

ARYAN SCHOOL OF ENGINEERING & TECHNOLOGY

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LECTURE NOTE

SUBJECT NAME-MINE GEOLOGY -I

BRANCH-MINING ENGG.

SEMESTER-3RD SEM

ACADEMIC SESSION-2022-23

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(Geology)

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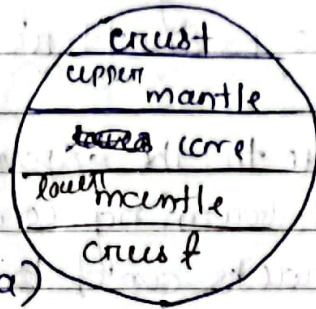
Geology is the branch of science which includes in deals with the study of earth.

The layers of earth is divided into three types

(i) Crust

(ii) Mantle (largest area)

(iii) core



Mineral :-

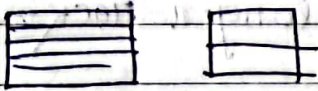
It is homogeneous solid material which are definite chemical composition and fixed crystal str.

Hema - Fe_2O_3

Magne - Fe_3O_4

colour

streak :- The colour is rendered from

cleavage :-  → less cleavage
→ largest cleavage.

lustre :-

Flours - Fauna

Weathering :-

It is the break down of largest rock to smaller rock. It is known as weathering.

Exogenic Agent (dışarıya)

Endogenic Agent

→ It is under dividing into three types.

- (i) Physical weathering
- (ii) chemical weathering
- (iii) organic weathering

Frost shattering :-

The break down of rock due to the expansion of water which enters de-forming core on rock, which induce cracks and breaks of the original rock. it is known as Frost shattering.

Chemical composition :-

The breaks larger rock into smaller rock due to the action of chemical agents. e.g. - Carbonation, oxidation & reduction, hydration etc.

Organic weathering :-

When the roots of trees passes through the body of rock which exerts de-forming forces on rock, which is breaks the body of rock into larger rock.

Erosion :-

- (i) River
- (ii) Rain water
- (iii) wind

moraine :-

Accumulation snow & melting snow

moraine are three types

- Lateral moraine
- medial moraine
- Terminal moraine (max value high)

Weathering :-

The rocks break up down under the influence of atmospheric agents, like wind, sun, water and organisms. and this phenomenon is called weathering.

EROSION :-

(vii) Erosion is a process which includes the destruction of existing rock and the removal of the product from the site of destruction.

(viii) Transportation is the important aspect of erosion. It is usually by river, wind, water, ice etc.

(v.i) Weathering divided into three types :-(1) Physical weathering :-

The physical weathering involves application of mechanical process. In physical weathering a rock is broken into smaller pieces without any chemical change.

(Imp)Frost-shattering :-

When water freezes, which expands about 9% of its volume. In nature water enters into the cracks of rocks. on freezing it expands and exerts great pressure on the rocks. as a result the rock breaks into pieces. this process is called frost-shattering.

Climatic action :-

Daily's cycle of chemical temp. change or season change, weaken rocks particularly in those regions, heating a rock causes to expand and cooling causes contraction. The repeated expansion contraction end to develop cracks and fissures.

Chemical weathering :-

Chemical weathering is a process in which rocks are broken by chemical decay minerals, during a chemical weathering a set of chemical reaction acts on rock which changes minerals to more stable forms. The principle agents of chemical weathering are water and organisms. Reaction in Envolps In Chemical weathering are oxidation, Reduction, carbonation, hydration.

* Organic weathering :-

Many organic acid produce a decay this acids increases, the solvent power of water, for example, the solubility of silica, alumina, iron, is much greater in the presence of organic acids.

Erosion By Wind :-

What is wind :-

(Air's motion is called wind)

The wind is an important agent of erosion, transportation and deposition.

Wind does erosion in three ways.

- (i) Deflation
- (ii) Abrasion
- (iii) Attrition

(i) Deflation :-

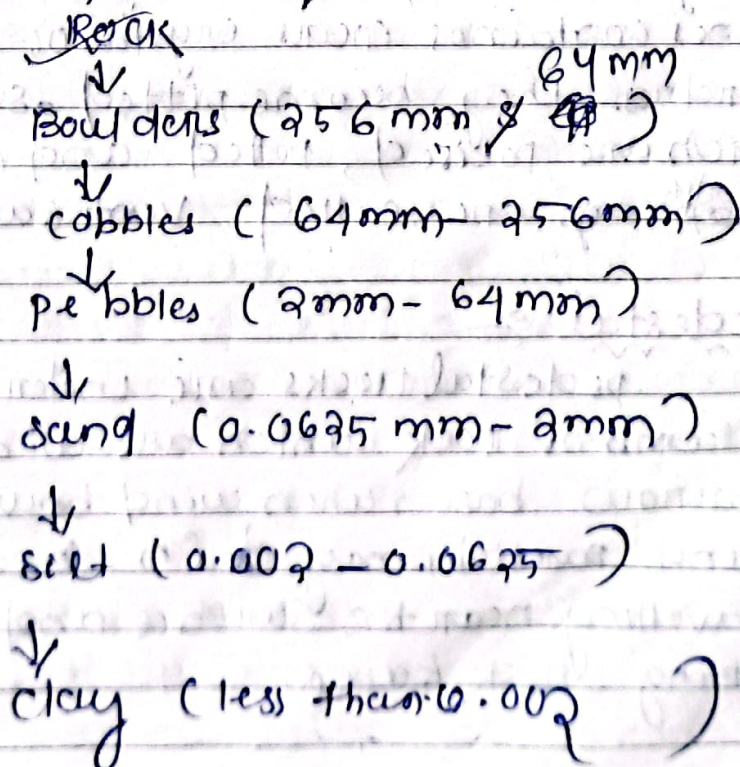
lifting and removal of loose material is called deflation.

Arid
 Semi Arid

by this process the land surface will gradually lowered in many deserted area deflation produces below medullae on beams in which their

Abrasion :-

During the dust storm the wind carries minute grains of sands in suspension and ~~sand~~ rolled against the exposed rock masses and caused erosion.



This process in which sand's grains are used as tools for pooding rock.

Attrition :-

The particles travel with wind called agents one another, this mutual collision lead to there further break down and the process is called Attrition.

(Imp)

Erosional creatures :-

The important creatures of wind erosion are polishing of rock face, and formation of ventifacts, rock and pedestal rock.

Ventifacts :-

wind mixed with sand abrades rocks near the ground surface this is called sand blasting. where pebbles and boulders are subjected to sand blasting large side and sharp edges, if the stones contains coarse crystal or on equal hardness they become pitted, such stones which are polished, pitted and contains sharp edges are called ventifacts.

pedestal :-

pedestal rocks are undercut vertical column of rock which are wider top and narrow base, when wind blows the sand particles may be in heavy travelling near the surface and undercutting rock bases.

deposition of wind :-

wind deposition are commonly called aeolian deposit. The rock particles in the aeolian deposits are generally well rounded and sorted according to their size and weight.

wind deposits are two types -

- (i) accumulation of sand called sand dunes.
- (ii) deposited or accumulation of silt occurs is called when a particular village is called loess.

(Long question)

Sand dune

The wind generally deposits sand in mounds are called sand dunes. The sand travelling as a load in wind accumulates. It meets in any obstruction such as mountain or a bush. (eg)

Sand dunes are four types -

(i) Transverse dune :-

Transverse dunes are they are longer dunes at right angles to the direction of wind they are called in areas with strong wind where small sands are available.

(ii) Barchan :-

Crescent

Barchans are ~~convex~~ crescent shaped dunes the convex side ~~for~~ faces the wind direction, the horns and wings on convex point in the direction of the wind flow.

Barchan are formed where wind is mainly unidirectional. They occur in areas of greatest sand supply. The high large dunes

don't exceeded 30m to point to point length
is generally 300m.

(iii) longitudinal dune :-

longitudinal dune which are elongate in the wind direction are called longitudinal dune. These dune is usually developed at strong wind in areas where small amount of sand is available. The longitudinal dune may reach height of 100m.

* Erosion action by rivers :-

(vii) Wind loess :-

The suspended load of rivers formed by wind consist mainly of silt and dust particles, when it settles it forms a blanket deposit of silt known as loess.

The deposits are grey or yellow in colour loess is a deposit of mainly many mineral including quartz, feldspar and calcite.

* erosion acting by river :-

River caused erosion by way's.

(i) chemical action

(1) Hydraulic action

(ii) Abrasion action

(iii) Attrition action.

* (Plunge) :- (vector quantity)

It is angle form betⁿ horizontal plane

(i) Chemical action :-

It includes the solvents and chemical action of water on country rock & the chemical decay.

(ii) Hydraulic action :-

The swiftly flowing water hammers the uneven surface of rocks being process of erosion is called hydraulic action.

(iii) Abrasion action :-

The flowing boulders uses of rocks fragments such as pebble and sand as for scrubbing and grinding the size of the flow valley, give a this process of erosion is known as abrasion action.

(iv) Attraction action :-

It is the breaking transported materials them sets, their colliding. A glacier is a thick mass of ice with move over the ground under the action of gravity.

Glacier erosion :-

Glacier caused erosion in 3 way,

- (i) plucking erosion
- (ii) Abrasion erosion
- (iii) Frost-wedging erosion.

(i) plucking erosion :-

The glacier while flowing over a jointed rock surface ^{pull} them out and carry them out.

