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SILICA GROUP

1. QUARTZ



QUARTZ

colour	: colourless or white; but colour may vary widely according to the presence of impurities
Break	: white on colourless
Lustre	: vitreous
Form	: massive
Cleavage	: absent
Fracture	: conchoidal
Hardness	: 7
Specific Gravity	: low
Diagnostic Properties	: Hardness 7 and low specific grav.
Chemical Composition	: SiO_4
Crystal System	: Hexagonal
Occurrence	: It occurs commonly in acidic igneous rocks, sedimentary and metamorphic rocks.
uses	: It is used in glass industry.

OLIVINE Group

2. OLIVINE



Olivine Mineral

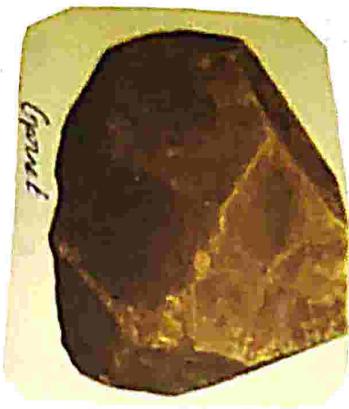


OLIVINE

- Chemical Composition : $(Mg, Fe)_2 SiO_4$
- Crystal System : orthorhombic
- Occurrence : mostly appears as grains and ~~grains~~
in basalts, gabbros & norites.
Dunite, peridotite rocks, primarily
composed of olivine. Kimberlites contain
air inlets of olivine with most part
altered into serpentine. It also occurs
in metamorphic rocks.
- Uses : peridot, a variety of olivine with
transparent green colour which is used
as gemstone.

GARNET GROUP

3. GARNET



GARNET

Colour	: Brown, Blood red, purplish red, green
Streak	: colourless
Luster	: vitreous or sub vitreous
Form	: rhombohedron, trapezohedron, complex forms
Cleavage	: absent
Fracture	: uneven
Hardness	: Not scratched by pen knife (may be 6 to 7)
Specific Gravity	: Medium (may be 3.5 to 4.2)
Diagnostic Properties	: Rhombohedron form, trapezohedron
Chemical Composition	: $(M^3)^3(M^2)^2(SiO_4)_3 - M = Mg, Fe, Mn$
Crystal System	: cubic
Occurrence	: Garnet occurs mainly in metamorphic rocks and it is found in amphibolites, kyanolite, meta orthosites and other high grade schists.
Uses	: It is mainly used as abrasive and also sometimes as ornamental stone.

PYROXENES

4. HYPERSTHENE



HYPERSTHENE

- colour : Grayish to bluish black
- streak : colourless
- lustre : Sub-metallic
- Form : Massive
- cleavage : Parallel to the prismatic face.
- Fracture : uneven
- Hardness : Hardly scratched by pen knife (may be 5 to 6)
- Specific Gravity : Medium may be 3.5
- Chemical Composition : $(Mg, Fe)_2 SiO_6$
- Crystal System : Orthorhombic
- Occurrence : It occurs in basic igneous rocks such as norites, gabbros, etc. It is the principal mafic mineral in charnockites and in some massive amphibolites.

PYROXENS

5. AUGITE



AUGITE

colour	dark green to black
streak	colourless or greyish green
lustre	vitreous to sub-vitreous
form	short prismatic
cleavage	perfect, good cleavage
fracture	wavy
hardness	hardly scratched by pen knife (may be 5 to 6)
specific gravity	medium maybe 3 to 3.5
diagnostic properties	dark green colour, short prismatic form, prismatic cleavage.
chemical composition	$(Mg, Fe)_2 SiO_6$
crystal system	monoclinic
occurrence	Augite is a characteristic mineral of many basic and ultra basic igneous rocks such as gabbros, peridotites, pyroxenites etc. It is also found in meta-gabbros, amphibolites.

USED

- It is an important rock-forming mineral.

PYROXENES

6. Diopside



Specific Gravity
Diagnostic Properties
Chemical Composition
Crystal System

3.278
Prismatic crystals, vitreous lustre
Mg₂SiO₄

Monoclinic
occurs in various igneous rocks, lime-
enriched pegmatites and granites and
Crystalline lime stone

Gneiss, diamond indicator mineral.
Potential industrial use in ceramics.

Diopside

AMPHIBOLE Group

7. TREMOLITE



Colour	: colourless, white, pale green depending on Fe Content
Streak	: white
Luster	: vitreous
Form	: Fully developed crystal, usually in fibrous, radiate aggregates
Cleavage	: perfect
Fracture	: uneven
Hardness	: 5.5 to 6
Specific Gravity	: medium
Diagnostic Properties	: white to green colour with good cleavage
Chemical Composition	: $\text{Ca}_2\text{Mg}_3(\text{OH})_2\text{Si}_5\text{O}_{16}$
Crystal System	: orthorhombic
Occurrence	: Tremolite mainly occurs in metamorphic rocks like schists. It is mainly associated with serpentine, talc, abalone, epidote, calcite, dolomite.

