

STRUCTURAL GEOLOGY:

Introduction:

It gives the details about how inherent properties of rocks get modified, making them either suitable or unsuitable for civil engineering works.

Outcrop:

- Any geological information exposed on the surface is called an outcrop.
- It is also used as a general term to refer to exposed folds, faults, joints, etc...

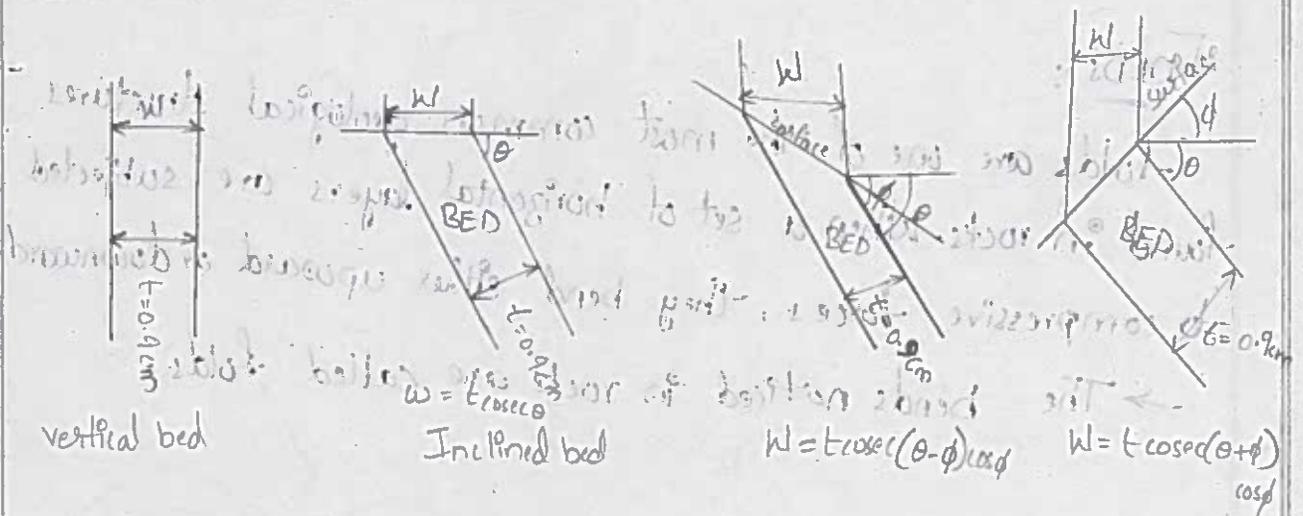


Fig: Outcrop width in relation to surface slope.

Strike and Dip:

- When strata are affected by tectonic forces & structures have developed they can be studied by their attitude.
- Attitude comprises two factors known as strike and dip.
- Strike refers to the direction which a geological structure is present.
- Strike direction may be defined as the direction of the trace of intersection b/w the bedding plane & horizontal plane. Dip (literally means slope or inclination).

→ The innumerable directions which lie in b/w the strike direction & the true dip direction known as apparent dip direction & inclinations along them are apparent dip amounts.

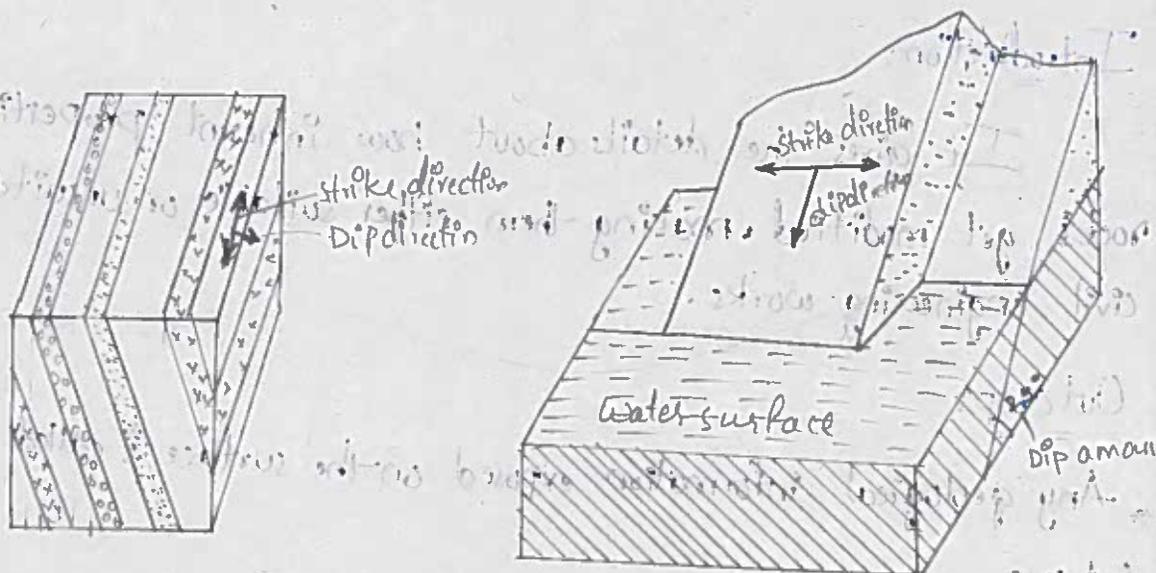


fig: strike & dip

### FOLDS:

Folds are one of the most common geological structures found in rocks. When a set of horizontal layers are subjected to compressive forces, they bend either upward or downward.

→ The bends noticed in rocks are called folds.



Horizontal beds

A = Beds bent upward  
B = Beds bent downward

fig: folded beds

### Parts of fold:

→ limbs or flanks:

These are sides of a fold. There are two limbs for every fold & one limb common to adjacent folds.

Axial plane: This is imaginary which divides into two halves. It passes through either crest or trough

## Crest and Trough:

The curved portions of the fold at the top & bottom are called crest and trough respectively.

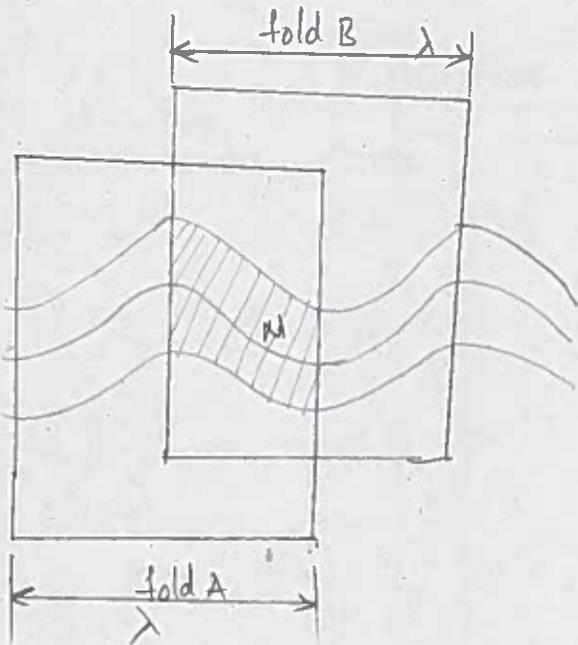
## Axis:

This is the trace of the intersection b/w the axial plane & the crest of the fold.

When it is inclined, the angle b/w the axis & the horizontal plane is called the plunge or pitch.

## Wavelength:

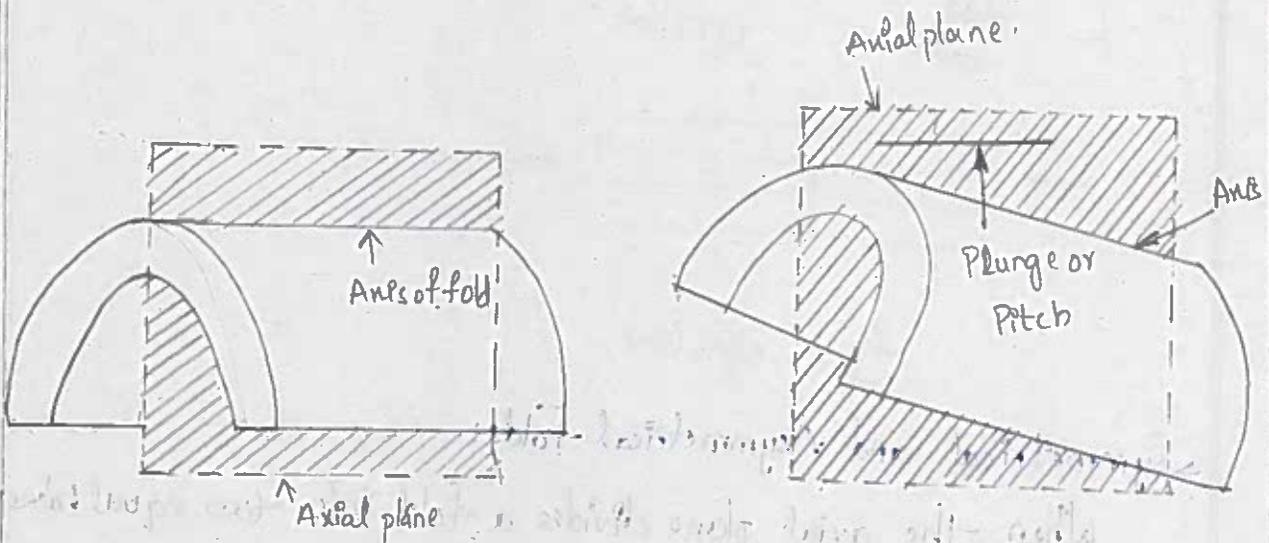
The distance b/w the successive crests or troughs is called wave length.



