GROUP-A

(Short Answer Type questions)

(Answer all the following questions).

1. Answer the following questions in few words.

ⓐ What is porphyritic texture? 1X5=5

Ans. In porphyritic texture, the larger crystals are surrounded by the fine-grained ground mass.

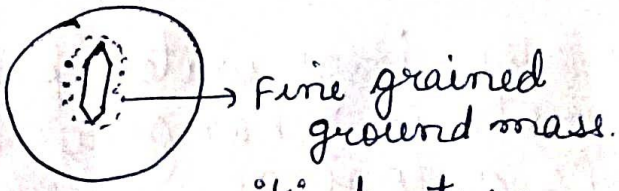


Fig: Porphyritic texture.

ⓑ What is an earthquake?

Ans. An earthquake is a sudden motion of the ground by rapid release of energy. This energy is released when two parts of rock masses ~~so~~ moves suddenly in relation to each other.

ⓒ Define Dendritic pattern.

Ans. Dendritic pattern is also known as tree-shaped pattern. This develops in a terrain which has uniform lithology and where faulting and folding are insignificant.

ⓓ Define Cirque.

Ans. ~~It~~ is a erosional feature of glacier. ~~It~~ It is a ~~semi~~ semi circular or bowl-shaped, excavated mainly by the frost action. It takes the shape of an amphitheater.

Fig: Cirque.

© Define Potholes.

Ans. These are cylindrical or bowl-like depressions in the rock beds. The drilling of the potholes are usually due to eddies of water.

2. Describe erosional features of ~~water and~~ river with neat sketches. 5 Marks

Ans. Several small streams and nalas unite in down hill direction to form bigger stream of flowing water is known as river.

The running water plays an important role in changing the earth's surface. The geological work done by a river is maximum in rainy season whereas it is minimum during summer season. The water which comes on the earth's surface through rain, some % of them penetrate downward as underground water and the remaining flowing on the surface gives the formation of river.

The geological work of river is divided chiefly into three parts —

① Erosion ② Transportation ③ Deposition.

Erosion → The disintegration of rocks and their migration from one place to another place by the action of river water.

River erodes in following way —

① Hydraulic action
② Abrasion
③ Attrition
④ Solution

EROSIONAL F

① Potholes → These are the cylindrical or bowl like depressions in the rock beds. The drilling of the potholes are usually due to eddies of water. Potholes may vary in dimension ranging from a few cm to several metres.

② Water fall → When the river falls from a height and acquires ~~no~~ normal flow against some distance below - such a river gives the formation of water fall.

eg: Gersoppa (Jog) waterfall in Swarati river ~~to~~ Karnataka is the highest waterfall in India.

③ Gorges & Canyons → In initial stage, down cutting erosion by the river is maximum and gives rise to a deep narrow valley with vertical wall, known as gorges or canyons.

The grand canyons of Colorado river in USA is the greatest canyon in the world.

④ Mesa & Butte → An isolated table land area with steep slope is known as "mesa." With continued erosion of sides, a mesa is converted into a smaller flat, topped hill, known as butte.

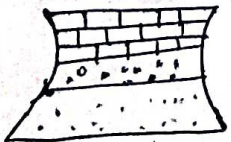


Fig:- Mesa

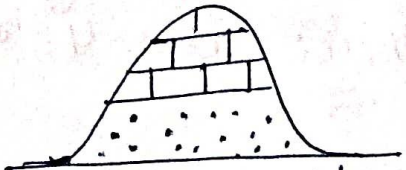


Fig: Butte.

⑤ Hog back → It is a 'cuesta' in which the dip slope and scrap slope are both approximately 45°.

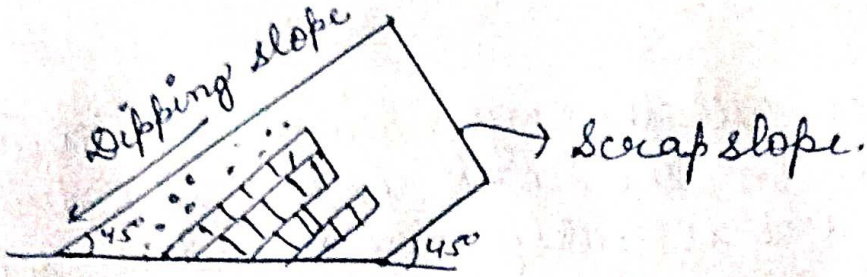


Fig: Hog-back.

⑥ Cuesta → Cuesta has the slope of a symmetrical low ridge with a steep slope on one side and a gentle slope on the other side.

3. Describe hydrosphere. 5 Marks.

Ans. It is a term used for the total body of water of the earth. In other words, all the natural water occurring over below the surface of the earth is known as the Hydrosphere. Hydrosphere includes the ocean, seas, lakes, rivers, ice, snow, as well as underground and atmospheric water.

About 71% of the surface of the ~~world~~ entire globe is covered by oceans and seas. The average depth of the ocean is about 3800 m. The total volume of the world's ocean is about 1.4 billion cubic km i.e; about 97% of the world's free water is made up by the world's ocean.

There are 4-major oceanic bodies —

① The Pacific Ocean
② The Atlantic Ocean
③ The Indian ocean
④ The Arctic ocean.

Composition of water (Sea).

The sea water are more variable than the atmosphere. Sea water is a solution of salt. These salt result in the property of salinity, but the degree of salinity is not the same everywhere. The average salinity of the sea water is 35 parts per 1000 ie, on the average, 1000 gr of sea water contains 35 gr of dissolved solids.

According to Dittmar, the proportion of these solids are as follows:-

1. Sodium chloride – 27.213 gr.
2. Magnesium chloride – 3.807 gr.
3. Magnesium sulphate – 1.658 gr.
4. Calcium sulphate – 1.260 gr
5. Potassium sulphate – 0.863 gr.
6. Calcium carbonate – 0.123 gr.
7. Magnesium bromide – 0.076 gr.

35.000 gr.

Of the various elements combined in these salts, chlorine alone makes up 55% by weight, sodium makes 31%, of all the dissolved matter. Magnesium, calcium, sulphur and potassium are the other four major elements in these salts.

(Group - B (Answer any Three))

4) Write short notes on any three of the following :— (5×3)

(a) **Vesicular and Amygdaloidal Structure :-**

⇒ Most lava contain large amount of gases and volatiles. These gases and volatiles escaped into the atmosphere when they solidify on the earth's surface. Here, there is a decrease in the temperature and pressure. Thus, near the top of lava flow, numerous gas cavities of various dimensions are formed. These cavities are known as "vesicles" and the structure as a whole is known as Vesicular structure.

If these vesicles are filled with some low temperature secondary mineral such as calcite, zeolite, ~~chal~~ etc. such infillings are called "Amygdales" and the rock is said to have an Amygdaloidal structure.

(b) **Earthquake waves or Seismic waves :—**

⇒ During each earthquake, elastic waves are generated at the focus. These waves are called Seismic waves and they travel in all directions with their characteristic velocities.

Seismic waves are of three main types :—

(i) **P-wave :—** These are also called the primary waves, push and pull waves, longitudinal wave and compressional waves. These are the fastest of the seismic waves and are longitudinal in character ie, the particle vibrate in the direction of propagation. These wave pass through solid

as well as liquid.

(ii) S-wave :- These are also called Secondary waves, the Shear waves, the transverse wave or the distortional waves. These wave are transverse in character like the light waves, ie: particles vibrates at right angles to the direction of propagation. Their ~~we~~ S-wave only travel through solid and do not propagate through liquid medium at all.

The p and S-waves are sometimes collectively referred as body waves because they travel deep into the body of the Earth before re-emerging on the surface.