TREMOLITE

AMPHIBOLE GROUP

8. HORNBLEND



- | | |
|-----------------------|--|
| Specific Gravity | : Medium (range 3 to 3.5) |
| Diagnostic Properties | : Medium specific gravity, prismatic form, prismatic cleavage and dark green color. |
| Chemical Composition | : $(\text{Na}, \text{Ca}, \text{Mg}, \text{Fe}, \text{Al})_2 (\text{Si}_4\text{O}_11)_2 \text{O}_2$ (6.H.F ₂) |
| Crystal System | : Monoclinic |
| Occurrence | : It is an important constituent of basic and ultra basic igneous rocks such as hornblendites, gabbros, diabases and lamprophyres. |
| Uses | : It is an important rock-forming mineral. |

HORNBLEND

Amphibole Group

q. ACTINOLITE



Actinolite

Colour	: Pale to dark green, yellowish green & black white or grey when in asbestos
Streak	: white
Lustre	: Vitreous to dull
Form	: Bladed, fibrous, radial
Cleavage	: Perfect along 110
Fracture	: uneven
Hardness	: 5-6
Specific Gravity	: 3.00 (+0.10, -0.05)
Diagnostic Properties	: Fibrous form
Chemical Composition	: $\text{Ca}_3(\text{Mg}_{0.85} \text{Fe}^{2+}_{0.15})_2$
Crystal System	: monoclinic
Occurrence	: occurs in metamorphic rocks arising by the metamorphism of pyroxenes and hornblendes
Uses	: Actinolite and tremolite both contain a form of asbestos which is made of malleable and elastic fibers.

FELDSPARS GROUP

10. ORTHOCLASE FELDSPAR



Chemical Composition	: $KAlSi_3O_8$	Flesh red
Crystal System	: monoclinic	Colourless
Occurrence	: Orthoclase feldspar occurs as a primary mineral in many acid igneous rocks such as granite, pegmatites, granitoidites, syenites. It is also found in many sedimentary rocks and metamorphic rocks.	Sub-vitreous
Diagnostic Properties	: Low specific gravity, distinct one set of cleavage, and flesh red colour.	Distinct (one set)
Hardness	: Hardly scratched by knife - 6	Uneven
Specific Gravity	: Low (may be 2.5)	

USES

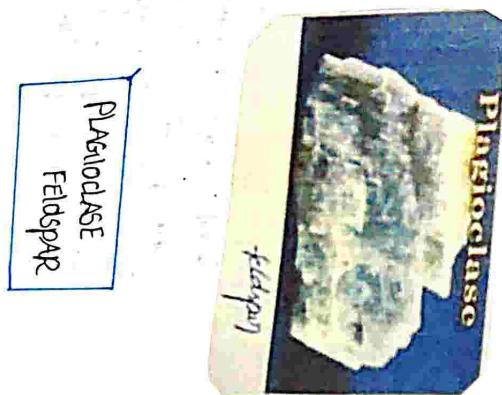
- : It is used in porcelain and pottery industries.

ORTHOCLASE FELDSPAR

FELDSPARS GROUP

11. PLAGIOLASE FELDSPAR

Chemical Composition	: $(\text{Na}, \text{Ca})\text{Al}(\text{Al}, \text{Si})\text{Si}_2\text{O}_6$
Crystal System	: Tridimic
Occurrence	: plagioclase feldspar widely occurs as a primary mineral in igneous rocks from acid to basic varieties. It is also found in arenaceous sedimentary rocks and in medium to high grade metamorphic rocks.
Uses	: It is used in porcelain and pottery industries.



FELDSPARS Group

12. MICROLINE



MICROLINE

Chemical Composition	: $KAlSi_3O_8$
Crystal System	: Triclinic
Occurrence	: microline is the lowest temperature form of potassium felspar and occurs in acid igneous rocks.
uses	: microline is industrially important in the manufacture of glasses and ceramics. Amazzone is also used as a gemstone, and is polished into beads, cabochons, and ornamental figures.

