Drilling and Blasting Technology
Prof. Kaushik Dey
Department of Mining Engineering
Indian Institute of Technology, Kharagpur

Lecture – 04
Rock Formation (Contd.)

Let me welcome all of you to the 4th lecture of the Drilling and Blasting Technology course, in this lecture we will continue our Rock Formation which we are discussing in the last class also.

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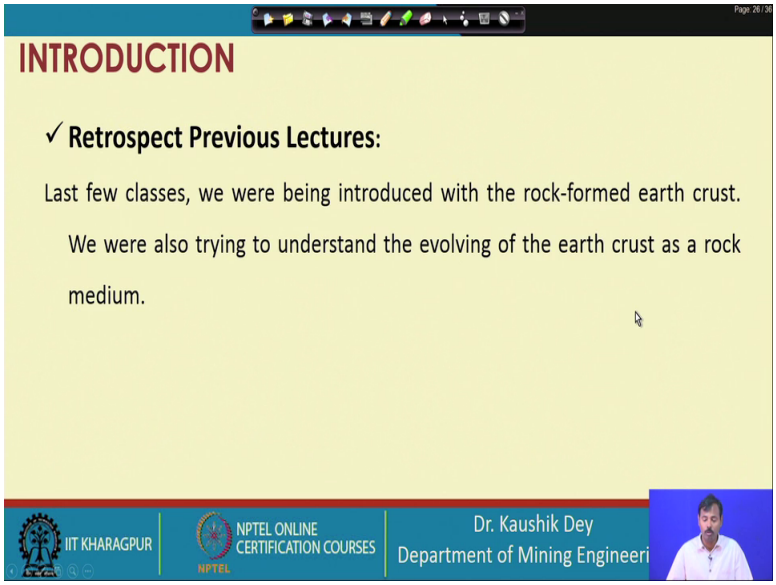

So, first retrospect the last class in last few classes, we are being introduced with the rock how it is the rock is formed forming the earth crust. And we have already understood that the, our activities are limited to the outer earth crust that is called sial.

And also the sial which is up to the 25 kilometer of the earth crust, we are limited to few kilometers only and our deepest excavation is within the 4 kilometer of the earth crust. So, that is very very in the super in the surface part of the earth we are only carrying out. So, rock is our excavation medium which we are carrying out and we are trying to understand the rock and rockmass as our medium. So, we in this context we are trying to understand the geology of the earth also.

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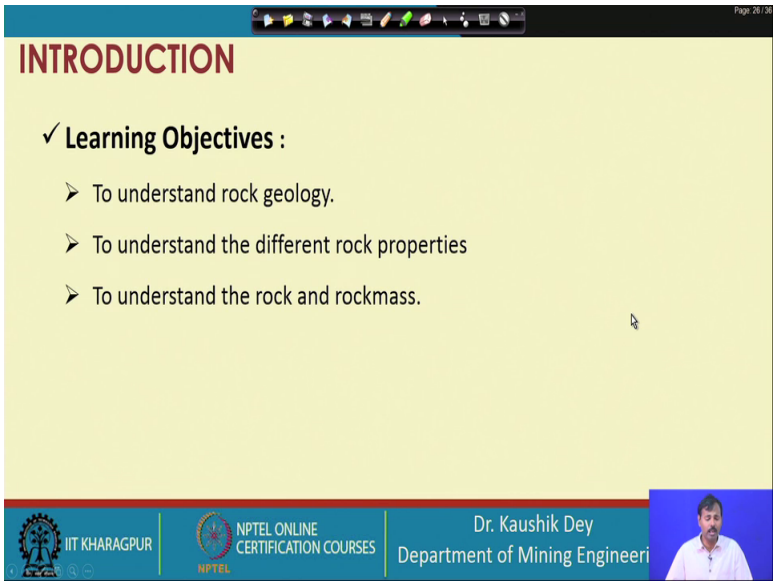

So, our learning objective at the present stage is that we should understand the rock geology, we should understand the different rock properties and we should understand the rock and rockmass how if they are differing.

