Earth Sciences for Civil Engineering
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Module 2
Lecture No 8
Rock types and their Properties (Part-2)

Welcome back. During last lecture, we were talking about eruption which took place along Saint Mount Helens so that during 1980.

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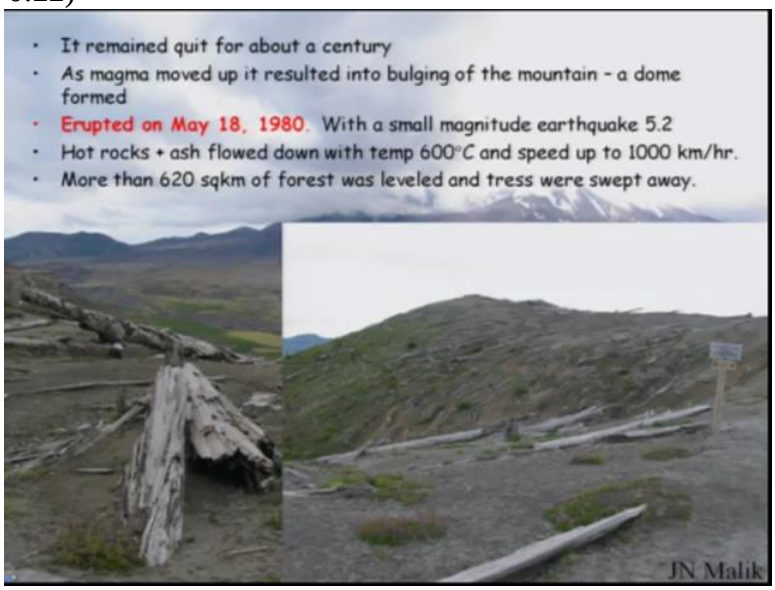

So this is how they have preserved level their forest to show the people that how what happened during that event.

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This is the Observatory what they are having, the seismic activities they try to monitor and the events which are being shown, these are all small events, earthquake events which have been triggered recorded during 2004. So this helps them identifying or knowing, or predict whether there will be an eruption in short period or not.

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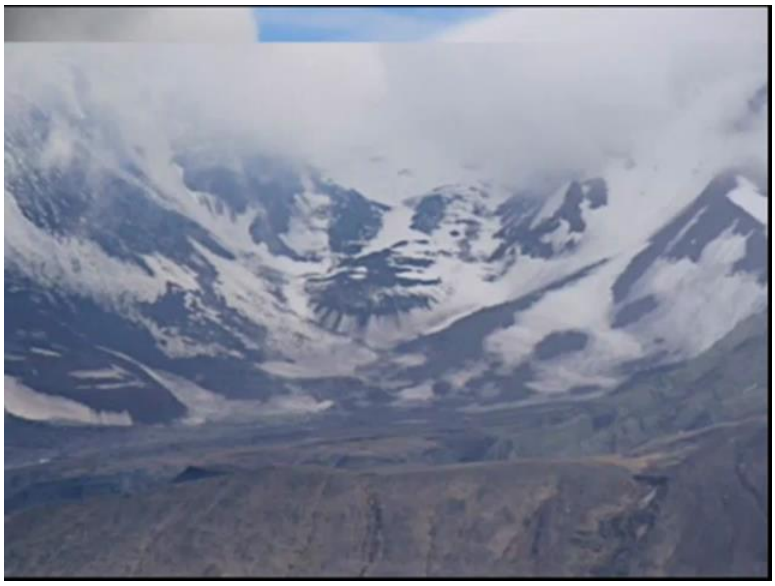

So this is one of the and if you look at this picture, at the centre, this shows dome. This is an enlarged one. Now this is again building up. They are watching it very precisely and geo-datic measurements also they are taking and trying to understand that how then this dome is growing in the centre of the crater. Then again, with the help of the increasing dimensions of this one, they will be able to predict when the next event will be and then they can they can…

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So this is again from 2004 to 2006 they have taken this picture of Mount St Helens. It is showing the deep magma pushing up. So this portion is again growing up slowly after the 2004 this has been shown.

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So if we take the volcano, if we define it is an gap in the Earth's crust through which the molten rocks or the magma comes out to the surface. Or you can say it is a conical mountain formed around the vent through which the molten mass comes out of the surface. So this is the definition which we see for the volcanoes mainly.

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Now volcanoes in the past and in the recent past they have affected the climate also to some extent. But it is temporal. But in some of the events in the geological past if you take, they have completely ruined the species and they were responsible for completely extinction of many species on the earth because of the massive volcanic eruptions. Now if you see this table, you can you will be able to look at we are just going to point out few which where is the volcanic eruption. On this side if you look at, this is the volcanoes and then you are having the cities named here and this again you are having the year and then you have the effects.

What effect was been created by these volcanic eruptions? So these are the historical events which are from AD 78 which goes up to 2010. So these are some of the (())(3:42). Not much of the later events have been added after this. But if you can take into account and try to understand that volcanic eruptions can result into a major devastation on the on on the earth and it may result into the extinction of many species.

So Vesuviun volcano if you take, it was from Italy. It destroyed the Pompeii city and killed almost like 16,000 people in that time. And the city was buried by volcanic activity and this was rediscovered in 1595. So we have the cast which were formed and many people were killed while sleeping. So you can see those cast of the persons or the people and the animals which were been buried during this eruption.

It was very massive, very fast. Then another which you can take is the Tambora. It is from Indonesia. It occurred in 1815. And this resulted into global cooling. So eruption will result into the, it will pour out lots of ash and the gases in the atmosphere and which resulted into the global cooling. And killed almost like 10,000 people. So this resulted, that produced an year without summer. So we did not see summer, these people they did not see summer during that period, that is in 1850.

Then another one was tremendous a dangerous, explosive one as this Krakatau. This is again in Indonesia. And if you remember, this we were talking about the Pacific Ring of Fire and all that. So this is coming to the Indonesia part. So we are having in 1883, another tremendous explosive which occurred and it killed more than 36,000 people and it also resulted into the tsunami because it was close to the ocean and it is resulted into the formation of tsunami also and which also was, the tsunami was also experienced in India in 1883 Krakatau.