FELDSPATHOIDS

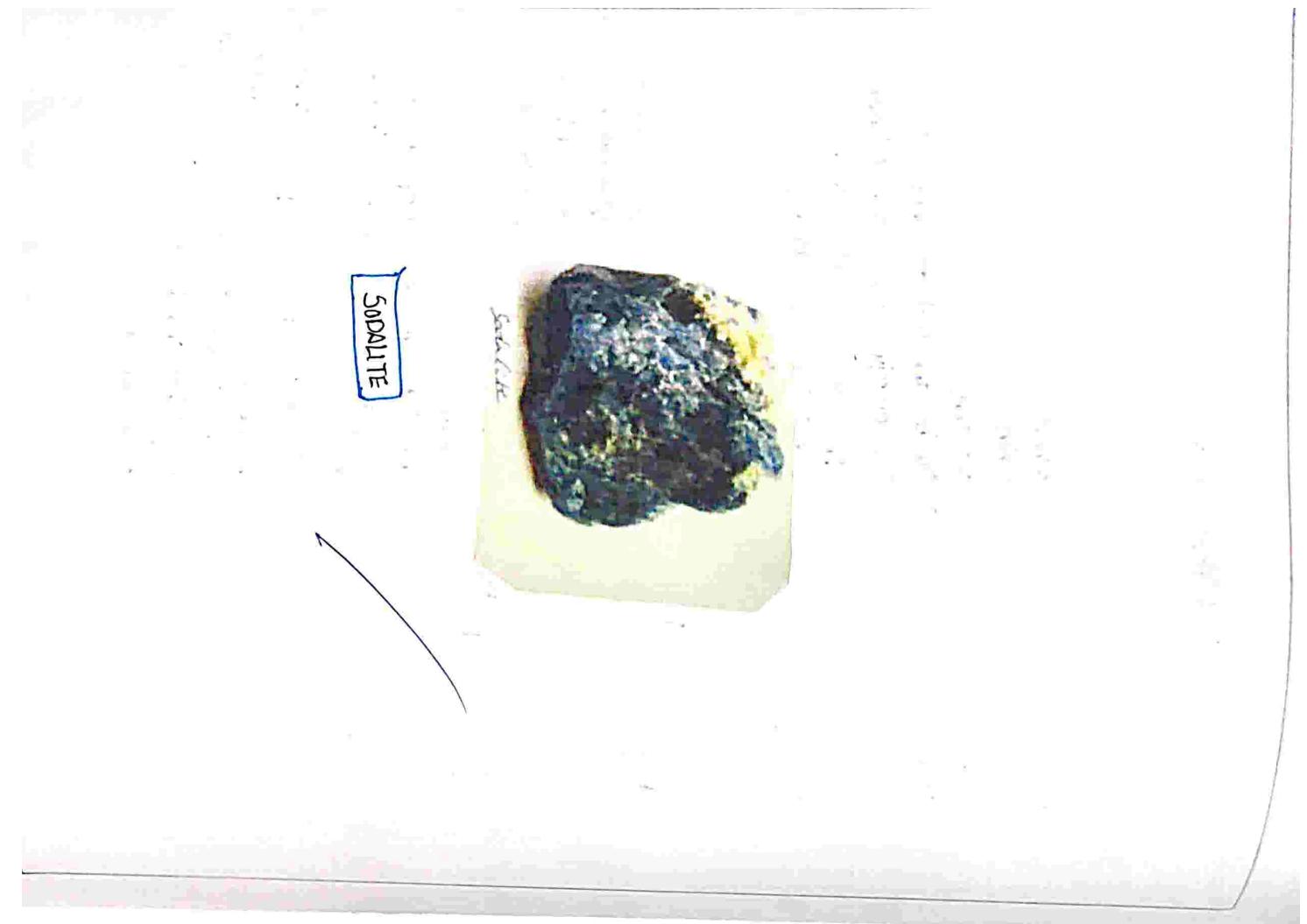
13. SODALITE



SODALITE

Specific Gravity	: low
Diagnostic Properties	: light blue colour and granular massive form
Chemical Composition	: $3(\text{Na Al Si}_3\text{O}_8)\text{NaCl}$
: Cubic	
Occurrence	: Sodalite occurs as a primary mineral in low silica and rich soda igneous rocks, such as nepheline-syenite, alkali-syenite.

Note: It is rarely used as an ornamental stone.



FELDSPATHOIDS

14. LEUCITE

colour	: white to grey
Streak	: Colorless
Lustre	: Vitreous
Form	: Trapezohedron, Rhombohedron
Cleavage	: Imperfect
Fraction	: Cardoidal
Hardness	: 5.5-6
Specific Gravity	: 2.5
Diagnostic Properties	: Convexoidal fracture and vitreous lustre.
Chemical Composition	: $K_2AlSi_3O_8$
: Tetragonal	
Occurrence	: Occurs in volcanic rocks
Uses	: Useful for the production of pottery fertilizers.

LEUCITE



Micas

15. **MUSCOVITE**

MUSCOVITE

Colour	: Translucent white, yellowish, greenish, reddish
Streak	: Colourless
Lustre	: Pearly
Form	: Book form, well develop tabular form
Cleavage	: Perfect basal cleavage
FRACTURE	: Brittle
Hardness	: Low - 2.0
Specific Gravity	: Scratched by nail (2 to 2.5)
Diagnostic Properties	: Excellent cleavage, colour, book form, pearly lustre
Chemical Composition	: $KAl_3(AlSi_3O_{10})(OH)_2$
Crystal System	: monoclinic
Occurrence	: Muscovite occurs as an important constituent of acid igneous rocks, such as granites, pegmatites. It also always occurs as flakes in sandstone and clay.
USES	: It is used in electrical industry for insulating purposes and is also used in making of lubricants, wall-finishing, rubber hoses and Christmas cards, which are used in many optical minerals.