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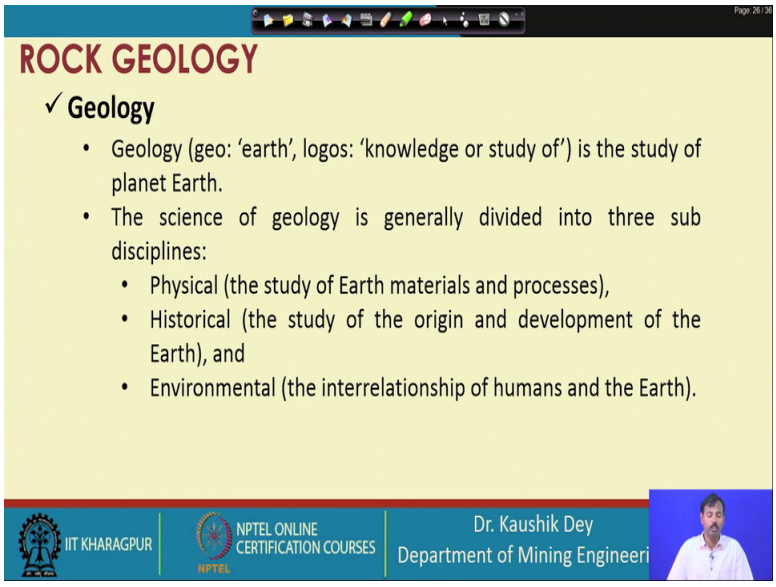

So, let us first start understanding what is rock geology. So, geology basically geo means earth logos means knowledge or study. So, geology basically the study of earth and the science of geology is generally divided in three sub discipline one is physical, another is historical, another is environmental.

So, the physical geology basically is studying the earth material and the process, historical geology basically studying the origin development of the earth. So, basically the stateography etcetera are basically the part of historical geology and environmental geology is carrying out with the inter relationship of the humans and the earth. So, basically this stateography part is also important and physical part, which is the study of the earth material and its processes are very very important, while we are considering the a rock as a medium of our excavation.

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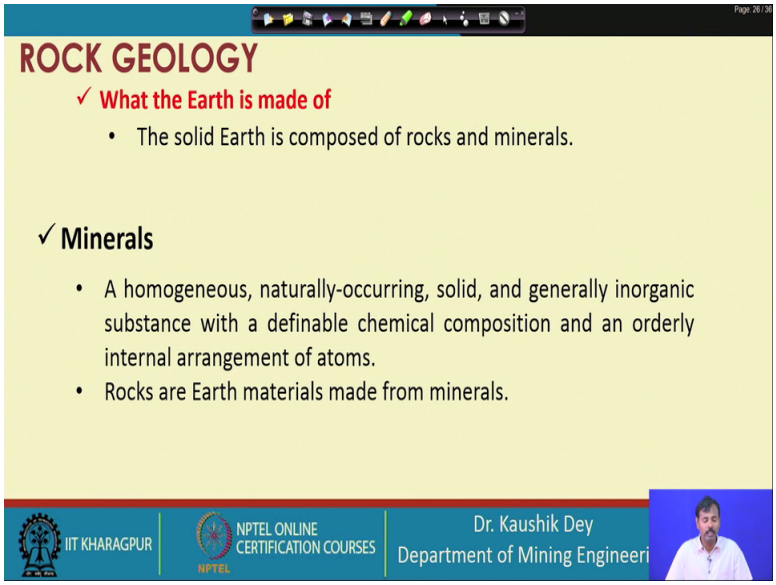

So, basically earth made of rocks and minerals and let us understand what is a mineral. Basically, mineral is a homogeneous naturally occurring solid and generally inorganic substance with a definable chemical composition and orderly internal arrangement of atoms. So, basically minerals are the material, which we can describe with a chemical formula. And, we can say that the properties of a mineral are more or less similar, rocks are the earth material basically that is made of minerals.

So, basically a number of minerals gather together to form a rock. So, mineral is a part of rock; a rock may comprise a number of minerals, but mineral is having a specified chemical formula and, it is having the chemical composition and, it is having some particular properties.

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So, basically while mining engineer is trying to excavate something, they search for minerals. So, there are thousands of different types of minerals and they are of they are produced of from different activities. But it has been found more than 95 percent of the earth crust is igneous rock and basically this igneous rocks contains only few minerals. The other minerals are available with the other types of rocks.