N = common limb for A & B folds

$\lambda$  = wavelength.

(a)



(b)

(c)

Fig: (a), (b), (c) Fold & its parts.

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## Classification & Types of Folds:

→ Anticline and Syncline.

→ When the beds are bent upward, the resulting fold is

anticline.

→ Syncline is just opp. to anticline in its nature, i.e., when beds are bent down wards, the fold is syncline.

This fold is convex downwards.

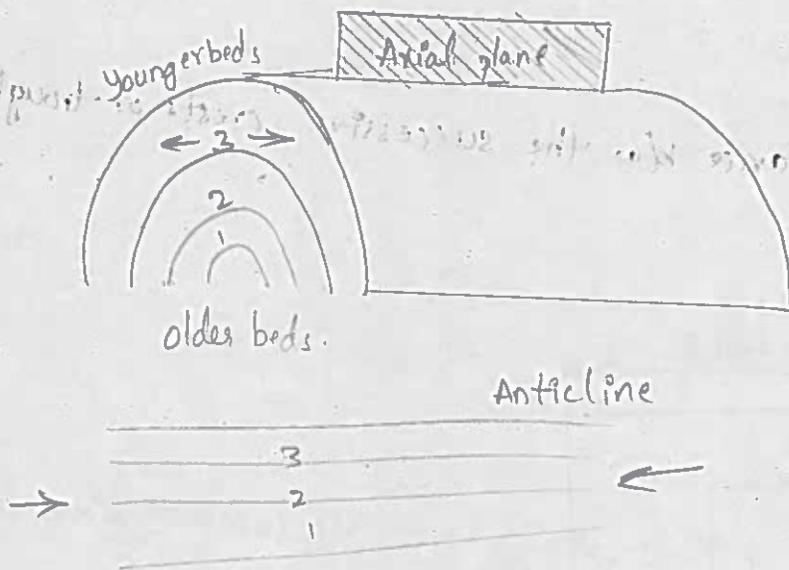


Fig: Anticline.

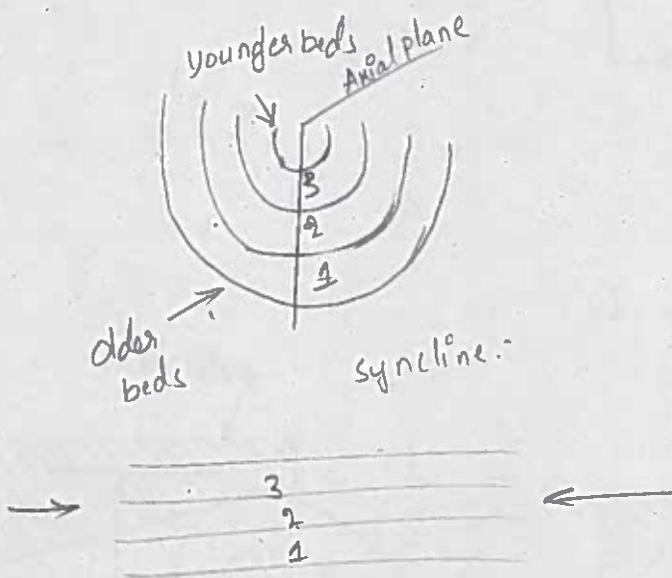


Fig: syncline

→ Symmetrical and Asymmetrical Folds:

When the axial plane divides a fold into two equal halves in such a way that one half is the mirror image of other such fold is symmetrical fold.

→ If two halves are not mirror images, then such folds are asymmetrical folds.

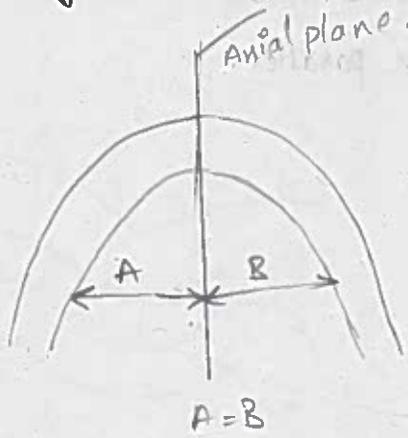


fig: Symmetrical

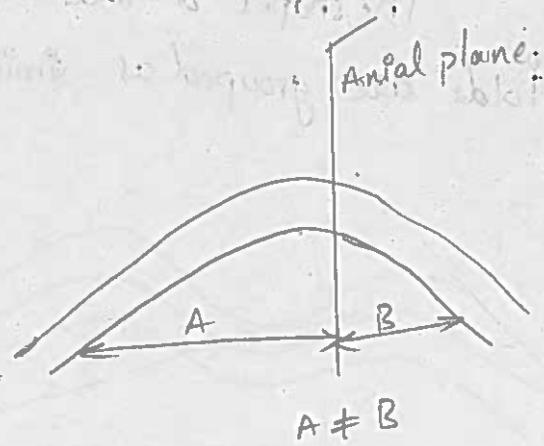


fig: Asymmetrical

Open & closed folds:

→ Depending on the intensity of deformation, the beds of the fold may or may not have uniform thickness.

→ If the thickness is uniform, then it is open fold.

→ If the beds are thinner in limb portions & thicker at crest & troughs, such are closed folds.

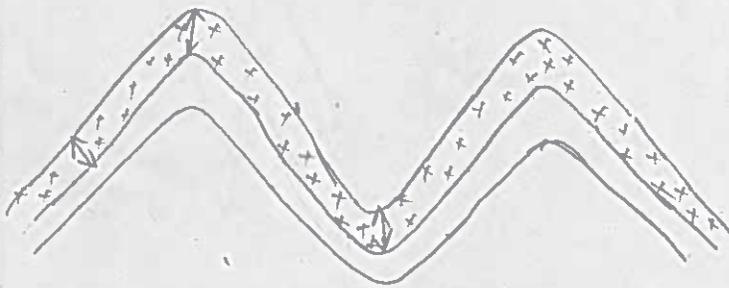


fig: open fold

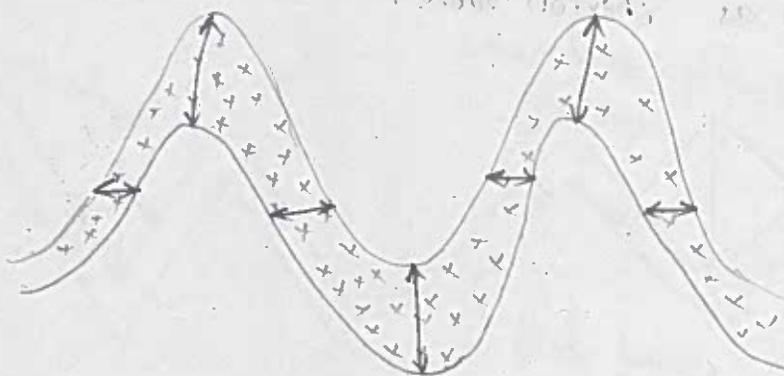


fig: closed fold

## Similar and Parallel folds:

The shapes of folds remains same or is altered with depth folds are grouped as similar or parallel.

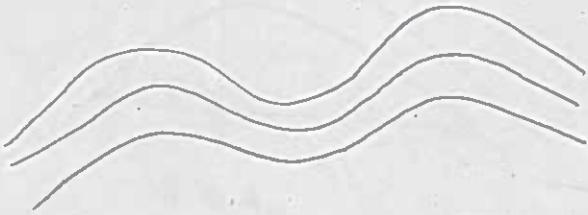


Fig: Similar fold

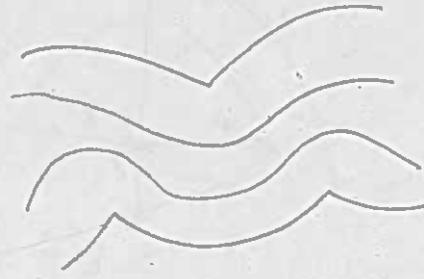


Fig: Parallel fold

## Overturned fold:

The limbs show the order of superposition - the order of superposition of beds in that limb will be in reverse order & such a fold is called overturned fold.