And then we are having another one. That is Mount Pelee. It was in 1902 and it resulted into and it killed almost like 30,000 people in a minute. And then we are having Villarica, Chile. Again it forced almost 30,000 people to excavate their homes. And this was in 63 and 64.

And then we are having again that what we were discussing about in the beginning, this Mount St Helens, Washington DC, United States, 1980. So debris avalanche, lateral blast and mudflows. And this mud flow was created because it was been cone was been kept by the ice sorry snow. So that resulted into the mud flow of that region and killed almost like 57 people, destroyed more than 100 houses. But now they have restricted. Nobody stays in the vicinity of that volcanic eruption.

And then we are having Mount Pinatubo in again Philippines. It was tremendous explosion. Again very much similar to what we are looking at in Krakatau. And this was like it combined with a typhoon and it resulted into the people were been killed . Almost like thousands of people were forced to evacuate from there and then around 740 people were been killed.

And then we are having again from Chile, 2008. And then then finally this one. That is from Iceland. So this was the event in Iceland which emitted a lot of ash in the in the atmosphere and

it affected the flights in that region. So these are the some of the events which are the historical events which resulted into the massive destruction.

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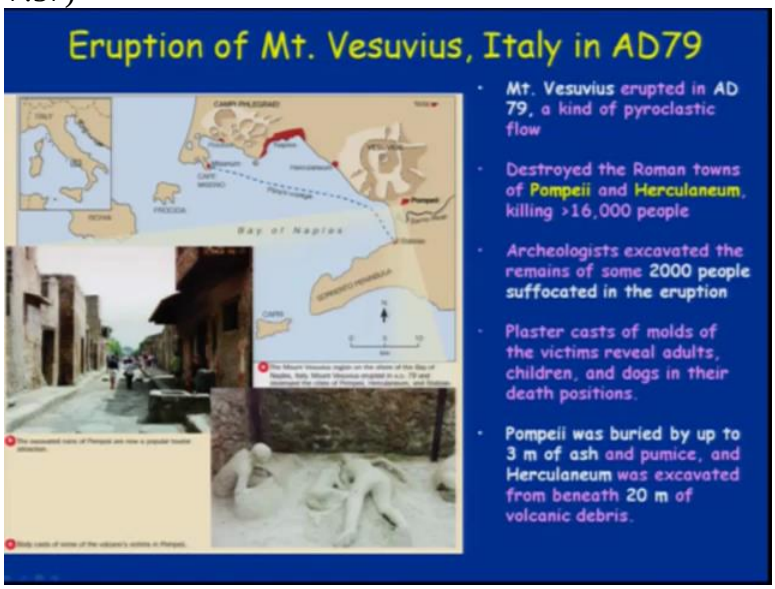

Now eruption of Vesuviun, very quickly will see what we are talking about, the Italy. So we can see this type of cast which still exist in the region and it was rediscovered in 1500 A.D. Almost like archaeology excavated the remains of some 2000 people who were suffocated and then got killed during this earthquake. More than 16,000 people were been killed during this earthquake.

So you can see the plasters, the cast moulds of the victims. In this picture, you are having dog and then the people who are who have been killed.

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Then Tambora again in 1815, killed almost 10,000 people. This is from Indonesia.

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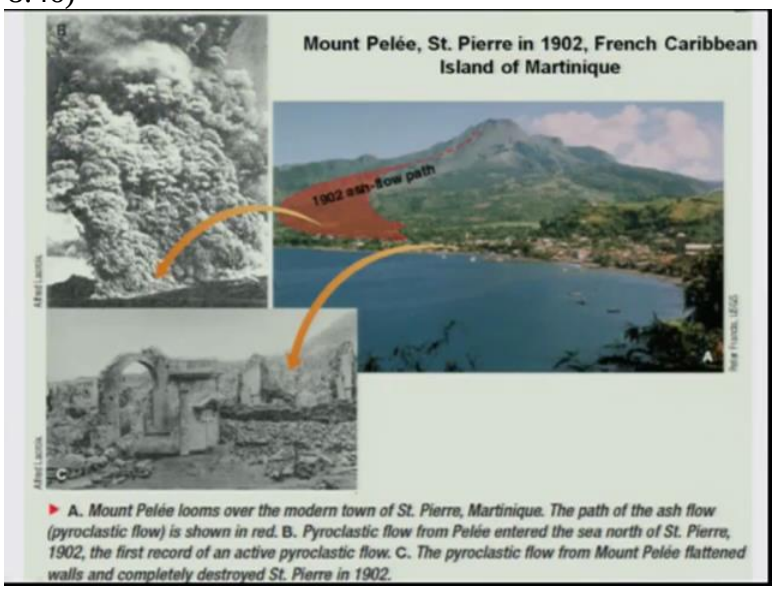

And then we are having Mount Pelee from Caribbean.

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And we are having St Mount St Helens. Before and after it shows. So this part if you look at, was being blown off during the earthquake, the volcanic eruption. So you can see this is again the crater which was been formed. So the top was being blown off completely. And during the eruption, what it says that much of the northern side of the composite volcano was blown away.

And the altitude of the summit was reduced by almost 400 m. So this resulted into the reduction of the height also. So almost like 400 m was been reduced, the top was being eroded. And it was around 9677 feet before and 8363 after. And then it remained something like this. So the height was reduced by almost 400 meter or so.

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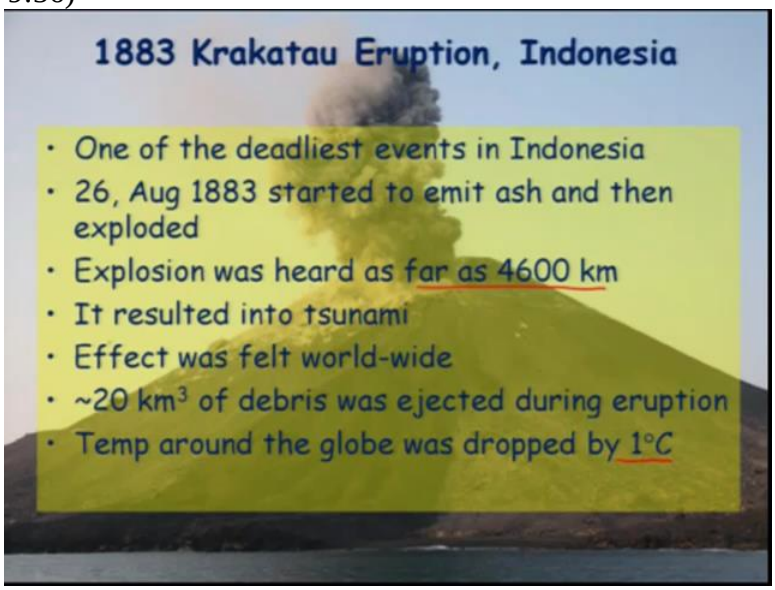

So this is an exam the photograph of Krakatau and as I told that as it is close to the ocean, it resulted into the formation of the tsunami. So one of the deadliest event in Indonesia of August 26, 1883, started to emit ash and then exploded. Explosion was heard almost as far as 4600 km from the place of the eruption. It resulted into tsunami. The effect was felt worldwide.