So, let us see some of the rock forming minerals. This rock forming igneous rock forming minerals are basically quartz, feldspar, mica, pyroxene, amphibole, olivine. So, these are the main rock forming minerals which are available in the earth crust and basically the properties of those rocks are depend dependent on the percentage of this minerals on that. So, other common rock forming minerals are also available calcite clays, magnetite, pyrite, talc these are also available, but major are the above one the lower are the very rarely or mostly available in the earth crust only.

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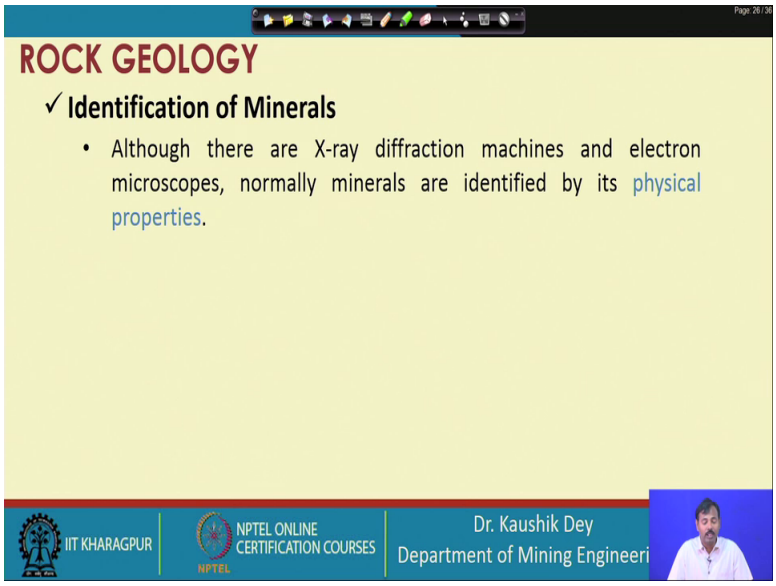

So, minerals are easily identifiable, because of their definite different properties, there are some physical properties there are some specified chemical properties. So, most of the physical properties which are used to identify the minerals are X-ray diffraction, then electronic microscope, then the gm counter, those common physical instruments are used for identifying the minerals most of the times we carry out this one.

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So, let us see what are the different mineral properties using, which we can identify the minerals, say first is the colour in most of the cases we identify the mineral, because of

the colour only say coal is very very black, we can identify the formation of a coal among to sand stone bed by from the colour of the coal itself. Similarly gold chalcopyrite both are of golden color and their occurrence can be easily identified because of their colour golden colour only. So, this is basically most commonly colour is utilize as the most physic most common distinguishable a property of the, for the minerals.

In most of the cases we identify the mineral bed, mineral fan from the our from the colours from by our eye only. The next property which is very very important is the streak, why this colour are streak, I am telling side by side you the main reason is that often the colour may be same of two different mineral, but the streak may be different, what is streak basically, when you scratch the mineral with a streaking plate the colour of the line is called as the streak.

So, one very common example of use of streak is the moment you are trying to distinguish between the chalcopyrite and the gold ore that is a anamoxide. So, if you have a streak of the chalcopyrite and the anamoxide, you will find the gold ore is giving you the golden streak whereas the chalcopyrite give you the black streak. So, that is why the streak is different though the mineral is having the similar colour.

So, the streak may be a one identifying property of the mineral in which we can used, luster means the you can you can see the glaziness of the material we can say. So, basically it may have metallic it may have non metallic, it may have adamantine type, whichever it is you can have different type of luster in facts very often copper ore are also identified, because of its luster because it is a very very glazy metallic lusters are observed in the copper ore.

So, like that way luster is another very very important property, which is commonly used for identifying the mineral crystallization is also another property, which can be used for identifying the minerals.

