EES - 311: MINERALOGY LAB REPORT

"All the work of the crystallographers serves only to demonstrate that there is variety everywhere where they suppose uniformity...that in nature there is nothing absolute, nothing perfectly regular"

- Georges-Louis Leclerc de Buffon

Om Vaknalli

Roll No. 18376

11.10.2021

4th Year BS-MS EES Major

AIM

1. To distinguish opaque minerals from transparent minerals.
2. To identify the colour of mineral(s) in plane polarized light.
3. To determine relief of the mineral (low, medium or high relief).
4. To describe mineral form as euhedral, subhedral and anhedral.
5. Identify and describe pleochroism.
6. Identify sets of cleavages.
7. Identify fractures in minerals.

THEORY

1. **Plane Polarised Light:** Plane polarized light (PPL) has one single plane of vibration, in which the direction of vibration is always perpendicular to the direction of propagation.

2. **Cross Polarised Light:** It is a light produced by a process wherein two polarisers with perpendicular orientation to one another are used on the incident and reflected lights. Under cross-polarised light, birefringent structures which are otherwise invisible become apparent.

3. **Isotropic Minerals:** It refers to the optical properties of the mineral, which are the same and independent of the orientation. Minerals that are isotropic are the minerals with cubic symmetry (the symmetry of minerals crystallized in the cubic system have a=b=c and $\alpha=\beta=\gamma=90°$).

4. **Anisotropic Minerals:** It means that the properties of the material are not the same at all points or directions, but may vary continuously with changing direction (orientation) of observation. Examples of anisotropic behavior when changing orientation include different absorption of light, different refractive indexes, etc. All minerals, other than those belonging to the isometric system, are anisotropic.

5. **Ordinary and Extraordinary Rays:** One of the rays passing through an anisotropic crystal obeys the laws of normal refraction, and travels with the same velocity in every direction through the crystal. This light ray is termed the ordinary ray. The other ray travels with a velocity that is dependent upon the propagation direction within the crystal, and is termed the extraordinary ray. Therefore, each light ray entering the crystal is split into an ordinary and an extraordinary ray that emerge from the distant end of the crystal as linearly polarized rays having their electric field vectors vibrating in planes that are mutually perpendicular.

6. **Opaque Mineral:** A mineral is opaque if it appears totally black and stays black regardless of the rotation of the stage under plane polarised light.

7. **Translucent Mineral:** Light can pass through the mineral but is diffused so that images cannot be seen clearly.

8. **Transparent Mineral:** If the mineral appears anything other than totally black (no matter what other colour is observed) it means that the light passes through the mineral, so the mineral is transparent.

9. **Crystal shape:** Can be either euhedral, subhedral or anhedral. Euhedral minerals show perfect or nearly perfect crystal faces (euhedral or panidiomorphic (fully crystal-faced). Subhedral minerals are rounded but still show the general characteristic shape of that mineral (texture developed is called hypidiomorphic (partly faced). Anhedral crystals are completely irregular in shape or rounded (rapid crystallization with no free space for the formation of crystal faces). All component mineral grains are anhedral and the resulting texture in magmatic rocks is Allotriomorphic.

10. **Crystal Habit:** Following are the different crystal habits:

    - Individual crystal analysis:

        - *Cubic* - cube shapes
        - *Octahedral* - shaped like octahedrons
        - *Tabular or Platy* - rectangular shapes
        - *Equant* - a term used to describe minerals that have all of their boundaries of approximately equal length
        - *Acicular* - long, slender crystals
        - *Prismatic* - abundance of prism faces
        - *Bladed* - like a wedge or knife blade
        - *Capillary or Filliform* - hairlike or threadlike
        - *Foliated or Micaceous* - easily split into sheets (muscovite, biotite)
        - Others - Stubby, Elongate, etc.

