An Element is an assemblage of atoms.

Atom : An Atom is made up of Protons, Electrons and Neutrons.

Stone : A hard, compact and tough rock is called a stone.

PETROLOGY COMPARES OF THE FOLLOEING CHAPTERS

Chapter 1	:	Classification of Rocks
Chapter 2	:	Textures and Structures of rocks
Chapter 3	:	Distinction between Igneous, Sedimentary and Metamorphic rocks
Chapter 4	:	Engineering properties of Rocks
Chapter 5	:	Description of Individual Rocks

Classification of Rocks

Types:

- Igneous rocks
- Sedimentary rocks
- Metamorphic rocks

1. Igneous rocks:

Igneous rocks are first formed primary rock.

Igneous rocks are formed due to the consolidation of magma.

2. Sedimentary rocks:

Sedimentary rocks are the secondary rocks, formed from either Igneous or Metamorphic rocks, due to weathering, erosional and depositional processes.

3. Metamorphic rocks:

Metamorphic rocks are formed due to Metamorphism of Igneous and or Sedimentary rocks due to the impact of temperature, pressure and chemically active fluids.

Classification of Igneous Rocks

1. Classification based on Depth of formation or origin.
2. Chemical classification.
3. Mineralogical classification.
4. Textural classification.
5. Tabular classification.

1. Classification based on Depth of formation or origin :

- i. Plutonic rocks
- ii. Hypabyssal rocks

iii. Volcanic rocks

i. Plutonic rocks :

The Igneous rocks formed at greater depths or at deep seated conditions are called Plutonic rocks. The depth may be around 10 km or more. E.g. Granite, Syenites, Gabbros, etc.

ii. Hypabyssal rocks :

The Igneous rocks formed at intermediate depth or at shallow depth (say around 3 km) are called Hypabyssal rocks. E.g. Granite Porphyry, Dolerite, etc.

iii. Volcanic rocks :

The Igneous rocks formed upon the surface of earth, due to volcanic eruption, are called volcanic rocks. E.g. Basalt, Trachyte, etc.

2. Chemical classification:

This classification is based on the chemical composition of rocks, established by Cross, Iddings, Pirson and Washington.

Classified as Salic and Fermic minerals present in rocks.

Salic / Fermic ratio and classified the rocks as follows:

S.NO	SALIC / FERMIC RATIO	CLASS
1	> 7.00	Persalic
2	7 -- 1.66	Dosalic
3	1.66 – 0.60	Salfermic
4	0.60 – 0.14	Dofermic
5	< 0.14	Perfermic

Salic Minerals (Light Colored) : Quartz, Feldspar, Nepheline, Halite, etc.

Fermic Minerals (Dark Colored): Magnetite, Haematite, Olivine, Pyrite, etc.

3. Mineralogical classification:

Based on 'Color Index' of minerals present, rocks are classified in this category. Based on mineralogical composition, Felsic and Mafic minerals are recognized.

i. Felsic Minerals :

They are light colored. Quartz, Feldspar, and Feldspathoid group of minerals are included in this category.

ii. Mafic Minerals :

They are dark colored. Ferro – magnesian minerals such as Micas, oxides of iron, Amphiboles, Pyroxenes, and Olivine etc. are included here.

S.NO	CLASS	COLOR INDEX	EXAMPLE
1	Leucocratic	1 – 30	Granite
2	Mesocratic	31 – 60	Gabbro
3	Melanocratic	61 – 100	Dolerite

4. Textural classification :

Based on texture, rocks are classified into three categories,

i. Phanerites :

The coarse grained igneous rocks with mineral grains greater than 5 mm in size, able to be identified with naked eye are called Phanerites. E.g. Granite.

ii. Aphanite :

The Igneous rocks with mineral grains less than 1 mm in size, able to be identified only under microscope are called Aphanite. E.g. Basalt.

iii. Glasses :

Rocks of zero grain size, formed due to super cooling effect are grouped under glasses. E.g. Obsidian.

5. Tabular classification :

The most important system of classification of rocks is tabular classification.

Rock class	Over Saturated	Saturated		Under Saturated
	ACID (Free silica > 66 %)	Intermediate (Free silica 55 – 66 %)	Basic (Free silica 44 – 55 %)	Ultra Basic (Free silica < 44 %)
Plutonic	Granite	Syenite	Gabbro	Peridotite
Hypabysaal	Granite Porphyry	Syenite Porphyry	Gabbro Porphyry	Limburgite
Volcanic	Rhyolite	Trachyte	Basalt	Olivine Basalt

In Tabular classification, igneous rocks are vertically classified as Plutonic, Hypabysaal and Volcanic rocks, horizontally classified as acid, Intermediate, basic and ultra basic rocks, as well as oversaturated, saturated and under saturated rocks, based on the % of free silica present.

Classification of Sedimentary Rocks:-

Sedimentary rocks are classified as

- I. Clastic Rocks
- II. Non – Clastic Rocks

I. Clastic Rocks :

Clastic rocks are mechanically formed rocks, due to weathering processes.

Class	Grain size
Boulders	> 256 mm
Cobbles	16 – 256 mm
Pebbles	2 – 16 mm
Sand	1 / 16 – 2 mm
Silt	1 / 256 – 1 / 16 mm
Clay	< 1 / 256 mm

II. Non – Clastic Rocks :

Non – Clastic rocks are the rocks, formed due to chemical and organic processes.

They are:

1. Chemically formed rocks
2. Organic deposits

1. Chemically formed rocks :

The Chemical processes involved in forming these rocks are precipitation, evaporation, crystallization, etc.

They are further classed as

i. Siliceous Deposits :

Silica is chief constituent of these deposits, formed due to solution and evaporation. E.g. Flint, Cherts, Jasper, etc.

ii. Carbonate Deposits :

These are formed due to precipitation of carbonate rich waters. E.g. Limestone, Magnetite, Dolomite, etc.

iii. Ferruginous Deposits :

These are formed due to chemical precipitation of oxides and hydroxide deposits of iron. E.g. Iron – ore deposits.

iv. Evaporites :

Evaporation is the formation process of some common salt and Gypsum deposits. E.g. Gypsum, rock salt, etc.

2. Organic deposits :

Sedimentary deposits formed from the remains of plants and animals. E.g. Coral Limestone.

Some types of organic deposits are listed below.

i. **Carbonaceous Deposits :**

They are carbon rich. E.g. Coal.

ii. **Phosphatic Deposits (Guano) :**

They are formed due to accumulation of excreta of some birds. E.g. Guano.

iii. **Ferruginous Deposits :**

Iron Carbonates formed, due to reduction process by bacterial action in swamps. E.g. Siderite.

iv. **Carbonate rocks :**

Sedimentary lime stones and skeletal bones of marine organisms like corals, foraminifera, etc. fall under this group. E.g. Shell limestone.

Classification of Metamorphic Rocks:-

Metamorphic rocks are classified into

- i. Foliated rocks
- ii. Non – Foliated rocks

i. **Foliated rocks :**

In some metamorphic rocks, some of the lenticular minerals are oriented and arranged themselves parallel to the least strain direction. Such direction is called foliation. E.g. Schist, Slate, Gneiss, etc.

ii. **Non – Foliated rocks :**

No Foliation can be seen in these rocks. Non – Foliated rocks are massive and compact. E.g. Quartzite, Marble.