So this was a massive volcano which occurred in 19th century. And almost like about 20 cubic km of debris was being injected during this eruption. And the temperature around the globe was reduced or dropped by almost 1 degree. So this resulted into the dropping of the temperature also. Now suppose this is only one volcano which has erupted and which has resulted into the effect around the or affected the environment.

Now if it keeps on erupting many volcanoes, then what will happen? So that is another part which one should think of,. That it can affect the climate also.

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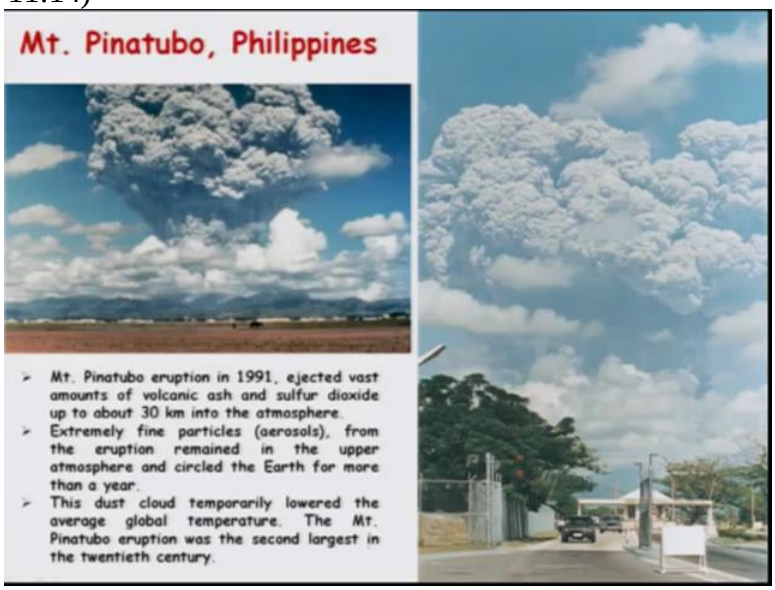

Then, Pinatubo, again in Philippines. It was again a massive one. So Pinatubo eruption was in 1991. Ejected vast amount of volcanic ash and sulphur dioxide and up to about 30 km in the atmosphere. It was too high. And this dust does cloud temporarily lowered the average global temperature. Again it resulted into that. And that was the 2nd largest in the 20th century.

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Then again the Iceland one which erupted and this was in 2010 and during this, all the flights in and out the Britain airport were grounded. So it affected the region because of the dust which the ash which was being pushed up in the atmosphere.

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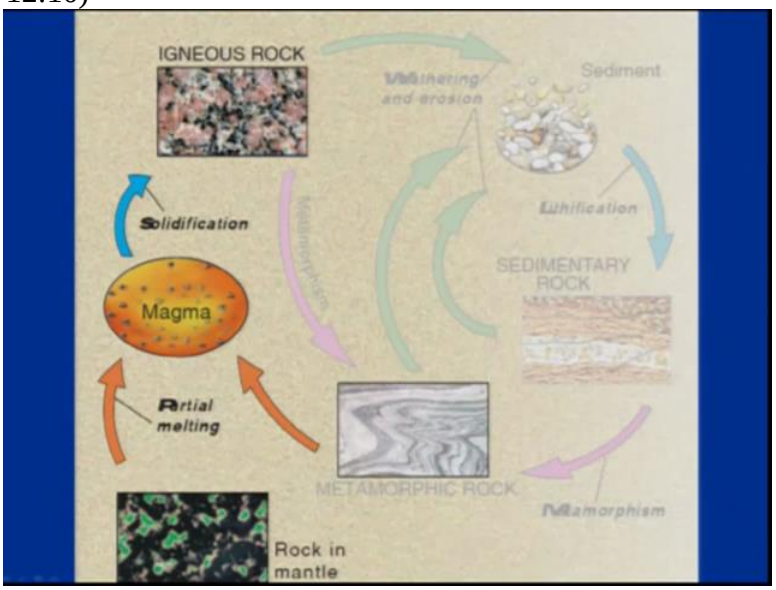

Now, let us start with the igneous rocks part. So if we talk about the igneous rocks, when we talked about the cycle, rock cycle, we talked about the magma which has melted which will come up and then it will solidify. So in the beginning which we were talking about that this magma which comes out on the surface or it remains or that is it forms intrusion or it is coming right up to the surface in the form of a extrusion. So we will have extrusive rocks and we will have intrusive rocks.

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This is just to show that that the volcanic eruptions around its periphery or its surroundings will create a very beautiful landscape. And this an example of one of the beauty the beautiful volcanic cone that is Mount Fuji in Japan with the steep clinical mounts and you can see how beautiful it looks like. But it is more again a dangerous one because it emits tephra and lava. So it can result into the devastation.

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So the height of the, it is around 3776 m high and it erupted in 1707. That was the last eruption. And I visited this place. So I can see, this top portion was being covered by the. so it was difficult to see the top portion.