(ii) Abrasion erosion :-

The moving ice grinder and polish the rock surface with the help of rock fragments which are help to move within the body glacier. Apoglyze surface form when the glacier performed abrasion by find silt side sediments.

(iii) frost-wedging erosion :-

Freezing of factors in cracks and jointed of rock break them by wedge wedge action.

(Structural Geology)Horizontal

Inclined bed

Dip :- when horizontal bed is deformed from its original state and inclined against the horizontal bed than it said to be dip.

Strike :-

It is a line formed by the intersection of inclined bed and horizontal bed. strike is a scalar quantity - It has only directions no magnitude.

Angle of Dip :-

Angle of subtends by the inclined bed with the horizontal bed is known as angle of dip. angle of dip varies from 0° to

* Rock is property of ductility

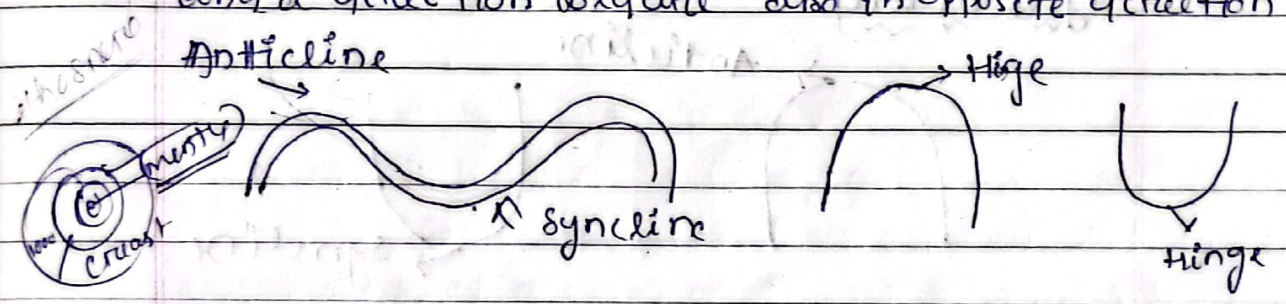
90° when angle is zero it is said to be horizontal bed when the angle is 90° it is said to be vertical.

Fold morphology :-

(IMP)

Fold :-

Fold are like ~~wave~~ ^{wave} undulating formed when compressive force act at the opposite end and a direction would be also in opposite direction.



Crest :-

The highest point of an anticline is called crest.

Trough :-

The lowest of a syncline is called trough.

Hinge :- The point of maximum curvature in anticline and syncline.

Inflection point :- (through)

The point of the zero curvature it is known as inflection point.

Hinge line :-

Hinge line the line which joins in the hinge point of the fold is known as hinge line.

Inflection line :-

It is line which joins all the inflection point in a fold known as inflection line.

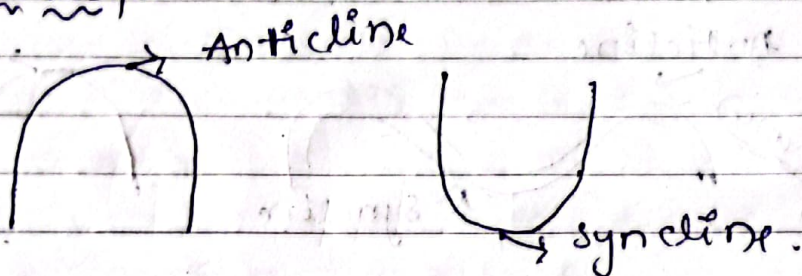
Fold axis / axial line :-

It is a line which is formed by the intersection of axial line and fold.

limb :-

It is the portion of fold extend from hinge line to inflection line.

Types of fold :-

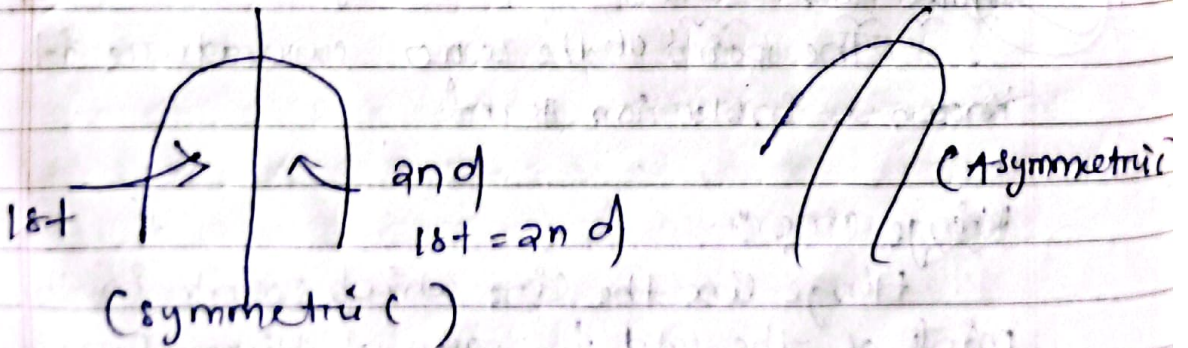


(1) on the basis of curving direction it is divided into two types.

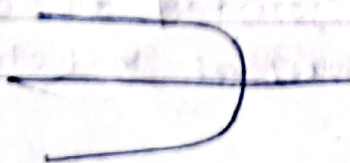
(2) on the basis of symmetric of fold is divided into two types.

(i) Symmetric

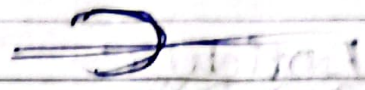
(ii) Asymmetric



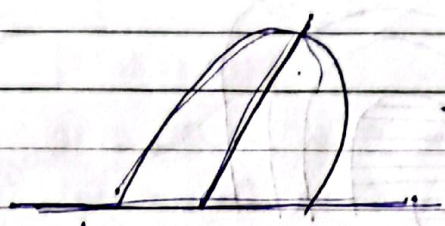
(3) on the basis of axial line



(i) Recumbent fold :-
 when the axial plane of a fold lies parallel to the horizontal plane this type of fold is called Recumbent fold.



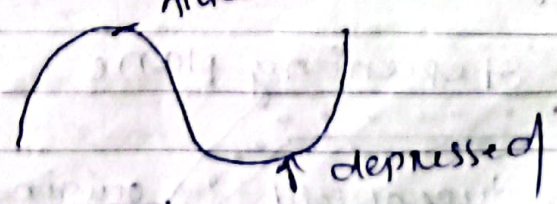
(ii) Inclined fold :-
 when the axial plane of any fold makes some angle with respect to the horizontal plane it is known as inclined fold.



Limb angle :-
 The angle makes by two limb of a fold at its joint is known as limb angle.
 → limb angle should be greater than 20° less than 180° .

- (iii) On the basis of inter limb angle :-
- (i) isocliner fold
 - (ii) tight fold
 - (iii) flows fold
 - (iv) open fold
 - (v) gentle fold

Trough plate :-



The trough is a line occupied by the lowest part of the fold. The plane containing such the line are called trough plane.

Anticline:-

It is generally convex upward and concave downward where the limbs commonly slope away from the axial line.

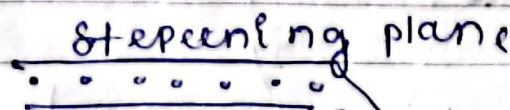


Syncline:-

It is a fold which is concave upward and commonly dips towards the axial line plane. Successive younger beds are found towards the centre curvature of the fold.

* Monocline / Anticlinal bend:-

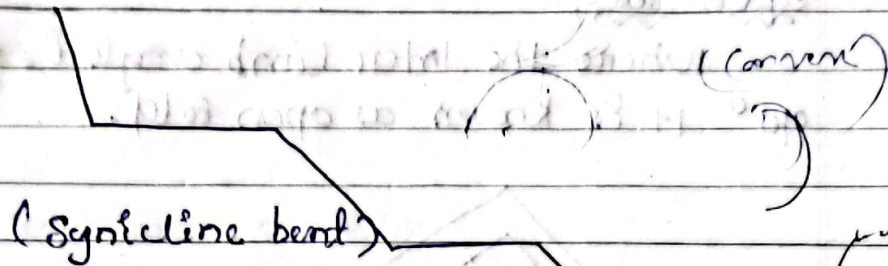
It is formed due to local steepening of a bed where there occurred the sudden increase in the top of a ~~bed~~^{bed}, which is originally horizontal to near a vertical position, but the original bedding remains are below.



It is a type of fold where one limb dips sharply on the other but another limb dips gently with the horizontal. It is due to the steepening of fold in wider of interlimb angle betⁿ two limb.

Syncline bent :-

In case of syncline bent one limb remains at its position and other limb dip towards trap plane this type is known as syncline bent.

(v.i) Geosyncline or synclineorium :-

It is a large syncline with a secondary fold of a smaller size development on it.

(v.ii) Geo Anticline or Anticlyone :-

It is a large anticline with secondary folds of a smaller size development on it.

Thickness of limb :-parallel or concentric :-

- Thickness of the layers are same.
- Radius gradually increase in a particular constant.
- Syncline becomes sharper with depth, but broader and mark open upward. where as anticline is broader with depth and sharper upward.