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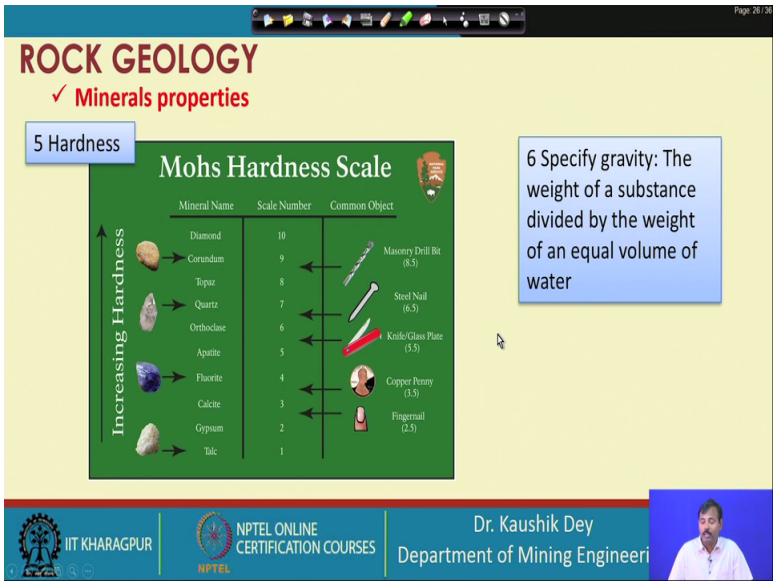

And another is very very important is the hardness, there is a hardness scale, which is called mohs hardness scale, where the material which material is hard that can be identified. Basically hardness is also another measure of the grain of the mineral, the moment a mineral comprises of the grain, which is of very hard and angular that shows the hardness much much more in the hardness scale. So, this angular and a hard grain material most of the time, they arise the they were occurred, because of the high temperature ignition rocks.

So, like that way the material is becoming hard and a hard for the for of for their grain sizes only. So, in the mohs hardness scale the lower talc is considered as the 1, gypsum is considered as the 2, calcite is the 3, fluorite as 4 apatite, as 5 orthoclase, as 6 quartz 7 topaz 8 corundum 9 and the most hardness material considered is diamond as 10.

So, in between the some other things are there like say del is considered of about the hardness of 2.5 ok, steel plate is considered about the hardness of 6.5. So, like that way there are some other common objects are the are there which is having the different hardness parameters. But if we are having some material it identifying the hardness scale a hardness in the hardness scale, we can detect which type of material it is. So, the hardness is another very very important a parameter which is used for identifying the mineral.

Specific gravity of the mineral are more or less similar generally specific gravity used to identify the different mineral. In fact, a number of minerals are very are of very high density and those minerals occurrences are identified form their weight only if. So, the like chromite ore, magnetite ore, these ore are very very of high density. So, the moment we get a rock of high density, we can try to search out the probability of the having it is it is of becoming magnetite, or it is of becoming chromite.

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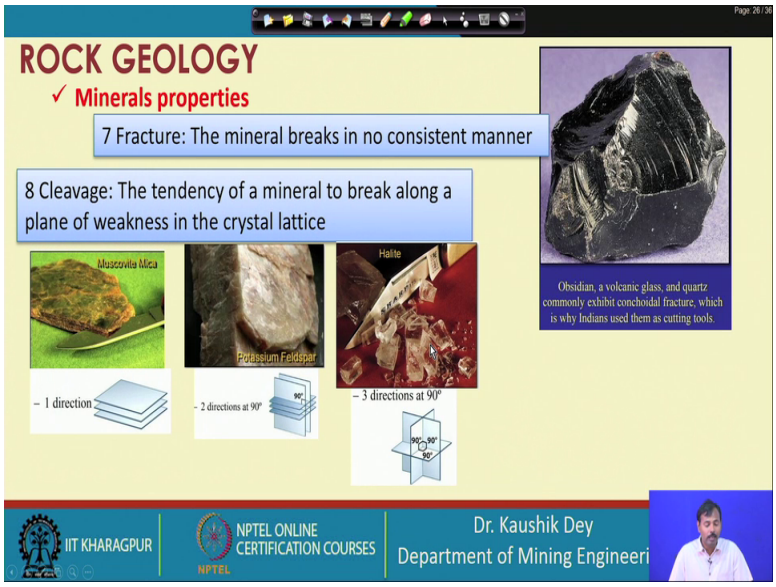

In fact, a number of cases we use gravity method to identify the occurrence of those chromites or magnetites. Apart from the fracture the mineral breaks in is no consistent none are those fractures are also identifiable mineral property cleavages are also, there to identify the mineral from it is, there are three types of orthogonal cleavages are or observed in the mineral.