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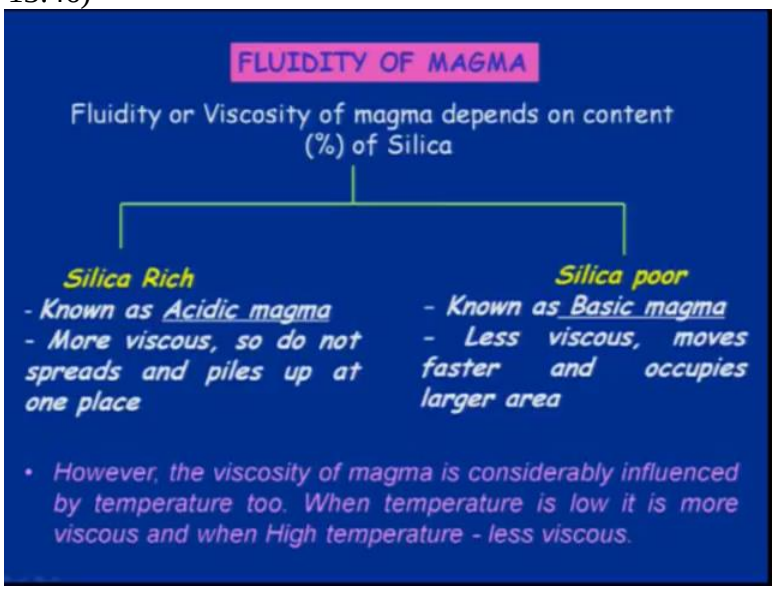

So let us look at that how what are the different compositions of magma here? So one is like, you are having fluidity which is one important property of magma or viscosity of magma depends upon the content of silica. If you are having silica, we can say silica rich or silica poor magma. So silica rich magmas are termed as acidic magmas and silica poor are termed as basic magma.

And they are more viscous. These are less viscous. Silica poor are less viscous. So do not spread and piles up at one place. So one thing is in terms of the hazard. Whereas this one I will talk about the hazard here. Now another one, silica poor more faster and occupies larger space. So if you know that what type of magma will be erupted by the volcano which is sitting close to you, you can judge that how fast the magma will move.

Either it will be if it is an acidic magma, then it will move very slow. Whereas if it is the poor sili the basic magma, then it will move comparatively faster and cover large distance. So it will cover larger distance whereas it will keep on piling at the same place. However again, the viscosity of the magma is considerably influenced by the temperature too. So when the temperature is low, it is more viscous and when the temperature is higher, it is less viscous. So this is one important property of magma. Silica rich and silica poor.

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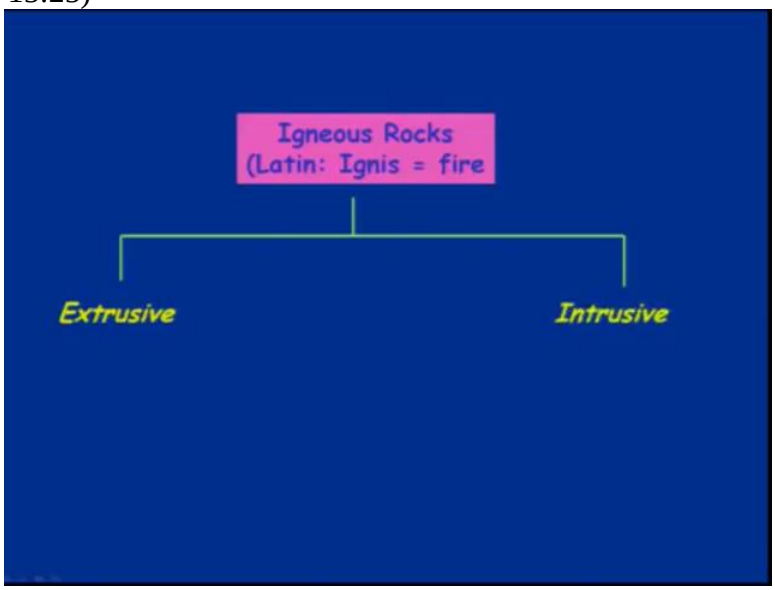

Igneous locks are again Latin term which is being used as fire. So we have seen that whenever there is an eruption, there is a lot of magma coming up along with the fire. So if you classify the igneous rocks, we can classify as we were talking in the beginning. It is the extrusive rocks or the intrusive rocks. So we will see one by one the different types of igneous rocks in this one.

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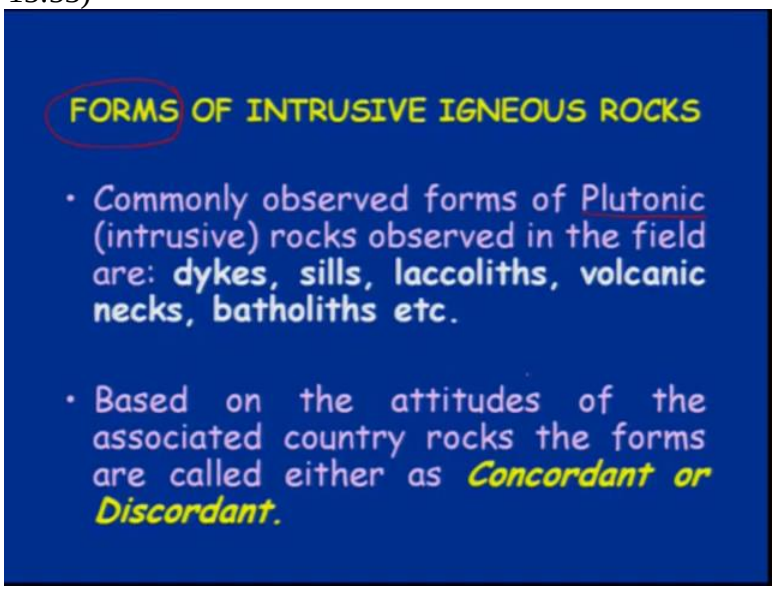

So form of the igneous intrusive igneous rocks mainly. So these are either they are coming right up to the surface through the cone or they are remaining within the Earth's crust. So different types of forms we will see very quickly. So the commonly observed forms of plutonic rocks. So

intrusive rocks are also termed as plutonic rocks. So this we can remember here. They are termed as plutonic rocks.

Observed in the field are mainly. So we are having dykes, we have sills, we say laccoliths, volcanics neck volcanic necks or you having batholiths, etc. These are the different types of forms of intrusive rocks mainly. Now based on the attitude that is the angle between the country rock where they intrude. So we are having the rocks which are sitting on the surface of the crust and the intrusion will take place from below.

