EWCE 203

Geology and Geomorphology

Geology

Common Rock Forming Minerals

Common Rock-Forming Minerals?

- Scientists have **identified over 4,000 different** minerals.
- **A small group of these minerals** make up almost **90%** of the rocks of Earth's crust.
- These minerals are known as **the common rock-forming minerals**.
- **Olivine**, **augite**, **hornblende** and **biotite**
- **Muscovite**, **feldspar** and **quartz**

What Are Minerals?

Minerals are materials that meet five requirements. They are:

- **naturally occurring,**
- **inorganic,**
- **solids,**
- **element or compound of elements,**
- with a **definite chemical composition, and** an **ordered internal structure**.

Consideration to become Rock-Forming Minerals?

To become a **common rock-forming mineral**, a mineral **must:**

- be **one of the most abundant** minerals in **Earth's crust;**
- be **one of the original minerals present** at the **time of a crustal rock's formation;** and,
- be an **important mineral** in determining a **rock's classification.**

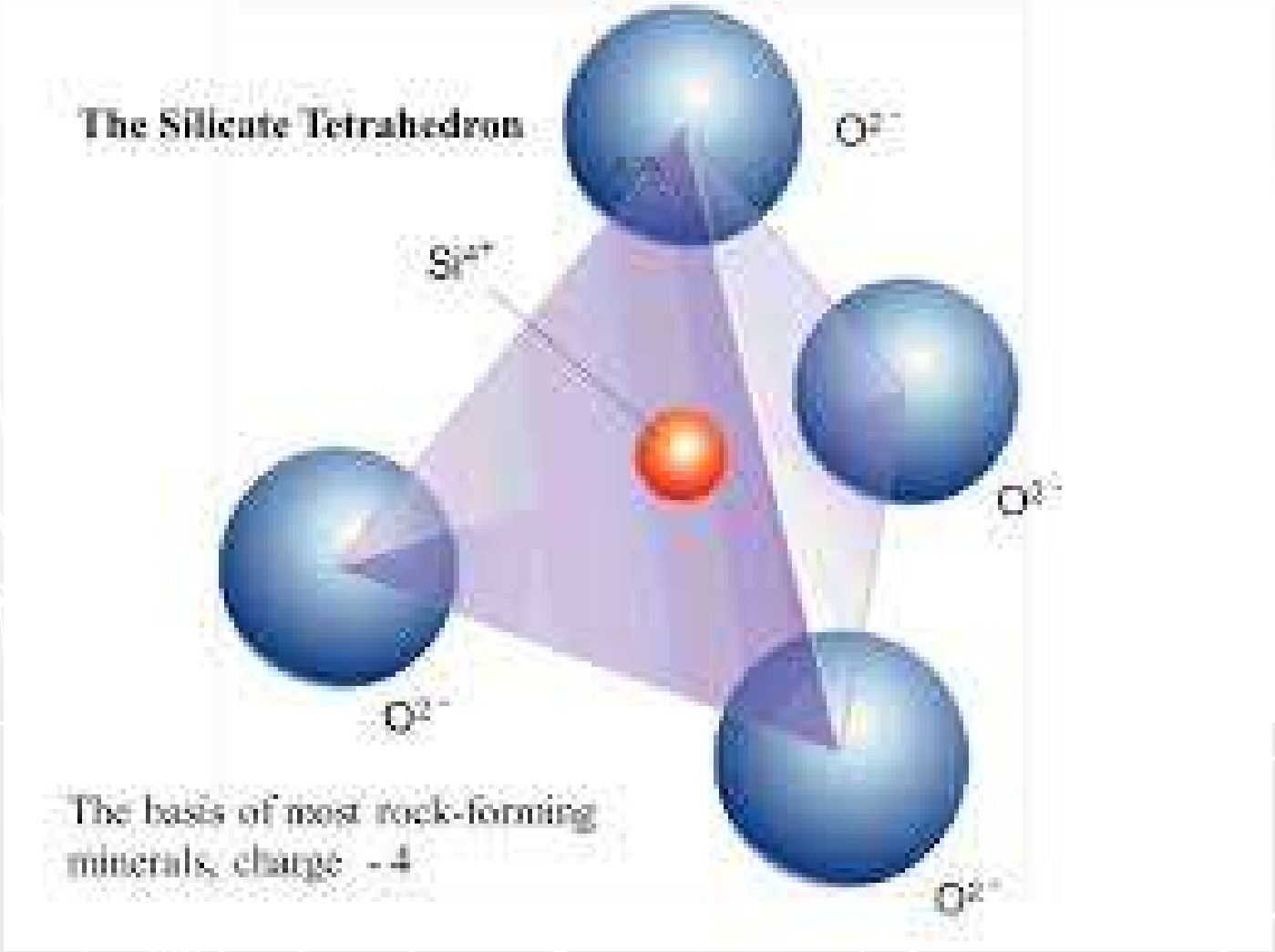
Minerals that **easily meet these criteria** include:

- **Olivine, augite, hornblende and biotite**
- **Muscovite, feldspar and quartz**

Types of Rock-forming minerals:

- **Silicates** or Silicate Minerals
- **Oxide**
- **Sulfide**
- **Carbonate or sulfate**
- **Halide**

Silicate Minerals

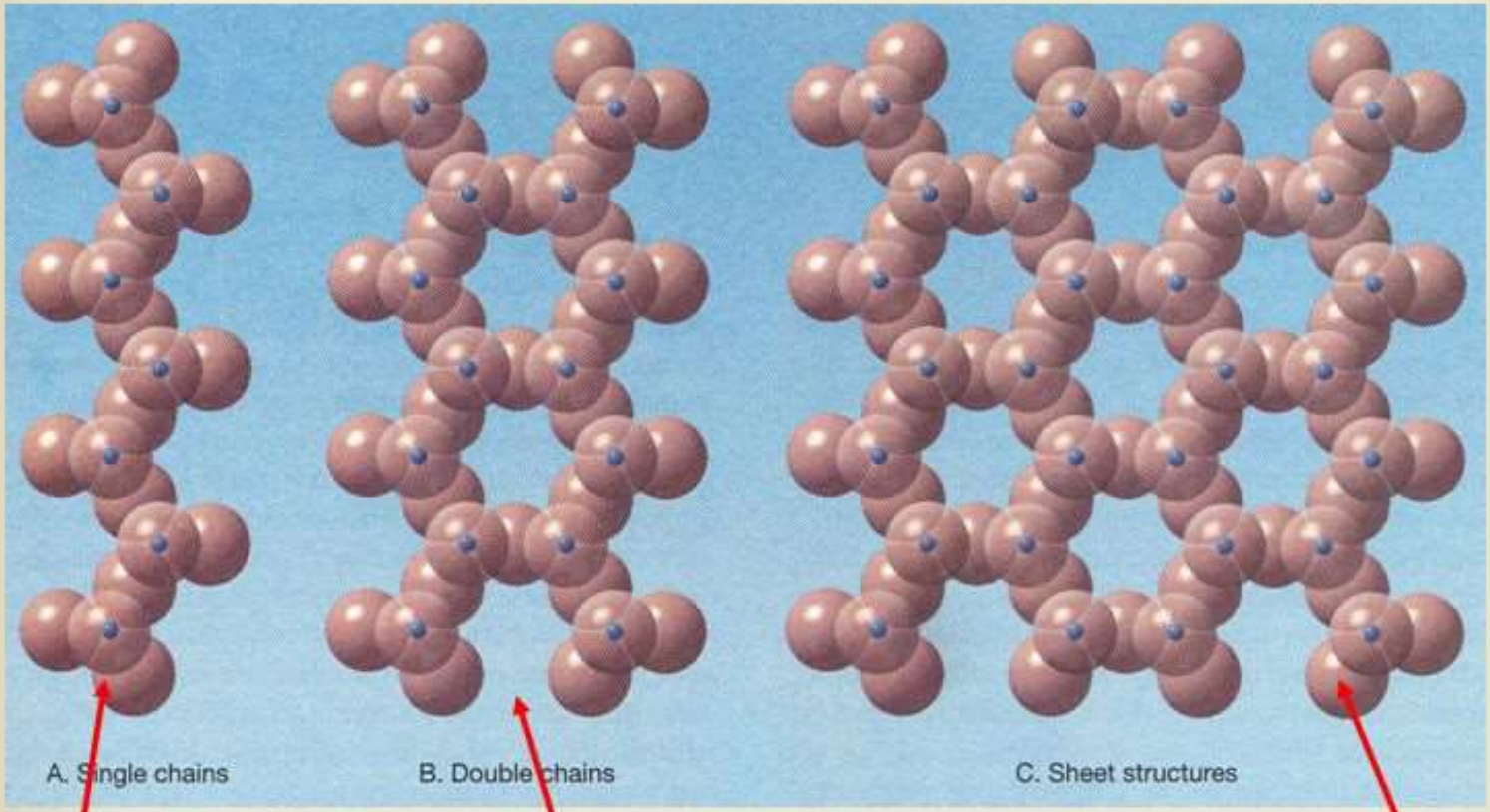




The Common rock-forming minerals

Silicates

Silicon-oxygen tetrahedra can be arranged into:



Single chains: Pyroxene

Double chains: Amphibole

Sheets: Micas

Ferromagnesian Silicate Minerals:



Non-Ferromagnesian Silicate Minerals:



What is silicate mineral?

- **More than 90%** of rock forming minerals are silicate minerals.
- **Composed of** silicon & oxygen (**tetrahedra** SiO_4) and **one or more metals.**
- Forming **silica-oxygen tetrahedron**, the **basic building block of silicate minerals.**
- **Examples**: Olivine, Muscovite.





Types of Silicate Minerals:

- **Ferromagnesian**
- **Non-ferromagnesian**