(iii) The L-wave :- These are also called long waves or surface waves because their journey is confined mainly to the near surface layers of the earth. These waves are comparatively inactive and recorded only after ~~reaching~~ arrival of P and S-waves. In character, the surface wave are of two types :-

* The Rayleigh waves :- These are the wave in which the displacement of particle is of a complex nature, partly being in the direction of propagation and partly at right angle to it.

* The Love wave :- The wave in which the displacement of particle is ~~para~~ practically horizontal, that is, in the direction of propagation.

(c) Glacial Moraines and its types :-

⇒ Glacial Moraines may be defined as localised accumulation of glacial debris (fragments of rocks, sand, silt and clay etc) that are found either on the body of an existing glacier or at various places along a glaciated valley of an extinct glacier.

Materials making the moraines of existing glaciers are a heterogeneous mixture of fragments, sediments and particles supplied to the glacier by the weathering of the valley walls and projecting cliffs. The moraines of extinct glaciers, also include all those fragments and particles that the glacier was capable of abrading and plucking during its life time.

~~The moranic material~~

⇒ A number of glacial moraines are distinguished on the basis of their position on the body of an existing glacier or along the glaciated valley of an exinct glacier. Following are the common types of moraines :-

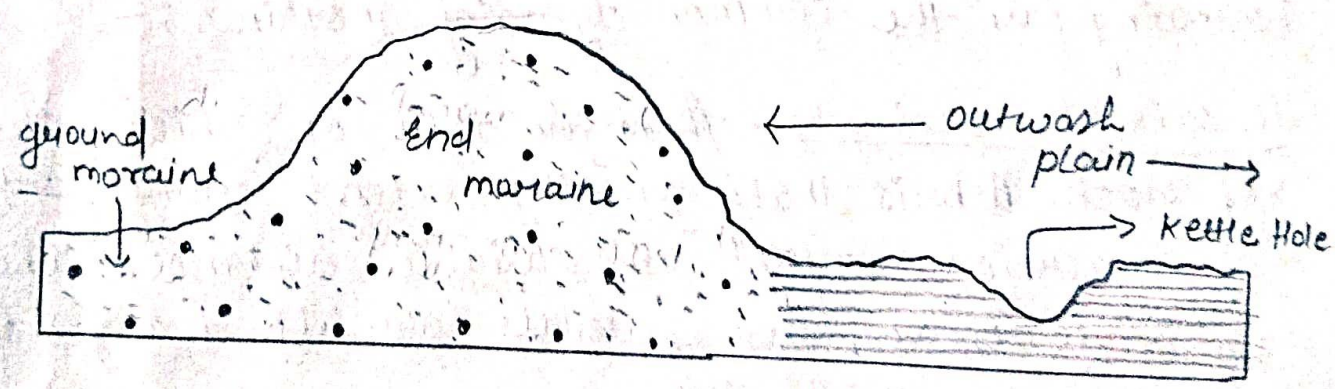
(i) lateral moraines :- These are thin or thick streaks of rock debris that generally extend along sides of a glacier valley for variable distances. When the glacier disappears, these materials are left a ridges along the side of the valley.

(ii) Medial Moraines :- when two or more valley glaciers meet and form a piedmont glacier in the lower reaches of valley glaciers, their adjacent lateral moraines merge together to form a comparatively thick bands of debris running through the central regions of the

composite glaciers. These medial ridges of accumulation ~~from~~ form the Medial Moraines.

(iii) End Moraines :- These are formed as accumulations running across the glacial body at its terminus or end, ie; the place where melting of glacier is so heavy that it cannot move ahead as a body of ice. These are called End moraines or Terminal moraines.

(iv) Ground Moraines :- With the disappearance of a glacier, material embedded along its base is scattered all over the surface of the bed rock. or on the bared ground of the glacier valley. Heap of such material spread irregularly over the floor of glacier valley are termed as ground moraines. Many glaciated valleys are full of such material.



(d) Sand dunes :- Heaps or mounds of sand are generally called sand dunes or simply dunes. These are variously shaped deposits of sand grade particles accumulated by winds. A typical sand dunes is defined as a broadly conical heap of sand characterised with two slopes on either sides of a medial or crest.

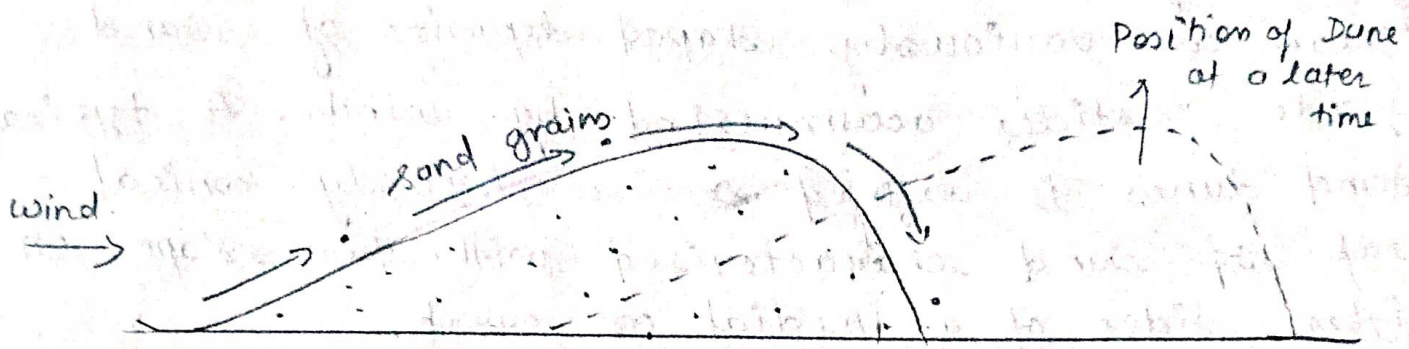
A dune is normally developed when a sand-loaded wind comes across some obstruction, a small bush or raised surface or even a ~~small~~ pre-existing sand heap.

A typical sand dunes is characterised with a gentle windward side and a steep leeward side meeting at the crest. Dunes are generally formed in groups. Such dunes area are called dune complex, dune colony and dune chain.

The height of sand dunes depends on the wind speed and the size of sand grains. Dunes heights of 30 meters are not uncommon.

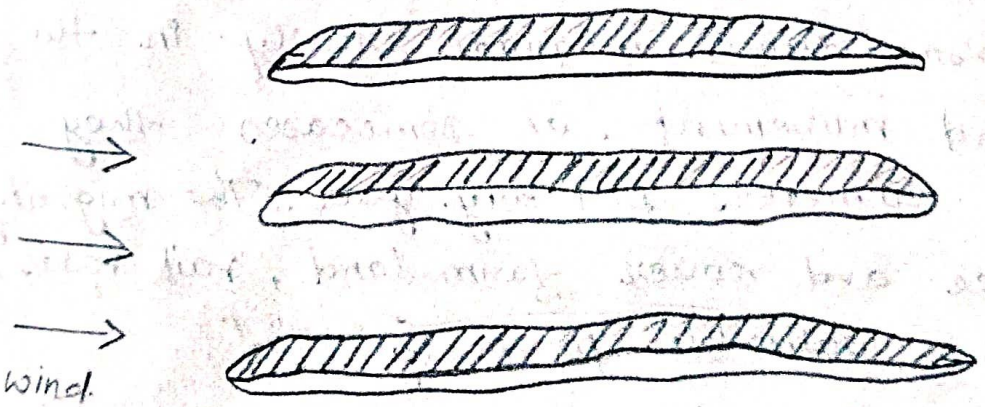
The sand dunes migrate slowly in the direction of wind movement. In somecases they move as much as 20 meters per ~~day~~ year. The migrating dunes may advance and cover farm land, rail roads, highways and other valuable property.