So depending on that, whether it is almost right angle or if it is parallel to the beds and all that, or the layers of the different rocks, then that what we called the country rock. So the different type of intrusions are being termed as, either it is Concordant or it is Discordant looking into the attitude of the associated rocks in which the intrusion is taking place.

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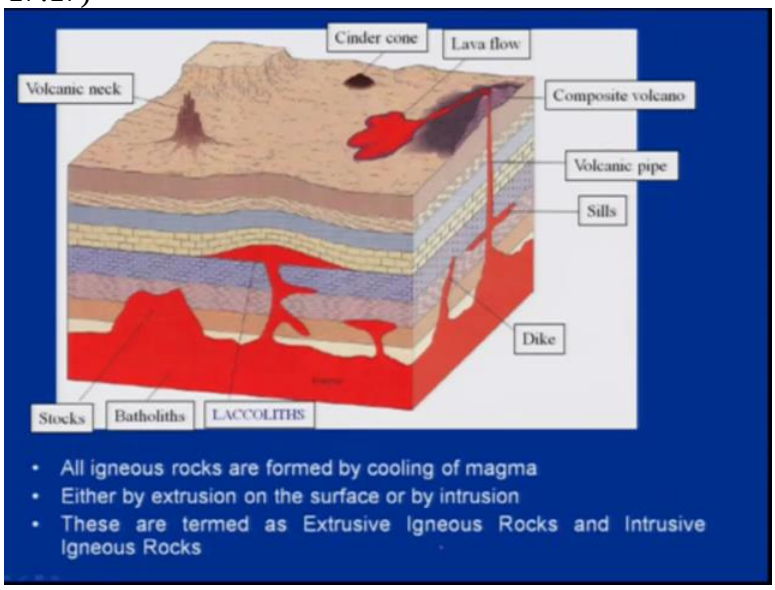

So here, there are different forms which are being shown which we have like either it is volcanic pipes. Volcanic pipes are also very important because maybe in the last slide I am talking about the kimberlite pipes and all that. And they are also termed as diamond deforest because these are the source for the formation of diamonds and all that. So volcanic pipes.

Then we are having sills. So sills are the structures which are almost parallel to the beds. So these are these are the different rock layers and this is what we term as a country rock. So

intrusion is taking place within the country rock coming right up to the surface through the cone and this is the pipe here or the conduit and try to flow in on the surface there is a cone.

So this is a composite. So one eruption, another eruption will result into the formation of the composite volcanoes. And then we are having this is the conduit or we can say the volcanic pipe. And if the intrusion is parallel to bedding planes or parallel to the country rock then we term that as a dyke. If they are discordant in nature, then we term that as a dyke.

So these are these. And then we are having a sort of domal shape intrusion is there. So if you if you try to like eruption is there that is a plume sort of a thing which goes up which also results into the formation on the surface. And this is being termed as laccolith. And then wider areas which has been covered, they are also termed as stock or batholiths. So this we will quickly look at that what are the different types of forms.

So all igneous rocks are formed by cooling of magma either by extrusion on the surface or by intrusion. This is a very important part which you can remember. These are termed as extrusive rocks and intrusive rocks. So either we call them intrusive rocks or extrusive rocks.

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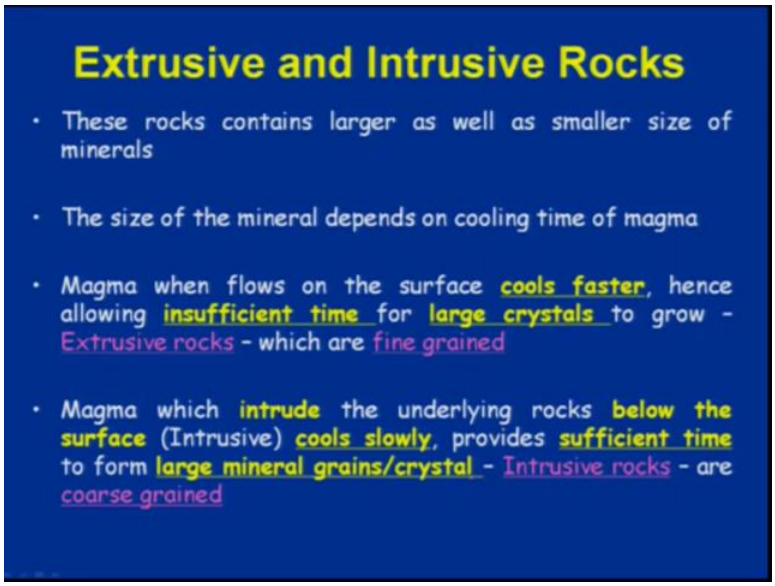

Now extrusive and intrusive rocks, these are rocks contains larger as well as smaller size minerals. The size of the mineral depends on the cooling time of the magma. Magma when flows on the surface, cools faster. So when you are bringing the magma on the surface, it will cool very

fast. Hence allowing insufficient time for large crystals to form because Crystal or crystallisation needs time. So if you are allowing the magma for a longer period to cool down, then the larger crystals will be formed. But if you are not allowing them and cooling it faster then very small fine-grain crystals will form.

So larger crystals to grow whereas this is for intrusive one. So magma when flows on the surface, cools faster. Hence allows insufficient time for the larger crystals to form. Whereas the extrusive rocks which are fine. So the extrusive rocks which we see on the surface are fine grains because they do not allow the magma to cool slower. So cools faster, insufficient time for the larger crystals to form.

So the extrusive rocks is magma coming on the surface. So extrusive rocks will be fine grain one. Now the opposite one is the magma which intrude underlying with the underlying rocks below the earth's surface. These are termed as intrusive rocks. Cools slowly. Whereas here, it cools faster. This cools slowly. Provides sufficient time to form larger mineral grains or the crystals.

So the intrusive rocks are coarse-grained. So this is an important point which I was mentioning there that depending on the cooling of magma, you should remember that one is extrusive rocks are fine-grain because the magma which comes on the surface cools faster. So it does not allow the larger crystals to form. Whereas the intrusive rocks which are cooling slowly, has sufficient time to form the larger crystals. Hence they are coarse-grained.