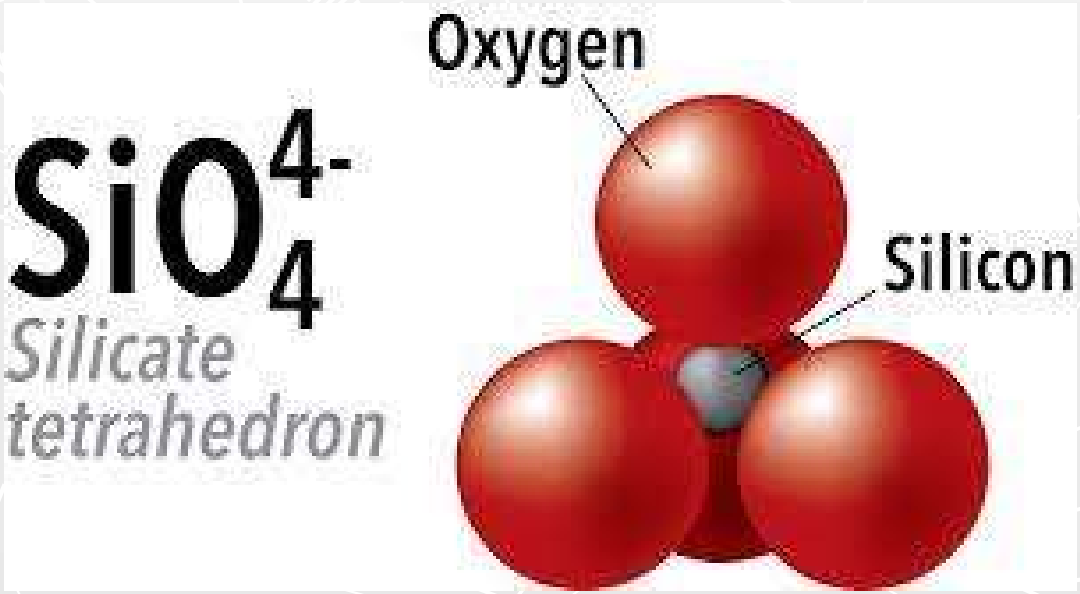
Ferromagnesian Silicate Minerals:

- **Silico-oxygen tetrahedron** joined by **ions of Fe and Mg.**
- Very dark or black
- Higher Sp. Gr.

- **Examples**: Olivine, Augite, Hornblende and Biotite.

Olivine:

- **Isolated tetrahedron** held together by ions of Fe and Mg.
- **$[Mg, Fe]_2 Sio_4$**
- Important mineral of **deep-seated rock**
- Occurs in **grains or granular** form
- Color: **Olive to grayish green or brown**
- Sp Gr: 3.27 – 4.37




Olivine

What is Isomorphism?

- **General tendency** of minerals for **two or more ions to substitute one another** in their **crystalline structure.**

- Example: **Olivine**, **$[Mg, Fe]_2 Sio_4$**

- End members of Olivine series are **Forsterite**, Mg_2Sio_4 and **Fayalite**, Fe_2Sio_4

Solid-solution Mineral Series: When the **ions substitute in a continuous series** (like Mg and Fe in Olivines), the **process** is called solid-solution mineral series.

