Engineering Geology Laboratory Manual

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Civil Engineering Department

LIST OF EXPERIMENTS

EXPERIMENT NO. 1

Aim: To study of Physical properties of minerals**.**

Equipment Required

Mineral Specimens, Lenses, Colored pencils etc.

Theory

Mineral

Mineral are defined as naturally occurring, inorganic, solids with a definite chemical composition and a regular, internal crystalline structure. Different chemical composition results in different minerals. Mineral are the building blocks of rocks.

Mineral Physical Property chart		
Physical Property	**Definition**	**Testing Method**
Cleavage	Breakage of a mineral along planes of weakness in the crystal structure	Examine the mineral for area where the mineral is broken. Look for area where the light reflects from planar surfaces. This can be easily confused with a crystal face and is the most difficult properties for student to master
Color	Visible light spectrum radiation reflected from a mineral.	look at the sample and determine its color white, green, black, clear etc.
crystal forms	Geometric shape of a crystal or mineral	examine and describe the geometric shape of the mineral, cubic, hexagonal, etc. Not commonly seen in most lab samples
Fractures	Breakage of a mineral, not along planes of weakness in the crystal structure	Examine the mineral for area where the mineral is broken. Describe the breakage as either irregular or conchoidal (has the appearance of broken glass)
Hardness	Resistance to scratching or abrasion	Use mineral of know hardness from the Mohs hardness Kits. Scratch the unknown mineral with a know hardness to determine which is harder. Continue doing this with harder or softer minerals from the kit until the hardness is determined.

luster	Character of the light reflected by a mineral	Look at the samples to determine if the mineral is metallic in appearance or non metallic. Vitreous, like glass and earthy (like dirt, or other Powderly material)
Magnetism	Electromagnetic force generated by an object or electric field.	Use of magnet to determined in an introductory lab.
Specific gravity	Ratio of the mass of a mineral to the mass of an equal volume of water	Generally not determined in an introductory lab.
Streak	Color of the mineral when it is powdered	Grind a small amount of a mineral into a powder on a porcelain streak plate and determine the color of the powder.
Transparent	Stages of transparency of mineral	A mineral is Transparent when the outline of an

Table -2 Moh's scale of Hardness

Hardness	Mineral
1	Talc
2	Gypsum
3	Calcite
4	Fluorite
5	Apatite
6	Orthoclase
7	Quartz
8	Topaz
9	Corundum
10	Diamond

(Table - 3) Specific Gravity of the Impotant Minerals

Mineral	Specific Gravity
Graphite	2.23
Quartz	2.65
Feldspars	2.6- 2.75
Fluorite	3.18

Topaz	3.53
Corundum	4.02
Barite	4.45
Pyrite	5.02
Galena	7.5
Cinnabar	8.1
Copper	8.9
Silver	10.5

Mineral Specimen Figure

Properties

EXPERIMENT NO. 2

Aim: To study Geological cross sections and study of geological maps.

Equipments Required:

Maps, Scale, Set Square, Papers, Pencils etc.

EXPERIMENT NO. 3

Aim: To Identification of rocks forming silicate and ore minerals.

Equipments Required

Mineral slides, Petrological Microscopes, Colored Pencils etc.

Theory

The silicate mineral make up the largest and most important class of rock forming minerals. They are classified based on the structure of their silicate group. Silicate minerals are composed largely of Silicon and Oxygen, with the addition of ions such as aluminum, magnesium, iron and calcium. Some important rock forming silicate includes the feldspar, Quartz, Olivines, Pyroxenes, Amphiboles, Garnets and Micas.

Subclasses

Nesosilicates or Isosilicates (They have isolated that are connected only by interstitial cations) **Sorosilicates** (They have isolated double tetrahedral group) Cyclosilicates (rings silicates, in this division, tetrahedral sharing two oxygen link together to form a ring of composition) **Inosilicates** (chain silicates, have interlocking chains of silicates tetrahedral) **Phyllosilicates** (sheet silicates formed when three oxygen all shared between adjacent tetrahedral) **Tektosilicates** (Framework silicates, in this division the four oxygen's in this division the four oxygen's in each tetrahedron are shared with other tetrahedral).

Mineral Slide Figure

Properties

Mineral Slide Figure

Properties

EXPERIMENT NO. 4

Aim: To study rock specimens.

Equipment Required

Rock specimens, lenses, Colored pencils etc.

Procedure

To identify a rock three things must be considered: (1) Origin, (2) Composition (3) Texture

Rock Origin: The first step to identify a rock is to try categorizing the rock into of the three main types or group of rocks. These include igneous, sedimentary and metamorphic types. The only rocks which do not fall into one of these categories are meteorites. Igneous, sedimentary and metamorphic rock tupes are distinguished by the processes of their formation.

Rock Composition: The rock composition is determined by the identification of mineral make up the rock. By the identification, a rock is a solid mass or compound consisting of at least two minerals (although there are some exceptions when a rock may consist entirely of one mineral). The minerals comprising the rock cab be identified using common field testing method for individual minerals, particularly where the texture is sufficiently coarse grained enough to distinguish the individual minerals with the naked eye or a hand lens. Where the grain sizes of the minerals comprising the rock are too fine grained to recognize identification in many cases.

Rock Texture: The texture of a rock is defined by observing two criteria: 1) grain size, 2) grain shapes.

Grain Size: it is the average size of the mineral grains. The size scales used for sedimentary, igneous and metamorphic rock are different.