MCAS

16. BIOTITE

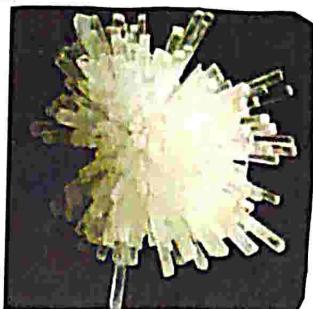
- 16. BIOTITE**
- | | |
|-----------------------|---|
| Colour | : Dark brown |
| Break | : Coloursless to light brown |
| Lustre | : Splendent to pearly |
| Form | : Foliated |
| Cleavage | : Perfect basal cleavage |
| Fracture | : uneven |
| Hardness | : Scratched by nail |
| Specific Gravity | : Low to medium |
| Diagnostic properties | : Foliated form, basal cleavage, low hardness, and dark brown colour. |
| Chemical Composition | : $K_{(Mg,Fe)}(AlSi)_3O_8(OH, F)_2$ |
| Crystal System | : Monoclinic |
| Occurrence | : occurs as an important constituent of acid igneous rocks such as pegmatites, granites. It is also a principal mineral of biotite mica-schists and gneisses. |
| Uses | : It is used in electrical industry for insulating purpose. |

BIOTITE

MISCELLANEOUS GROUP

18. NATROLITE [NEOLITE]

Colour	: white
Break	: white
Lustre	: vitreous
Form	: Radiating
Cleavage	: Distinct
Fracture	: uneven
Hardness	: scratched by pen knife
Specific Gravity	: low
Diagnostic Properties	: Low specific gravity, white colour, and radiating form
Chemical Composition	: $\text{Na}(\text{Al}_2\text{Si}_2\text{O}_8)_2 \cdot 2\text{H}_2\text{O}$
Crystal System	: orthorhombic
Occurrence	: It occurs as a secondary mineral in amphiboloidal basalts. It is also found in cavity filling, fracture fillings in basalts.
Uses	: It is used as soil conditioners and as ion exchange in pollution abatement.



Natrolite

NATROLITE

MISCELLANEOUS GROUP

19. TALC



TALC

- Colour : whitish green
- Break : white
- Luster : Greasy to Pearly
- Form : massive
- Cleavage : Distinct parallel to the basal pinacoid (001)
- Fracture : uneven
- Hardness : Very easily scratched by nail (may be 1)
- Specific Gravity : Low
- Diagnostic Properties : Lowest hardness, distinct cleavage, greasy luster and whitish green colour.
- Chemical Composition : $MgSi_4O_{10}(OH)_2$
- Crystal System : Monoclinic
- Occurrence : Talc occurs as a secondary mineral which is derived from magnesium bearing rocks, such as peridotite, gabbro, dolomite by the hydrothermal process.
- Uses : It is mainly used as filler in paints, paper, rubber and plastics.

MISCELLANEOUS GROUP

20. BERYL

Colour	Green
Streak	Colourless
Lustre	Vitreous
Form	Prismatic Crystals
Cleavage	Indistinct
Fraction	Uneven
Hardness	Not scratched by pen knife (may be 7 to 8)
Specific Gravity	: Low
Diagnostic properties	: Crystalline form (hexagonal prisms), green colour, high hardness and low specific gravity.
Chemical Composition	: Be ₃ Al ₂ Si ₆ O ₁₈
Crystal System	: Hexagonal
Occurrence	: Beryl occurs as an important accessory mineral in pegmatites and granites.
Uses	: It is used as gem stone.



BERYL

MISCELLANEOUS GROUP

21. CORUNDUM

Colour	: light brown
Break	: colourless
Luster	: Sub-vitreous
Form	: barrel shaped crystals
Cleavage	: Absent
Fracture	: uneven
Hardness	: not scratched by pen knife (may be 9)
Specific Gravity	: medium
Diagnostic properties	: barrel shape, very high hardness
Chemical Composition	: Al ₂ O ₃
Crystal System	: Hexagonal
Occurrence	: It is an original constituent of alumina-rich igneous rocks, such as syenites, nepheline syenites and monzonites.
Uses	: It is mainly used as abrasive and some varieties of corundum (RUBY, EMERALD) are used as gemstones.

CORUNDUM



MISCELLANEOUS GROUP

22. GYPSUM



Gypsum

colour	: white transparent
Streak	: white
Lustre	: pearly
Form	: platy
Cleavage	: distinct
Fracture	: uneven
Hardness	: easily scratched by nail (may be 2)
Specific Gravity	: low
Diagnostic Properties	: platy form, pearly lustre, low hardness and low specific gravity
Chemical Composition	: $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$
Crystal System	: monoclinic
Occurrence	: Gypsum occurs chiefly as evaporites in sea bottoms. It is usually associated with anhydrite, marl and lime stone beds.
Uses	: Gypsum is used as a retarder in cement.

MISCELLANEOUS GROUP

23. CALCITE



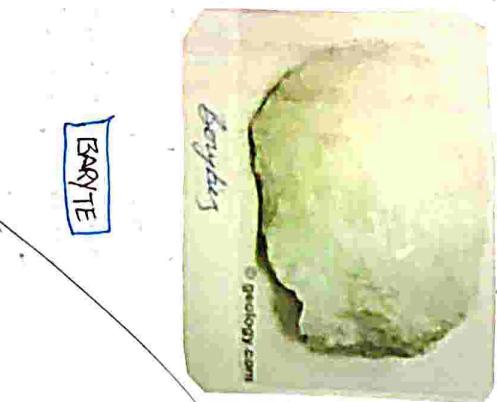
CALCITE

Chemical Composition	: CaCO_3
: Hexagonal	
出 现 地 方	: It is an important constituent of lime-stone marble. It is also found in calc-silicate rocks.
用 途	: Calcite is used in the manufacture of bleaching powder, calcium carbide, glass, soap etc.,

MISCELLANEOUS GROUP

24.