The



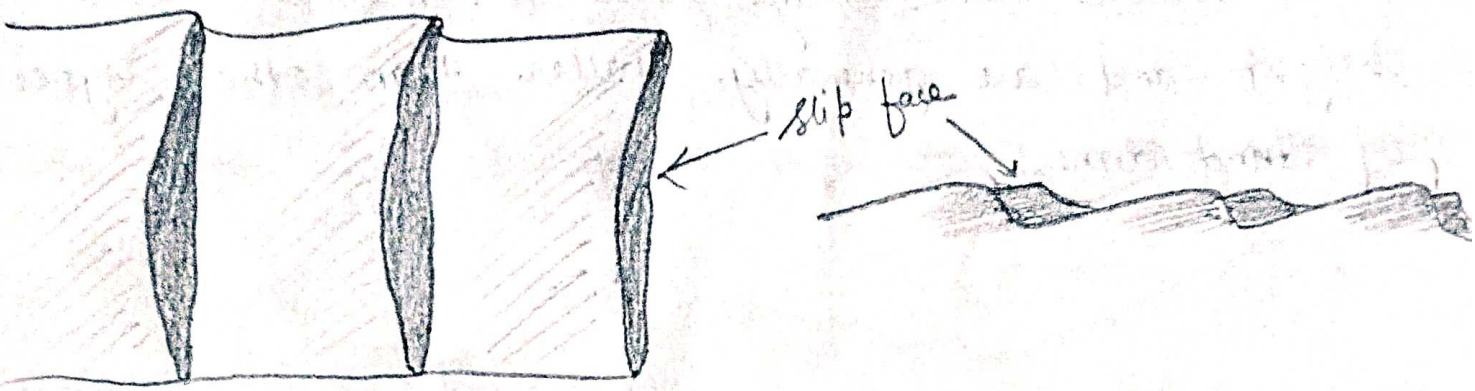
⇒ The sand dunes are of following types :—

(i) Longitudinal dunes :— The dunes which are elongated in the wind direction, are called longitudinal dunes. These dunes usually develop in strong winds in areas where small amount of sand is available. The longitudinal dunes may reach heights of 100 meters and may extend for about 90 km. In the Arab countries these dunes are called seifs because they apper similar to an Arab sword.

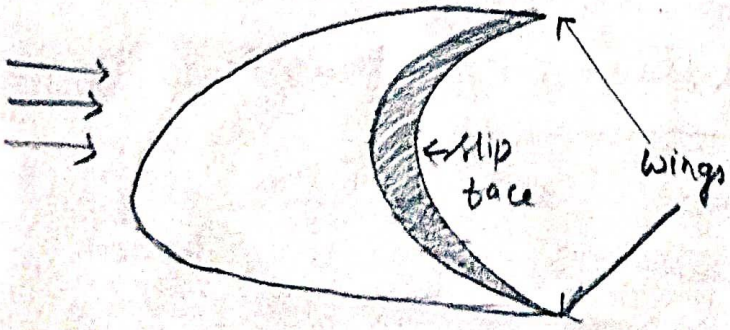


(Slip face may developed on either side depending on direction of wind)

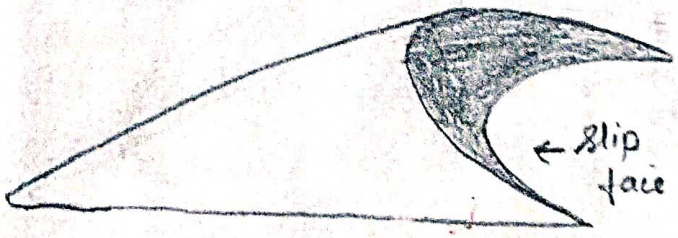
(ii) Transverse dunes :- Transvers dunes have their longer axis at right angles to the direction of wind. They are formed in areas with strong winds where more sand is available.



(iii) Barchans :- Barchans are crescent shaped dunes the convex side of which faces the wind direction. The horns or wings of the crescent point in the direction of wind flow. Barchans are formed where wind is nearly unidirectional. They occur in groups in areas of greatest sand ~~support~~ supply. The height of large dunes does not exceed 30 meters and their point to point length is generally 300 meters.



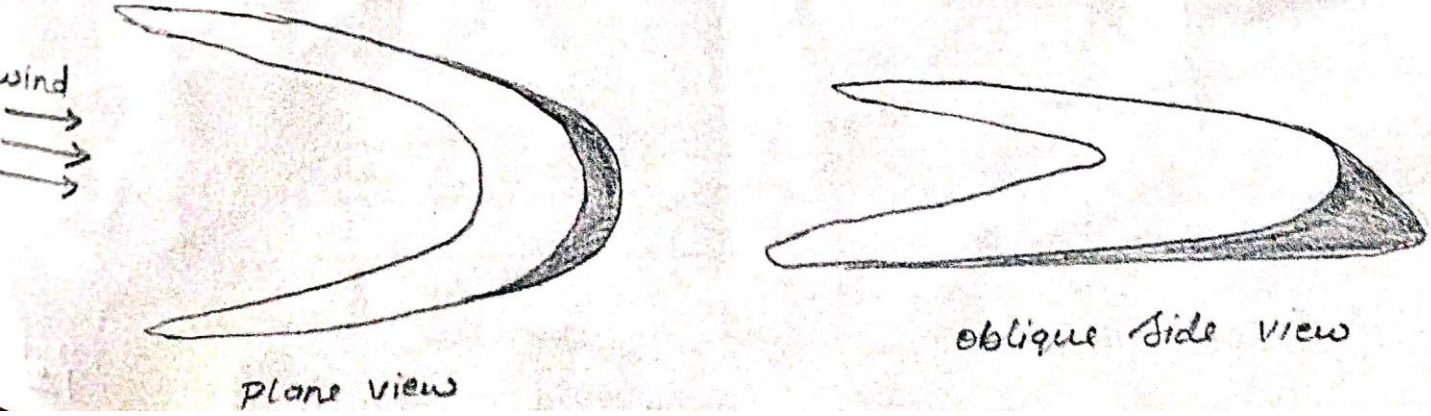
Plane view



Oblique side view

(iv) Star dunes :- The dunes having multiple slip face, high central part, radially extending three or more arms are called star dunes. These dunes are formed when the direction of wind changes a lot. These dunes may grow to a considerable height and are generally taller than other types of sand dunes.

(v) Parabolic dunes :- These are generally developed in the partially stabilised sandy terrains. They are usually U-shaped having convex nose which migrates downwind. These dunes are much longer and narrower than barchans but are always associated with blow out.



Q.5 What is texture of an Igneous Rock? Discuss briefly the types of texture found in Igneous Rocks. 15 marks

Ans The term texture is defined as the mutual relationship of different mineralogical constituents within the body of the rock.

The texture of Igneous rocks is based on three important ~~function~~ factor which are as follows:

(A) ~~The~~ On the basis of degree / Amount of crystallisation i.e,

(B) On the Basis of Size of the grains (granularity)

(C) Fabric, which include :-

(i) * On the basis of Shape of the crystal.

(ii) * On the basis of Mutual arrangement between the grains of crystal and glasses.

(A) On the basis of degree / Amount of crystallisation (ie; crystallinity) :-

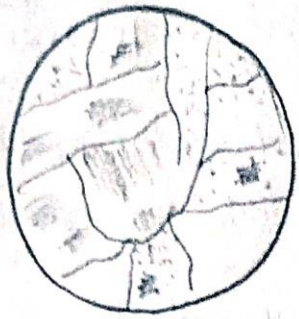
(a) Holocrystalline texture :- When the igneous rock is fully made up of crystals than such type of texture of Igneous rock is called Holocrystalline texture.

(b) Hemicrystalline / Macrocrystalline texture :- It is also known as Hypocrystalline texture. Such type of Igneous rock are made up of both crystal and glasses.