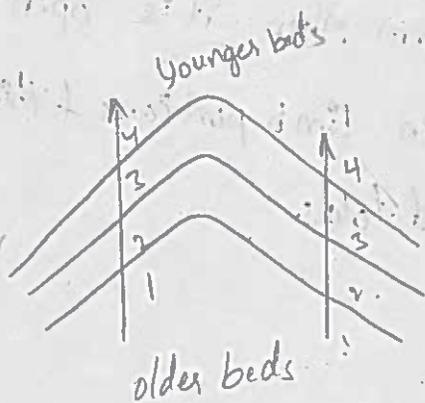
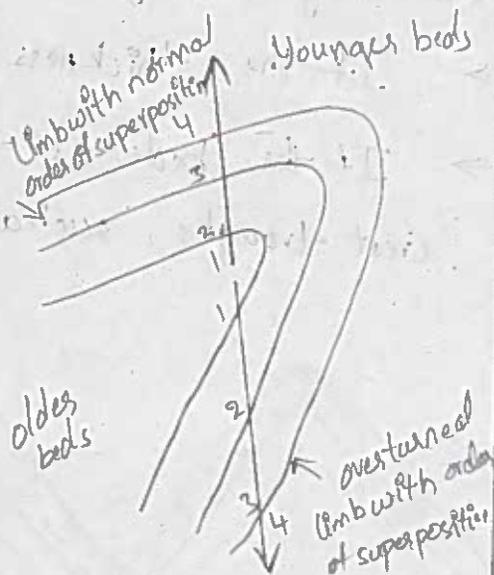


Fig: Normal fold



## Chevron folds:

The crest & troughs of beds are smoothly curved. But some folds have sharply bent, angular crests & troughs. Such folds are known as "chevron folds".

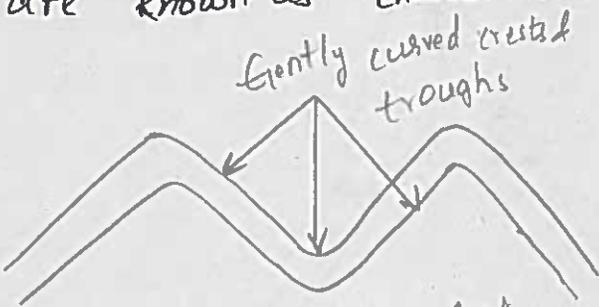


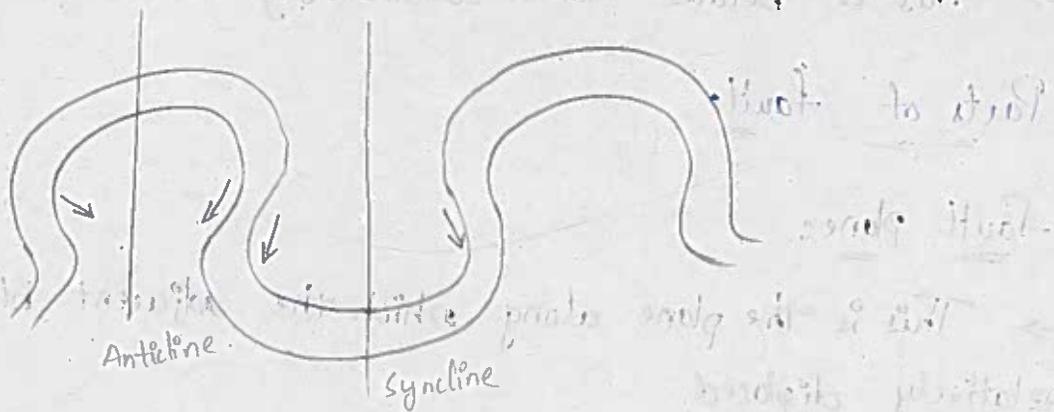
Fig: Normal fold



Fig: chevron fold

## Fan fold:

The limbs dip towards each other with reference to their axial plane. In synclines of this kind, the limbs dip away from each other. As the term suggests, these folds are fan shaped.



Anticlinorium & synclinorium: When the limbs of folds are not plain but characterized by the appearance of other minor folds on them.



fig: Anticlinorium & synclinorium

Drag folds: These are the minor asymmetrical folds within major folds but confined only to incompetent beds which are sandwiched b/w competent formations. These develop because of the shearing/dragging effect.

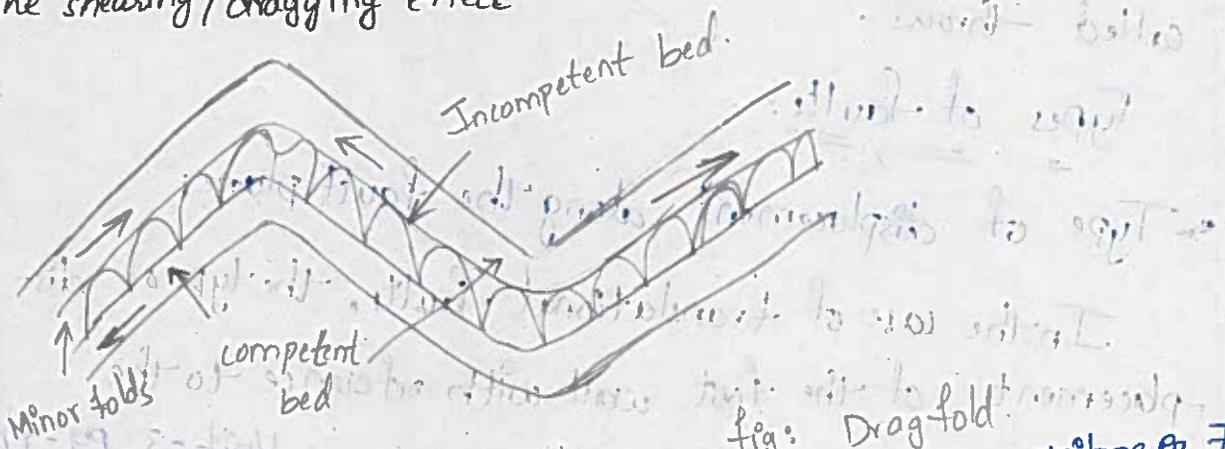


fig: Drag fold

## FAULTS :

→ faults are the most unfavorable & undesirable geological structure at the site for any given purpose.

→ This is because faults considerably weaken the rocks.

### Parts of faults

#### Fault planes

→ This is the plane along which the adjacent blocks were relatively displaced.

→ In other words, this is the fracture of surface on either side of which the rocks had moved past one another.

#### Footwall and Hanging wall

the faulted block which lies below the fault plane is called the "foot wall."

The other block which rests above the fault plane is called the "hanging wall".

#### Slip

The displacement that occurs during faulting is called slip. The total displacement is called net slip.

#### Heave and Throw

The horizontal component of displacement is called "heave" and the vertical component of displacement is called "throw".

#### Types of faults

→ Type of displacement along the fault plane:

In the case of translational faults, the type of displacement of the foot wall with reference to the

→ the hanging wall wall is uniform along the fault plane.

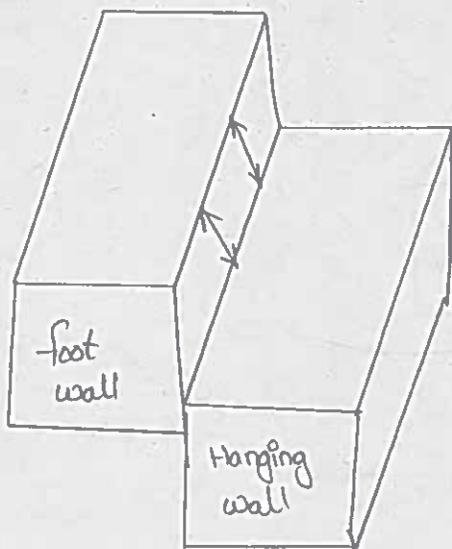


Fig: Translational fault

### Relative movement of footwall & hanging walls

→ If the hanging wall goes down with reference to the foot wall, it is called normal fault or gravity fault.

→ If the kind of relative displacement of the hanging wall is opp. to this, the fault is reverse fault or thrust fault.

→ If the relative displacement of the hanging wall is neither up or down words with reference to the inclined fault plane, but sideways, such faults are as dextral fault or sinistral faults.

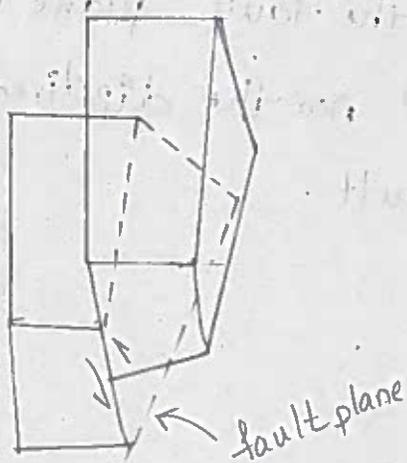


Fig: Reverse fault

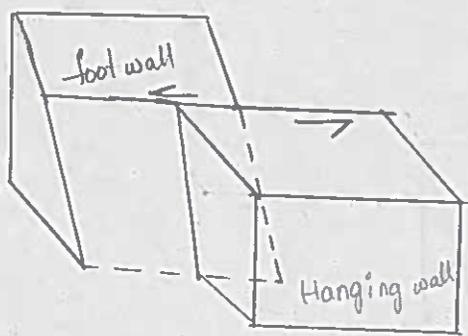


Fig: Normal fault

### Type of slip Involved :

"Slip" has been already described as the displacement along the fault plane. If the displacement along the fault plane, such fault is slip fault.