BARYTE



BARYTE

Colour	: white
Break	: white
Luster	: vitreous
Form	: massive
Cleavage	: indistinct
Fracture	: uneven
Hardness	: scratched by pen knife
Specific Gravity	: High may be 4.5
Diagnostic Properties	: High specific gravity, massive form, low hardness
Chemical Composition	: Barium
Crystal System	: orthorhombic
Occurrence	: Baryte occurs as vein in the meta-sediments, such as slates, phyllites, mica-schists, etc.
Uses	: It is mainly used as drilling mud in oil exploration and also used in the manufacture of paints, paper weights, etc.

MISCELLANEOUS Group

25. TOURMALINE

Colour	: white
Streak	: white
Luster	: vitreous, sometimes resinous
Form	: prismatic crystals
Cleavage	: indistinct
Fracture	: uneven, small conchoidal, brittle
Hardness	: 7-7.5
Specific Gravity	: 3.06 (+20-0.6) [1]
Diagnostic Properties	: Prismatic crystals
Chemical Composition	: (Ca,K,Mg)
Crystal System	: Trigonal
Occurrence	: occurs as accessory in granites, syenites, pegmatites, mica-schists and Gneissic limes stone
Uses	: used as gem stones.



TOURMALINE

Tourmaline

MISCELLANEOUS GROUP

26. APATITE



Apalite

APATITE

Colour	: Transparent to translucent, usually green, less often colorless, yellow, blue to violet, pink, brown.
Streak	: white
Lustre	: vitreous to sub resinous
Form	: Tabular, prismatic crystals, massive, compact or granular
Cleavage	: [001] indistinct [100] indistinct
FRACTURE	: Conchoidal to uneven
Hardness	: 5
Specific Gravity	: 3.16 - 3.22
Diagnostic Properties	: Prismatic form
Chemical Composition	: $\text{Ca}_5(\text{PO}_4)_3(\text{F}, \text{Cl}, \text{OH})$
Crystal System	: Hexagonal
Occurrence	: Occurs as a primary constituent of igneous rocks in small amounts. Also present in metamorphic rocks.
Uses	: It used as a source of phosphate in fertilizers.

SILICA GROUP

27.

Colour	: yellowish to greenish white
Streak	: colourless
Lustre	: sub-vitreous
Form	: Botryoidal
Cleavage	: Absent
Fracture	: conchoidal
Hardness	: Hardly scratched by pen knife may be 5.5 to 6)
Diagnostic properties	: Low specific gravity, cleavage none, botryoidal form and conchoidal fracture
Chemical composition	: $\text{SiO}_2 \text{H}_2\text{O}$
Crystal System	: Hexagonal
Occurrence	: Chalcedony occurs as filling cavities in angular boulders and as nodules in limestone
Uses	: chalcedony and its varieties are used in porcelain and pottery industry.

CHALCEDONY



1.

Microscope

POLARIZING MICROSCOPE

Polarizing microscope is used for determining the optical properties of minerals. To study minerals under the microscope, thin sections about 0.035 mm thick are prepared. These thin sections are then placed on the rotating stage of the microscope and examined.

The main parts of the polarizing microscope are as follows.

Rotating stage: The thin section of a mineral to be examined is placed on this stage.

Polarizer: The polarizer is fitted below the stage. It transmits polarized light vibrating in the E-W direction.

Analyser: The analyser is placed in the microscope tube above the stage and is removable. The analyser transmits light vibrating in the N-S direction.

Eyepiece: The eyepiece of the microscope carries cross-hairs, one in the N-S direction and the other in the E-W direction.

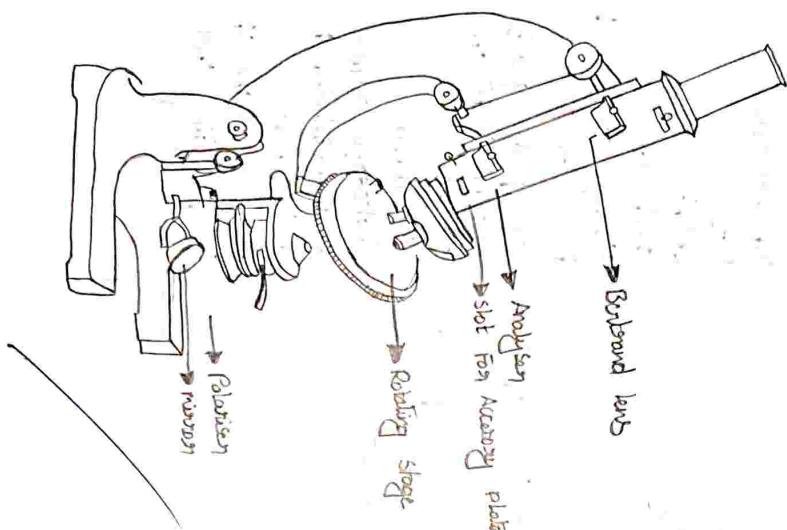
Objective: For mineralogical work, generally three objectives are used (low power 2x), medium (10x), and high power (20x).