    - Crystal aggregation analysis:

        - *Arborescent or Dendritic* - tree like growths
        - *Reticulated* - lattice like groups of slender crystals
        - *Radiated or Divurgent* - radiating groups of crystals
        - *Fibrous* - elongated clusters of fibers
        - *Botryoidal* - smooth bulbous or globular shapes
        - *Globular or Colloform* - radiating individual crystals that form spherical groups
        - *Drusy* - small crystals that cover a surface
        - *Stellated* - radiating individuals that form a star-like shape
        - *Massive or Blocky* - appearing as a solid mass with no distinguishing features
        - *Granular* - composed of many individual grains
        - *Stalactitic* - appearing stalactite shaped
        - *Plumose* - having feathery appearance
        - *Reniform* - having a kidney shaped appearance
        - *Mammillary* - having breast like shape
        - *Elliptic or Pisolitic* - composed of very small ellipsoidal structures
        - Others – Dipyramidal, Fine-grained, Asbestiform, etc.

11. **Pleochroism:** A mineral shows pleochroism when the absorption colour changes when the stage is rotated under plane polarised light. It means that absorption of specific light wavelengths depends on the crystal orientation. This happens when the mineral is anisotropic. However, the intensity of pleochroism (the changing of colour) can be different (from strong to weak)**.**

12. **Cleavage:** Cleavages are planar surfaces of low cohesion produced by weaker atom bonds across them. Cleavages seen in thin sections are linear expressions of the intersection of particular planes of crystal faces with the cut surface of the thin section. Some minerals may have three “good” cleavages (e.g., calcite), some have a “perfect” cleavage (e.g., micas). Some may have no cleavages at all (e.g., olivine, which therefore has no “preferred” planes of splitting, and gets fractured, instead). The quality of cleavage is described as perfect, imperfect, good, distinct, indistinct, poor/weak, or absent. The quality decreases from perfect (dense, almost continuous and thin lines of cleavage) to weak cleavage (few, disperse segments of thicker lines) to absent (no cleavage, different curved and/or broken thick lines).

13. **Fracture:** Fracture is the appearance of a surface broken in directions other than along cleavage planes. Fracture is the "chipping" of a mineral.

    - *Conchoidal* - curved concavities resembling shells. e.g., flint, quartz, glass.
    - *Even* - rough, approximately plane surfaces.
    - *Uneven* - rough and completely irregular surfaces
    - *Hackly* - sharp edges and jagged edges and depressions. e.g., most metals.
    - *Splintery or Fibrous* - partially separated splinters or fibres. e.g., jadeite.
    - *Earthy or crumbly* - this describes minerals that crumble when broken.

14. **Relief:** It refers to the relative difference in refractive indices (RI) between neighboring crystals. Although relief is most useful as a comparative term (some minerals show higher relief than others), the relief can be positive or negative compared to a reference material of fixed and known RI. This reference standard is the resin, which has a known refractive index (n = 1.54 - 1.55). All minerals with relief higher than the resin have positive relief and all minerals with lower relief than the resin, have negative relief.

- *Positive Relief* - It refers to a mineral that stands out higher than the medium, and the mineral has a higher refractive index than its surroundings.
- *Negative Relief* - It refers to a mineral that appears to "sink in", and the mineral has a lower refractive index than its surroundings.
- *High Relief* - Minerals with high relief have sharp grain boundaries, and the difference in the two refractive indices is large.
- *Low Relief* - If the difference in the two refractive indices is small, it does not show up well in the enclosing material, and the mineral is said to have low relief.