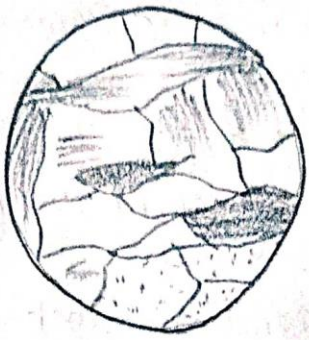
Eg :- Some Sub-Volcanic or extrusive rock.

(c) Holohyaline texture :- When the Igneous rock is fully made up of glasses then such type of texture of Igneous rock is called holohyaline texture.

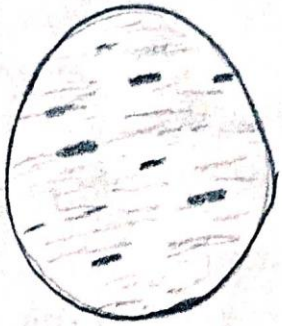
Eg :- Obsidian rock, Pumice, Scoria, etc.



Holocrystalline



Merocrystalline



Holohyaline

(B) On the Basis of Size of the grains (granularity):-

a) On the basis of grains, the texture of igneous rock is classified into two types:-

(i) Phaneric texture:- In such type of igneous texture, the individual grains can be identified by naked eye or with the help of pocket lens (hand lens/magnifying glass). These are of three types:-

(a) Coarse grained texture:- Grains are greater than 5mm in diameter.

(b) Medium grained texture:- Grains are of size between 1mm to 5mm in diameter.

(c) Fine grained texture:- Grains are less than 1mm in diameter.

(ii) Aphanitic texture:- In such type of igneous texture, the individual grains cannot be identified / seen by naked eyes or with the help of pocket lens.

Aphanitic texture is divided into two types:-

(a) Macrocrystalline texture:- In this type of texture the individual grains are identified only under

microscope.

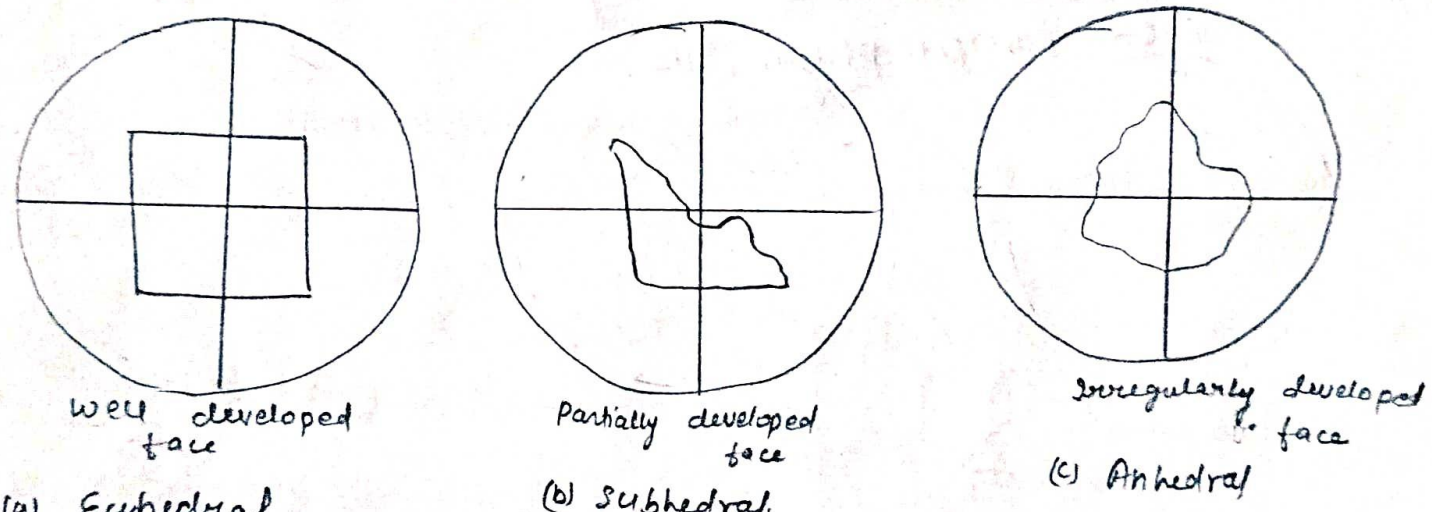
(c) Fabric which include:-

(i) On the basis of shape of the crystal.

(a) Euhedral texture :- The faces / outline of ~~this~~ the crystal are well developed in this type of igneous texture.

(b) Subhedral texture :- The faces / outline of the crystal are ~~well~~ partially developed in this type of igneous texture.

(c) Anhedral texture :- The faces / outline of the crystal are irregularly developed.



(a) Euhedral (b) Subhedral (c) Anhedral

(ii) On the basis of Mutual arrangement between the grains of crystal & glass:-

→ On this basis, the texture of igneous rocks may be broadly divided into four types.

(a) Equigranular texture.

(b) Inequigranular texture.

(c) Directive texture.

(d) Intergrowth texture.

(a) Enequigranular texture:— All the grains of the minerals are more or less of equal size.

Eg:- Most granites ~~may~~ have equigranular texture.

Types:—

(i) Allotriomorphic texture:— crystals are Anhedral.

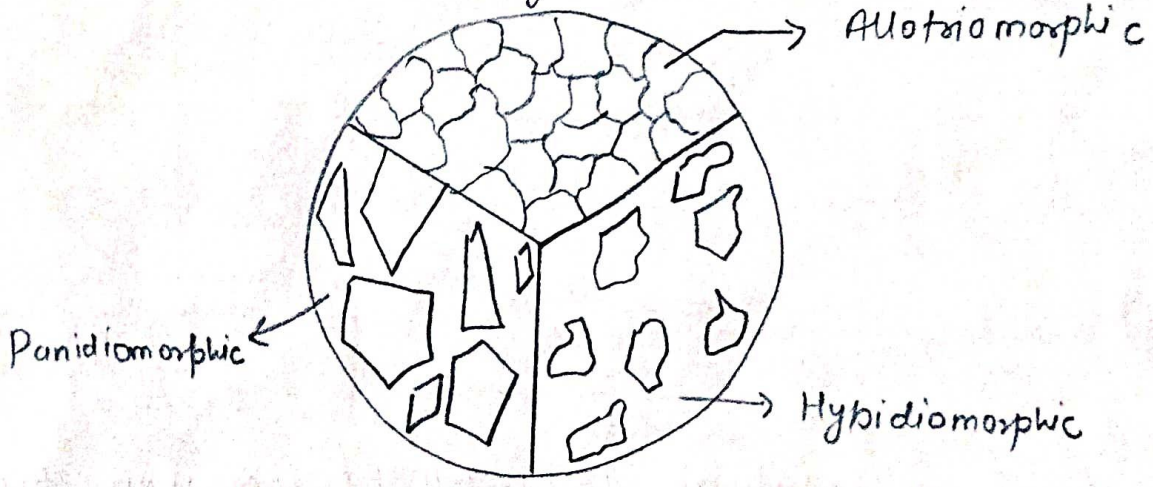
Eg:- Aplite, Mosaic, etc.

(ii) ~~crystal~~ Hypidiomorphic texture:- crystal are ~~Subhe~~ Subhedral.

Eg:- Granites, Gabbro, Syenite, etc.

(iii) Panidiomorphic texture:- Crystal are Euhedral.

Eg:- Lamprophyre, etc.



(b) Inequigranular texture:- The mineral grains forming an Igneous rock showing variation in grains size, the texture is described as Inequigranular texture.