Small fold :-

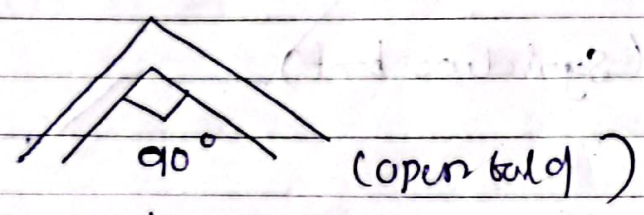
In this case the shape of folds may vary along the axial plane and Right angle to the fold axis. This case of crest and the thick where limbs are thick.

isoprotaxial fold :-

In this case the crest are thick where the trough are inter limb angle.

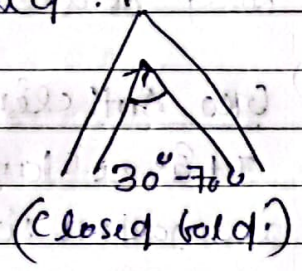
open fold :-

where the inter limb angle is greater than 90° it is known as open fold.



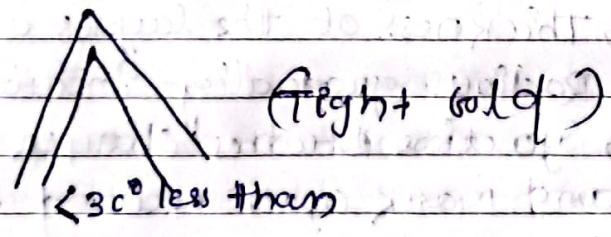
closed fold :-

where the inter limb angle is betⁿ 30° to 70° it is known as closed fold.



Tight fold :-

The inter limb angle is less than 30° it is called tight fold.



Attitude of fold :-

plunging fold :-

In this case the axis of fold is not horizontal.

Double plunging fold :-

when the fold is reversible its direction of plug with in the limit.

Dome

Dome :-

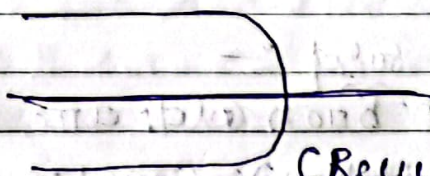
It is a anticline ^{fold} str. which plunging in the direction thus forms a [^]ampherical structure.

Basin :-

It is a synclinal depression with [^]deeps in all the direction.

Recumbent fold or nappe :-

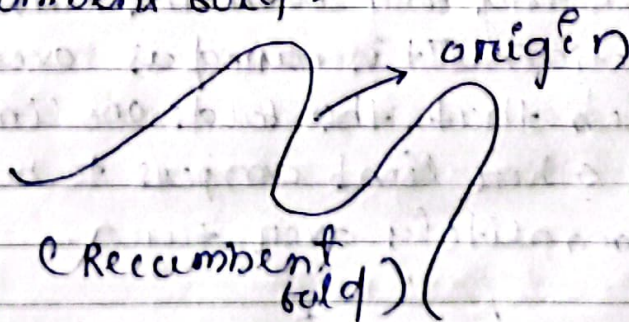
when the fold is so much over turned that its axial plane is horizontal or nearly horizontal it is known as Recumbent fold or Nappe.



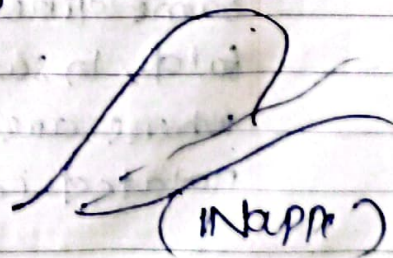
(Recumbent fold or Nappe)

Nappe :-

A Nappe is large sheet of a body of rock that is moved [^]from from the original position. Nappe is formed during continental plate collision. when folds are sheared so much that they fold back over themselves and break apart the resulting str. is a large scale recumbent fold.



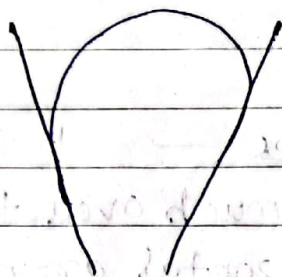
(Recumbent fold)



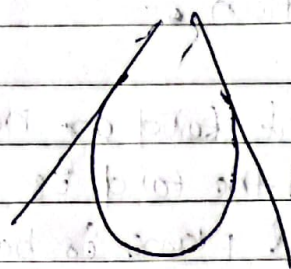
(Nappe)

Fan fold :-

It is in any fold both the limbs over turned. In the anticlinal fold two limbs dip toward each other. In synclinal fan fold two limbs dip away from each other.



(Anticlinal Fan fold)

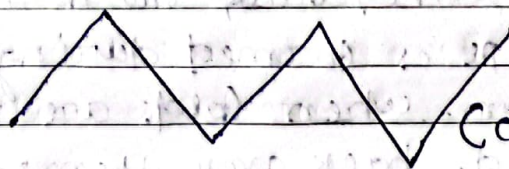


(Synclinal fan fold)

(Imp)

Chevron fold :-

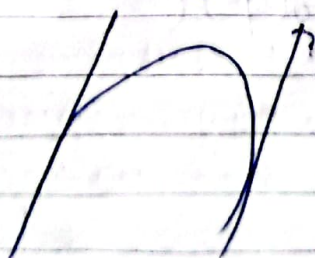
Chevron folds are sharp angular crest and sharp angular trough. It has sharp hinges and straight limbs. It is known as chevron fold.



(Chevron fold)

Over turned fold :-

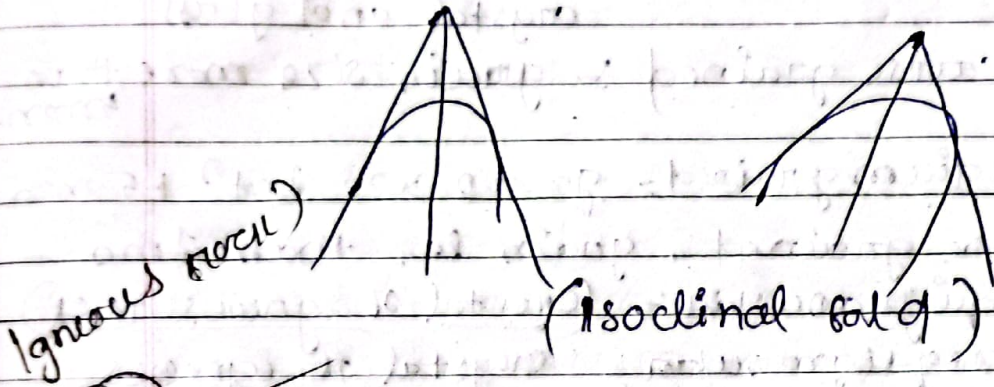
It is in any fold both the limbs are in same direction. It is called as over turned fold, in such that the folds one limb occurs where another limb appears to have been rotated completely over turn.



(Over-turned fold)

Isoclinal fold :-

It is a any fold to the amount of over turning be such that both the limbs are same amount of deep in the same direction the str. is known as isoclinal fold.



Classification of Igneous Rock on Basic occurrence

(i) Extrusive rock :-

Rock formed due to solidification of lava on surface called extrusive rock. volcanic igneous rock. Above the surface.

(ii) Intrusive rock :-

Intrusive rock forms when magma crystallized beneath surface depending on depth of formation intrusive rocks are divided in two groups -

(a) Hypabyssal igneous rock :- below earth surface upto depth of 12 km.

(b) Plutonic igneous rock :- these rocks are formed at greater depth from magma.

Texture of Igneous rock :-

The term texture is defined as the mutual relationship of different mineralogical constituents in rock. It is determined by the size, shape, and arrangement of these constituents within body of rock.

(Magma :- liquid rock in molten state)

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- To study of texture of igneous rock following terms are important to understand textures.
- (Imp)
- (i) Holo crystalline :- Rock made of crystals only
 - (ii) Holo hyaline :- Rock made of glass only
 - (iii) Crypto crystalline :- The rocks made of both crystal and glass.
 - (iv) coarse grained :- grain size more than 5mm.
 - (v) medium grained :- grain size betⁿ 1.5 mm
 - (vi) Fine grained :- grain less than 1mm
 - (vii) Equigranular :- (Crystal of igneous rock)
 - (viii) Inequigranular :- crystal of igneous rock are not equal.
 - (ix) Phaneritic :- Mineral present in rock identify by naked eyes.
 - (x) Aphanitic :- size of mineral present in rock are very fine.

Texture of igneous rock depend upon mutual relationship betⁿ glassy matter and crystalline matter.

Some Important Textures of Igneous rock :-

(a) Granitic texture :-

It is holo crystalline, equigranular and medium grained, present in plutonic acid igneous rock.

(b) Porphyritic texture :-

When smaller crystal or glass or both enclose large crystals. The large crystal called phenocrystals and small crystal are ground.

Fold type of rocks → ① sedimentary
 ② igneous
 ③ metamorphic

(c) Porphyritic Texture :-
 when smaller crystal enclosed with bigger crystal without common orientation.

(d) Ophitic texture :-
 Special type of porphyritic texture in which bigger crystal or augite enclosed smaller laths or plagioclase - eg Hypabyssal rock.

(e) Directive texture :-
 Texture produce as a result of flow of lavas during their consolidation, are called Directive texture.
 (i) Trachytic texture
 (ii) Hyalopilitic texture

(f) Inter growth texture :-
 The inter growth quartz and orthoclase may take place when they crystallize simultaneously these type of texture observation hypabyssal and plutonic acid rock.
 (g) Equigranular texture
 (h) Inequigranular texture.