SILICATE MINERAL ANALYSIS

MINERAL NO.	1	2	3	4	5	6	7	8
Colour	Whitish - Gray	Colorless	Colorless	Whitish - Gray	Whitish - Gray	Colorless	Colourless	Brown, green, or reddish color Strong brown, yellowish brown
Crystal Shape	Subhedral	Euhedral or Anhedral	Euhedral to Subhedral	Subhedral	Subhedral	Anhedral to Subhedral	Subhedral	Euhedral to Anhedral.
Transparency	Transparent	Transparent	Transparent, Translucent	Transparent	Transparent	Transparent	Transparent	Transparent
Habit	Massive, Prismatic	Prismatic, Stubby to elongate. May be flattened or doubly terminated	Prismatic, Tabular	Prismatic, Stubby	Prismatic, Tabular	Prismatic, Tabular, Bladed, Cleavable masses, Irregular grains	Disseminated grains, Books with or without pseudohexagonal outline	Massive, Platy
Cleavage	Absent	Perfect	Perfect, 2 - {001} Perfect, {010} good	2 (90°), Perfect	Poor	Perfect	Perfect on {001}	Perfect {001}
Fracture	Conchoidal	Conchoidal	Uneven	Conchoidal	Uneven	Uneven	Micaceous	Micaceous
Relief	Positive Low	Low	Low	Negative Low	Positive Low	Low	Moderate	Moderate
Pleochroism	Absent	Absent	Absent	Absent	Absent	Absent	Weak	Strong Presence
Isotropism	Anisotropic	Anisotropic	Anisotropic	Anisotropic	Anisotropic	Anisotropic	Anisotropic	Isotropic

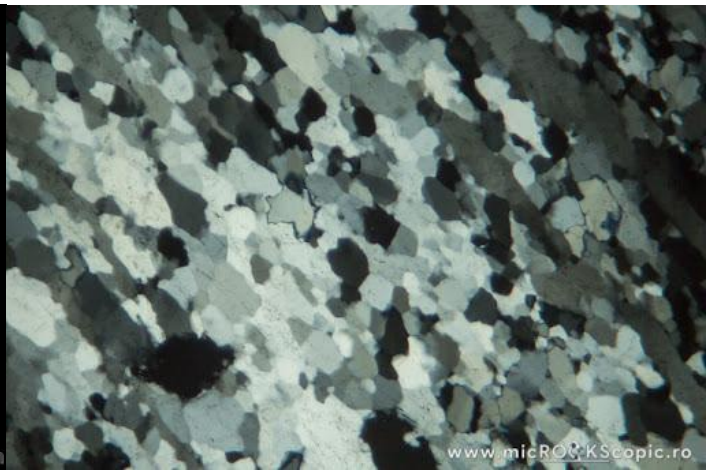
Mineral	**Quartz**	**Orthoclase**	**Sanidine**	**Microcline**	**Albite**	**Anorthite**	**Muscovite Mica**	**Biotite Mica**
Chemical Formula	SiO2	K(AlSi3O8)	K(AlSi3O8)	KAlSi3O8	NaAlSi3O8	CaAl2Si2O8	KAl2(AlSi3O10)(OH)2	K (Mg, Fe) 3(Al Si 3O 10) (F, OH) 2

MINERAL NO.	9	10	11	12	13	14	15	16
Colour	Colorless to pale yellow color	Brown, Green, Blue-Green or Yellow-Brown	Dark Gray	Gray	Whitish-Gray	Clear, pink, green, brown to green	Colorless	Strong but variable
Crystal Shape	Euhedral to anhedral	Euhedral to anhedral	Anhedral	Subhedral	Anhedral	Euhedral	Euhedral	Euhedral
Transparency	Transparent	Translucent	Translucent	Translucent	Transparent	Transparent	Transparent to translucent	Translucent
Habit	Prismatic with striations, fibrous, massive	Massive, Prismatic, Bladed, Columnar, Fibrous	Massive, Fibrous, Prismatic, Acicular	Stubby, Prismatic	Granular	Rhombic dodecahedron or cubic	Hexagonal prisms	Elongate, striated trigonal prisms Parallel or radiating aggregates Massive and compact
Cleavage	Perfect	Two perfect prismatic {110}	2 Perfect	2 Perfect	Poor	Indistinct	Poor {001}	2 - Poor {101}, Poor {110}
Fracture	Uneven	Uneven	Uneven	Uneven	Conchoidal	Conchoidal, Subchonchoidal, Uneven	Even	Subconchoidal