Following are the types of Inequigranular texture:—

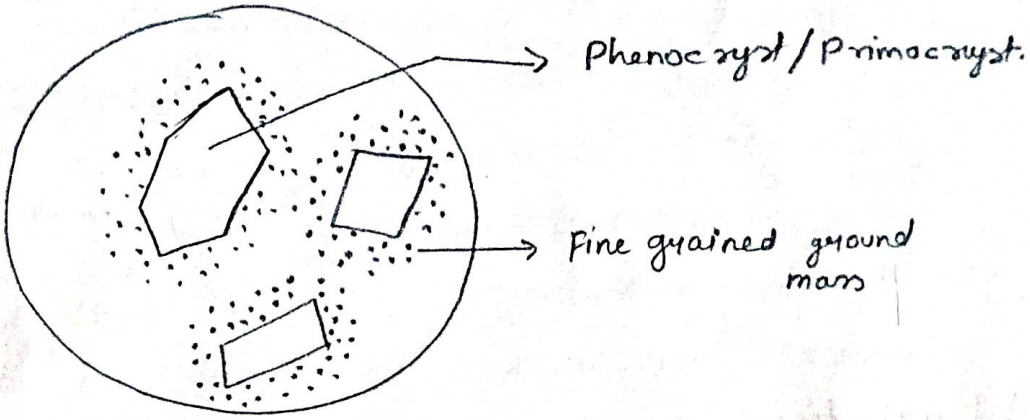
(i) Porphyritic texture:- In this texture, the larger crystal are surrounded by the fine grained ground

mass. Such crystal texture result due to :—
↳ Change in physio-chemical condition of the crystallisation.
↳ Molecular concentration.
↳ Insolubility.

→ For larger crystal, two terms are recognised :—

* Phenocryst :- Cooling of the magma is very rapid, crystallised in shallow depth.

* Primocryst :- It is formed as very deep seated. where cooling ~~the~~ of magma is very slow.



⇒ Types of Porphyritic texture :-

(a) Megaporphyritic texture :- The phenocryst can be identified by naked eyes. It is also known as megacryst.

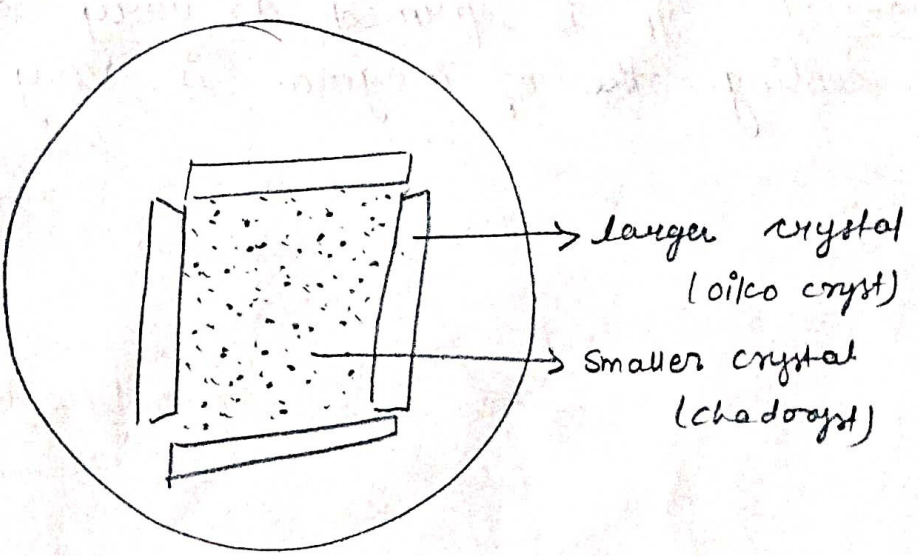
(b) Microporphyritic texture :- The phenocryst can be identified by microscope. It is also known as micro-phenocryst.

(c) Glamerosporphyritic texture :- The phenocrysts are assembled at one spot.

(d) Vitrophyric texture :- The ground mass is glassy (in some Pyt. Rhyolites).

(ii) Poikilitic texture :- It is just reversed to porphyritic texture. It is a variety of inequigranular texture in which the smaller crystals (chado-cryst) are enclosed by the larger crystals (oiko-cryst).

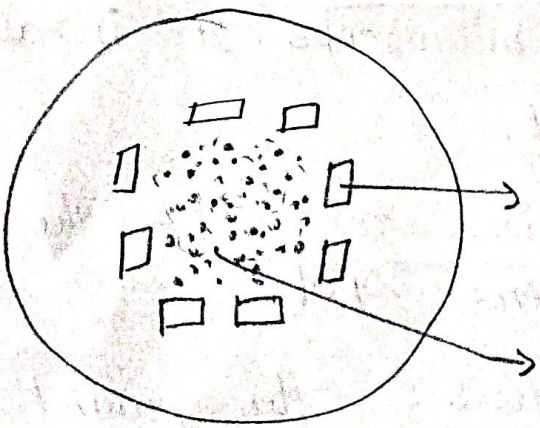
The formation of poikilitic texture is complex and difficult to explain properly. One constituent must be present in larger amount than the other constituent. The larger constituent must be crystallised in the last.



Diag.
Poikilitic texture

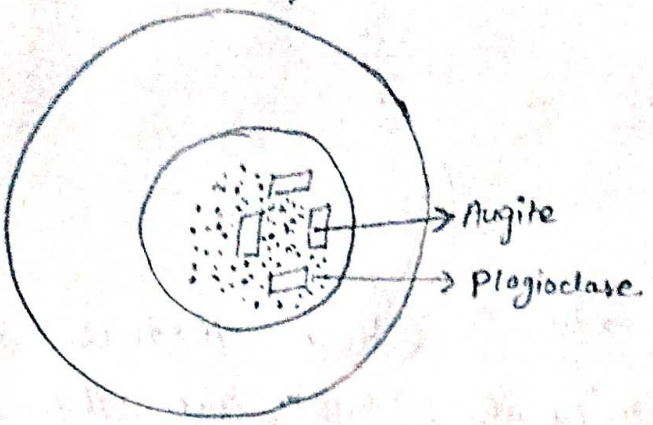
Varieties :-

(a) Ophitic texture :- This is the characteristic texture of dolerite rock. In this texture, the larger crystal of Augite (clinopyroxene) enclosed the numerous thin, ~~crystals~~ grains of labradorite (plagioclase feldspar).



Diag.
ophitic texture.

(b) Subophitic texture :- If the plagioclase are only partially enclosed in the larger grains of augite, then it is known as subophitic texture.



Diag.

Subophitic texture.

(c) Intergranular and Interseral texture :- These are commonly found in basalt.

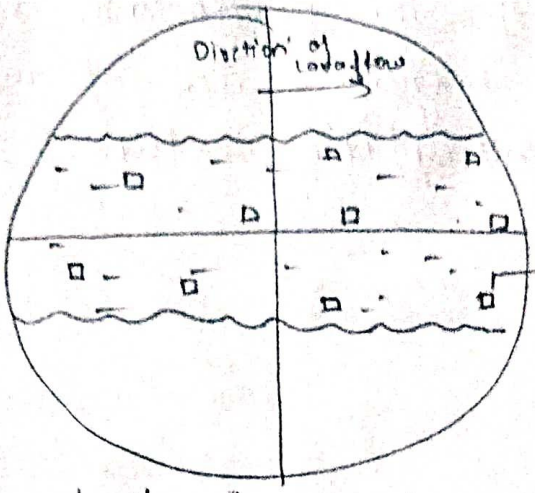
Elongated crystal leave polygonal space between them. If these space are filled up with minute grains of pyroxene, olivine and iron oxide, then such type of texture is called Intergranular texture, and if that space is filled up by glassy material than it is known as Interserfal texture.

(iii) Directive texture :- The texture which are formed due to the flow of magma/lava during the process of crystallisation, are known as directive texture.

The most important directive texture is known as Trachytic texture in which felspar lath are arranged into parallel or subparallel position by flow.