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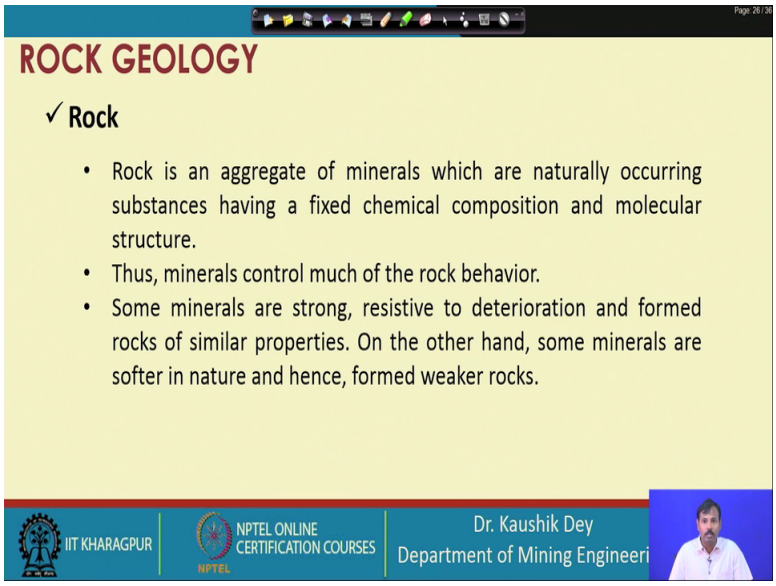

So, like that way different aspects are there physical properties are there, from which we can identify the mineral apart from the chemical compositions, which can be tested from the chemical testing's. So, from the chemical testing we can get the idea about the mineral, but to reduce the chemical testing cost physical testing should be carried out ahead of that. In fact, chemical testing will give us the idea about the percentage of some particular element in that mineral also can be determined. So, basically rock is the aggregate of minerals which are naturally occurring substance and having a fixed chemical formula the minerals are having, but rock is the aggregate of different composition of those minerals.

And with the percent of minerals in that rock the rock behavior is basically controlled, some minerals are strong resistive to deterioration and formed rocks of similar properties and, other hand some minerals are of softer in nature and has formed the rock of weaker properties. So, that is by that way different rocks, different rocks are of different compositions and may be with the variations in the compositions the properties are varying.

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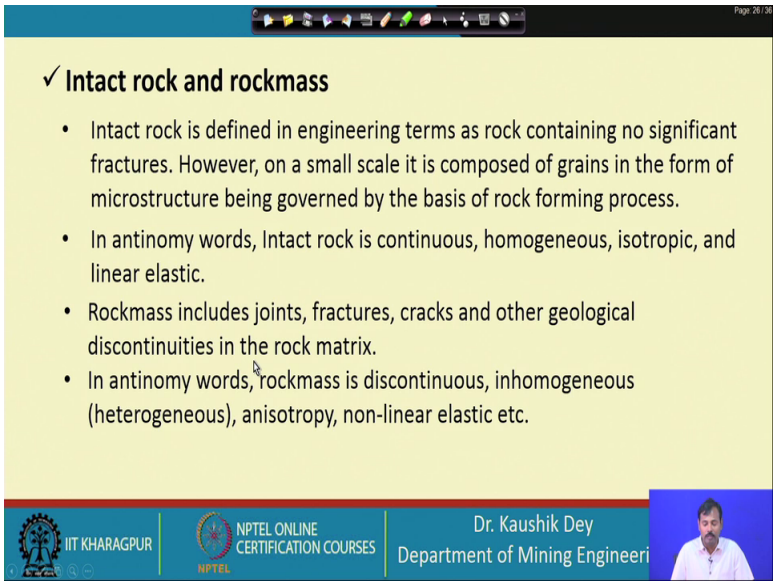

In fact, there is a little bit difference into the rock and rockmass, which is very very important for our rock excavation purpose say a an intact rock piece is called rock and whenever, the rock is existing inside the earth crust it is called rockmass. So, intact rock is defined in engineering term as a rock containing no significant fracture and, it can be used separately in the laboratory for the testing so, that is called intact rock.