Relief	High	Moderate to high positive	Positive High	Positive Moderate	Positive High	High	Moderate	Medium
Pleochroism	Weak	Moderate to strong	Weak	Weak	Weak	None	None	Strong and variable
Isotropism	Isotropic	Anisotropic	Anisotropic	Anisotropic	Anisotropic	Isotropic	Anisotropic	Anisotropic
Mineral	**Epidote**	**Hornblende**	**Enstatite**	**Augite**	**Olivine**	**Garnet**	**Beryl**	**Tourmaline**
Chemical Formula	Ca2(Al, Fe)3Si3O12 (OH)	(K,Na)(Ca,Na) 2(Mg,Fe,Al)5S i8O22(OH)2	Mg2Si2O4	(Ca,Mg,Fe,N a)(Mg,Fe,Al) (Si,Al)2O6	(Mg,Fe,Mn)SiO4	X3Y2(SiO4) 3	Be3Al2Si6O1 8	(Na,Ca)(Fe,Mg,Al,Li) 3Al6(BO3)3Si6O18(OH)4

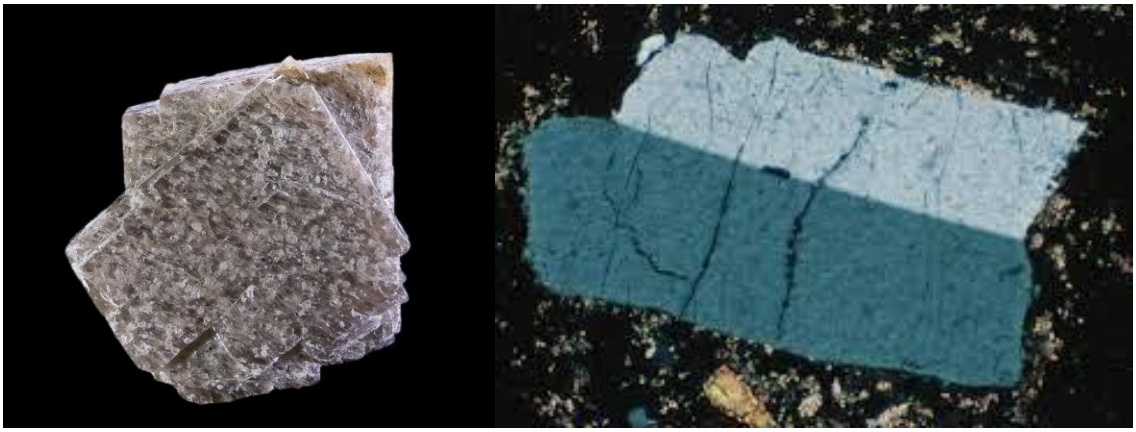
MINERAL PICTURES

1. Quartz

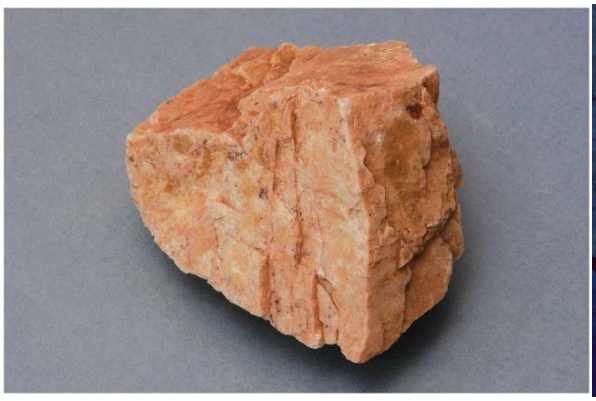


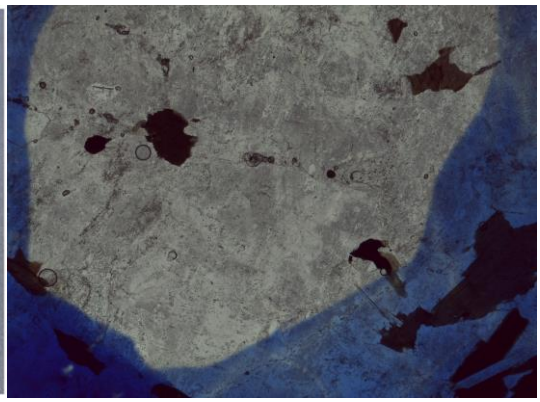
2. Orthoclase

3. Sanidine

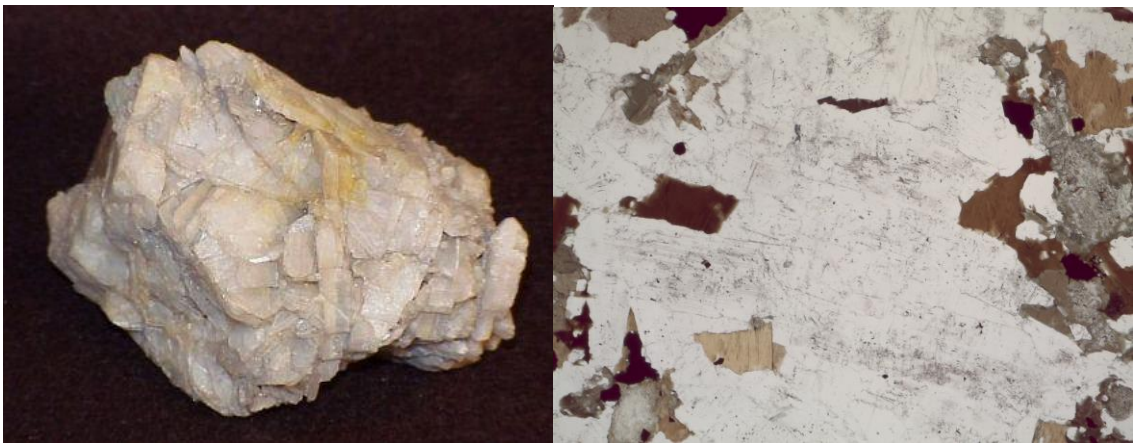


4. Microcline





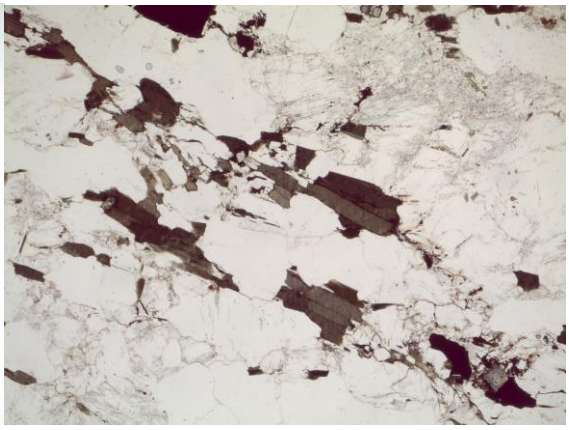