Imp

Structure of Igneous Rock :-
 The physical appearance of igneous rock, usually influenced by process of formation result in typical structural characteristics. These structure are use in field identification of rock.

(Plutonic (ଆଗନ୍ତବ୍ୟ ଚକ୍ରର ଶରୀରରେ) ଥିବା ବୃହତ୍ ବୃତ୍ତି ଚଳନ ସମ୍ପର୍କରେ କହୁଥିବା ପ୍ରକାରର ଶୁଦ୍ଧ ଉଦାହରଣ ।)

(i) Flow Banding :-

New lava from magma chamber reaches surface and overlies the previous flow before years at layer of cool lava from rock layer this resulting str. resembles flow bands.

(ii) Vesicularity :-

When lava reaches surface the atmospheric pressure acting on lava suddenly immediate. As a result cavities are formed and the gases escape through these cavities leaving behind empty cavities called vesicles.

(iii) Amygdalae :-

When the interconnect gas cavities in vesicular basalts are filled with secondary minerals like quartz, zeolites, calcite, etc. The resulting str. is called por amygdalae. The basalt in which amygdalae are present is called as amygdalae basalt.

(End)

Mineralogy and Petrology

Mineralogy : Introduction :-

- Mineralogy is the branch of geology deals with the scientific study of minerals.
- Mineral formed below surface endogenic origin.
 - Minerals formed at the surface - exogenic origin.
 - Mineral having same chemical compositions but different atomic arrangement is responsible for variable properties of crystal such minerals called polymorph.
 - Physical properties are when vary with chemical composition then minerals called isomorph.
 - Identification of mineral in field achieve by studying its physical properties.

Physical properties of Minerals :-

- Physical properties of Minerals can be determined readily by simple test because the physical properties are determined in hand specimens they are important in the recognition of mineral in field.

(i) Colour :-

Colour is a light dependent property it's appearance of particular object in light. Some mineral possess characteristic fairly constant colour.

(a) Lead - grey

(b) Galena - Brass - yellow

Presence of small amount of impurities can give variety of colour to white to colourless.

(a) Moon stone - Brick red

(b) Quartz - pink, Rosy, milk.

(i) Streak :-

The colour of mineral powder is called streak. It is consistent. Reliable than the body colour of the mineral. Transparent mineral show coloured streak.

(ii) Lustre :- It is defined as shine or minerals or general appearance of mineral surface in reflected light.

various type - metallic lustre, sub metallic lustre, Adamantine lustre, vitreous lustre, pearly lustre.

(iv) Hardness :- Resistance of mineral to abrasion or ~~scratch~~ scratching.

(v) Cleavage :- If a mineral breaks along flat surface. It is said to possess a cleavage and it breaks with an irregular surface is said to show fracture.

(vi) Fracture :-

mineral which do not exhibit cleavage breaks with irregular surface. The not created this broken surface is called fracture.

Types conchoidal fracture, uneven fracture, Hackly fracture.

(vii) Form / Habit :-

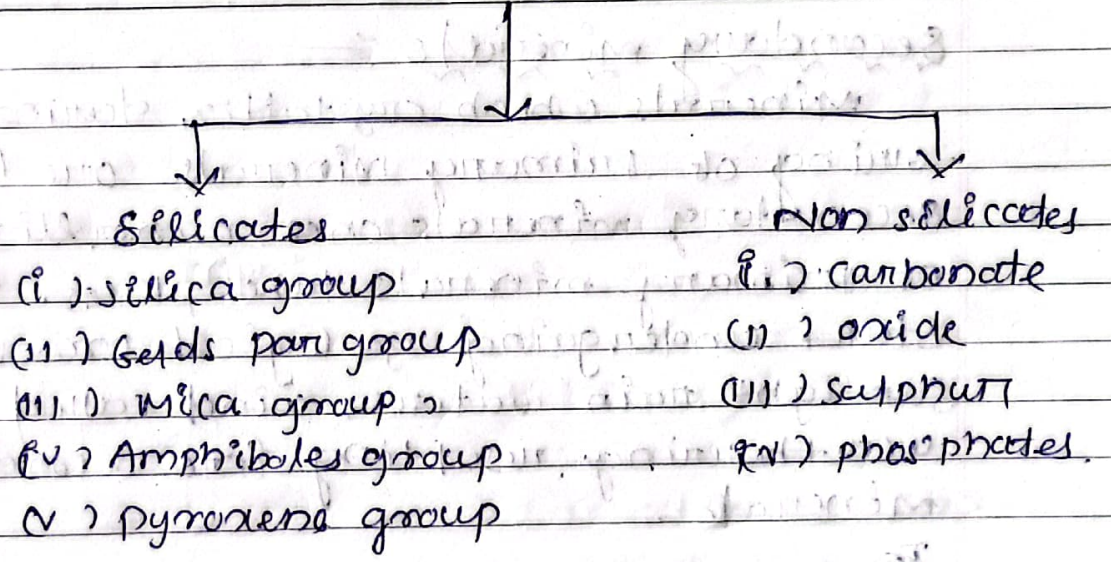
Mineral often occur in characteristic body form or physical shape i.e. tabular, Bladed, Radiating, crystalline, amorphous.

(11/11)

Rock forming Minerals :-

Rock forming minerals, one mineral that occur widely in a abundance in all type of rocks of earths crust. Rock forming Minerals contain silica called silicates Minerals not containing silica called non silicates. Rock forming minerals, Quartz, Feldspar, mica, pyroxene, olivine, epidote, talc.

Rock forming Minerals



ore forming minerals :-

Some minerals have limited mode occurrence different minerals containing particular metal occur together in deposit are referred as ore forming minerals.

ore forming mineral are mineral which contain a metallic element in a quantity than can be extracted for use economically

- hematite
 - magnetite
 - bauxite
- } one of iron
one of aluminium

Primary Minerals :-

As the time of volcanism when magma erupts and flows & starts cooling as soon as it comes in contact with atmosphere, which crystallized forms magma are called primary minerals.

Important primary Minerals :-

Quartz, orthoclase, plagioclase, Muscovite, Biotite, Hornblende, Augite, Olivine

Secondary Minerals :-

Minerals which crystallize during weathering of primary minerals are called secondary minerals once mineralisation of primary minerals takes place. These start undergoing geological process due to sunlight rain waters, wind called weathering resulting into secondary minerals.

For

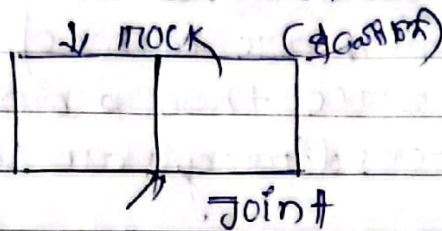
Important Secondary Minerals :-

- (i) Clay minerals e.g. montmorillonite, kaolinite.
- (ii) Non silicates e.g. oxide, carbonates, sulphate.

Joint :-

A joint is defined as a fracture in a rock betⁿ the side of which there is know obsen variable relative movement. There are present in most consolidated rocks of igneous, metamorphic (solid rock)

Sedimentary origin joint may form as a result of either contraction or Diastrophism



Diastrophism :-

Diastrophism is large scale deformation of earth crust by natural process which leads to the formation of continent and ocean basin.

Description of joint :-

- (i) A series of parallel joint is called joint sets. Two or more joint intersecting each other producing (joint system).
- (ii) Two set of joint at nearly or right angle to another produce by the same stress is known as conjugate system.
- (iii) A persistent joint may be horizontal or vertical are called master joint.

Classification of joint :-

Petrology :-

Petrology consist of a study by all available methods of natural history of rock including their origin present conditions alteration decay etc.

Main classes of rock :-

- (i) Igneous Rock
- (ii) Sedimentary Rock
- (iii) Metamorphic rock.

(111)

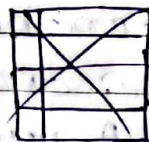
Classification of joint :-

(i) Tension joint :- Tension joint are those which are formed as a result of tensile force these joint are relatively open rocks of irregular surface.

(ii) Shear joint :-

Shear joint those which are formed due to application of ^{compressive force} shear stress these joints are clean cut and ^{tightly} closed. Shear joint occurring as sets and intersect at a high angle to form conjugate line.

(iii) Mural joint :- General shows 3 sets of joint mutually at ^{right} angle to each other which divide to rock mass into more or less cubical blocks.



(iv) Sheet joint :-

Sheet joints are often seen in exposures the ground. This joint is running in horizontal direction.

(v) Columnar joint :-

Columnar joint are formed in tabular igneous masses such as dykes, sills & lava flows. These joint divided the rock masses in to polygonal columns.

(vi) Master Joint :-

In sedimentary rocks the joint usually joint in two direction at nearly right angle one set of joint runs parallel to the dip direction other parallel to strike of these one set of joint commonly more strongly develop than the others and extend the for long distance.

Disconformity :-

An unconformity is the plane or disconformity separates two rocks strata which differ in formation it. The younger of this rocks are nearly always sedimentary origin and have been deposited on surface of older rock which is a surface of erosion.

Why this structure formed?

This type of str. formed is cause in deposition of sediments and erosion of upper surface take place.

The formation of an unconformity may be activated 3 main process.

(i) erosion

(ii) Deposition

(iii) Tectonic activity

(iv) Tech. Hotic activity

The stages of development involve -

(i) The formation older rock

(ii) upliftments and subaerial erosion of the older rock.

