

Hello students, this is DSC GEC102

Paper is introduction to petrology module name

is mode of occurrence of igneous rocks Part One module number is 4.

Here you will learn about various

modes of occurrence of igneous rocks.

First one intrusive rocks

second one dykes

which could be radiating

arcuate, ring or cone sheets,

volcanic necks and sills,

third one is laccoliths, phacoliths, lopoliths, batholiths

and stocks and bosses.

Students will be able to differentiate

between intrusive and extrusive

rocks, distinguish a dyke and a sill

Know various types of dykes

Intrusive forms of igneous rocks

intruding magma may occupy spaces

And openings of various shapes and sizes.

Sometimes these openings,

such as fissures, joints,

etc may be pre-existing.

Very often, however,

the openings are created due to forceful

injection of the invading magma.

The shape of deep seated plutonic

bodies also depends on the rate

and the manner in which the

melting takes place to form magma.

Some of this magma may even solidify

at the site of its formation,

which is called as in situ with little or no transport

Forms of intrusive igneous rocks

are termed as concordant

when the igneous rocks penetrate along

and remain parallel to the structure

of the rock that is intruded. Here,

the structure of the rock could mean

sedimentary bedding or metamorphic foliation.

The term discordant is used to describe

igneous rocks that cut across structures

like bedding planes of the surrounding rock.

This means that two types of magmatic intrusions can occur.

One is parallel to the pre-existing feature of the rock.

The second one is in any other direction other than being parallel to the pre-existing structure in the rock.

This pre-existing structure could be existing foliation or bedding planes.

Forms of igneous rocks are of two types, discordant and concordant. In discordant.

We have dykes, ring dykes, cone sheets and volcanic necks. In concordant,

We have sills,

Laccoliths, lopoliths, batholiths, stocks and bosses and phacoliths.

It's we are going to look at each one of these in the following slides.

Dykes these are discordant tabular igneous intrusions.

As you can see in this image you can see that the rock has pre-existing layers which are shown

with different colors like purple,

Blue, brown,

Grey and red,

within which a magmatic body is  
represented by a black thick line.

Now this igneous body has

intruded against the parallelism

of the pre-existing structure

that is bedding plane and hence

it is a discordant body.

The another picture is a block diagram

where we can see that there is a

magma chamber beneath this magma from

the Chamber moves to the surface.

Through cracks which are vertically

oriented in this block diagram.

This magma that moves from the

magmatic Chamber upwards it cuts

across the pre-existing structure and

hence these red lines that you see

here are the dykes. So dykes when

exposed they exhibit thickness is  
wearing from few inches or centimeters  
to even 100 meters or more,  
but the thickness rarely exceeds.

50 meters. Now this magma that moves from  
this Chamber in this block diagram,  
it moves upwards,

the surficial expression of this dyke is  
a line which is represented by this feature,  
so the thickness of this feature could be  
as great as even hundreds of kilometers,  
but never exceeds 50 meters. In length  
however, the dykes may be several  
kilometers long.

Very often the length can be measured  
in 10s or hundreds of meters  
before the dykes taper out. Dykes often occur in swarms where  
they may form a network or pattern  
of interconnected dykes and sills.

Sometimes dykes may form a radiating  
Pattern. Whenever a channel or

A fissure along which an intrusive mass of earlier origin exists, is refilled that is occupied side by side by magma of the same composition results in the formation of multiple intrusion.

If however, the magma intruding later is of a different composition from that of the previous intrusive, the form is described as

Composite intrusion.

In this photograph you can see that there are several intrusions.

This is 1 intrusion on the side of which there is another intrusion on the side of which there is a third intrusion on the other side there is an intrusion here, and there is an intrusion here, and hence we can see this is the first intrusion.

This is the second intrusion.

This is the third intrusion then 4th, 5th and 6th.

There are six intrusions that  
could be seen in this photograph.

These are examples of multiple intrusions.

When the composition of the magma changes  
and you have different compositional rocks,  
that type of multiple intrusion is  
called as a composite intrusion.

Ring dykes are occasionally arcuate in nature,  
and sometimes the curvature may be complete,  
resulting in a circular ring  
like outcrop on the surface.

When exposed,  
hence we can see that the  
dykes are ring shaped.

As we can see the planar view of this block diagram.

These are the ring,  
like it's represented here.

To recall this is a dyke straight linear  
feature that we discussed sometime back  
whereas this is a ring like the whole dyke  
would be cylindrically or cone shaped,

tapering either upwards or downwards.

So in case of ring dykes the

tapering is generally upwards.

That is widening downwards,

so this expression of the intrusion

on the surface is shown by this,

widening downward expression

in the subsurface.

It is shown in this block diagram.

Also, the width between the dykes

It widens as you go deeper and

deeper towards the magma chamber.

The magma chamber is situated here.

Ring dykes are formed when Magma fills

up fissures that are formed earlier.

These cracks are formed.

Due to partial collapse of

the roof at a quieter period,

which the magma was temporarily

cooling and shrinking,

later rejuvenated magma fills these openings,

forming ring dykes.

Cone sheets have the opposite nature

of opening, which is upwards. cone

sheets are believed to form

when magma occupies fissures that it

generates while up arching overlying rocks.

This magma that is at a depth.

It pushes the overlying rocks,

thereby causing cracks in

them which are widening upwards.

When the magma chamber is Dome shaped,

the cracks that develop

due to tension are curved,

circular and spread out upwards.

These are filled with intruding magma

forming cone sheets.

Volcanic necks

These are igneous masses that fill

up the events of ancient volcanoes.

They may completely occupy

the cylindrical channel.