### Mutual Relationship of Attitudes of Fault plane and Adjacent Beds :

If the strike direction of the fault plane and that of adjacent beds are the same, the fault is called a "strike fault".

→ If the strike direction of the fault plane is parallel to the true dip direction of the adjacent strata, such a fault is described as a dip fault.

→ If the strike direction of the fault plane is  $\neq$  to neither the strike direction nor the dip direction it is called "oblique fault".

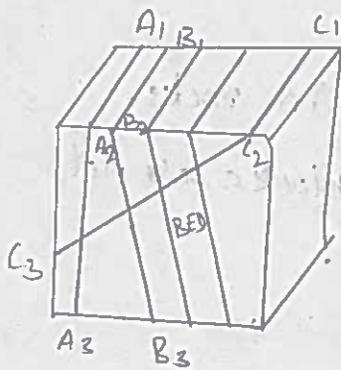


Fig: strike fault

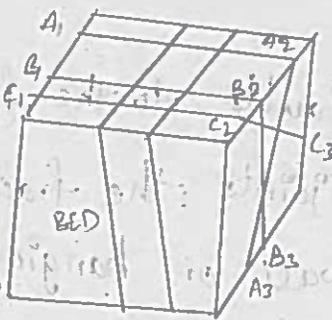


Fig: dip fault

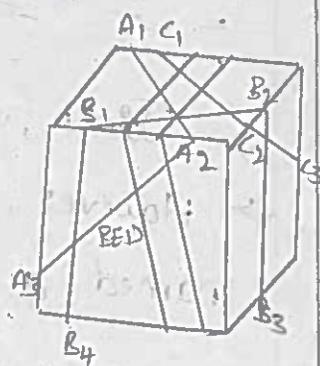


Fig: oblique fault

Mode of Occurrence:

Radial fault: when a set of faults occur on the surface & appear to be radiating from a common point.

Echelon fault: These refer to a series of minor faults which appear to be overlapping one another.

Arcuate or peripheral fault:

These also refer to a set of relatively minor faults which have curved outcrops & are arranged in a peripheral manner.

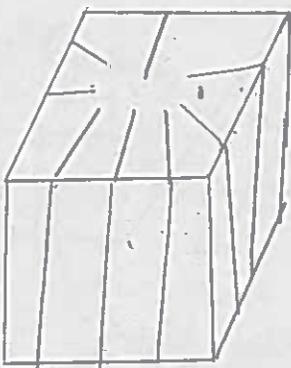


Fig: radial fault

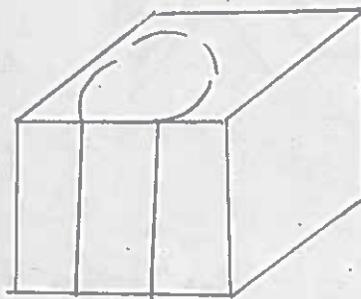


Fig: Arcuate fault

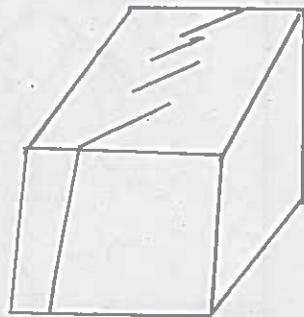


Fig: Echelon fault

Joints:

Joints are like cleavage of minerals, occur oriented in a definite direction as a set.

Joints occur generally, as a no. of 11' & oriented fractures in rocks.

## Parts of joints:

- Joints, like faults, to the fracture in rocks.
- However, in joints, the fractured blocks are not named as foot wall or hanging wall.

## Classification of joints:

### Classification Based on the Relative Attitude of Joints:

When joints are  $\parallel$  to the strike direction or dip direction of adjacent beds, they are, strike joints or dip joints.

### Classification Based on the origin of Joints:

Most of Joints are formed, due to either tensional forces or shearing forces. Accordingly, they are described as tension joints or shear joints.

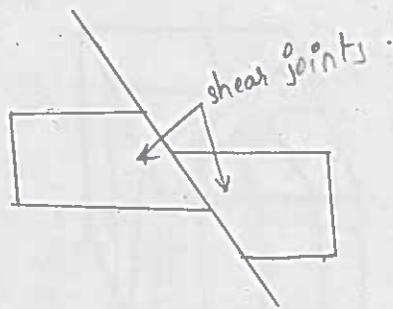
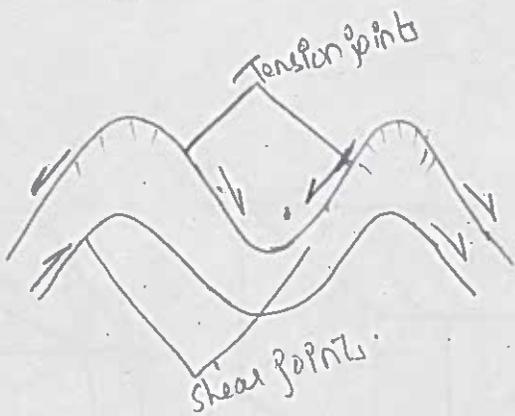


Fig: Tension Joints & Shear joints

## Ground water.

Groundwater is the water present beneath Earth's surface in rock and

## Water Table:

The percolation of rain water leads to the development of a zone of saturation above the bedrock, in which all openings are filled with water.

The upper surface of this zone of saturation is called "water table".

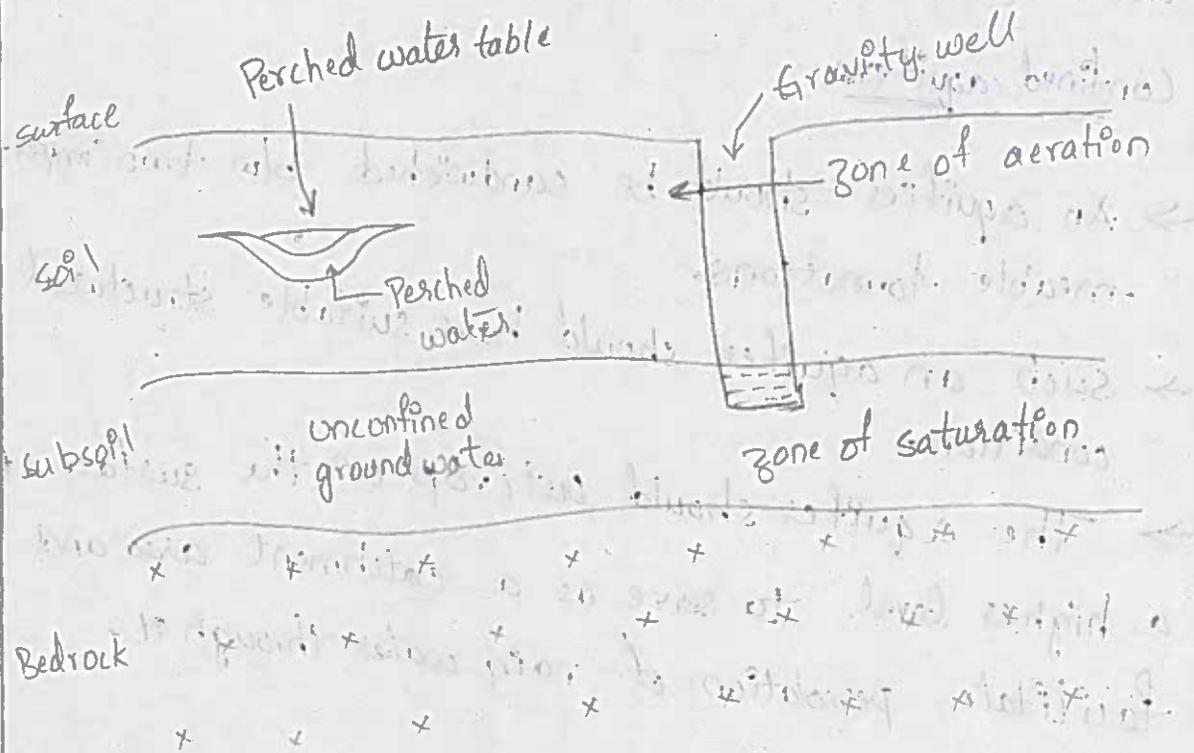


Fig. Water table.

## Types of Ground Water:

Soil water: This is the water which occurs in the soil & is available to the roots of plants & vegetation existing on the surface.