(iii) The formation of younger subsection of base above the surface of erosion.

Imp

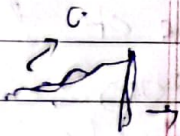
Types of unconformity :-

- (i) Angular unconformity
- (ii) Disconformity / parallel unconformity
- (iii) Local unconformity
- (iv) Non conformity / Hetero unconformity
- (v) Blended unconformity

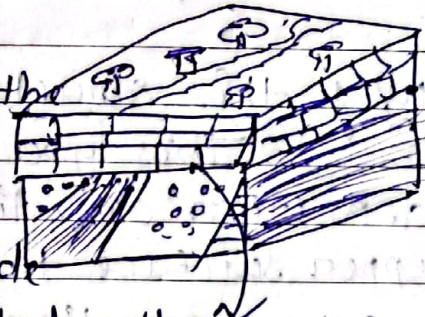
①

Angular unconformity :-

As the beds beneath of the eroded surface are rotated and tilted show that there is angular disconformity between among the older and younger beds occurs and the intersection line is called angular unconformity.



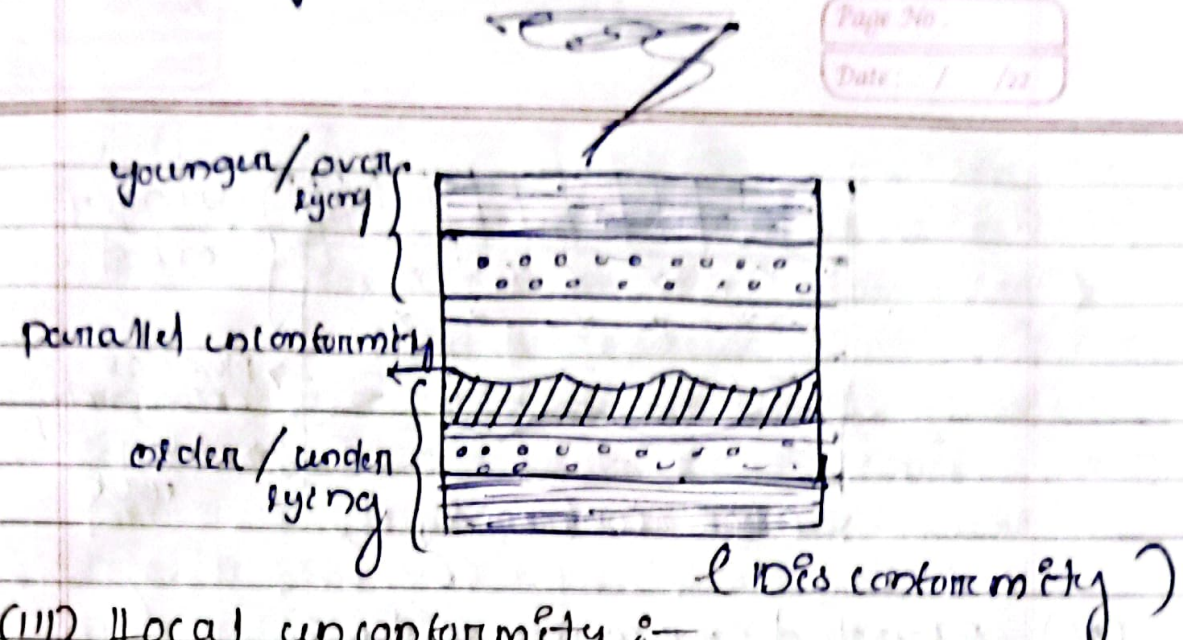
In this case both the younger and overlain are sedimentary origin and the attitude of rock above and below the unconformity differs from each other.



(ii) Disconformity / Parallel unconformity :-

It is also known as parallel unconformity in view of fact that the bedding above the below the plane unconformity dip at a same angle and same direction. This type of unconformity formed there is a lesser lesser magnitude disturbance of two section.

plutonic rock = granite



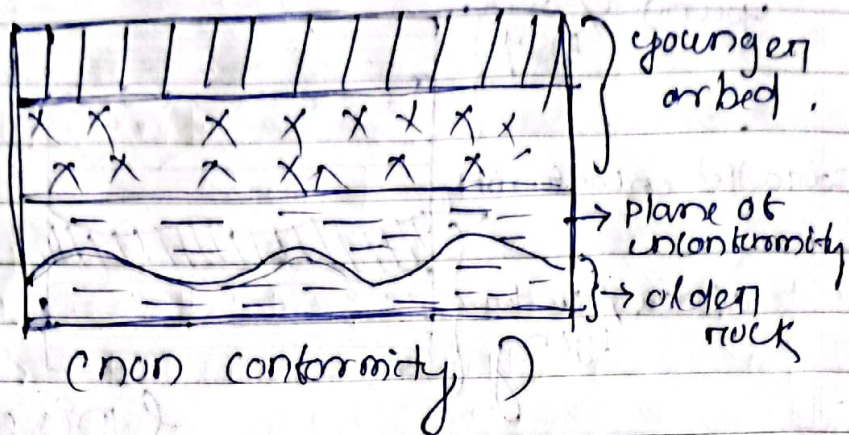
(iii) Local unconsolidation :-

It is also known as known depositional unconsolidation. It is similar to the disconformity but it is local in extent and the time of formation to upper and lower rock is very short. Hence it is represent short period of sediment deposition.

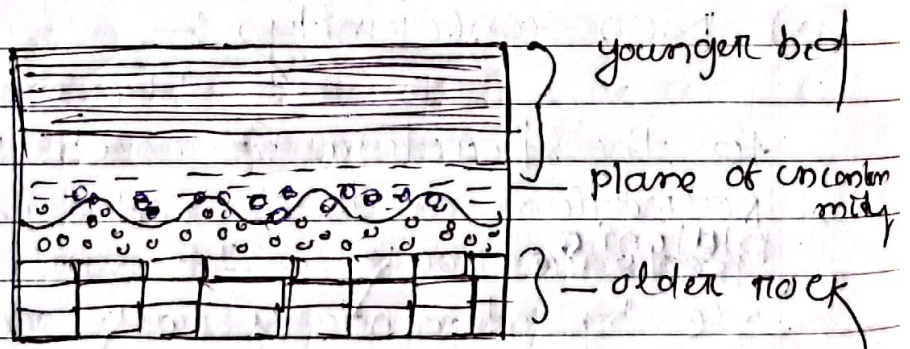
18.11.22 - Date

(iv) Non-consolidation :-

It commonly applied to the structure in which the older formation made of extensively of plutonic rock. It overlies unconsolidable by sedimentary rock or lava flow.



(v) Blended unconformity :- It is a surface of erosion which may be thick residual soil that grades in to under line rock. The younger sediment deposited above the surface may ~~also~~ included some of the residual soil and a sharp contact may be lacking ~~and~~ such a contact may be called blended unconformity.



Blend - mixture

⇒ An unconformity having no distinct surface of separation ~~at the~~ & erosional surface that was originally covered by thick residual soil with ~~blends~~ graded down ~~into~~ into under line rock

AMP

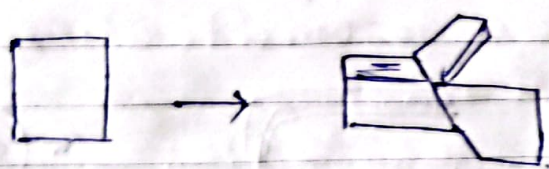
FAULT :- well defined
 * Faults are cracks along which the rock masses on either side have relative dispositive. The strike of faults are defined in terms of their strike and dip. The strike and dip of the faults are measured as true bearing.

Classification of fault :-
 There are mainly classified into two part -

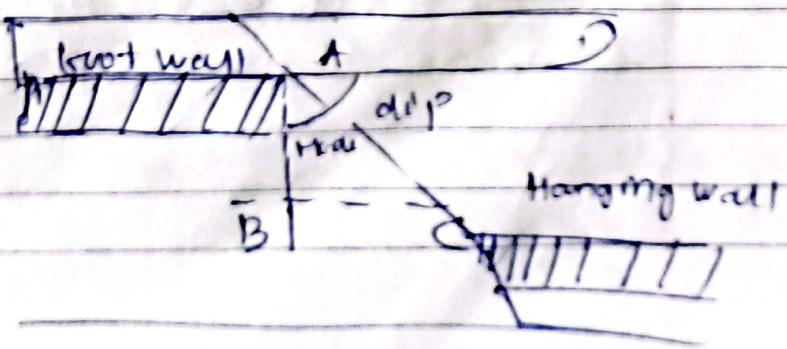
- ① Geometric classification
- ② Genetic classification

① Geometric classification :-
 classification is slightly ^{based} on the altitude of the fault. There are five faults based on geometric classification of fault.

Fault :-
 A fault is defined as a fracture (break) along which blocks of rocks have been displaced relative to each other.