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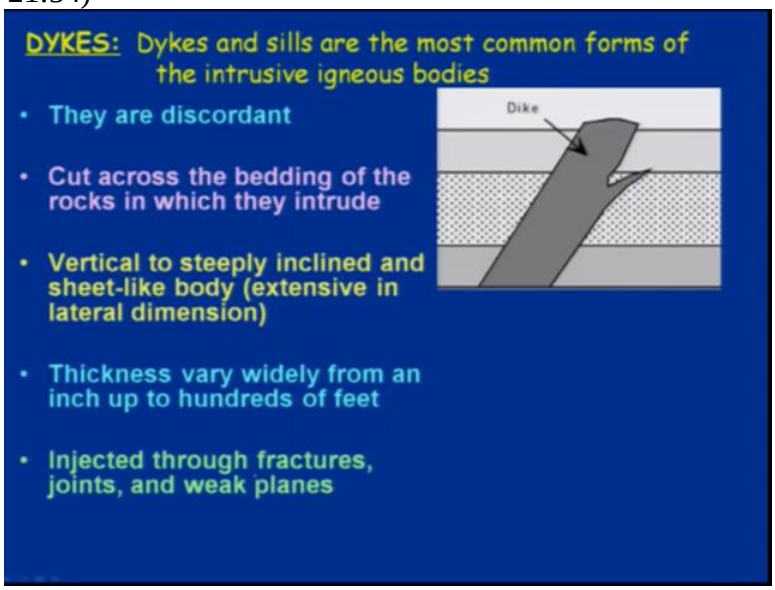

Now the other part which the forms will be believable look at dykes and the sills. So we are having concordant relationship between the country rocks. So we are having some angle between the altitude of the intrusive rocks and the country rocks. So they are discordant in nature. Cuts across the bedding plane of the rocks in which they are intruded.

Vertical to steeply inclined and sheetlike body extensive lateral and dimension. Thickness varies widely from an inch up to hundreds of feet. So it is they are quite wide also at some places you will find, injected through fractures, joints. So you are having cracks or fractures which are in the in the portion of weak planes. There you will have the intrusion of and the formation of the dykes of that.

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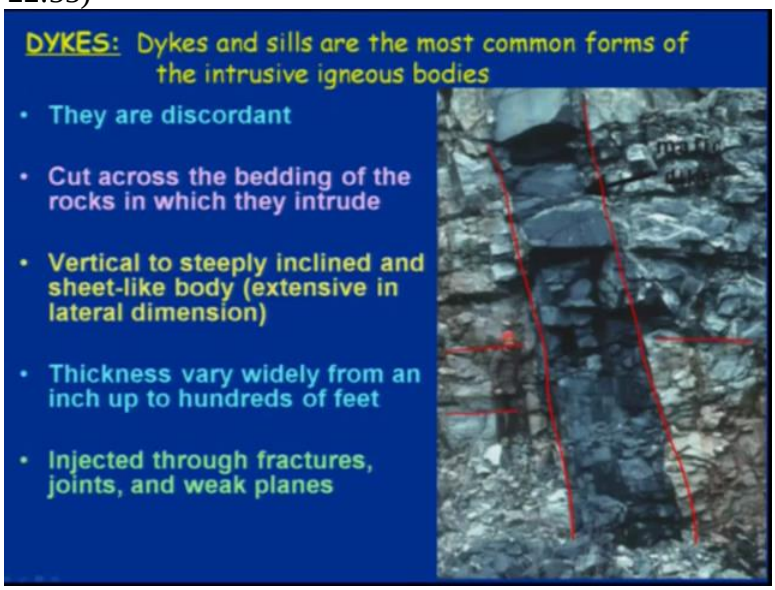

So these have been shown here. So this is the portion, the contact here dyke which has been shown. Then these are the bedding planes here. You can see here this one. These are all the bedding planes. So these are almost discordant in nature with the country rocks. So this is termed as dyke. And the dimension as is being seen it varies from inch to up to like almost like hundreds of feets. So we are having the dimension is much much larger at some places.

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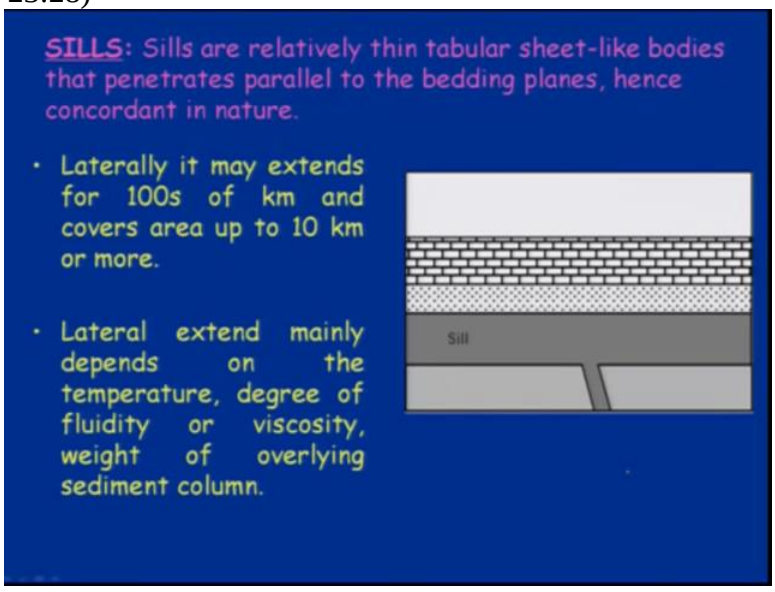

Then we are having sills. Again they are they are all parallel to the bedding planes.