Pellicular water: When rain water percolates downwards, such water is pellicular water.

Perched water: This occurs above a suitable aquiclude or aquitard within the zone of aeration.

Capillary water: This exists within very fine openings, just above, & in contact with, the water table.

### Types of aquifers:

#### Unconfined Aquifers:

These do not have any impermeable beds above them & the water table is under atmospheric pressure only.

#### Confined aquifers:

→ An aquifer should be sandwiched b/w two impermeable formations.

→ Such an aquifer should have suitable structural condition.

→ The aquifer should outcrop on the surface at a higher level to serve as a catchment area and facilitate percolation of rain water through it.

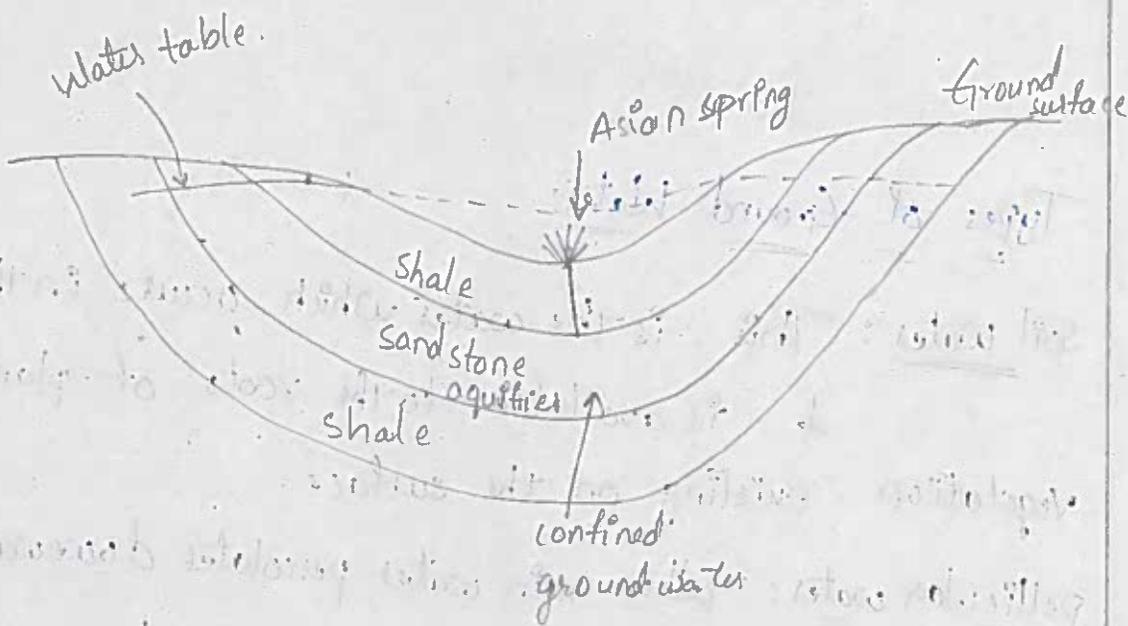


Fig: Types of aquifers

## Geological controls on Ground Water Movement.

Ground water movement in the zone of aeration takes place under the influence of gravity. Most of them are geological & are as follows:

- The permeability character of rocks is one of the most influencing factors of ground water movement.
- Faults, if present, also influence the ground water to move along them. This is the reason for the alignment of springs.
- The other important geological control is the attitude of bedding. Generally, different sedimentary beds differ in their permeability.
- The buried river channels & unconformities occur with influence the ground water movement as they are more porous and permeable.

### Cone of Depression

In any gravity well, the static level of water coincides with the water table level of surrounding aquifer.

When water is pumped out the water is measured from such a well, the level of water in it goes down, leading to the depression in the water table.

This phenomenon is called the cone of depression or the cone of exhaustion.

This is temporary fluctuation in the level of water table because the original position is restored within short period.

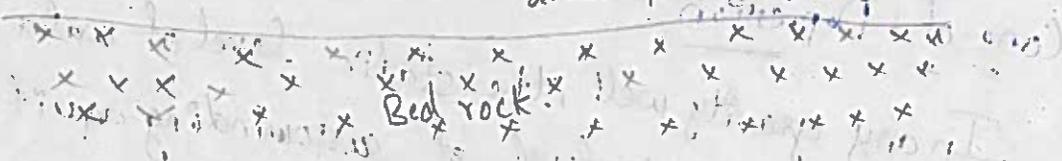
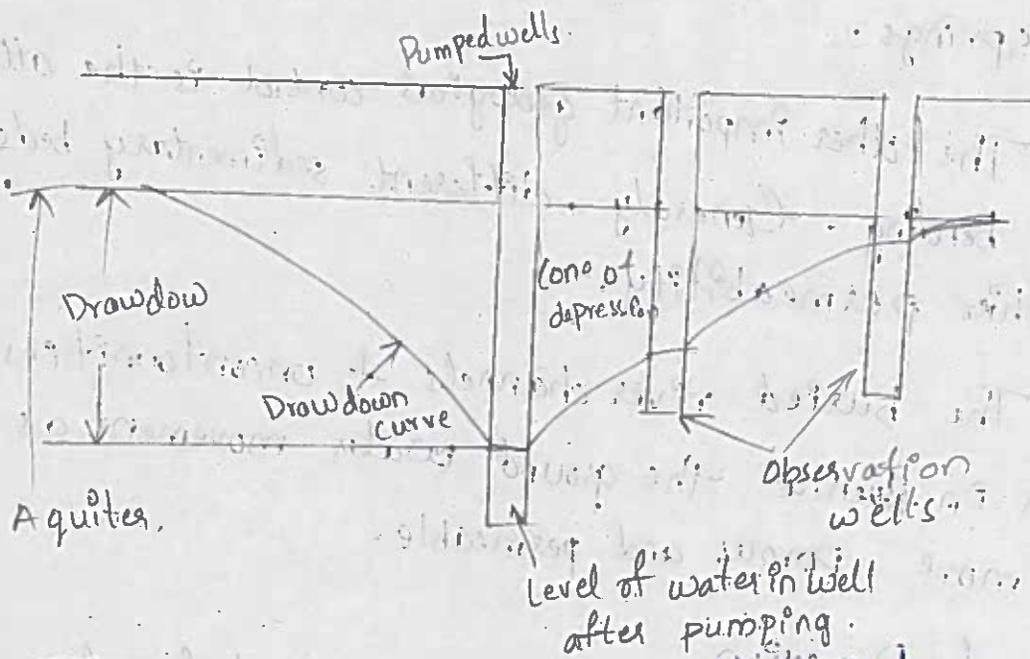
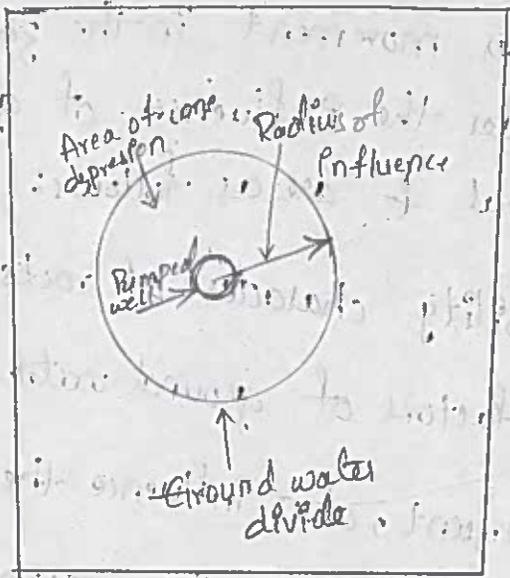


Fig: Cone of depression.

### Ground Water Exploration:

There are 2 diff. approaches: one by water divining and the other by scientific studies.

### Geological Investigations:

In ground water exploration among the three kinds of Investigations is most important & main deciding factor.

- study of rock types.
- study of topography.
- study of weathering.
- study of geological structures.
- study of intrusive rocks.
- Geological Mapping.

### Geophysical Investigations:

Geological investigations remain incomplete because.

- (i) It outcrops of insitu rocks may be absent or few and widely scattered.
- (ii) The surface is covered with soil, sediments, etc...
- (iii) The rapidly expanding fields of cultivation covers vast areas. All these hide the actual rock type and geological structures, lying underneath.

### Hydro-logical investigations:

Such investigations are relatively simple but very important in the assessment of the ground water potentially in any region.

- study of water table.
- study of surface water bodies.
- study of springs and seepages.
- Quality of water.
- study of rainfall, climate, etc...
- Pumping Tests.

## Gneiss:

- In metamorphic rocks, this is widespread & abundant.
- Gneiss is a general name given to any metamorphic rock which shows a gneissose structure.

### Physical description:

- Diagnostic character: foliation present.
- colour: Different shades of grey & pink.
- Grain size: Medium to coarse.
- Texture: equigranular.
- Minerals present: Feldspar & quartz.