Terms :-

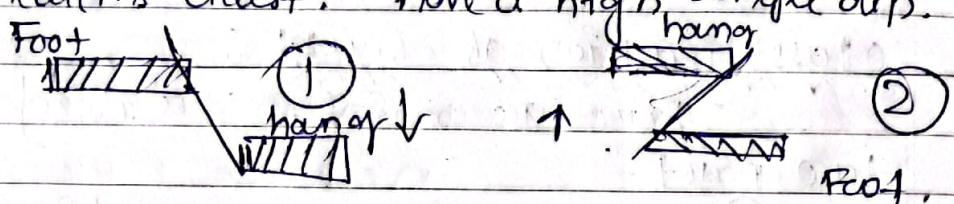


Types of Fault :-

① on the basis of apparent movement -

① Normal fault :-

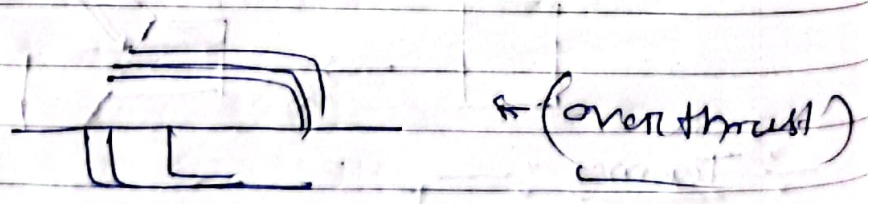
Normal fault is one in which hanging wall moves down ward relative to foot wall. Fault plane dips towards down through side (Gravity fault) produced by tensional forces and indicate lengthening of earths crust. have a high angle dip.



② Reversed fault :-

is one which hanging wall appears to have moved upwards relative to foot wall. Fault plane dips towards upthrown side, produced by compressional forces, high angle of fault (dips $\geq 45^\circ$)

- Intense compression results in low angle reverse faults called "thrusts".
- Horizontal low angle thrust fault with large displacement : i.e. "over thrust".
- Sheet of rock moved backward along thrust plane is Nappe.



(IMP)

Texture of Sedimentary Rocks :-

The word texture refers to the size, shape, packing & fabric of components of the rock.

⇒ Sedimentary rocks are broadly classified of
 (1) Exogenetic or clastic texture
 (2) Endogenetic or crystalline rock.

(1) Exogenetic or clastic texture :-

It includes elements like
 (a) size, (b) shape, (c) sphericity
 (d) packing (e) fabric

(a) Size :- The grain size is depend upon the-
 (i) mode of weathering
 (ii) Nature of the source rock
 (iii) kind & distance of transport & Nature of deposition.

⇒ Broadly, the size & character of the sediment are described by the coarse, medium & fine the size particles. In the went scale are indicated as follow:

<u>Size</u>	<u>Name</u>	<u>Equivalent rock</u>
(i) > 256 mm in diameter	Boulder	Boulder Cobble pebble } Reddish -aceous rock
(ii) 64 mm - 256 mm	cobble	
(iii) 4mm - 64mm	pebble	
(iv) 2mm - 4mm	granule	arenaceous } sandstone -aceous rock
(v) 2mm - 1/16 mm	sand	
(vi) 1/16 mm - 1/956 mm	silt	siltstone } Argillaceous -aceous rocks.
(vii) 1/956 mm to unless	clay	

② Shape :-

It is defined as the shape and edges of a clastic fragment. According to the shape may be angular, sub-angular, rounded, sub-rounded, well rounded etc.

③ Specificity :-

It is defined as the extent to which particle approaches upflow. It depends on

(i) Distance of transport

(ii) mode of transport

(iii) Provenance

④ Packing :-

It is the manner of arrangement held together in place in the of sedimentary grains, which are held together in place in the earth's gravitational field.

⑤ Non-clastic texture :-

It is the arrangement of a result of deposition through chemical reaction. They are transported chemically by getting dissolved by transported media but reappear due to precipitation or evaporation.

⇒ It is also two types -

* Crystalline texture

* non-crystalline texture.

(6) Fabric :-

It is the arrangement of the clastic particles in sediment.

Rocks → (change)

(13th) Texture of (Meta)morphic Rocks :-

The metamorphic str. are determined by definite mechanical conditions and also by recrystallisation.

Metamorphic str are of following types -

✓ (1) Cataclastic texture

(2) Maculose str

(3) Schistose str

✓ (4) Granulose str

✓ (5) Gneissic str

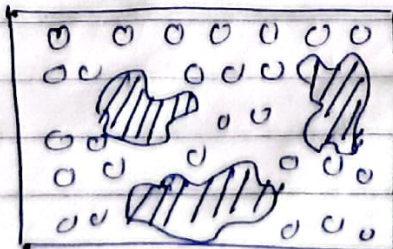
→ Metamorphic rocks derived from sedimentary rocks known as metamorphic rocks.

(1) Cataclastic Texture :-

→ It is produced under stress and in absence of high temp. where by rocks are subjected to shearing and fragmentation.

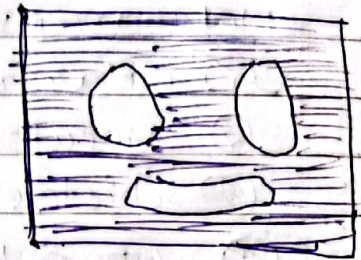
→ Only the durable minerals partly survive the crushing force & less durable ones are powder.

→ Thus, when resistance mineral and rock fragments stand out in a pseudo porphyritic manner in the linear materials. It is known as the Porphyroblastic str.



(ii) Micaceous stn.

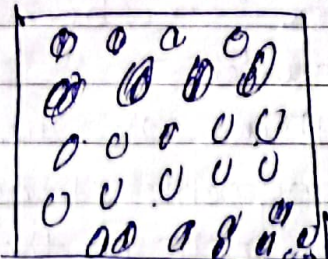
It is produced by thermal metamorphism of argillaceous sediments on rocks like shales. Here larger crystals of any calcic mica, biotite are sometimes well developed giving a spotted appearance to the rocks. The well developed crystals are known as "Porphyroblasts".



(iii) Schistose stn.

Here platy or flaky mineral like mica and other inequidimensional minerals shown as preferred orientation along a parallel plane. Under the effect of the stress dominating during metamorphism. The longer direction are parallel to the direction of maximum stress.

Schistosity is property of a foliated rock where by it can be readily split along foliation plane



(Crystallography)

Page No

Date: / / 22

Crystal :- A crystal is defined as a solid body bounded by plane natural surface, which give the external expression of a regular arrangement, of its constituent patterns.

Crystal structure :-

This is the orderly arrangement of atoms or group of atoms. Their constituents a crystal.

Lattice :-

This is an imaginary three dimensional ~~amorphous~~ ^{frame work} that can be referred to a network of regularly spaced points, each of which represent the position of motive.

Unit cell :-

This is a pattern that yields the entire pattern, when translated repeatedly without rotation in space.

Motive :-

This is the smallest representative unit of a structure. It is an atom or group of atom when repetition by translation give rise to an infinite number of identical regularly organised unit.

Crystal structure :- (lattice and unit cell)
A crystal is a three dimensional repetition of some unit of atom and molecules

Crystal shape :-

The Angle between crystal boundary are determined only by internal crystal structure. The relative size of the crystal boundary depend on the rate of growth the crystal boundary.

→ Example of crystal shape are :-

- (i) cube
- (ii) ~~rhombic~~ ^{trigonal} rhombohedral
- (iii) trapezohedral
- (iv) Octahedral (regular)
- (v) pyramidal
- (vi) Tetragonal
- (vii) hexagonal
- (viii) Orthorhombic
- (ix) monoclinic

Classification of crystal :-

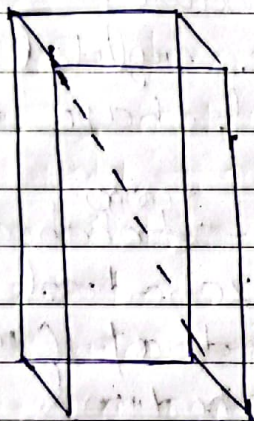
There are mainly 6 system of crystal

- (i) isometric system ($a = b = c$)
- (ii) Tetragonal system ($a = b \neq c$)
- (iii) Hexagonal system ($a = b \neq c$)
- (iv) orthorhombic system ($a \neq b \neq c$)
- (v) monoclinic system
- (vi) Triclinic system

Plane of Symmetry :-

It is an imaginary plane which divide crystal into two equal part in such a manner that one and half will be the mirror image of other this plane of symmetry may \rightarrow

\rightarrow These plane of symmetry may be diagonally, vertically and horizontally.



(Not a plane of symmetry)

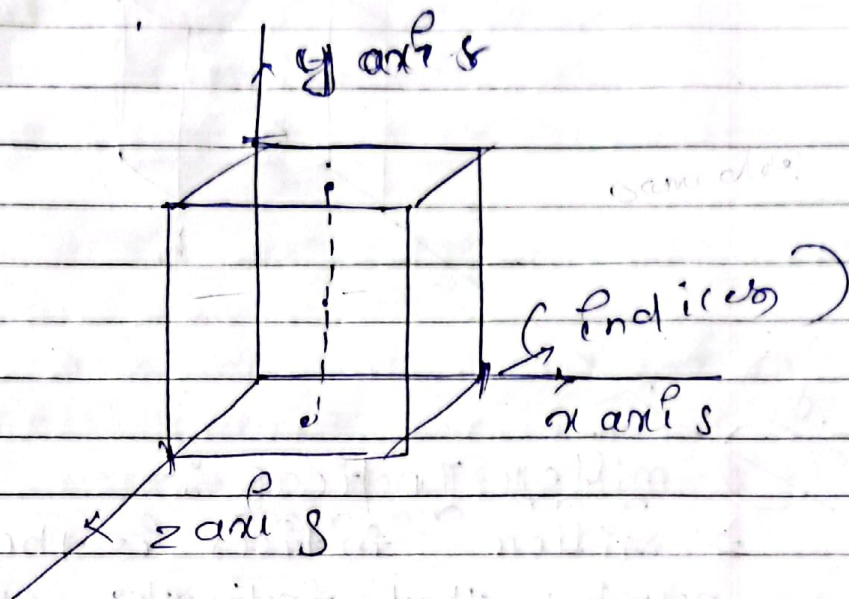
Centre of Symmetry :-

It is a plane within a crystal through which a straight line can be drawn so that on either at the same distance from the centre of similar faces, edges and solid angle are intersected, is known as centre of symmetry.

