Hello students, I'm doctor Manoj

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This lecture is scheduled for TYgeology students for the course

on igneous petrology. This is the first unit of this course.

And module number is 7. The topic for today's lecture is Mode of

occurrence of igneous rocks. In this lecture we will discuss

about mode of occurrence of igneous rocks, that is plutonic,

igneous rocks. Hyperbyssal igneous rocks and

volcanic igneous rocks.

At the end of this lecture,you'll be able to define.

Plutonic igneous rocks. Hyperbyssal igneous rocks and

volcanic igneous rocks and also you will be

able to describe the general characteristics of these

rocks. So based on the mode of formation, the igneous

bodies are broadly divided into two categories, namely

intrusive, igneous rocks, and extrusive, igneous rocks.

When the magma is emplaced in the Earth's crust at great depth

the body that solidifies is called as

intrusive igneous body.

Whereas if the magma successfully reaches onto the

surface of the earth and then solidifies on the surface of the

Earth, then that body is called as extrusive igneous rock. The

intrusive igneous rocks cut across the structure of the

country rock for example. In this diagram I have drawn this

layers with different colors. They are the sedimentary rocks

and this is the magma chamber.

The magma if it intrudes and cuts across the structure, that

is the stratification of the country rock, then

the rock is called as discordant to the country rock,

whereas if it flows parallel

to the stratification of country rock. It is called as

concordant igneous rock.

The intrusive igneous rocks are of two types, Plutonic igneous

rocks are high those rocks when the magma intrudes

the crust at deeper levels. This is the surface

of the Earth.

And this magma has intruded at great depth and then solidified

at great depth. Such a body is called a plutonic igneous rock,

whereas if the magma intrudes.

Through a fracture or a

vent and solidifies at shallow depth, not very great depth,

Shallow depth in thus crust, then that body will be called

as hypabyssal rock.

Whereas if the magma

Successfully reaches the surface of the earth and then

solidifies on the surface of the Earth. Then that will be called

as volcanic igneous rock.

Coming to plutonic igneous rocks.

So as I said, this is the magma

chamber. If the magma intrudes the country rock or the Earth's

crust at great depth.

The rock will be called as plutonic igneous rock.

The depth is very important. It should be at least more than

five or 10 kilometers.

Such bodies are usually large in

dimensions. Large meaning…

the width may be

few kilometers, the length may be few kilometers as well and the

height of the body, may be few kilometers, so they're really

big bodies. So when magma intrudes

with such a large volume,

an intrusion at such

great depth, the magma itself has a high temperature more than

1000 degrees, and the adjoining rock is also at a very high

temperature that is maybe around 7 or 8 hundred degrees, so the

temperature gradients are not high, therefore the

heat will not be lost very

easily. So the magma body cools very slowly. This allows

crystals to grow to larger size because the cooling is slow.

There are very few centres of

crystallization and there is sufficient time for material to

move towards the centre of crystallization. That is,

diffusion is better and therefore minerals grow to

a larger size. And therefore, most of the Plutonic igneous rocks are

coarse grained. This is a very characteristic property of

plutonic igneous rocks. That they're coarse grained.

And such bodies are exposed on the surface of the earth only.

If there is uplift of that body to the surface of the earth that is

either by orogenic or epirogenic movements or the top

layers are eroded completely and then only the body is exposed on

the surface of the earth.

So therefore, it is very difficult sometimes to establish

the true dimensions of such bodies. They appear to grow

larger and larger as you go deeper inside because their

exposure depends on the erosion process. So if the erosion is more

the body is exposed more. If the erosion is less, the body is

exposed less so therefore it is very difficult sometimes to

establish the dimensions of such igneous bodies.

Coming to hypabyssal igneous rocks.

Solidification of magma during its journey to the surface of

the earth at shallow levels in the crust, results in hypabyssal igneous rocks.

As I said, this is the magma chamber,

and when the magma.

tries to reach the surface of the Earth.

But it stratifies on the way. Then,

that rock will be called as Hypabyssal igneous rock.

Such bodies are comparatively smaller than the Plutonic igneous bodies.

They are small size to medium

sized. Now because they solidify at shallow depth

where the adjoining rock is also at less temperature, the

magma is at very high temperature, may be around

1000 degrees, whereas the adjoining rocks may be at

lesser temperature 200-300 degrees centigrade like

that, so therefore,

the magma that comes in contact with the country rock

solidifies. Suddenly there is a rapid cooling and therefore at

the contact the body is usually fine grained or as we move

towards the axial region of the

body the minerals have more time to grow. The cooling is

little slower comparatively, and

therefore, medium grained crystals are formed, so

therefore, most of the Hypabyssal igneous

rocks are medium grained.

And this is a characteristic property of hypabyssal Igneous

rocks also at the contact such bodies show closely spaced

jointing. There is a cooling effect of the contact on the

magma. So, wherever there is a contact of the country rock

with the igneous body, there will be closely spaced joints,

whereas as you move towards the axial region of the body the

the joints are widely spaced.

And this is also a characteristic feature of hypabyssal igneous

rocks.

Coming to volcanic igneous rocks.

When the magma

successfully reaches the earth

surface in the form of a volcano

and spreads out on the surface,

the rock that solidifies is called as volcanic

igneous rock.

Now this may happen on the land that is

subaerial volcanism or under the sea, that is, subaqueous

volcanism.

The areas covered by such rocks depend on the volume of magma or

lava that comes out on the surface of the Earth.

And, as you know, that at the surface of the earth

the temperature is about 30 degrees.

And the magma is at very high temperature. Therefore there

is rapid cooling of the magma and there is hardly any time

for crystals to grow to larger size, and therefore the

crystals are fine grained in such bodies. So most of the

volcanic rocks are fine grained or sometimes even

glassy. That is a supercooled liquid.

Along with the lava, gases and

solid matter is also thrown out from volcanoes and when

the solid material

 falls on the earth surface and then

consolidates or solidifies, those rocks

will be called as pyroclastic igneous rocks.

So to summarize, igneous rocks occur as plutonic, hypabyssal and volcanic rocks.

Plutonic igneous rocks solidify

at great depths and are coarse grained and are usually large in

dimensions, whereas hypabyssal igneous rocks solidify at

shallow depths are medium grained and form small to medium

sized bodies. Volcanic igneous rocks solidify on the

surface of the earth and are fine grained? These are the

references for this topic.