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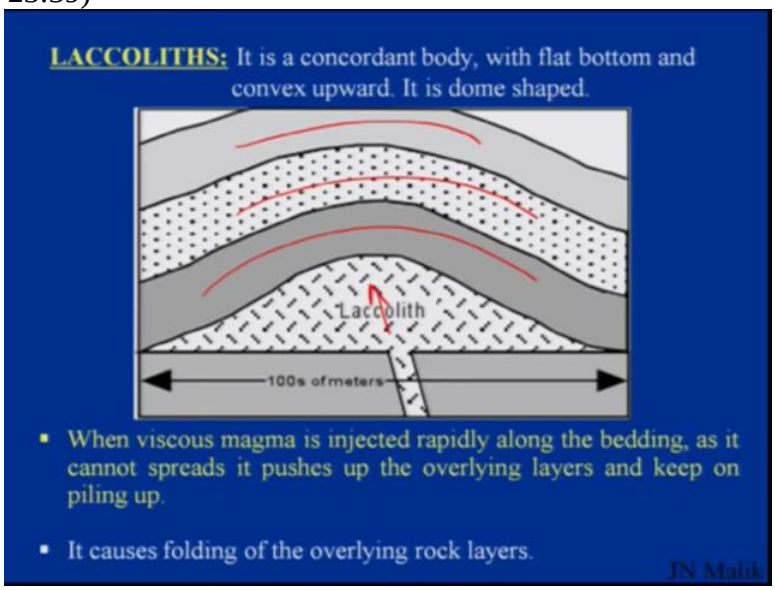

And then we are having laccoliths. laccoliths are again is a discordant body with a flat bottom and convex upward domal shape feature. And this will result into the deformation. So this is what has happened. This has been deformed, these layers have deformed when there is an intrusion here. So this is one typical nature of laccoliths we are having.

So when viscous magma is ejected rapidly along the bedding planes as it cannot spreads, it pushes up the overlying rocks. And this is the pushing will result into the reformation when it keeps on piling up. So it causes folding. This causes folding of the overlying rocks or we can say that it warps the overlying rocks then there is an intrusion, rapid intrusion or the injection of the magma.

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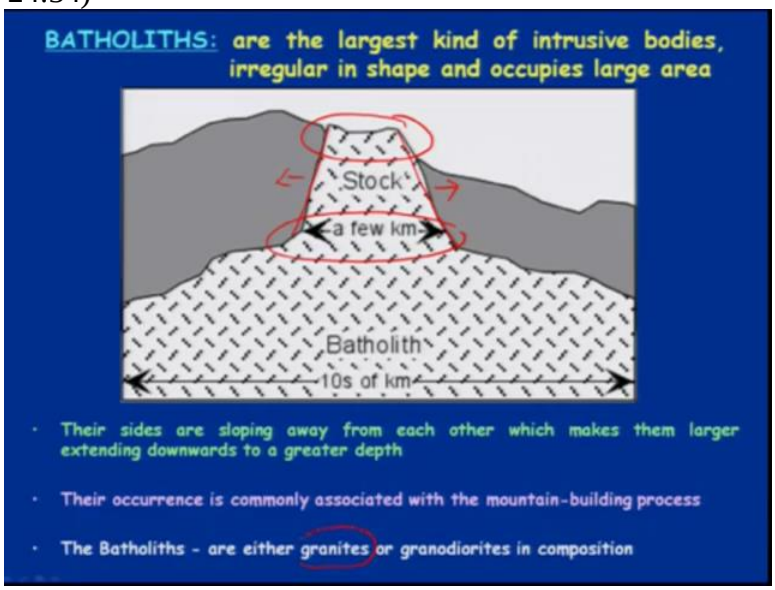

And then another one which is more or less similar but are the larger bodies and they are also irregular in shape and occupies larger area. They are being termed as batholiths. So their sides are sloping away. So this will be sloping away from one another. So that is an intrusion of that. And makes them larger, extending downward at greater depths.

So because they are they are like this they will be having this will be wider in shape. So this portion will be comparatively wider as from the top. So these are termed as batholiths. So their occurrence is commonly associated with mountain building activities.

So when we are having deformation which is going on around the plate tecton, plate boundaries so mostly you will be able to see the formation of the batholiths. So either they will comprise the granites or granodiarite in composition.

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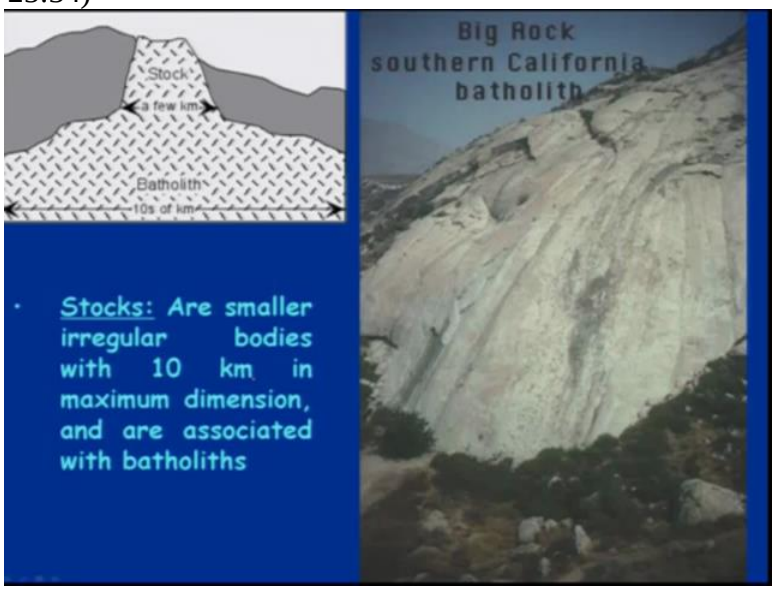

Stocks are also similar to that but they are again an very wide bodies as compared to they are a smaller irregular bodies within 10 km. Whereas the batholiths will be much more wider in shape. So stock is mostly seen on the top of that.

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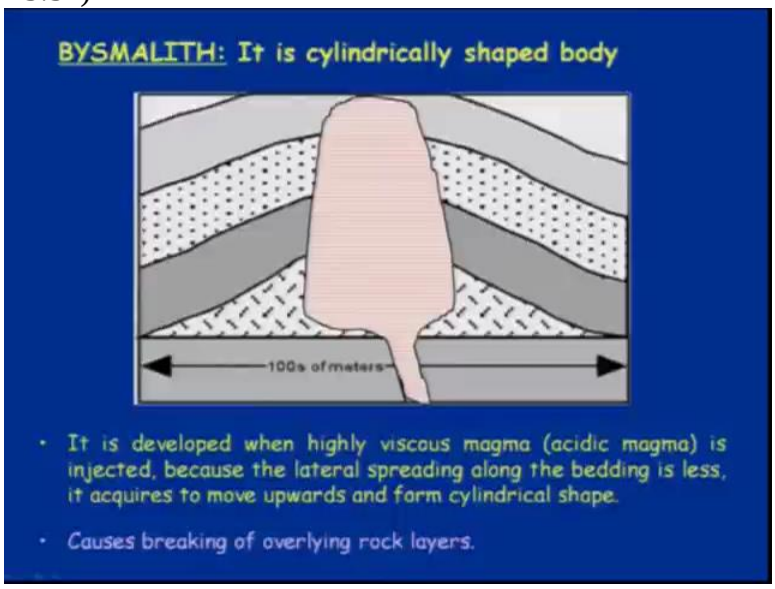

Then we are having this is bysmalith. It is again a cylindrical shaped body and it is developed when high viscous magma or the acidic magma is injected because of the lateral spreading and all that. So this also, these are the different forms of the but this we cannot see from the surface. We have to look at subsurface.