Or maybe intrusive around

and into the agglomerate.

That is the fragmentary material

which partly fills it.

Volcanic necks may throw off sills and

dykes into the surrounding strata,

and may sometimes even pass

literally into lava flows.

This is a block representing a volcanic neck.

In fact, it is representing magma chamber

and then giving rise to a volcano.

This orange portion is the magma

chamber through which the magma is now.

Getting erupted outwards.

So this part which is shown here are

representative volcanic neck

This results when the magma that

moves through this neck solidifies

into a solid rock.

This surrounding material gets

eroded over period of time this

volcanic connect throws off.

Sills and dykes throws,

meaning it gives rise to dykes and sills.

For example.

This is a sill which is marked in red.

Whereas this

is a dyke that is also marked in red

This volcanic neck may also

pass laterally into lava flows.

The lava that flows on the outside.

Hence this lava that is flowing

on the outside. It is shown here.

Hence here it is flat over a period

of time when this material gets eroded

it will look like the volcanic neck

is being graded into the lava flow.

We have an example here.

This is a ship rock.

And associated dykes picture is taken by

NASA in 2006, which the Terra satellites.

The colors shown represent

infrared wavelengths.

Now here.

To make matters simple,

this is the scale at which we

have to look at this photograph.

This bar represents around 8 kilometers.

This is a volcanic neck.

This is 1 dyke.

This is another dyke this is the third

dyke this is a photograph of a ship rock,

a cross section of a photograph.

Shiprock, New Mexico,

USA.

Here we can see the volcanic neck.

This is the place from where

Volcano had erupted seals.

These are similar to dykes except they

are concordant and often have horizontal

or near horizontal disposition.

Now sills in contrast with dykes

they move parallel to the structural

features of the rock which means that

these are the layers of the rock.

The magma that moves parallel to

the layers of the rock and then gets

solidified is known as a sill. In dimensions

They are very similar to dykes and

often occur in combination with dykes.

Hence here in this block we can see

that the magma from the magma chamber

has intruded into the overlying

rocks. This part is called as a dyke

whereas the magma that moves along the

structural grain is called as a sill.

Hence we have a sill here.

We have a another sill here,

followed by another sill here and then

We can also see there there is one sill here.

More sills can be seen

in the block

Laccoliths.

These are a Dome shaped medium

sized concordant intrusions.

A type of sills,

the magma that forms laccoliths is

acidic and viscous and therefore it tends

to pile up rather than flow freely.

The result is that the overlying

sedimentary beds are up arched

Laccoliths when exposed to may occupy

a few 100 square meters in an area that

is often circular to elliptical in shape.

Hence Laccoliths are also a type

of sills which remain parallel

to the structural grain of the

rock like bedding planes.

But in this case we have a magma

that is acidic in composition.

This composition does not allow

magma to move freely through rocks

as the magma is highly viscous.

Hence the magma tends to pile up.

At a place where it piles up at a

place more and more magma as it is squeezed from the bottom to the top, it also pushes the overlying rocks, resulting in uparching of the rocks.

This type of intrusion is called

As a laccolith.

In contrast with LACCOLITH we have lopolith

it's which are a gigantic saucer shaped conquerant intrusions.

Their diameter is often 100

kilometers or more.

The maximum thickness is 1/10th

to 1/20th of the diameter.

And decreases towards the periphery local.

It's are made up of basic magma

which is denser than the rocks

through which it penetrates.

The result is that after penetration

the underlying rocks begin to

sag downwards with weight.

The lopolithis mass itself bends

downwards along with the overlying rocks.

In this block image we can see a lopolith

It's where magma chamber is not shown,

but a dyke is shown

That is a passage along which the magma.

travels and it starts accumulating at

this layer as it starts accumulating,

in contrast with the laccolith

where we have acidic magma.

In this case,

we have a basic magma which is very heavy.

Now in this case this heavy magma,

as it piles up,

it pushes the underlying rocks

and they get sagged downwards.

This feature is called as a lopolith.

It a single lopolith is believed to be made up of

magma from several. Intrusive phases

When exposed by erosion a local,

it may occupy several 100 square kilometers.

The rocks formed our course grained,

that is gabbro a single lopolith

could come could be comprised

of several magma intrusive phases.

Means that several times this

intrusion must have taken place.

That is,

supply of magma has taken place in

this type of intrusion and hence

it has become heavy

And it is sagged.

We have phacoliths

which are also types of sills

during folding.

The crests and troughs of folds become

regions of tension and weakness,

while the limbs in between are compressed.

The igneous material,

when present, tends to find its

way into crests and troughs,

exhibiting double convex lens like forms.

Such bent forms occupying,

crests and troughs.

Of folds are called as phacoliths

It's in this block diagram.

We can see black colored phacoliths

which are presented,

crests and troughs.

Then we have large sized intrusions.

Which are called as

batholiths stocks and bosses.

Batholiths are discordant rock

bodies of extremely large size,

so much so that their exposures

upon the surface are expressed in

terms of 10s or even hundreds of

miles there of extremely irregular

outline and appear to widen

gradually with increasing depths.

The illustrated diagram

here shows you a batholiths.

In fact a batholith means.

A huge magmatic chamber

that has been solidified.

It has a huge dimension in this block

diagram that we have used all these slides.

The batholith lies at the bottom.

It is a huge magma chamber that has

supplied magma at different locations.

At the top batholiths of comparatively

smaller dimensions are described

as stocks and stocks of circular

outline are known as bosses now.

This terminology is dependent on this scale.

So smaller sized intrusions

are called as stocks,

whereas circular sized stocks are called bosses

This boss is these are the references

used to make this presentation,

thank you.