Grain Shape: It is the general shape of the mineral grain (crystal faces evident, or crystals are rounded)

Rock Type	Very Fine grained	Fine Grained	Medium Grained	Coarse Grained	Very Coarse Grained
Clastic Sedimentary	.06 - .125mm	.125 - .25 mm	.25 - .5 mm	.5 - 1 mm	1 - 2 mm
Metamorphic		<.25 mm	.25 - 1mm	1 - 2 mm	> 2 mm
Igneous		< 1 mm	1 - 5 mm	5 - 20 mm	> 20 mm

Recognition of Sedimentary Rocks				
Hardness	**Grain Size**	**Other**	**Composition**	**Rock type**
Hard	Coarse	White to brown, Foliated	Clean Quartz	Sand stone
Hard	coarse	Quartz and Feldspar	Usually very coarse	Arkose
Hard to Soft	Mixed	Mixed rocks and sediments	Round rocks in finer sediment matrix	Conglomerate
Hard to soft	Mixed	Mixed rocks and sediments	Sharp and angular pieces of rocks in finer sediments matrix	Breccia
Soft	Fine	Fizzes with acid	Calcite	Limestone
Soft	Fine	Foliated	Clay minerals	Shale
Hard	Fine	Chalcedony	No fizzing with acid	Chert
Hard	Fine	Feel gritty on teeth	Very fine sand no clay	Silts tone

Recognition of Igneous Rocks				
Grain size	**Usual color**	**Other**	**Composition**	**Rock type**
Coarse	Green	Dense	Approximately 90 to 95% Olivine	Dunite
Fine	Dark	Contain Quartz	Low - silica lava	Basalt
Coarse	Light	Wide range of color and grain size	Large grains of quartz, feldspar, Olivine and pyroxene	Granite
Coarse	Medium to dark	Little or no Quartz	Plagioclase and dark mineral	Diorite
Coarse	light	Wide range of color and grain size but no Quartz	Feldspar with Pyroxene, amphibole and mica	Syenite
Coarse	Medium to dark	Quartz may have Olivine	Calcium Plagioclase and dark minerals	Gabbro
Fine	Medium	Between felsites and basalt	Medium Silica Lava	Andesite
Fine	Light	Contain Quartz	High Silica Lava	Felsites

Recognition of Metamorphic Rocks					
Grain Size	**Hardness**	**Foliation**	**Usual Color**	**Other**	**Rock Type**
Coarse	Hard	Foliated	Mixed dark and light	wrinkled foliation; often has large crystal	Schist
Coarse	Hard	Foliated	Mixed	Banded	Gneiss
Fine	Soft	Foliated	Dark	"tink" when struck	Slate
Coarse	Soft	Nonfoliated	light	Calcite or dolomite by the acid test	Marble
Coarse	Hard	Nonfoliated	light	Quartz (no fizzing with acid)	Ouartzite
Fine	Soft	Foliated	Dark	Shiny, Crinkly foliation	Phyllite
Coarse	Hard	Foliated	Dark	Mostly hornblende	Amphibolite
Coarse	Hard	Foliated	Mixed	Distored "metled" layer	Migmatite

Specimen Figure

Properties

EXPERIMENT NO. 5

Aim: To measure dip, dip direction and strike of given formations with the help of Clinometer Compass and Brunton compass.

Equipment Required

Clinometer compass, Brunton compass, formations.

Theory

The true dip of a plane is the angle that it makes with a horizontal plane the angle being measured in a direction perpendicular to the strike of the plane. Apparent dip is the angle measured in any other direction.

Dip Slope: A topographic surface which dips in the same direction as the underlying beds and is often more or less parallel to them

Strike: The direction in which a horizontal line can be drawn on a plane. In geological usage, the strike is important in determine the direction in which to measure the true dip. The term is also used in the sense of the general trend or run of the beds; eg. One might say that the strike of the beds in a particular region is east – west, ignoring the fact that there are minor variations in the strike.

Strike line: A strike line (stratum contour and structure contour are synonyms) is a line joining points of equal height above or below a datum, on a planar structure. For a flat, evenly dipping plane, the strike line will be straight, parallel and evenly spaced. They are much used as a means of illustrating structural features without the complicating effect of topography.

Brunton compass

Theory

North of magnetic needle in brunton is towards south of earth's magnetic pole. Any magnetic is needle aligns itself along N - S of earth. i.e. North of magnet is toward South and South of magnet is toward North, that's why the east and west are opposite in Brunton Compass.

Observation Table					
S.No.	**Formation**	**Strike**	**Dip Angle**	**Dip Direction**	**Final Reading**

Observation Table					
S.No.	**Formation**	**Strike**	**Dip Angle**	**Dip Direction**	**Final Reading**

EXPERIMENT NO. 6

Aim: To study of models of geological structures and out crops patterns of different types of rocks and land forms.

Theory:

The dip and strike of beds can be easily measured in the field from their exposure called outcrops. Outcrops, infact, are those sections on the Earth's crust, where the solid rocks are exposed at the ground surface, without being covered by any unconsolidated alluvium or soil layer.

A landform is a natural feature of the Earth's surface. Landforms together make up a given terrain, and their arrangement on the landscape or the study of same is known as topography. Typical landforms include hills, mountains, plateaus, canyons, valleys, as well as shoreline features such as bays, peninsulas, and seas, including submerged features such as mid-ocean ridges, volcanoes, and the great ocean basins.

Description of Models