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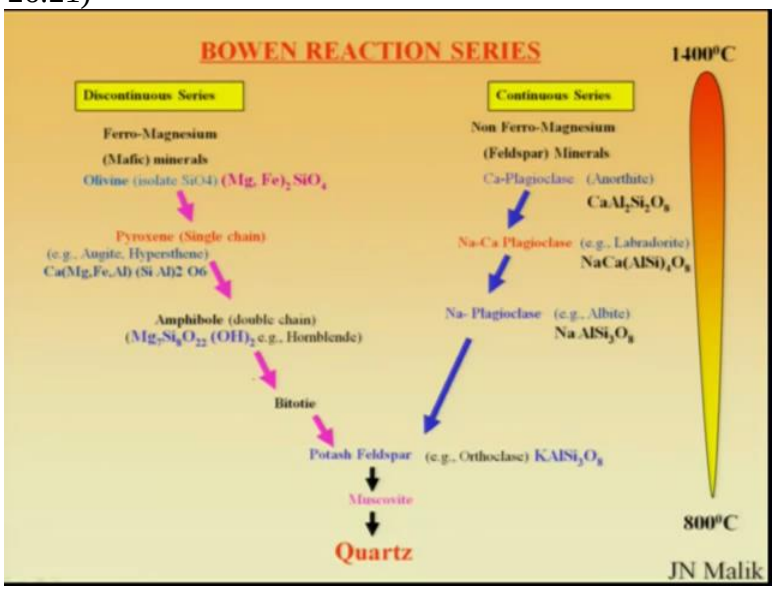

And variety of igneous rocks now if we take, then what we see is that again the formation. Then the identification criteria. So similar to what we learn, the Bowen reaction series is also is important because the cooling of the magma will result into the different type formation of the crystals and the minerals. And the different aggregates of minerals will result into the formation of the different rocks.

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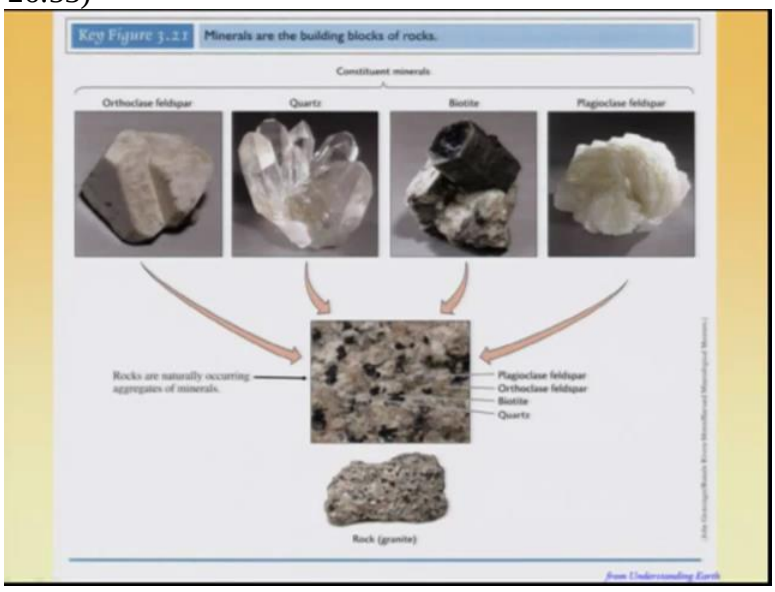

So for example, if we take granite, then we are having feldspar, we are having quartz, we are having biotite, we are having the plagioclase feldspar and all that. So aggregate of this will result into the formation of different types of rocks or the different types of igneous rocks mainly.

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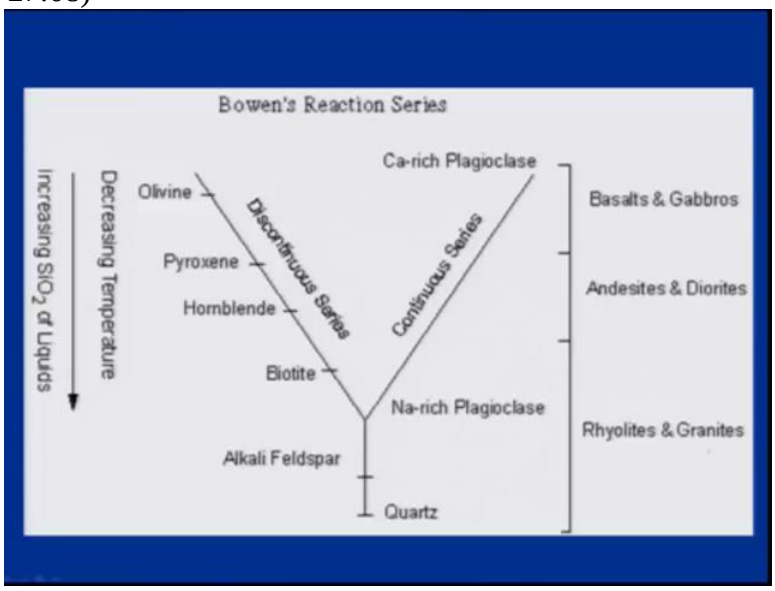

Now if you are looking at, again this is the same bowen reaction series which we looked at. We are having calc rich and the sodic rich feldspar. And then we are having the discontinuous series here. And then resulting into the alkali feldspar and all that. And then finally resulting into the formation of quartz. So we are having different type of rocks here.

With this composition we are having basalts, gabbros, andesites and diorites, these are the names of different rocks which we will talk in detail in the next lecture and then we will see what so I will stop here and we will continue in the next lecture and they will start with the igneous rocks. Thank you very much.