### Types:

- Orthogneiss
- Paragneiss
- Granite gneiss
- Banded gneiss
- Augen gneiss
- Injection gneiss.

### Schist:

- Like gneiss schist is also very abundant.
- It is also a very common metamorphic rock.
- Its name in general is given as rocks bearing a particular structure.
- Like gneiss it is also foliated rock.

### Physical description:

- colour: shows different colours.
- Grain size: Variable
- Texture: schistose
- Minerals present: It is composed of prismatic or platy minerals.

## Types:

- Mica schist.
- talc schist
- hornblend schist.
- Sillimanite schist.
- chlorite schist.

## Quartzite:

- It is typical example of para-metamorphic.
- It is siliceous, in composition & is formed out of dynamic or thermal metamorphism of sandstones.

## Physical description:

colour: Uniform colour: white, red, brown, grey, green, etc.,

Grain size: variable.

Hardness: very hard.

Texture: Granulose.

Minerals present: Quartz.

## Types:

- Micaceous quartzite.
- quartzite schist.
- Orthoquartzite.

## Marbles:

- The term marble is derived from Latin word marmor meaning "a shining stone".
- It is also a parometamorphic rock.
- Though it is not very hard or strong or durable, it is the most valuable rock occurring in nature.

## Physical properties:

Colour: Uniform colour; Pleasant shades of green, yellow, brown, blue or grey.

Grainsize: fine.

Texture: Granulose.

Hardness: less.

Transparency: Translucent.

Minerals present: quartz, calcite.

## Types:

- Forsterite Marble
- Serpentine Marble
- brucite Marble
- fine grained Marble
- coarse grained. marble
- dolomite Marble
- Magnesium Marble

## Slate:

- It is a dense, fine grained, parametamorphic rock.
- It has the unique character of ~~slaty~~ cleavage.
- It is formed of dynamic or regional metamorphism of shale.

## Physical properties:

colour: Green, grey, yellow, red, Brown, Black.

Grainsize: fine grained.

Texture: Unrecognisable.

Hardness: soft.

Minerals present: secondary mica (sericite), quartz.

Types:

- Black slate
- Grey slate
- Phyllite
- calcareous slate

Physical properties

Color: Uniform color in whole surface : black  
 Luster: dull  
 Fracture: conchoidal  
 Cleavage: perfect  
 Hardness: 2-3  
 Streak: black  
 Specific gravity: 2.7-2.8

- Laminar cleavage
- Fracture: conchoidal
- Hardness: 2-3
- Streak: black
- Specific gravity: 2.7-2.8

Uses:

- It is a common fine grained sedimentary rock
- It has the typical character of high cleavage
- It is found in abundance in various parts of the world

Physical properties

Color: Green, grey, yellow, black  
 Luster: dull  
 Fracture: conchoidal  
 Cleavage: perfect  
 Hardness: 2-3  
 Streak: black  
 Specific gravity: 2.7-2.8

## Common Structures of Igneous Rocks:

In igneous rocks common structures are; vesicular structure, amygdaloidal structure, columnar structure, sheet structure, flow structure and pillow structure.

### Vesicular structure:

This structure is due to the porous nature, commonly observed in volcanic rocks & is attributed to the following reasons: Magma is an intimate mixture of rock melt & volatiles.

The gases, being lighter, move upwards & as they escape into atmosphere create empty cavities of various sizes & shapes near the surface of lava flow. These cavities are called vesicles.

When the volcanic rock is highly porous & spongy in appearance, it is called scoria.

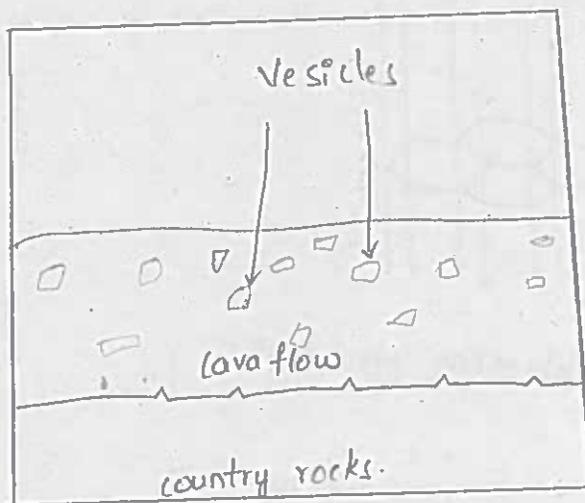


fig: Vesicular structure

### Amygdaloidal structure:

The vesicles, which are empty to start with in the vesicular structure, are subsequently filled up by the deposits of surface waters or underground waters or hydrothermal solutions. Such infillings are called "amygdales".

When empty cavities are filled with amygdales, the vesicular structure is called an amygdaloidal structure.

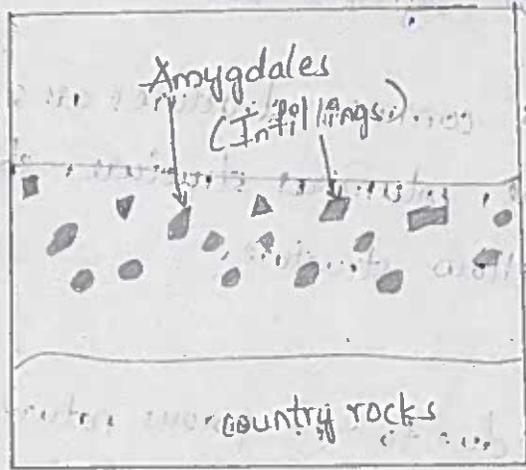


Fig: amygdaloidal structure

Columnar structure:

In this structure, the volcanic igneous rock appears to be made up of numerous parallel polygonal prismatic columns bundle together. This is the result of contraction of lava during cooling.

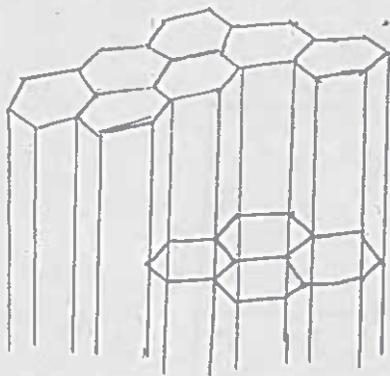
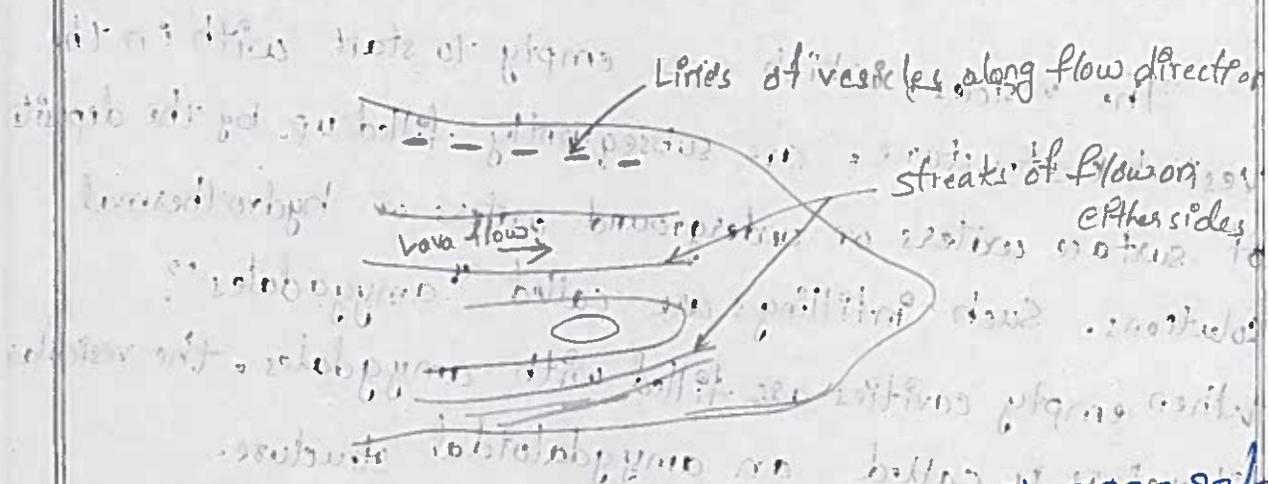


Fig: columnar structure

Flow structure:

This structure refers to linear & nearly parallel features occurring in volcanic rocks which develop as a consequence of the flow of lava.



## Common Textures of Igneous rocks.

### Textures Based on the degree of crystallinity:

Igneous rocks are formed due to cooling & solidification of magma or lava. Crystallization is different minerals takes place when the respective molecules in magma move to their centres of crystallization.

Depending on nature of cooling, the resulting igneous rocks are:

- (i) Completely crystalline.
- (ii) Completely glassy.
- (iii) Partly crystalline & partly glassy.