Eg :- Trachyte, Andesite phonolite etc.

Diag.
Direction flow



Felspar lath arranged in parallel or sub-parallel position along the direction of flow.

(iv) Intergrowth texture :- such texture shows intrruption between two minerals. These are the result ~~between two minerals~~. Th of simultaneously crystallisation of the two components of magma.

Graphic texture is the most important intergrowth texture in which there is intergrowth of quartz & k-felspar.

Eg :- graphic granite.

⇒ Varieties :-

(a) Granophyric :- If the irregular paths of quartz are seen intergrowth in felspar then it is known as Granophyric texture.

(b) Perthitic texture :- Intergrowth between albite and orthoclase.

(c) Myrmekite texture :- Intergrowth between quartz and oligoclase.

(8). Describe the following :— 5×3

(a) Dykes and Batholith :—

→ Dykes :— These may be defined as columnar bodies of igneous rock that cut across the bedding plane or unconformities or cleavage planes and similar structures. Generally the dykes are formed by the intrusion of magma into pre-existing fractures. It depends on the nature of magma and the character of the invaded rock whether the walls of the fracture are ~~poost~~ pushed apart ie; it is widened or not.

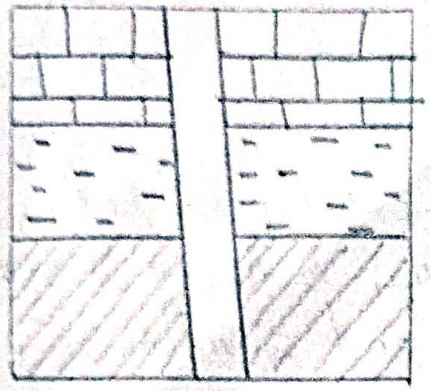
Dykes show great variation in their thickness, length, texture and composition. They may be only few centimeters or many hundreds of meters thick.

In length they may be anything between a few meters to many kilometers.

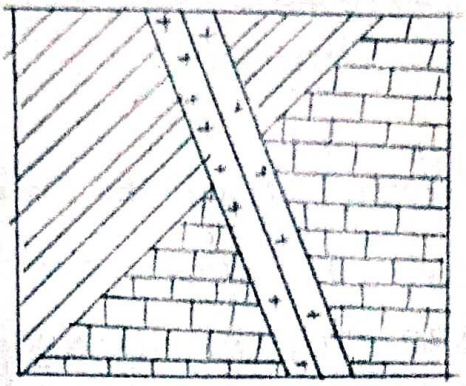
In composition, dykes are genrally made up of hypabyssal rocks like dolerites, porphyries and lamprophyres, showing all textures between glassy and phaneritic types.

Dykes are genrally tend to occur in groups or set. The term dyke-set is used for a couple of parallel and closely spaced dykes. When the numbers of dykes occuring in a limited area is quite large, the term dyke-~~swarm~~ Swarm is used.

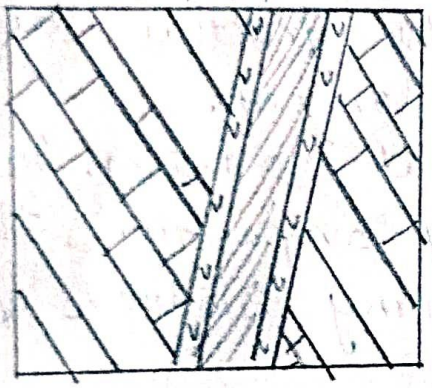
Dykes can be classified as simple dyke, composit dykes and differentiated dykes.



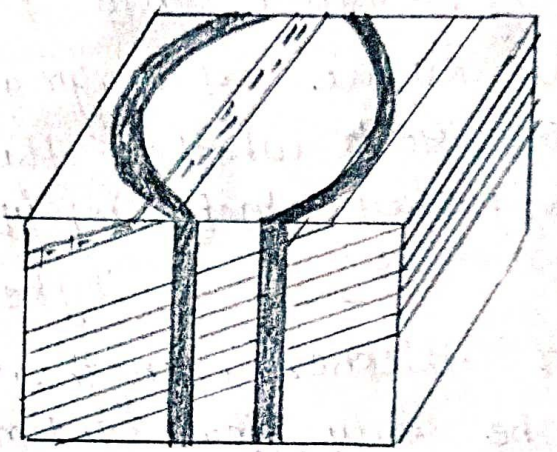
Simple



Multiple



composit



Ring dyke.

⇒ Cone sheet and Ring dyke are considered as the special types of dykes. The cone sheets are defined as assemblages of dyke like injections, which are generally inclined toward common centres. Their outcrop are arcuate in outline and their inclination is generally between 30°-40°. The outer sheet tend to dip more than the inner sheet.

Ring dykes are characterised by typical arcuate, closed ring shaped outcrop. These may be arranged in concentric series, each separated from the other by a screen of country rock. They show great variation in their diameter, their average diameter is around 7km.

a) Batholiths :- These are huge bodies of igneous masses that show both concordant and discordant relations with the country rock. Their diameter vary considerably but it is generally agreed that to qualify as the batholith, the igneous mass should be greater than 100 sq. km in area and its depth should not be traceable. They show extensive downward enlargement.

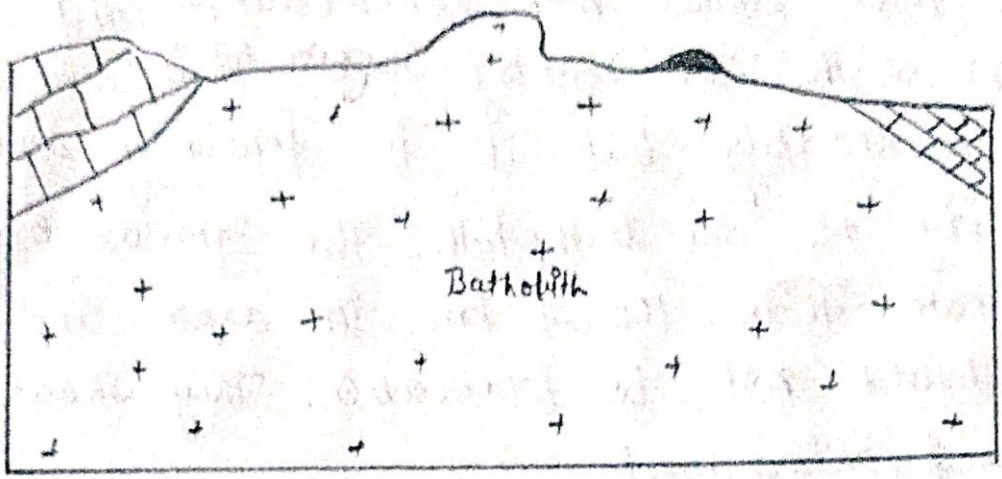
When the surface area of batholith-like igneous mass is less than 100 km, it is commonly termed as Stock.

When such a stock has roughly circular outline (rather than irregular), it is further distinguished as a Boss.

Minor projections of igneous mass from the roofs of batholiths, stocks and bosses are called Apophyses are often observed passing into the overlaying strata.

On composition, batholiths may be of any type of igneous rock. They also exhibit many types of textures and structures. But ~~as a matter~~ majority of batholiths show predominantly granitic composition, texture and structure.

Eg :- (i) Singhbhum Batholith, Jharkhand (8000 sq. km).
(ii) Patagonian Batholith of South America.
(iii) Costa Rica Batholith of British columbia.
(2000 km long & 40-90 km wide)



(b) Magma and its composition :- The hot molten material occuring naturally below the surface of the Earth is called magma. It is called lava when erupted through volcanoes. Igneous rocks are formed both from magma and lava. It is a melt formed at great depth below the surface due to very high temperature related to number of causes such as rise in temperature with depth and also occurrence of radioactive materials.