Augite:

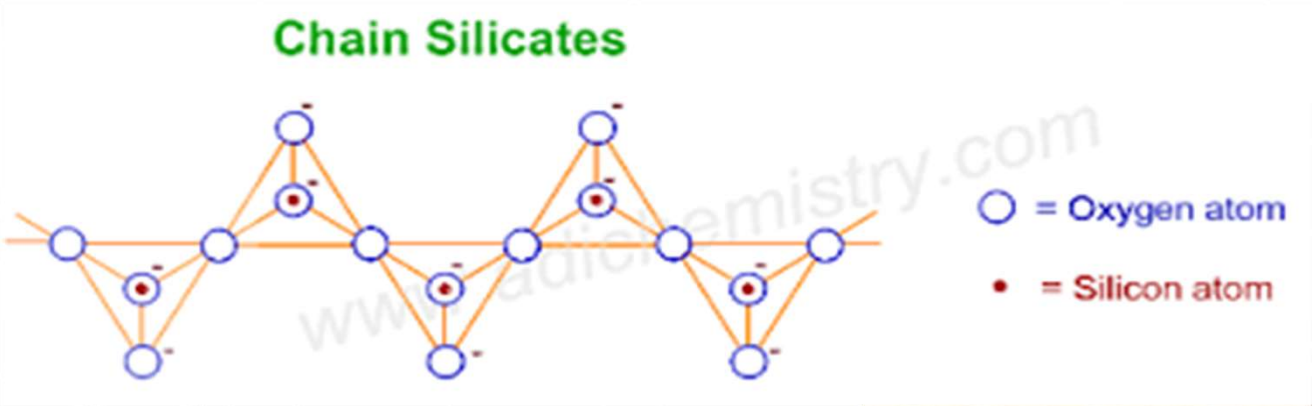
- Composed of **single chain tetrahedron**, joined by ions of **Fe, Mg, Ca, Na, and Al**.
- **Commonest group** of minerals called **Pyroxenes**.
- Has **poor cleavage along two planes almost at right angles** to each other.
- Color: **Dark green to black**, colorless streak.
- Sp Gr. 3.2 to 3.4



What is Pyroxenes?

- Group of minerals composed of **single-chain tetrahedron.**

Example: **Augite**, **Diopsite**, jadetite and spondumene are four of the best-known members of the pyroxene group.







Uses of Pyroxene – Construction Industry

- Pyroxene minerals are **primary or secondary constituents of many rocks** used to make **crushed stone**, **dimension stone**, and **architectural stone**.

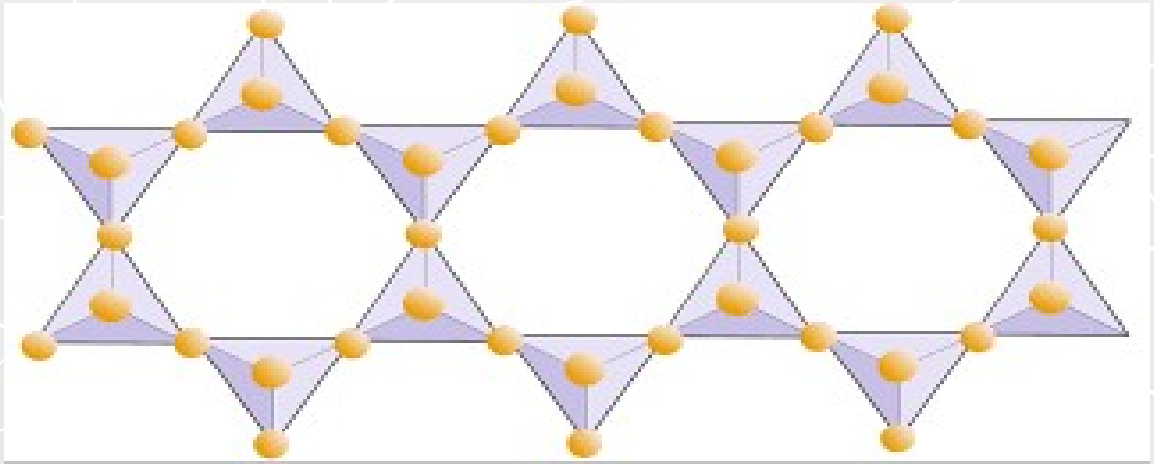
- Pyroxene is in the **trap rock** of the construction industry and in the **'black granite'** that are popular for making **decorative tile** and **facing stone.**



Erosion of trap rock created by the stacking of successive lava flows often creates a distinct **stairstep landscape** from which the term trap was derived from the Swedish word trappa, which means "stairs".

