



## **FACULTY OF AGRICULTURAL SCIENCES & ALLIED INDUSTRIES**

## MINERALS

Mineral is a naturally occurring, homogenous element or inorganic compound that has a definite chemical composition and a characteristic geometric form.

Two or more elements combined – Gypsum:  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$

Olivine –  $(\text{Mg, Fe})_2\text{SiO}_4$  Feldspar –  $\text{KAlSi}_3\text{O}_8$

Only one element – Metal – Cu, Fe, Ca. Non Metal – C, S, Si

### Formation & Distribution in the Earth's crust

When the molten magma solidifies, the different elements present there in freely arrange themselves in accordance with attractive forces and geometric form. Of the more than 2000 known minerals only a few occur in abundance in the earth crust.

### CLASSIFICATION OF MINERALS

- |                              |                         |
|------------------------------|-------------------------|
| 1. Based on mode of origin   | 2. Based on Chemical    |
| o composition of             | Primary Minerals        |
| * Native elements            |                         |
| o Secondary Minerals         | * Oxides and hydroxides |
| 3. Based on the Quantity     | * Sulphates             |
| o Essential Minerals         | * Sulphides             |
| o Accessory Minerals         | * Carbonates            |
| 4. Based on Specific Gravity | * Halides               |
| o Light Minerals             | * Silicates             |
| o Heavy Minerals             |                         |

**Primary Minerals :** The primary minerals are those which are formed owing to the crystallization of the molten magma. Depending up on the tetrahedral linkage, the silicate minerals are divided in to four groups.

1 Orthosilicates : Olivine

2 Inosilicates :

- o Single chained: Pyroxenes
  - o Double chained : Amphiboles
- 3 Phyllosilicates : Biotite, Muscovite
- 4 Tectosilicates : Quartz, Feldspars
- 5 Ferro - Magnesian Minerals**

Olivines, Pyroxenes, Amphiboles, Biotite

**Non Ferro Magnesian Minerals**

Muscovite, Orthoclase, Albite, Anorthite, Quartz

**Secondary minerals:** Minerals formed due to weathering action of primary mineral s.

**PRIMARY SILICATE MINERALS**

**Quartz:** The frame works of quartz is very densely packed and occurs in a high degree of purity. It is resistant to physical and chemical weathering as the structure is densely packed electrically neutral and prevents any form of substitution. It is ubiquitous in soils but its abundance is next only to feldspars.

**Feldspars:** Its frame work is less dense than quartz. They are most abundant among rock forming minerals in the earth's crust. These are non ferro - magnesian minerals and act as store house of sodium, calcium, potassium minerals and many trace elements in soils.

**Micas:** Occur most extensively in soils. Muscovite (white mica) a non - ferromagnesian mineral is resistant for weathering. Biotite (black mica) a ferro - magnesian is highly susceptible for weathering. Muscovite is present only in acid igneous rocks.

**Pyroxenes and Amphiboles:** These two minerals are two groups of ferro - magnesian minerals and their structure consists of long chains of linked silica tetrahedra (Inosilicates). Due to variety of substitutions these minerals are excellent host minerals for trace cations in soils and also for main constituent cations like Ca, Mg and Fe. Their weatherability is quite favourable to provide sufficient amounts of these ions in available form for plant nutrition.

Pyroxenes - Single chain eg. Augite  $(Ca, Na)(Mg, Fe, Al)(Si, Al)_2O_6$

**Olivines:** Olive green colored minerals. Olivines are relatively easily weathered. It is called island silicate. Ex: Forsterite  $-Mg_2SiO_4$ ; Fayalite  $-Fe_2SiO_4$

### **Weatherability of primary**

**minerals.** Early stage of

weathering

Olivine  $(Fe, Mg)_2SiO_4$

Pyroxenes (Augite  $-Ca_2(Al, Fe)_4(Mg, Fe)_4$

$Si_6O_{24}$ ) Amphiboles (Hornblende  $-Ca_2Al_2Mg_2Fe_3$

$Al_6O_{22}(OH)_2$ ) Biotite  $KAl(Mg, Fe)_3$

$Si_3O_{10}(OH)_2$

Albite (Sodium feldspar-

$NaAlSi_3O_8$ ) Anorthite (Calcium

feldspar  $-CaAl_2Si_2O_8$ )

### 2. Intermediate weathering stage

Orthoclase (Potassium feldspar -

$KAlSi_3O_8$ ) Muscovite

$KAl_3Si_3O_{10}(OH)_2$

Quartz  $SiO_2$

### 3. Advanced stage of weathering

No primary mineral is observed in advanced stage of weathering .

Hence young soils contain several primary minerals but highly weathered soils do not contain any primary minerals.

**Essential Minerals :** The minerals which form the chief constituents of rock and

which are regarded as the characteristic components of that rock are known as “Essential Minerals” eg. Quartz, Feldspars and Micas

**Accessory Minerals :** These minerals occur only in small quantities and whose presence or absence is of no consequence as far as the character of the rock is concerned, are called as accessory minerals eg. Tourmaline, Pyrite, Magnetite.

**Light Minerals :** Are the minerals which have specific gravity below 2.85 eg. Quartz (2.60), Feldspar (2.65), Muscovite(2.50-2.75)

**Heavy Minerals :** Having specific gravity above 2.85 g/cc e.g. Haematite (5.30), Pyrite (5.0), Limonite (3.8), Augite (pyroxene) (3.1 – 3.6), Hornblende (amphiboles) (2.9 – 3.8), Olivine(3.5)