But whenever the rock is off some fractures some other geological impurities some heterogeneities some anisotropic tropiness. So, in those cases the rock is called rockmass. In fact, the behavior of a rock and behavior of a rockmass is entirely different for, if you are considering our rock excavation or drilling and blasting in which our rock is the medium in that case, you have to consider the rockmass not the rock.

Say suppose a an intact rock may exhibit a strength compressive strength of say 60 mega Pascal, but whenever that rock is existing with a number of tracks number of fractures number of a fault, in those cases it may be possible that same rock is not exhibit a compressive strength of 60 mega Pascal, but its exhibits a much much lowers stress rock maybe of very hard in nature, but whenever it is associated with fractures etcetera our drilling type maybe different our blasting type may be different.

The reason is that as some explosive is giving the energy sock energy to the rock and, the rock is say fracture rockmass is say fractured in those case the dissipation of that sock rock will be entirely different, or the sock rock utilization is very will be very very lost in

those cases than the intact rock, where the rock is intact no fracture is there. So, like that way rock mass property is the most important part, whenever you are considering the drilling and blasting technology not the intact rock properties.

However, some of the intact rock properties are utilized as the rockmass property, because they are not to be measured in the rock mass condition like say compressive strength tensile strength, those strength properties are not possible to be measured in the in situ condition. So, for those cases those properties of the rock are utilized as the rock mass properties; however, rock mass acted differently from than a rock in the in situ condition.

So, rock mass basically includes joint fracture cracks and other geological discontinuities, but rock does not have this rock is considered as the a continuous homogeneous isotropic whereas, rockmass is anisotropic material inhomogeneous anisotropy non-linear in a non-elastic material.

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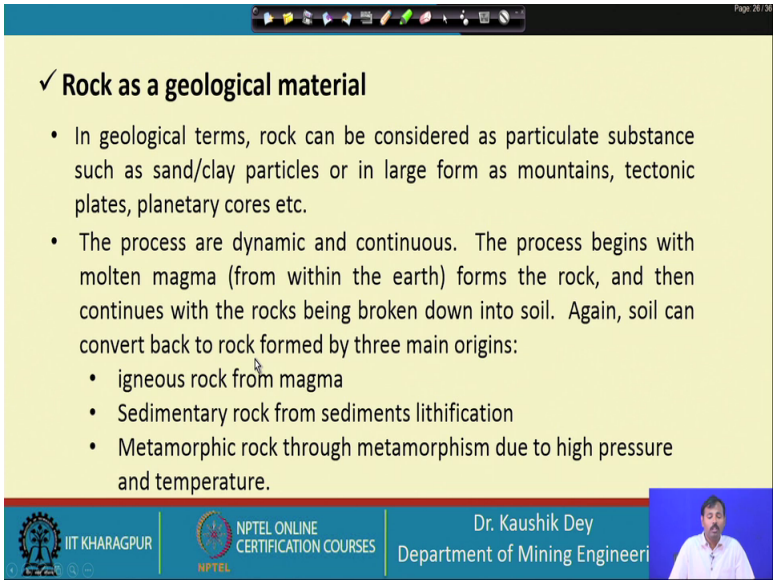

So, in geologic term rock can be considered as particular substance such as sand clay particle, or in large form of mountains tectonic plates planetary codes etcetera. Rock can be classified in basically three groups igneous rock sedimentary rock metamorphic rock. So, basically igneous rock is the rock which is directly coming out from the magma, in the molten stage then became cold down and in after the cooling that exhibit as a strong rock material. So, that is called igneous rock whenever the igneous rock is subjected to

some change, because of the atmospheric activities because of the human activities, because of some other metsomatic activities or may be some another igneous activities.

In those cases it is converted igneous rock is converted to the sedimentary rock, or to the metamorphic rock; that means, the moment one basic igneous rock; that means, once it is coming out from the magma solidified become the igneous rock. Once that rock is subjected to the temperature and pressure that may converted to the sedimentary rock up to the metamorphic rock. So, this is the basic three basic variations of the rock igneous sedimentary and metamorphic.

We will continue this lecture into the next class, where we will understand what is the igneous rock, what is the sedimentary rock, what is the metamorphic rock and how they behave.

Thank you.