Parameters are Indices :-

parameter of a plane or face consist of series of numbers which express the relative intercept of that plane or face with the crystal graphic

with respect to standard face.

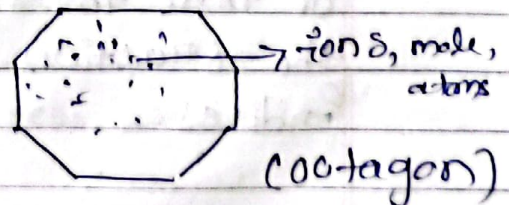


Indices :-

The reciprocal of parameters a, b, c called Indices. There are different type of Indices at the common type of Indices is known as Miller Indices.

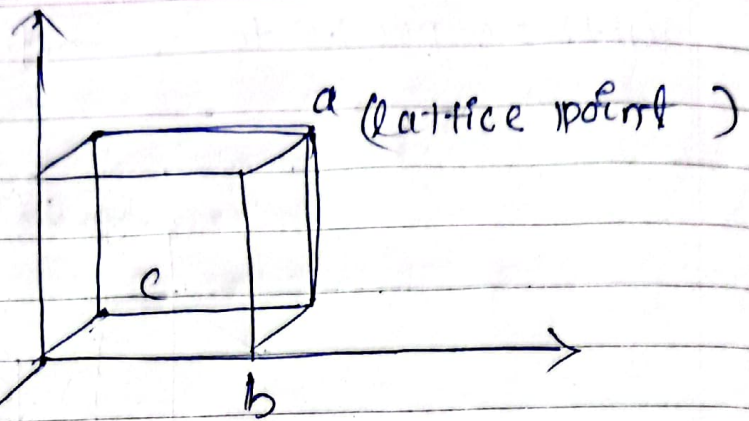
Crystal lattice :-

It is a three dimensional symmetric structure arrangement of atoms, molecules & ions in a crystalline solid.



Lattice point :-

Lattice point are the constituent of a crystal lattice i.e. atom, molecules, ions



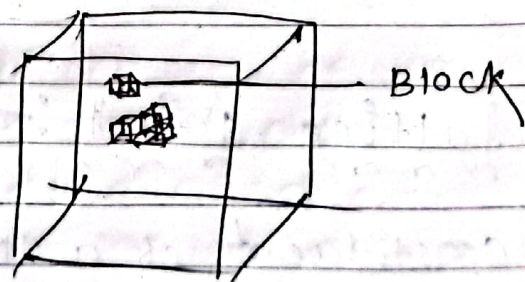
(L.O)

Miller Indices :-

⇒ Miller indices is the group of three number that indicates orientation of a plane or state of parallel planes of atoms in a crystal.

→ If each atom in the crystal is represented by a point and these points are connected by line which formed crystal lattice.

which may be further divided into a number of identical block, that block are known as unit cell. The intersecting edges of one unit cell defined a shape or crystallography axis. The reciprocal of these intersect are calculated and the fraction are taken as three Miller indices.



(Mineralogy)

Mineral

It is a branch of geology which deals with the study of all features of minerals. such as, physical properties, chemical composition, structure etc.

Mineral :-

Minerals are natural occurring inorganic substances which has definite chemical composition and fixed atomic structure.

Physical properties of Minerals :-

Physical properties of minerals is depends upon colour, streak, luster and hardness, degree of transparency, cleavage, form.

Form :- (shape - columnar)

Form is an important physical properties of mineral which represent the order of aggregation of atoms.

(i) columnar :-

It is more or less parallel imperfect prismatic crystal.
ex:- amphibole,

(ii) acicular :-

It is a needle like structure.

ex:- kyanite

h = length
b = breadth
l = height

(iii) Fibrous :- It is an aggregate of cotton like structure which may or may not separation.
Ex: - ~~as~~ Asbestos.

(iv) Botrioidal :- These are the aggregate of sphere (structure or like groups) (grapes)
Ex: - Silomian

(v) Foliated :- Mineral having thin and separatable sheets.
Ex: - biotite, muscovite

(vi) Tabular :- Minerals showing broad flat surface.
Ex: - orthoclase, Feldspars

(vii) Bladed :- Mineral having knife blade having.
Ex: - Kyanite.

(viii) Crystalline :- Crystalline is the orderly arrangement of unit cell.
Mineral that don't show crystalline there known as amorphous

diamond is made up of carbon crystal (811/1/11)
(Chalcopyrite ore of copper)

Page No. /
Date / /

Colour :-

colour of a mineral is determined by the absorption of spectrum of light and reflection of a particular light so it looks or appears.

Minerals :-

colour :-

- | | | |
|---------------------------|---|-------------------|
| ① Hematite | → | ① dark silty grey |
| ② orthoclase | → | ② fleshy red |
| ③ Chalcopyrite | → | ③ golden yellow |
| ④ Galena
(ore of lead) | → | ④ Lead grey |
| ⑤ Malachite | → | ⑤ sea green |
| ⑥ Pyrite | → | ⑥ brass yellow |
| ⑦ Graphite | → | ⑦ shiny black |
| ⑧ Talc | → | ⑧ purely white |
| ⑨ Mullcovite | → | ⑨ white |
| ⑩ Biotite | → | ⑩ brownise black |
| ⑪ Sphalerite | → | → |

Streak :-

It is the colour of mineral in powder is called streak. Streak is determined by rubbing the mineral against a porcelain plate known as streak plate.

- | Mineral | colour | streak |
|----------------|-------------------|------------------|
| ① hematite | → dark still gray | → cherry red |
| ② Chalcopyrite | → Golden yellow | → Greenish black |
| ③ Pyrite | → Brass yellow | → Brownish black |
| ④ | | |

Lustre :- It is the appearance of surface mineral as reflected lights.

⇒ Lustre is two types -

(i) metallic lustre

(ii) Non-metallic lustre.

(i) Metallic Lustre :-

Metallic lustre are shown by gold, silver, Galena, Graphite, Chalcopyrite & hematite.

(ii) Non-metallic Lustre :-

Non-metallic lustre are again divided into following types

(i) Vitreous :-

It is the lustre of broken glass.

ex :- quartz

(ii) Greasy Lustre :-

It is the lustre of an oily greasy.

(iii) Adamantine Lustre :-

→ Lustre like diamond

(iv) Resinous Lustre :-

→ Lustre like Resin.

ex :- Spalemites.

(v) Silky Lustre :-

→ It is the lustre of mineral possessive to fibrous matter.

ex :- Asbestos.

(vi) Pearly Lustre :-

→ It is the lustre of pearls.

Ex :- Talc, Gypsum, Kynite

(vii) Earthy Lustre :-

→ It is a dull lustre.

Ex :- Chalk (Mineral)

Hardness :-

→ hardness of mineral is defined as resistance to abrasion or scratching. The hardness of mineral is determined by rubbing the mineral of unknown hardness against ~~the~~ mineral of known hardness.

Mohr's scale of hardness

- ① Talc
- ② Gypsum
- ③ Calcite
- ④ Fluorite
- ⑤ Apatite
- ⑥ Orthoclase / ~~plagioclase~~ Feldspar
- ⑦ Quartz
- ⑧ Topaz
- ⑨ Corundum
- ⑩ diamond

Cleavage :- \rightarrow Cleavage may be defined as the tendency of a mineral that break easily with smooth surface in the plane of weak bonding.

Orthoclase \rightarrow 2 sets of cleavage

Calcite \rightarrow 3 sets of cleavage

Quartz \rightarrow absent of cleavage (Fracture)

Biotite \rightarrow one site of cleavage perfect

Fracture :-

\rightarrow Fracture is defined as the nature of broken surface of the minerals other than cleavage direction.

Different type of Fracture :-

(i) Conchoidal :-

\rightarrow when a mineral breaks with smooth, curve surface that resembled the interior of sea shell.

(ii) Even Fracture :-

This fracture forming smooth and flat surface.

ex :- Chalk, Flint

(iii) Uneven Fracture :-

\rightarrow when the fracture surface is rough due to ~~infinite~~ and random irregularities.

ex :- magnetite
Pyrite

(iv) Hackley Fracture :-
 → It is jagged, sharp and not even.

Ex :- copper, silver

Specific Gravity :-
 → It is the ratio of the ~~wee~~ weight of the mineral to the weight of equal volume of water. The specific gravity of a mineral can be determined by Wakre to still balance.

- (1) Low specific gravity: less than 2.5
- (2) Medium specific gravity: 2.5 to 3.5
- (3) High specific gravity: > 3.5
- (4) Very high specific gravity: > 7

(amp.)

Physical properties :-

(1) Quartz :- SiO_2

Form :- crystalline / massive

colour :- whiteness, milky white, pinky, colourless

Streak :- colourless

Lustre :- vitreous (amp.)