This diaphragm: This diaphragm is located below the stage. It regulates the intensity of light.

Condenser: The condensing lenses are located below the stage. They are used with high power objective and produce converging light rays when required.

Beyband lens: This lens is used to observe interference figures.

Slot for accessories: The microscope tube carries a slot at 45° to the cross hairs. It is used for the insertion of accessory plate.



Construction of Nicol Prism:

- It is constructed from the Calcite Crystal parts having length three times of its width.
- Its end faces PQ and RS are cut such that the angles in the principal section become 68° and 112° in place of 71° and 109° .
- The crystals is then cut diagonally into two parts. The surfaces of these parts are ground to make optically flat and then were polished.

Thus polished surfaces are connected together with a special cement known as Canada Balsam.

Working of Nicol Prism:

- when a beam of unpolarized light is incident on the face PQ, it gets split into two refracted rays, named O-ray and E-ray.
- These two rays are plane polarized rays, whose vibrations are at right angles to each other. The refractive index of Canada Balsam are being 1.5518 between those of ordinary and extraordinary and 1.6864 respectively.

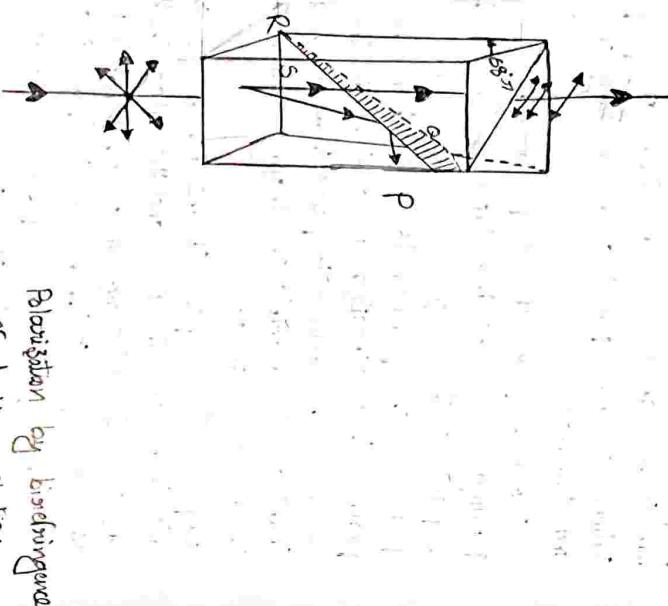
Nicol Prism as a Polarizer:

- In order to produce and analyze the plane polarized light, we arrange two Nicol prisms.
- when a beam of unpolarized light is incident on the Nicol prism, Slight beam from the prism is obtained as plane polarized, and which has vibrations parallel to the principal section.
- This prism is therefore known as polarizer. If this polarized beam falls on another parallel Nicol prism P2, whose principal section is parallel to that of P1, then the incident beam will behave as E-ray inside the Nicol prism P2 and gets completely transmitted through it.
- thus way the intensity of emergent light will be maximum.

$$n_e = 1.6584$$

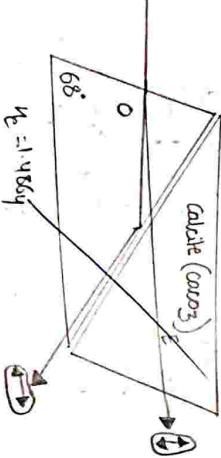
$$n_{baism} = 1.5518$$

$$n_b = 1.6584$$



Polarization by bisecting
of double refraction

calcite (CaCO₃)



OPTICAL PROPERTIES OF MINERALS

1.

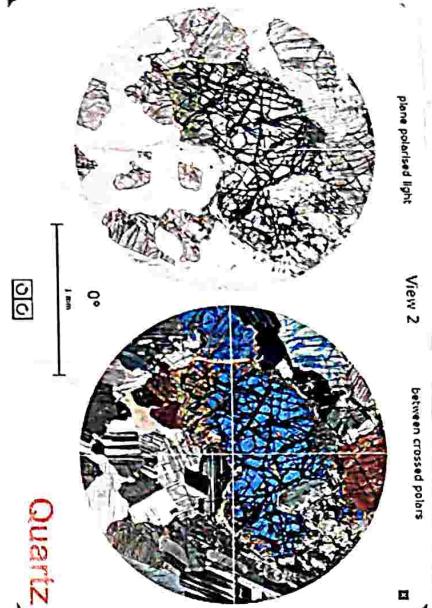
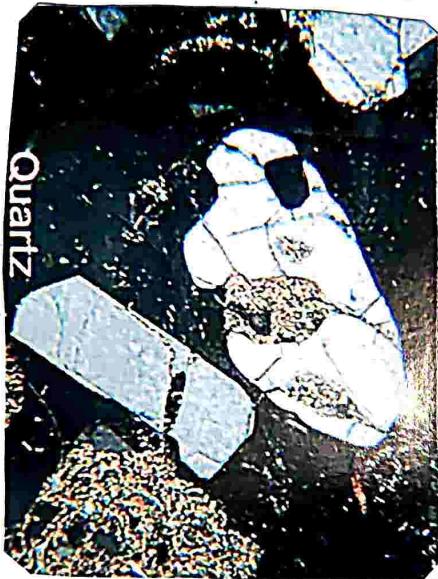
QUARTZ