Hornblende:

- Composed of **double-chain tetrahedron** joined by Mg, Fe and Ca, Na and Al.
- **Widely distributed mineral** in earth's crust
- **Two directions of good cleavages meet at angles of approximately 56° and 124°**
- Commonest mineral of a **group called Amphiboles**.
- Color: **Dark green to black** with colorless streak.
- Sp Gr. 3.2 to 3.4





Uses of Amphibolite

- Amphibolite has a variety of uses in the **construction industry**.
- Amphibolite is **quarried** and **crushed for use as an aggregate** in **highway construction** and as a **ballast stone** in **railroad construction.**
- It is also quarried and cut for use as a **dimension stone**.

How one can differentiate/distinguish Augite from Hornblende? Or Differences between Pyroxenes and Amphiboles.

- **Both are ferromagnesian silicate minerals.**

- Augite composed of **single-chain** and Hornblende composed of **double-chain** tetrahedron.

- Augite has **poor cleavage** along two planes almost at **90°** to each other but Hornblende has two directions of **good cleavages** meet at **angles of approximately 56° and 124°.**

- Both are used in **Construction Industries.**

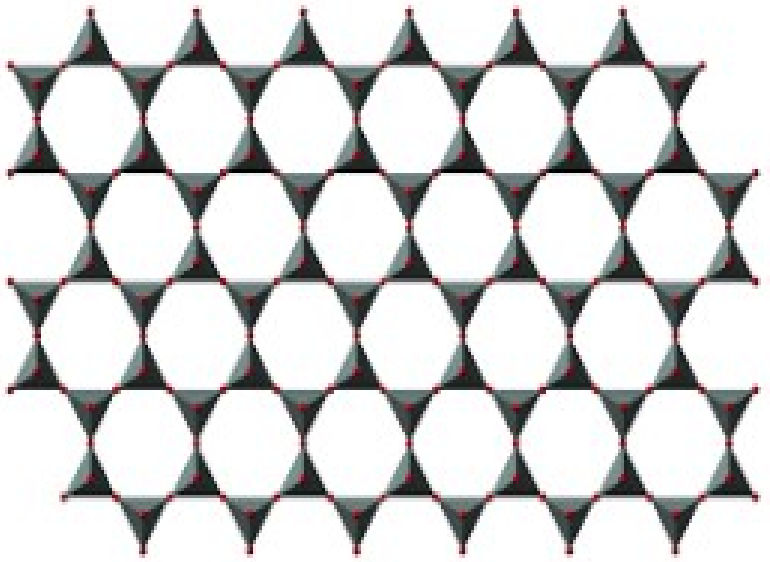
- General chemical formula for pyroxenes is $R_2[Si_2O_6]$ and that for amphiboles is $R_{14}[(OH)_4\ Si_{16}O_{44}]$; **pyroxenes** do **not contain hydroxyl ions (OH)**

Biotite (Black Mica):

- Composed of **tetrahedron in sheet**; group is called **Mica**



- Form a **pattern of wire netting.**
- Known as **black-mica, easily identifiable**
- **Layers can easily be peeled off.**
- **Perfect cleavage** and a **vitreous luster** on the cleavage faces.
- Color: **Dark green or brown** to black.
- Sp Gr. 2.8 to 3.2



Uses of Biotite

- Biotite has a **small number of commercial uses**.
- **Powdered mica** is used as a **filler and extender in paints**, as an **additive to drilling muds**, as **an inert filler** and **mold-release agent** in rubber products, and as a **non-stick surface coating** on asphalt shingles and rolled roofing.
- **Mica ash** used in **traditional medicine.**
- **Sheet mica** is a versatile and durable material widely used in **electrical and thermal insulation applications**.
- It is also used in the methods of **dating igneous rocks**.

Thanks