Hardness :- 7

Cleavage :- No. cleavage

Fracture :- conchoidal

Sp. gravity - High

Diagnostic properties :- Lustre, hardness, Fracture, ~~cleavage~~ colour

② Olivins :- $(Mg, Fe)_2 SiO_4$

- Form - Crystalline / Motive
- colour - Olivengreen
- Lecture - vitreous
- Streak - colourless
- Hardness - 6-7
- Cleavage - Imperfect
- Fracture - conchoidal
- Sp. gravity - High
- Diagnostic properties - Hardness

③ Feldspar :-

- Form - orthoclase in monoclinic
- colour - Flesh red
- Lustre - vitreous or pearly (शुद्ध, शुद्ध)
- Streak - ~~colourless~~ white
- Hardness - 6
- Cleavage - 2 set ^{perfect} ~~perfect~~ cleavage
- Fracture - sub-conchoidal
- Sp. gravity - Medium
- Diagnostic properties - Lustre, Hardness, Cleavage, Fracture, colour

④ Pyroxenes :-

- Form - prismatic ~~crystal~~ ^{crystal}
- colour - Nearly black or green
- Lustre - vitreous
- Streak - white
- Hardness - 5 to 6
- Cleavage - 2 set perfect cleavage
- Fracture - conchoidal
- Sp. gravity - Low
- Diagnostic properties - Hardness, Lustre, Cleavage, Fracture

Petrology:-

1

Igneous Rock

1

Granite

2

Basalt (Iron mud)

3

pumice

4

Diorite

5

Rhyolite

6

Obsidian

7

tuff

8

Pegmatite

9

Andesite

10

Gabbro

2

Sedimentary Rock:-

1

limestone

2

chalk

3

clay

4

sandstone

5

shale

6

coal

7

Quartz

8

chert

9

dolomite

10

breccia

11

conglomerate

3

Metamorphic:-

1

Marble

2

Schist

3

slate

4

gneiss

5

Serpentinite

6

Phyllite

7

Quartzite

8

hornfels

9

Amphibolite

10

Granulite

Imp

Physical properties :-

- ① Form - It is the arrangement of constituent atoms of mineral.
- ② Colour :- The reflection of a particular colour from spectrum light.
- ③ Streak :- The colour of mineral in powder form.
- ④ Cleavage :- The tendency of mineral to break along parallel / smooth surface.
- ⑤ Lustre :- The appearance of surface of mineral in reflected light.
- ⑥ Degree of transparency :- It allows the passage of light through it.
- ⑦ Hardness :- The resistance of mineral to abrasion.
- ⑧ Specific gravity :- The ratio of weight of mineral to that of the same volume of water.
- ⑨ Fracture :- The tendency of mineral to break along uneven surface.
- ⑩ Texture :- The orientation of grains of crystal inside a mineral.

(Imp)

Moraine :-Medial

Moraine is a deposition land form of glaciers when glacial ice melts slides down it carries away all the boulder soil, silts plant debris. The lower part of the mountain valley there forms new land form which is called Moraine.

→ Based on the position of this land form there are 3 types of Moraine :-

- ① Lateral Moraine
- ② Medial Moraine
- ③ Terminal Moraine

② Medial Moraine :-

→ Moraines are formed when two glaciers meet to lateral moraines from the different glaciers are pushed together. This material forms one line of rock and dirt in the middle new bigger glacier. It is a glacier medial moraine line behind will be long rise earth the middle of the valley.

③ Terminal Moraine :-

Terminal moraine is other wise known as end moraine it forms at the ~~valley~~ end of a glacier, all the debris of the debris that was pushed to the front of the glacier which deposited long clump of rock, soils, sediments.

① Lateral moraines :-

⇒ Lateral moraine form along the glacier side and consist of debris that faults horse slumb form the valley way or directly flow glacier surface.

(OIT)

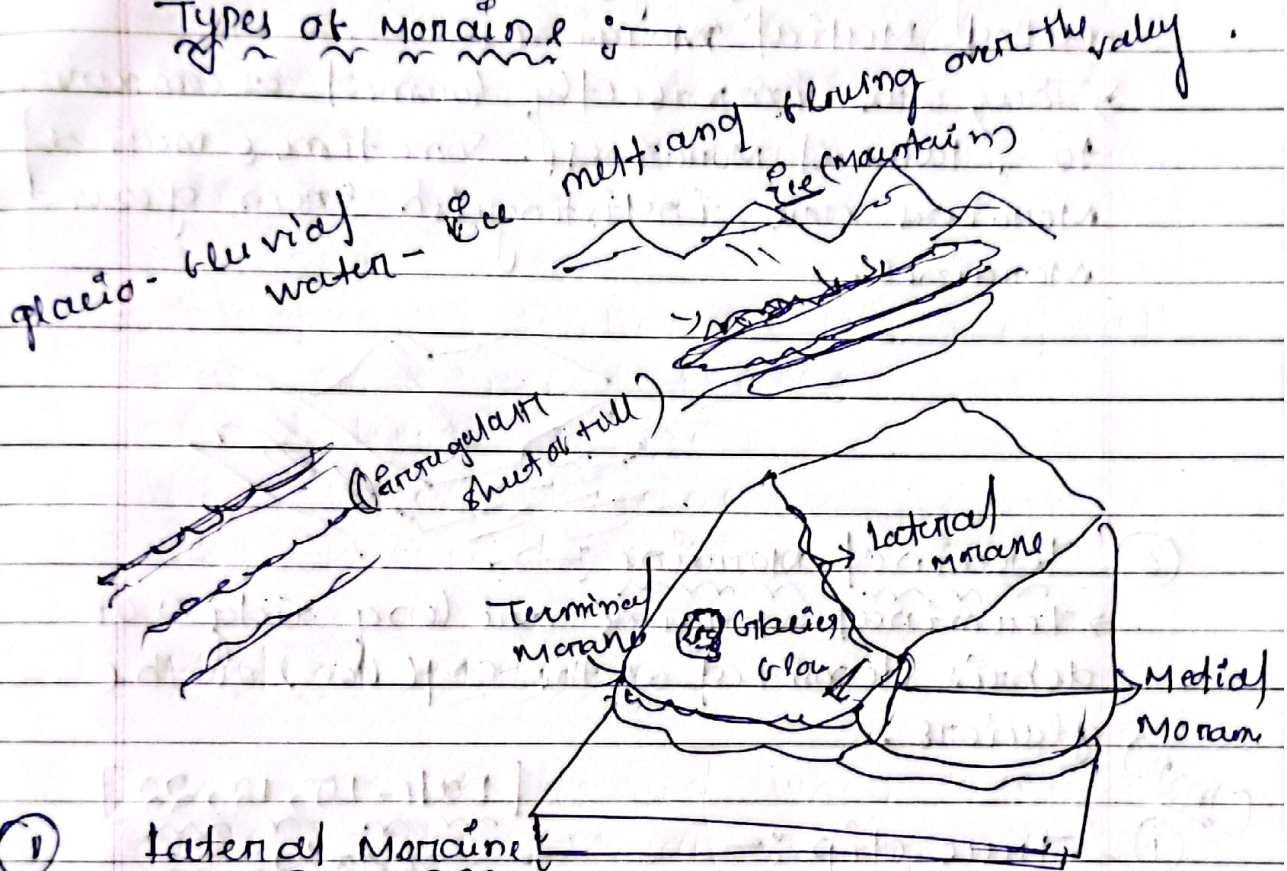
⇒ Lateral moraine is formed along the edge of stream as the velocity of debris / sediments moving along side of stream is very slower than that of moving in the middle.

The sediments leave behind along the side of glacial stream after the melting of ice is known as lateral moraine.

(Imp) Moraines :-

⇒ They are long ridges of glacial till.

Types of Moraine :-



① Lateral Moraine

⇒ Lateral moraine form along the sides parallel to the glacial valleys. The lateral moraines may join a terminal moraine a house-shoe shaped ridge.

⇒ These moraines partly or fully owe their origin to glacio-fluvial waters pushing up materials to the sides of glacier.

⇒ Many valley glaciers retreating rapidly leave an irregular sheet of till over their valley floors. Such deposits varying greatly in thickness and in surface topography are called ground moraines.

② Medial Moraine :-

→ The moraine in the centre of the glacial valley flanked by lateral moraines is called medial moraine.

→ They are imperfectly formed as compared to lateral moraines. Some times medial moraines are indistinguishable from ground moraines.



③ Terminal Moraine :-

→ Terminal moraine are long ridges of debris deposited at the end (nose) of the glaciers.

(imp)

① True dip :-

→ The maximum slope along a dip is known as true dip.

[Date-15, 12, 22]
 (45°)

② Apparent dip :-

→ All the dip in any direction other than the true dip is called Apparent dip.

③ Glaciers :-

→ when accumulation of snows becomes faster than the melting rate of snows on the ground then cementation of small pellets of snow forms a large bed of ice is known as glaciers.

(accumulation = parking)
 (cementation = parking)

→ When the accumulation of snows become faster than the melting ~~rate~~ rate of snows on the ground then cementation of small pellets of snow forms a large block of ice known as glacier.

④ Ice berg :-

It is a large piece of ice mass that has been broken off from ~~the~~ a bed of glacier. It slides down from ^{the} surface of higher elevation to the lower level ground by gravitational pull is called Ice berg.