5. Albite



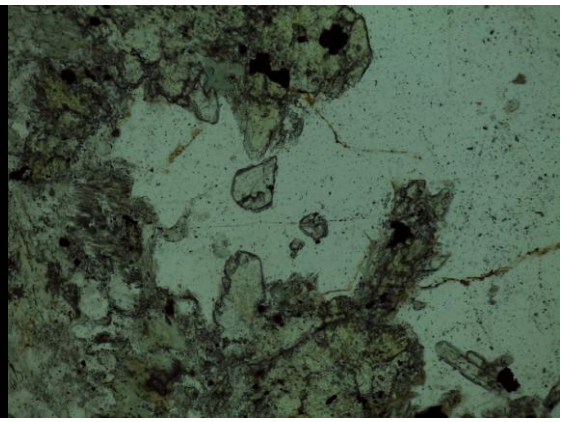
6. Anorthite

7. Muscovite Mica

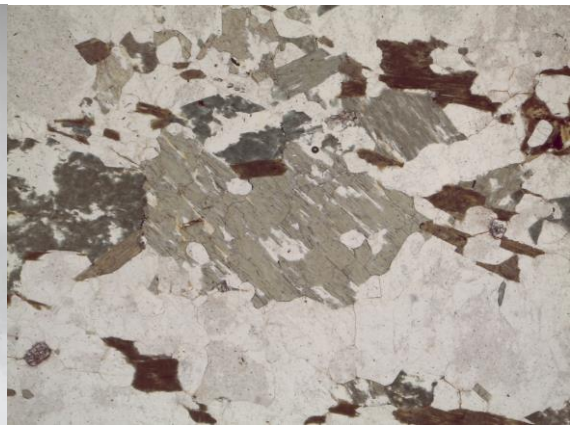
8. Biotite Mica



9. Epidote

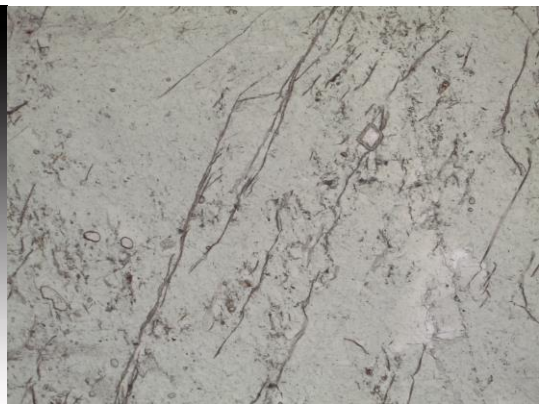



10. Hornblende

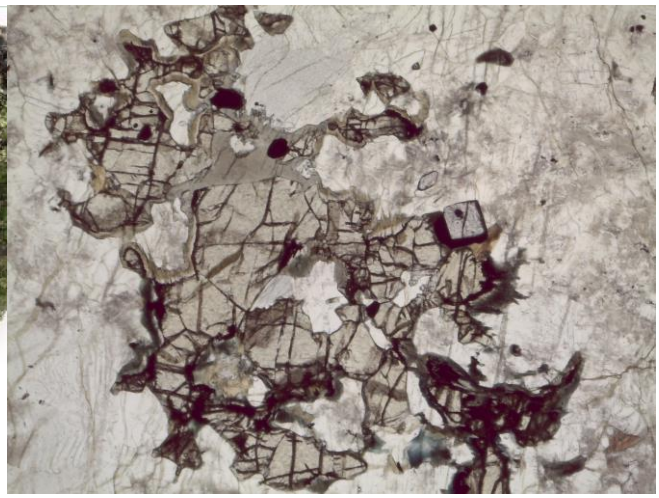



11. Enstatite


12. Augite

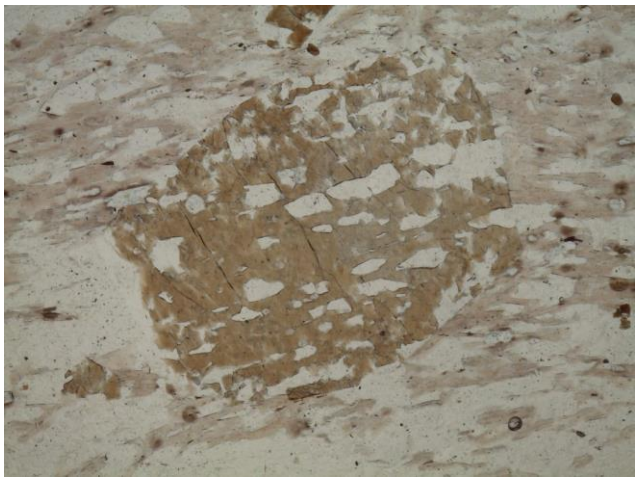
13. Olivine



14. Garnet

15. Beryl


16. Tourmaline

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