IV - INOSILICATES

PYROXENE GROUP

Orthopyroxene series

- Enstatite $Mg_2(Si_2O_6)$
- Hypersthene $(Mg,Fe)_2(Si_2O_6)$

Diopside series

- Diopside $CaMg(Si_2O_6)$
- Hedenbergite $CaFe(Si_2O_6)$
- Augite $Ca(Mg, Fe, Al)\ [(Si, Al)_2\ O_6]$

Spodumenes series

- Spodimene $LiAl(Si_2O_6)$
- Jadeite $NaAl(Si_2O_6)$
- Aegerine $Na,Fe(Si_2O_6)$

Pyroxenoid Group

- Wollastonite $Ca(SiO_3)$
- Rhodonite $Mn(SiO_3)$

ORTHOPYROXENES **Orthorhombic**

ENSTATITE **$Mg_2(Si_2O_6)$**
HYPERSTENE **$(Mg,Fe)_2(Si_2O_6)$**

Crystals generally small and rare, in short, tabular prisms. Often massive in compact to granular, fibrous, lamellar, spathic aggregates.

D = 3.2 to 3.3, increases with iron content/ H = 5.5 to 6. Fragile. Cleavage good. Irregular breakage. Color: gray, green, brownish, colorless white line glassy shine, transparent to opaque.

Iron can replace magnesium in any proportion up to 90%. However, in the most common orthopyroxenes the F:Mg ratio rarely exceeds 1:1. Pure **Enstatite** $Mg_2(Si_2O_6)$, contains MgO 40% and SiO_2 60%. If the FeO content is between 5 and 13% the variety is called **Bronzite**; If between 13 and 20% orthopyroxene is called **Hypersthene** $(Mg,Fe)_2(Si_2O_6)$

Orthopyroxene is found mainly in basic magmatic rocks (pyroxenites, peridotites, gabbros, norites, basalts), also in metamorphic rocks, gneiss in particular.

DIOPSIDE SERIES **$Ca(Mg, Fe)(Si_2O_6)$** **Monoclinic**

Diopside $CaMg(Si_2O_6)$

Hedenbergite $CaFe(Si_2O_6)$

Augite $Ca(Mg, Fe, Al)[(Si, Al)_2 O_6]$

Diopside and hedenbergite form a complete series of solid solutions. Augite can be considered as an intermediate term in the series, in which there is partial substitution of Mg and Si.

Free crystals or crystals included in the rock, in short prisms, with an octagonal section (8 lateral faces). Granular or coarsely lamellar aggregates. Very common macle. Easy but interrupted cleavages, often barely visible.

D = 3.3 / H = 5 to 6. Opaque. Vitreous or metallic shine (diallage). Color: white to pale green for diopside, increasingly darker with increasing iron content; the augite is black. Transparent to translucent. White to gray dust.

In igneous and metamorphic rocks.

Varieties of Diopside:

Diallage: Variety with a metallic appearance reminiscent of bronze, with very perfect cleavage.

Chromiferous diopside: Light green-emerald variety, decorative stone.

Alteration into Amphibole, Talc, Serpentine.

Diopside is found in limestones and dolomites recrystallized by contact metamorphism. Diopside and hedenbergite occur in regional metamorphism, associated with tremolite, scapolite, idocrase, garnet and sphene. The diallage variety is found in gabbros, peridotites and serpentines.

Augite is an important element of basic intrusive eruptive rocks (gabbros, dolerites) or volcanic rocks (basalts, basaltic tuffs).

Etymology of Augite: from the Greek "trough", shine (the crystals often have shiny faces).

AEGYRINE **Na,Fe(Si2O6)** **monoclinic**

Crystals included in the rock, in imperfect elongated prisms. Fibrous aggregates.

D = 3.4-3.55 /H = 6-6.5. Significant cleavage. Irregular breakage. Color: dark green, green-black, brownish. Yellowish to brownish, green dust. Vitreous, resinous sheen. Translucent.

In magmatic rocks poor in Silica, such as: nephelinite, syenite and phonolite.

AMPHIBOLES GROUP

Amphiboles constitute a family of minerals, whose structure is formed by the junction of tetrahedron chains of the pyroxene type, to form a ribbon structure, of formula Si4011.

The general formula is: $X_{0-7}\ Y_{7-14}\ Z_{16}\ O_{44}\ (OH)_2$; Where X = Na and Ca and rarely K

Y = Mg, Fe, Al, Mn

Z = Si, sometimes partial substitution by Al

Main minerals: Tremolite, Actinote, Hornblende, Glaucophane, Riebeckite.

TREMOLITE – ACTINOTE (Ca_2, Mg_5) [Si_8O_{22}] $(OH)_2$ - Ca_2 $(Mg, Fe)_5$ [Si_8O_{22}] $(OH)_2$

Monoclinic

Continuous series of amphiboles between Tremolite and Actinote.

Crystals elongated, striated longitudinally, often curved. Sometimes in fibroradiated aggregates; silky fibers in tremolite.

D: 2.9 to 3.2 / H = 5 to 6. Perfect cleavages. Color: pearly white (tremolite) to more or less dark green depending on the iron content (actinolite). Alteration in talc.

Silicates from contact metamorphism of magnesium carbonate rocks. Actinolite is a mineral typical of the "green schist" facies where it is associated with epidote and chlorite. Finally, it is formed at the expense of pyroxenes by metamorphosis or hydrothermal alteration.

Fibrous varieties constitute asbestos and are used as refractory materials and electrical and thermal insulation. Carcinogenic materials.

Etymology: Actinote, from the Greek "actis", radius: frequently in radiated needles

TREMOLITE – ACTINOTE

HORNBLENDE **$(Ca, Na)_2(Mg_2, Fe^{2+},Fe^{3+},Al)_5$ [$Si_6Al_2O_{22}$]$(OH)_2$** **Monoclinic**

Crystals generally well formed, short prisms, with hexagonal section (6 lateral faces); often in elongated, fibrous or grainy aggregates. Easy cleavages.

D = 3 to 3.4 / H = 5 to 6. Translucent to opaque. Glassy shine. Color: dark green or black-brown. Colorless dust. Alterations: talc, serpentine, chlorite, epidote….

Important mineral in certain intrusive eruptive rocks (granites, syenite, diorites, gabbros) or volcanic rocks (trachyte, andesites, basalts).

Mineral characteristic of the amphibolite facies due to the metamorphism of basic rocks: amphibolite, schist and hornblende gneiss.

GLAUCOPHANE $Na_2Mg_3Al_2(Si_8O_{22})(OH)_2$ **Monoclinic**

The crystals are generally not very sharp with generally rough faces. Often massive, fibrous or grainy. D = 3.15/ H = 6. Blackish blue color. Perfect cleavage giving transparent bluish gray lamellae.

In metamorphic rocks of low temperature and high pressure, frequently associated with epidote and garnet.