### Texture based on granularity:

Depending on the physical conditions that had prevailed during crystallization of magma, mineral grains occur in different sizes. The presence of volatiles, low viscosity, slow cooling & great pressure help to grow large minerals.

The textures have been recognised based on the granularity of minerals. If the rocks are big enough to be seen by the naked eye, the texture is described as phaneritic texture. On the other hand, if minerals are too fine to be seen separately by naked eye, the texture is described as aphanitic texture.

### Texture based on shape of crystals:

Magnetite, an early magmatic mineral, belong to this category. Further, there are some minerals like pyrite, garnet & staurolite which have the ability to develop good crystal outlines.

The development of crystal outlines of minerals when the mineral is completely bounded by faces, it is called, "euhedral".

When crystal faces are absent, it is called anhedral.

When only a part of chemical mineral is bound by crystal is called subhedral.

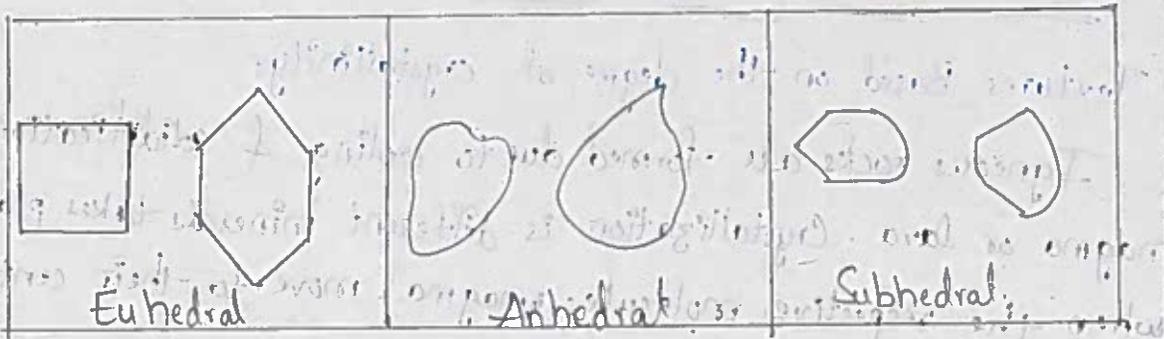


Fig: Euhedral, Anhedral, Subhedral

## Common Igneous Rock types:

### GRANITE :

Granite is a plutonic igneous rock because it is formed due to solidification of magma at great depths.

### Minerals present in Granite:

Granite is composed of only primary minerals. Among these, feldspars & quartz occur as essential mineral.

### Structure:

Granite is a compact, dense, massive & hard rock. But mural joints (one set horizontal - all mutually  $\perp$ ) occur in some, thereby facilitating the quarrying process.

### Texture:

Granite typically exhibit an interlocking, planar & coarse grained texture.

Granites are usually equigranular.

But sometimes an inequigranular porphyritic texture & are called granite porphyrys.

## Relation with other Rocks.

Granite is closely related to gabbroite & diorite, as all these contain similar minerals but in different proportions. When two feldspars are approximately equal in quantity the rock is called adamellite.

## Pegmatites:

These are holocrystalline, phaneritic-coarse grained igneous rocks with an interlocking texture. Many pegmatites are acidic & oversaturated. They resemble granites in mineralogy & hence are described as granite pegmatites.

## Minerals present:

Pegmatites are mainly composed of alkali feldspars & quartz but may also be rich in muscovite & biotite micas.

## Mode of formation:

The peculiar grain size & mineral composition suggest that pegmatites are formed as products of solidification of final magmatic residues which are specially rich in volatile constituents.

## Structure & Texture:

These are rather less common in occurrence & do not possess any specific structure diagnostic to them. But texturally, the minerals are very large in size and interlocked. Some of the constituent minerals develop very beautiful crystal outlines.

## Appearance in hand specimen:

Numerically very few minerals occur in hand specimens, as the minerals are unusually large in size. Feldspars & quartz are found in most of the cases.

## Dolerite:

The term dolerite was coined by Haüy to refer to a dark, heavy, fine grained igneous rock. This is the most commonly found hypabyssal rock.

### Minerals present:-

It is a rock, normally composed of labradorite type of plagioclase feldspar & augite type of pyroxene as essential minerals.

### Mode of occurrence:

Very often, dolerite occurs in nature as an intrusive rock, i.e., as dykes in granite. These dark coloured rocks are prominently noticed in the field by virtue of colour contrast with surrounding granites which are light coloured.

### Structure & Texture:

- It is a very dense, massive & compact rock.
- It is neither porous nor permeable.
- The texture is generally equigranular, phanitic & fine grained.
- The rock is called "porphyry". The common distinguishing character of igneous rocks.

## Structures and Textures of Sedimentary Rocks.

### ⇒ Stratification:

Sedimentary rocks have the general character of occurring in the form of series of beds. This phenomenon is known as "stratification" or "bedding".

When the thickness of individual beds is very small it is called "lamination".

If the beds or layers lie slightly oblique to the major bedding planes, it is called current or oblique or cross-bedding.

When deposition takes place in such manner that thin horizontal beds made up of fine materials occur alternately with coarse deposits, it is called torrential bedding.

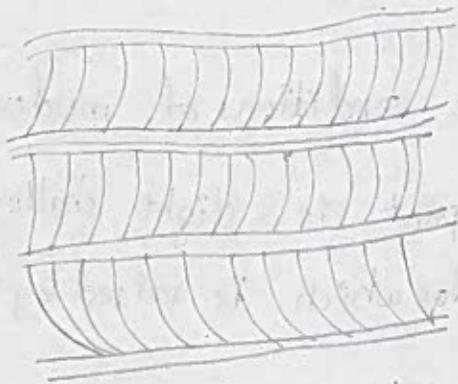


Fig. Cross-bedding



Fig: Torrential bedding.

### Possible Occurrence:

Fossils have been defined as "relics and remnants of ancient plants and animals preserved inside the rocks by natural processes".

### Ripple marks:

In stagnant & shallow water bodies, the waves and currents on the surface of water produces sympathetic impressions in the form of mirror undulations on the loose & soft sediments which lie at bottom. These are known as ripple marks.

These are 2 types: symmetrical & Unsymmetrical.

→ Symmetrical ripple marks forms due to wave action.

→ Unsymmetrical ripple marks are formed due to current action.



fig: wave ripple marks



fig: Current ripple marks

### Rainprints or rain marks:

These develop under the conditions of mudcracks on surface of some rocks. A rainprint is a slight shallow depression encircled by a low ridge which is raised by the impact of rain drop.



fig: Rain prints with raised ridges



figs: shape of rain prints when rain drops fall obliquely

### Track & Trail:

It indicates the paths of some animals or worms, over a soft sediment.



fig: Track/foot left by small insect or creature.



fig: Trail/groove left by worm

## Conglomerates:

- A conglomerate is a clastic, rudaceous sedimentary rock.
- It is which made up of rounded or subrounded pebbles & gravel.
- Occasionally, cobbles & boulders are also encountered in some conglomerates.

## Breccias:

- Like conglomerates, breccias also are made up of pebbles, gravels, etc...
- Fine grained cementing material provides the binding medium.
- But Unlike conglomerates, these have pebbles & gravels which have sharp & angular edges.

→ Till is the deposit of glaciers which is composed of fragments of various sizes.

## Sandstones:

→ Among sedimentary, this are the very abundant & are next to shales in this respect.

→ They represent nearly 15% of the sedimentary rocks of earth's crust.

→ These are very common elastic rocks made up of sand & are described as arenaceous rocks.

### Sand Grains & Their Minerals:

→ Sand grains in sandstones are most (>90%) quartz.

→ In add. the other minerals are mica, garnet, magnetite, rutile, monazite & feldspars.

## Types:

- Coarse grained sandstone (1 to 2 mm)
- medium grained sandstone (about 0.5 mm)
- fine grained sandstone ( $< 0.5$  mm)

## Shales:

→ These are the most abundant sedimentary rocks, representing nearly 80% of them. In other words shales are most abundant than all other sedimentary rocks.

→ Like conglomerates & sandstones shales are also typical classic rocks.

## Types:

- Calcareous shales.
- Carbonaceous shales.
- Alum shales
- Siliceous shales.
- Oil shales
- Mud shales/stones.

## Limestones:

→ In sedimentary's, in the order of abundance, limestone is rank third, next to shales.