Lava is however, a ~~thoroto~~ thoroughly studied material that has poured out occasionally from volcanoes in many regions of the world again and again.

Magma and lava from which igneous rock are formed may not be entirely a pure melt ; it may have a crystalline or solid fraction and also a gaseous fraction thoroughly mixed with it.

The solid and gaseous fractions, however, form only a small part of the magma

or lava, which are predominantly made up of liquid material.

In most cases magma is belived to be a sufficiently mobile melt. In fact this mobility is one important quality that enables it to cool down to igneous rock. This is because a magma can exist as a melt as long as physical and chemical environment surrounding it remain unchanged. But as and when there is a change in one or more of these conditions (ie; fall in temperature, or pressure due to its upward movement), cooling and crystallisation of magma may start and end up with the formation of a igneous rock.

There are two main type of magma:-

(i) Acidic magma:— The magma which is rich in silicon, sodium and potassium but poor in calcium, magnesium and iron. Then it is known as Acidic Magma. Acidic magma produces acidic igneous rocks such as granite, Rhyolite, etc.

(ii) Basic Magma:— The magma which is rich in calcium, magnesium and iron but poor in silicon, sodium and potassium. Then it is known as Basic magma. Basic magma produces basic igneous rocks such as basalt, Gabbro, etc.

Acid rocks are also called felsic rock and Basic rock are also called Mafic rock.

(c) Describe the occurrance of Igneous rock :-

a) Magma produced deep in the earth's crust where temperatures are of the order of 900°c - 1600°c. It being lighter than the surrounding rocks, works its way toward the surface.

On the basis of depth of crystallisation of magma, the igneous rocks are classified into two groups:-

(A) Extrusive Igneous rock:- When magma reaches the earth's surface, it cause a volcanic eruption. This eruption generates extensive lavaflows. The rocks formed due to solidification of lava are called extrusive rocks.

The extrusive rocks are also called volcanic rock As the lava tend to cool and crystallise rapidly, the texture of volcanic rock are genrally fine grained or 'glassy. During cooling of lava, the volatiles present in it escape into the atmosphere. Volcanic rocks often contain gas cavities called vesicles. These rocks sometimes show flow structure which is the result of movement in a viscous lava. It is seen as lines and streaks of different colours.

Eg:- Rhyolite, Trachyte, Andesite, Dacite, Basalt are some of the examples of a extrusive volcanic rock.

(B) Intrusive Igneous Rock :- Intrusive Rocks are formed when magma crystallise beneath the earth's surface. Depending on the depth of formation, intrusive rocks are divided into two groups :-

(i) Plutonic Rock :- Rock crystallised at great depth are called plutonic rocks. A magma which is deeply buried in the earth's crust, cools slowly with the retention of the volatiles. As a result the mineral constituents crystallizing from it have time to grow to considerable size giving the rock a course grained texture. The cooling of the magma takes place ~~neither~~ very slow ~~not nor fast but at a medium rate~~. So the grains of the minerals are ~~medium~~ coarse to very coarse sized.

Eg :- Dolerite, lamprophyre, Aplite, etc are some of the examples of plutonic Igneous rock.

(ii) Eg :- Granite, gabbro, Syenite, pegmatite, Diorite, kimberlite, etc are the examples of Plutonic Igneous Rock.

(ii) Hypabassl Igneous Rock :- Hypabyssal rocks are formed when magma solidifies close to the earth to the earth's surface. These rocks occur as injections within the country rocks. Their texture are usually finer grained than those of plutonic rock but coarser than those of volcanic rocks.

The hypabyssal rock commonly show porphyritic texture. Here cooling of magma takes place neither slow nor fast but at medium rate. So the grains of the minerals are of medium sized.

Eg:- Dolerite, lamprophyre, Aplite, etc are some of the example of Hypabyssal Igneous rocks.

⇒ <u>On the basis of mineral content, the Igneous rock is classified into two types:-</u>

(i) <u>Monomineralic Rock:-</u> The rock which is made up of single type of mineral (greater than 90%), then it is known as Monomineralic rock.

Eg:- Quartzite (Quartz), Amphibolite (Amphibole), Anorthosite (Anorthite), pyroxinite (pyroxene), Dunite (olivine) etc.

(ii) <u>Multimineralic Rock:-</u> The rocks which contain more than one type of mineral.

Eg:- Pegmatite, gabbro, granite, Sandstone, Dolarite, Synite, clay stone, etc.

⇒ <u>On the basis of silica content, the Igneous Rocks has been classified into four types:-</u>

(i) <u>Acidic Igneous Rock:-</u> These rocks contain more than 65% silica.

Eg:- Granite, Rhyolite, granodiorite, pegmatite, etc.

(ii) Intermediate Rocks :- These contain Silica between 55% and 65%.

Eg :- Diorite, Syenite, Andesite, etc.

(iii) Basic Igneous Rock :- Igneous Rock which contain silica between 45% and 55%.

Eg :- Gabbro, basalt, dolerite, etc.

(iv) Ultrabasic Igneous Rock :- These contain Silica less than 45%.

Eg :- Peridotite, dunite, pyroxenite, kimberlite, etc.

(4) (1) Explain in brief the wegener's theory of continental drift and give evidences that support this theory. 15 marks

⇒ continental drift :— It refer to the horizontal movement (lateral movement) of the continents on a vast scale.

⇒ wegener's hypothesis of continental drift :—

⇒ Alfred wegener (1910 - 1912) proposed that, till the end of carboniferous period, the present day continents were united together to form a super continent called Pangea. It was surrounded by a would ocean called Panthalasa.

According to him, the Sial floating on the viscous Sima. The continents were drifted westward and equatorward under the differential gravitational forces.

⇒ Evidences :—

⇒ wegener's hypothesis of continental drift was based on certain paleontological and Paleoclimatic data available at the begining of this centuary. Some of these are as follows :—

(i) wide spread glaciation toward the end of Palaozoic era (carboniferous period) found on the continents of Southern hemisphere such as. India, Australia, South America, etc support the idea of continental drift.

(ii) (ii) The occurrence of Glossopteris flora in the Southern America, India, Africa, Australia also suggested that they were united till late Paliozoic.

(iii) (iii) There is much similarity of pre-cambrian rocks of centeral africa, Medagascar, Brazil, south-india and Australia.

Early mesozoic lava flows and sedimentry rock with coal were found in India, Africa, South America, Australia and Antarctica. But yonger rocks in this locality are quite dissimilar indicating the older rocks sequence formed together as a single unit.

(iv) Poler wandering:- The paleoclimate data of wegner shows the shift of climate belts through geologic time which is related to the apparent movement of geographic north and south pole.

There may be two alternative explanation which are as follows:-

(a) Poles had actually mood moved but the continent were Stationary.

(b) continents had actually moved but the poles ware stationary.

=) wegener found that continents moved and poles were stationary.

(v) There is a continuity of tectonic trends of the blocks in countries like centeral Africa, Medagascar, Southern India, Brazil and Australia across their present boundaries.

According to wegener, all the sialic layer was concentrated in a large continental mass (the pangea) and was un-affected till the end of the carboniferous period. In the late Paleozoic, probably during permian or in the early mesozoic time, the pangea broake into peice and separated continental block began to migrate away from each other.

The southern part of the pangea broke during mesozoic and the northern in the tertiary period. The force responsible for fragmentation of pangea was tidal force or lunar-solar attraction as well as the earth rotation. Some force caused the drift toward the equator and the other toward the west. The drift of continents away from the poles was named Polflucht by wegener which means flight from the poles.

⇒ Palaeomagnetism :— Paleo means Ancient.

△ According to the study of paleomagnetism, it is possible to find out the earth's magnetic field during different geological past / period. It has been observed that the poles position of the planets are different from geological past and by

joining these poles, a curved is obtained which is known as Polar wandering curve. It is seen that the polar wandering curve drawn for different continents are not parallel which confirm continental drift.