A. UNDER PLANE POLARISED LIGHT

Colour	: Colourless
Form	: Anhedral
Relief	: Low
cleavage	: Absent
Cracks	: Indistinct
pleochroism	: Absent
pleochroic halos	: Absent
Twinkling	: Absent

B. UNDER CROSSED NELS

Iscopropic / Anisotropic : Anisotropic
 Extinction : straight or wavy
 polarization colours : grey, yellow



Quartz

2.

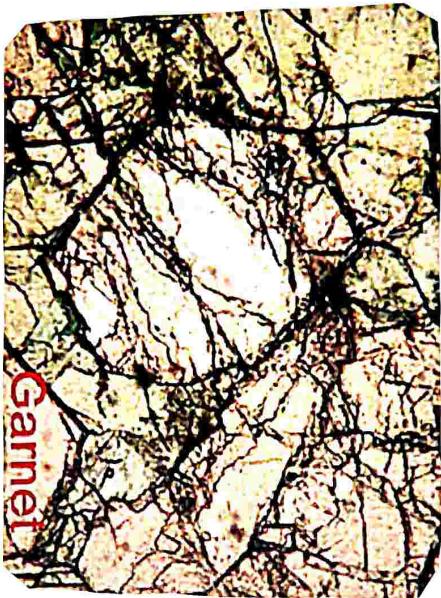
GARNET

A. UNDER PLANE POLARISED LIGHT

Colour	pink
Form	Surrounded
Relief	high
Cleavage	Absent
Cracks	Present
Pleochroism	Absent
Pleochroic halos	Absent
Twinkling	Absent

B. UNDER CROSSED NICKS

Isotopic / Anisotropic : Isotrophic



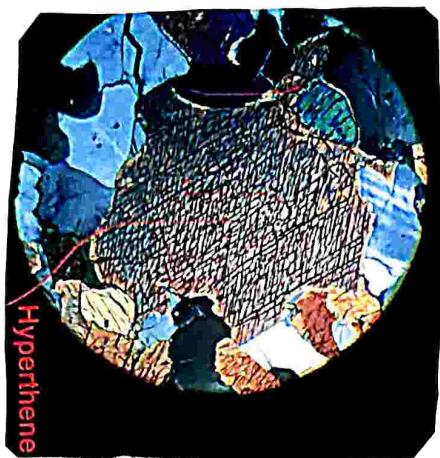
3.

HYPERTHENE**A. UNDER PLANE POLARISED LIGHT**

Colour	: Light pink
Form	: Subhedral
Relief	: High
Cleavage	: Absent (Rarely one set)
Cracks	: Present
Inclusions	: (Common) present
Pleochroism	: Greenish grey to pink
Pleochroic halos	: Absent
Twinkling	: Absent

B. UNDER CROSSED NICOLS

Isobropic / Anisotropic	: Anisotropic
Extinction	: straight
Polarization colours	: Bright 1 st order colours



Hypersthene

4. AUGITE

A. UNDER PLANE POLARISED LIGHT
 Colour : Pale green
 Form : Euhedral
 Relief : High
 Cleavage : One set
 Inclusions : Present
 Pleochroism : Absent

Pleochroic halos : Absent
 Twinkling : Absent

B. UNDER CROSSED NICKLS
 Isobropic /Anisotropic : Anisotropic
 Extinction : Inclined 40-45°
 Polarization : Bright 2nd and 3rd order colours
 Colours : Green, yellow, red etc.,



5.

HORNBLende**A. UNDER PLANE POLARISED LIGHT**

Colour	:	green
Form	:	Subhedral
Relief	:	High
Cleavage	:	one set of cleavage
Inclusions	:	Present
Pleochroism	:	Strong pleochroic - light green to dark green
Pleochroic halos	:	Absent
Twinkling	:	Absent

B. UNDER CROSSED NOLs

Isotropic / Anisotropic	:	Anisotropic
Extinction	:	Twinned (18-20°)
Polarization Colours	:	Bright 2nd order colours green yellow violet, etc



6. PLAGIOLASE FELDSPAR

A. UNDER PLANE POLARISED LIGHT

Colour	:	Colourless
Form	:	Subhedral
Relief	:	Low to medium
Cleavage	:	Indistinct
Inclusions	:	Present
Pleochroism	:	Absent
Pleochroic habits	:	Absent
Twinkling	:	Absent