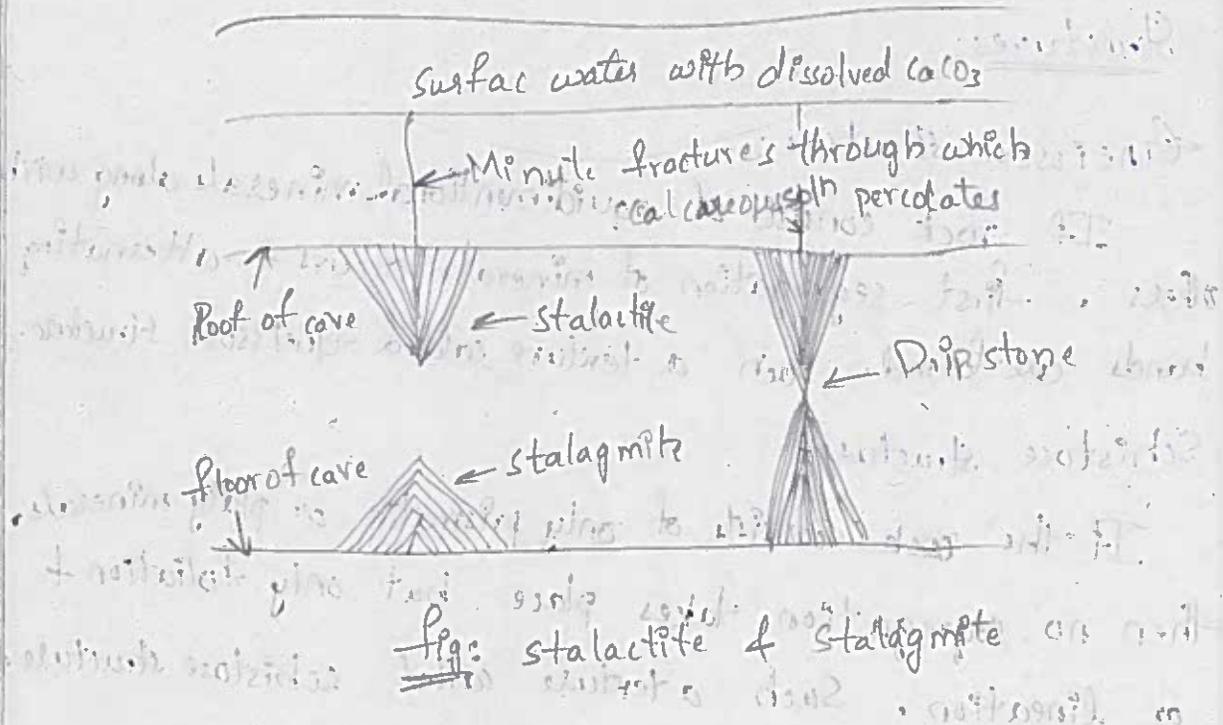
→ These comprise nearly 5% of all sedimentary rocks occurring on the earth's surface.

→ These are non-typical non-detrital rocks.

→ They are formed due to chemically or organically.

## Types

- Chalk :- It is formed out of the globigerina ooze.
- Stalactites, stalagmites & drip stones :- These occur in caves.



- Travertine (calc sinter)
- Kankar
- Shell limestone
- Flaggy limestone
- Lithographic limestone
- Magnesium limestone
- Argillaceous limestone
- Siliceous limestone

## Common structures & Textures of Metamorphic Rocks.

### Textures:

- Crystalloblastic and palimpsest Textures.
- Textures which have developed newly during the process of metamorphism called crystalloblastic texture.
- The other textures which belong to parent rock but still retained in metamorphic rocks are palimpsest texture.

## Xenoblastic & Idioblastic Textures:

→ The xenoblastic texture, the constituent minerals of rock have no well-developed crystal faces.

→ If the mineral have well-developed crystal faces & forms - the texture is known as idioblastic.

## Structures:

### Gneissose structure:

If rock consists of equidimensional minerals along with others, first segregation of minerals occurs & alternating bands are formed. Such a texture called Gneissose structure.

### Schistose structure:

If the rock consists of only prismatic or platy minerals, then no segregation takes place but only foliation & or lineation. Such a texture called schistose structure.

### Granulose structure:

→ If a rock is composed predominantly of equidimensional - then neither segregation or foliation takes place. Such a texture called granulose structure.

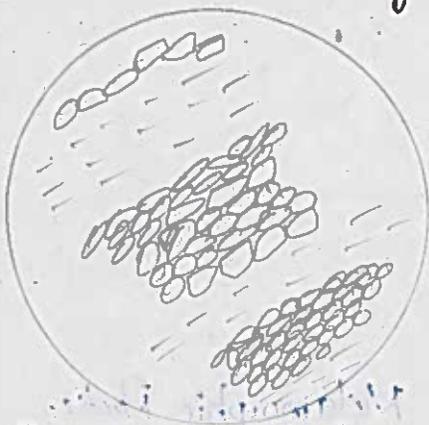


Fig: Gneissose structure

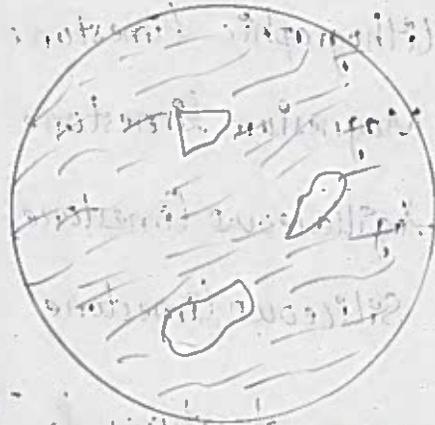


Fig: schistose

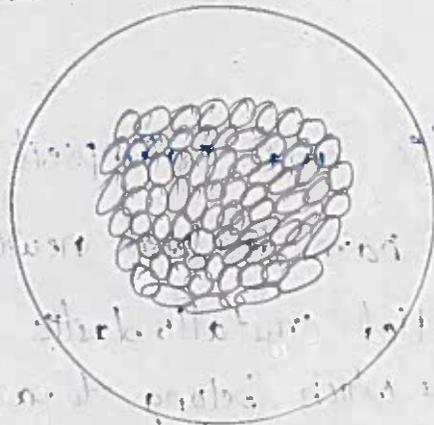


Fig: Granulose structure unit-B Pg- 33/35

# PETROLOGY

Text. book. Reference  
N. Chennai Kesavulu

## Introduction:

Petrology literally means study of rocks.

(Petro = rocks; logos = study.)

The subject matter of petrology comprises the origin, association, occurrence, mineral composition, chemical composition, texture, structure, physical properties, etc., of rocks.

## Definition of a rock:

A Rock may be simply defined as "an aggregate of minerals". Since the crust of the earth is composed of rocks, a rock may also be defined as "unit of the earth's crust".

## Classification of Rocks:

The rocks are classified in many ways based; physical, chemical and geological.

### Geological classification of Rocks:

Geological is the most proper because grouping of rocks is more logical, less ambiguous, orderly & comprehensive.

### 1) Igneous Rocks: (Ignis = fire, meaning very hot):

These are the first formed rocks which had made up the primordial earth's crust. Hence it is called as primary rocks. even though igneous rocks have formed subsequently also.

The igneous rocks are formed at a very high temperature directly as a result of solidification of magma and Lava.

ex: Granite, Quartz.

## Sedimentary Rocks:

Sedimentary are the products of weathering. Since these are secondary materials, the rocks formed out of them are called sedimentary or secondary rocks. The origin of sedimentary rocks is totally related to the weathering influence on rocks.

## Metamorphic Rocks:

These are third major group of rocks occurring in nature. Their mode of origin differs from that of igneous or sedimentary rocks. They are formed from any pre-existing rocks under the influence of temperature, pressure and chemically active solutions.

## Dykes and Sills:

Dykes and sills are the most common forms of igneous rocks. Dykes are discordant, sheet-like, vertical, intrusive igneous bodies.

They occur cutting across the bedding planes of the country rocks in which they are found.

Sills are similar to dykes in being sheet-like, intrusive igneous bodies but, unlike dykes, these are concordant.

Sills are formed due to the penetration of magma into bedding planes of country rocks & their spreading capacity depends on the viscosity of magma.

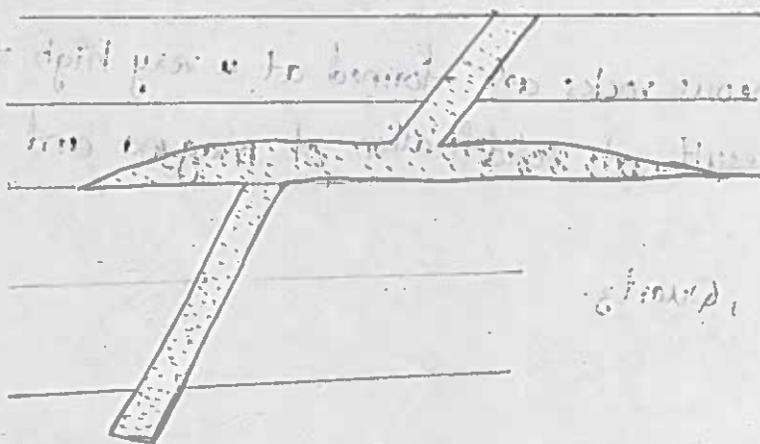


Fig: Dyke & sills  
Unit 3, Pg-35/35