According to the result obtained from paleomagnetic studies, the north pole had at one time been very much further from India that is at present. This indicate that there had been a rapid northward drift of India.

(8) Describe Bowen's reaction series and its significance. 15 marks

→ The process of magmatic differentiation by crystal fractination was infact imphasised by N.L. Bowen in the clastic book, "The Evolution of Igneous rock (1928)". Bowen considerd that how a primary magma (Basaltic) may solidify as a single rock type or may give rise to many rock types.

According to him, as crystallisation proceed, there is a tendency for~~maint~~ maintaining equilibrium between solid and liquid phase. The various mineral precipitating from a melt usually crystallises simultaneously. In the mixed crystal system a earlier formed minerals reacts with the melt and form a new mineral. The two adjacent mineral so related in the process for a reaction pair, the temperature range for Bowen's reaction series is approximately 1100°C to 573°C.

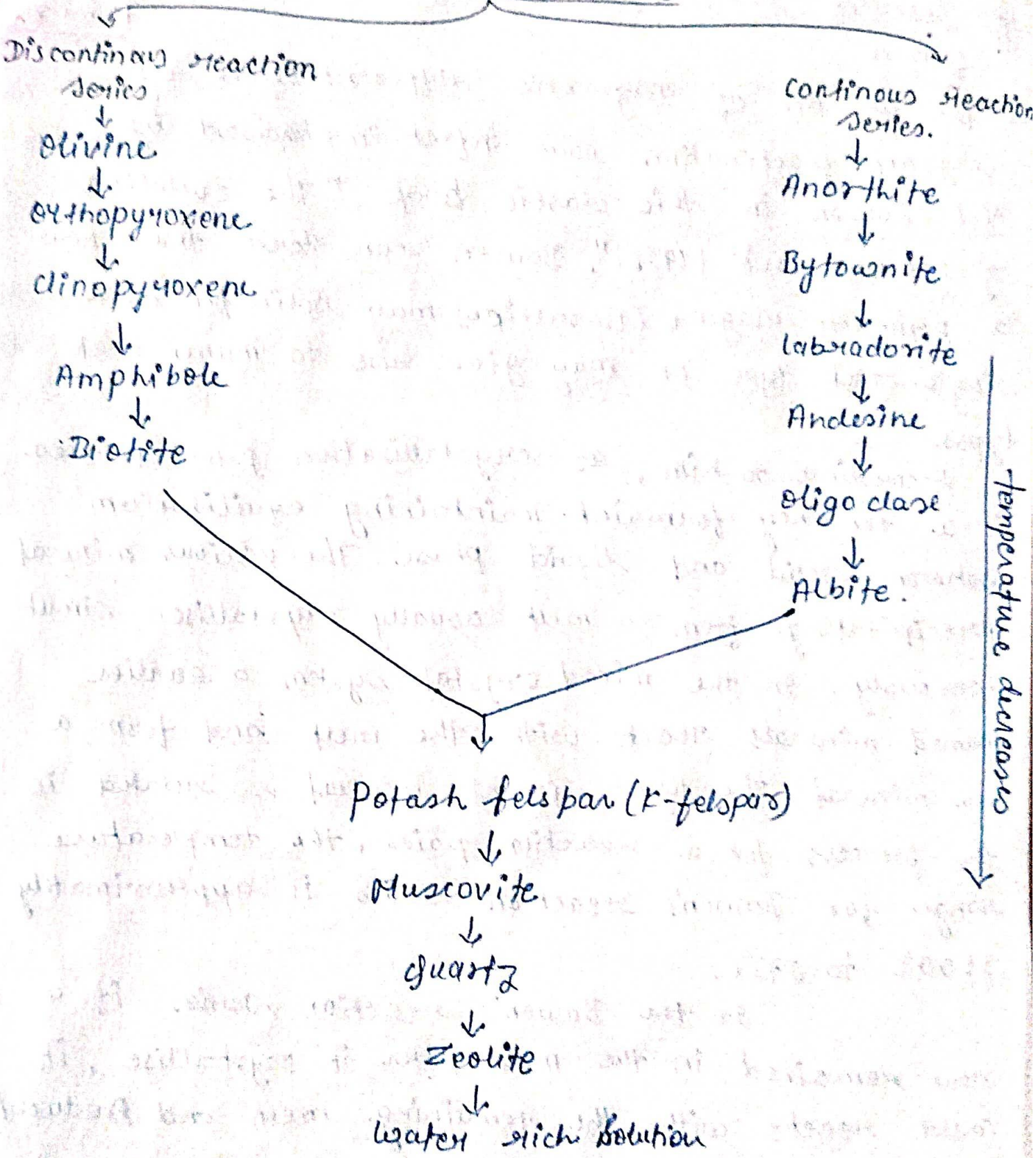
In the Bowen's reaction series if a new remained in the melt after it crystallise, it could reacts with the remaining melt and produced the next mineral in the sequence

During this crystallisation, two different types of reaction series are formed:

(i) Discontinous series.

(ii) continous series.

Bowen's reaction series



(1) Discontinous reaction series — The 1st mineral to crystallise in this series is Mg-olivine further it reacts with remaining liquid or melt and convert into the pyroxene which then convert to Amphiboles and then to Biotite. "The greater the

degree of fraction, the more extensive is reaction process". A reaction rim is then formed in which the earlier formed mineral are enclosed with the later formed minerals of the series. Thus, olivine is surrounded by pyroxene, pyroxene is surrounded by Amphibole and amphibole is surrounded biotite. This series show incongruent melting, ie; they have no fixed melting point. A mineral when heated breaks into solid and liquid.

Eg: (i) Orthoclase at 1170°c breaks up into liquid to leucite.

(ii) Mg- pyroxene break up into olivine and liquid

* Two adjacent discontinous reaction series are said to form a Reaction pair.

(iii) Continous series :- Minerals form a solid solution series of plagioclase and crystallisation of plagioclase series, in the magnetic liquid with the decreasing temperature. This series is a mixed crystal series. There is a zoning of plagioclase in which early formed minerals of the series, ie; calcic minerals are surrounded by sodic mineral.

The members of continous reaction series exhibit solution forming, "Isomorphous series" with falling temperature, there is a continous reaction between the melt and precipitation crystal and thus, the composition of crystal are continously

being changed. Such a solid solution series is called "continous reaction series".

⇒ Significance of Bowen's reaction series:-

(i) It illustrate how a primary magma may solidify as a single rock type or may give rise to many rock types. The primary basaltic magma may solidify as Gabbro consisting of olivine and calcic plagioclase or it may give rise to rocks varying from dunite through Gabbro - diorite - Tonalite - Granodiorite to Granite, depending upon the degree of fractionation and the extent to which the early formed minerals are removed from further reaction with the melt.

(ii) It explain the phenomenon of fractional crystallisation.

(iii) It explains the formation of mono-mineralic rocks such as Anorthosite, Dunite, etc.

(iv) The atomic structure became more complicated from olivine to quartz.

(v) Early formed crystal are denser than the late formed crystals of the continous reaction series.

(vi) It explains the phenomenon of zoning in plagioclase (Continous reaction series) and the reaction pair between the minerals of discontinous reaction series.

Zoning :- The zoning is a compositional variation found in the crystals.

(vii) The phenomenon of incongruent melting is shown by discontinous reaction series.

(viii) It explains the phenomenon of "Deliomorphism". The partial failure of reaction between olivine and liquid results in the inrichment of the liquid in silica and the final crystallised product may be mixture of olivine, pyroxene and quartz. In this case, the quartz is called "Released minerals." Rock containing released mineral are called "Deliomorphic rocks" and the process is called Deliomorphism.