B. UNDER CROSSED NEELS

Isobropic / Anisobropic	:	Anisobropic
Extinction	:	Inclined (oblique)
Polarization	:	Grey
Twining	:	Lantern
Alteration	:	Present



7. MICROCLINE**A NUMBER** PLANE POLARISED LIGHT

Colour	Colourless
Form	Subhedral
Relief	low
Cleavage	Indistinct
Inclusions	Present
Pleochroism	absent
Pleochroic halos	absent
Twinkling	absent

B. UNDER CROSSED NICKS

Isotropic / Anisotropic	: Anisotropic
Extinction	: inclined
Polarization	: grey
Twinning	: cross-hatched (met like) twinning
Alteration	: alters to sericite

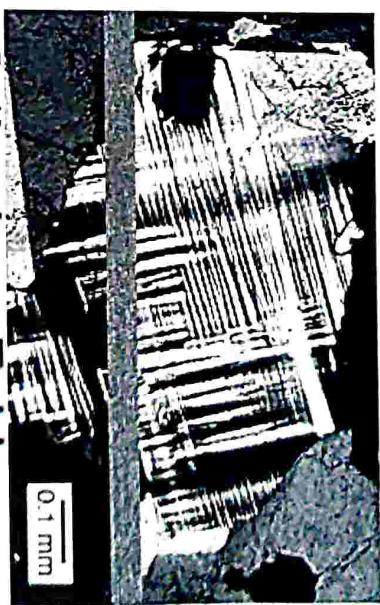
B. ORTHOCLASE

A. UNDER PLANE POLARISED LIGHT

Colour	: Brownish pink Colourless, white to pink
Form	: Rounded
Relief	: Medium
Cleavage	: Perfect
Inclusions	: Absent
Pleochroism	: Absent
Pleochroic halos	: Absent

B. UNDER CROSSED NICOLS

Isotropic / Anisotropic	: Anisotropic
Extinction	: Inclined
Polarization colours	: Grey



Orthoclase Feldspar

0.1 mm

10. MUSCOVITE

A. UNDER PLANE POLARIZED LIGHT

Colour : Colourless

Form : Subhedral

Relief : Medium

Cleavage : One set of cleavage

Pleochroism : Absent

Pleochroic Habits : Absent

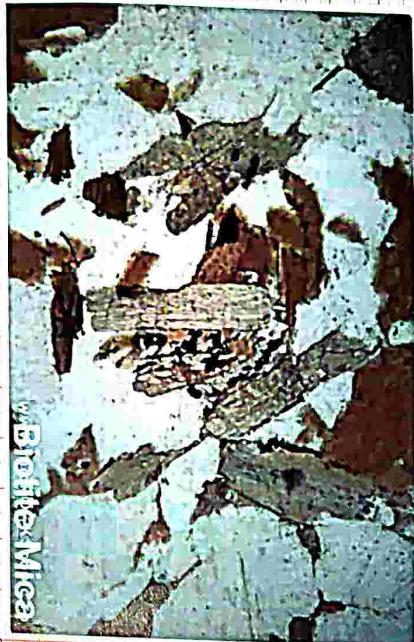
Twinkling : Absent

B. UNDER CROSSED NICKS

Isochromatic / Anisotropic : Anisotropic
 Extinction : Straight
 Polarization Colours : Bright, red, green, yellow, violet,
 etc.,



Muscovite



II. BIOTITE MICA	
A. UNDER PLANE POLARISED LIGHT	
Colour	: Brown
Form	: Subhedral (tabular)
Relief	: High
Cleavage	: One set of cleavage
Inclusions	: Present
Pleochroism	: Strong by pleochroic light green to dark green
Pleochroic halos	: Present
B. UNDER CROSSED NAILS	
Anisotropic / Anisohoric	: Anisotropic
Extinction	: Straight
Polarization	: Bright 2nd order colours - brown, yellow, red, green, etc.

12. APATITE [Longitudinal Section]

A. UNDER PLANE POLARIZED LIGHT



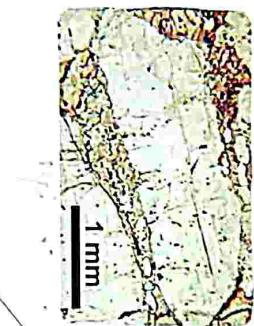
Colour	: Colourless
Form	: Fibrolitic (Elongated Prism)
Relief	: High
Cleavage	: Absent
Pleochroic holes	: Absent
Twinning	: Absent

B. UNDER CROSSED NICKS

Tetragonal	: Anisotropic
Extinction	: Straight
Polarization	: Grey

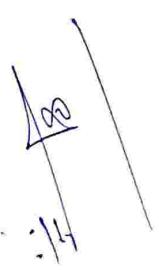
13. APATITE (Transverse section)

A. UNDER PLANE POLARISED LIGHT



Colour	:	colourless
Form	:	tetrahedral (hexagonal outline)
Relief	:	High
Deafle	:	Absent
Pleochroism	:	Absent
Pleochroic Halos	:	Absent
Twinkling	:	Absent

B. UNDER CROSSED NIELS



(Isotropic) Anisotropic : Anisotropic