Rock Engineering
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Lecture - 04
Rock Identification Procedure

Hello everyone. In the previous class we had the discussion on mineral identification procedure with the help of some of the minerals. I mentioned to you that what are their typical characteristics and how one can be differentiated from the others. We will have similar kind of discussion today in this class, but with respect to various rocks. So, let us start with first the rock identification procedure, then we will learn about some of the rocks and their typical characteristic.

So, to start with, as we discussed in the previous class with respect to minerals. So, today we have rock identification flowchart. So, again here in this case, we have 2 parts on the basis of whether the mineral grains or crystals they are easily visible to the naked eye or not. So, the first part, deals with that when they are visible.

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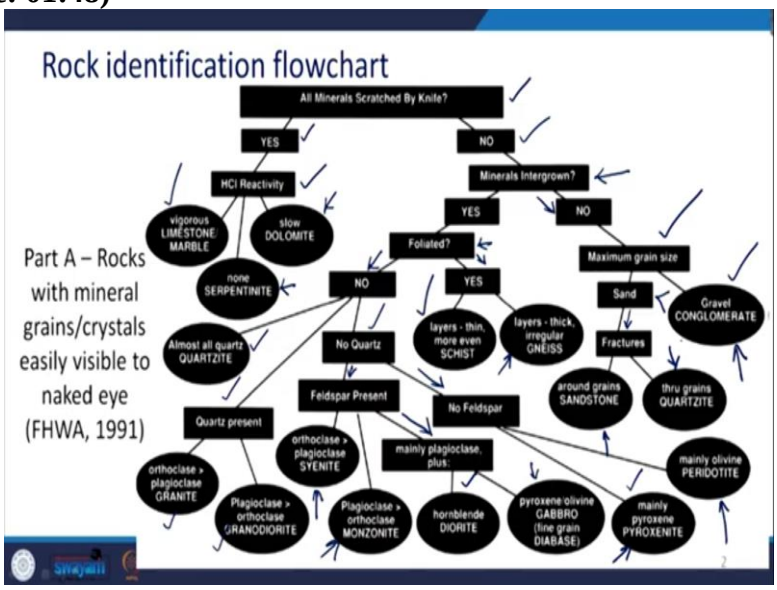

To start with, we need to see whether all the minerals are being scratched by knife or not. If yes, come to this branch, if it is no then we have to go there. If minerals are scratched by knife, then we will check for their acid reactivity that is HCl reactivity. If they have vigorous reactivity, then

those rocks may be limestone and marble. If they do not have any reactivity, then it can be Serpentinite and if it shows slow reactivity, then it is the Dolomite. Now, this is all about when all the minerals they are scratched by knife.

Now, come to the next branch that when they are not scratched by knife. Next question which is asked is whether the minerals are intergrown or not? If they are yes, then the next thing comes, whether they are foliated or not? If they are not foliated, that means we have to follow this branch. If they are not foliated then almost all quartz, you have Quartzite. If quartz is present, but in some quantity see, then you will have whether Orthoclase is more than Plagioclase.

We have seen in the previous class how to differentiate between orthoclase and plagioclase. So, if orthoclase is more than plagioclase then it is Granite and if it is other way around, then it is Granodiorite. If there is no quartz which is present and if there is Feldspar which is present, then again, we need to check whether Orthoclase is more or Plagioclase is more. Accordingly, we will have either Syenite or Monzonite. If Feldspar is present and there are mainly Plagioclase plus Hornblende, then it is Diorite. If it is pyroxene olivine in then it is Gabbro.
So, you see here, how once we identify the mineral, how that information now is being used to identify different types of rocks. I have been mentioning that one type of the rock differs from the other on account of change in their mineralogy. In case no quartz and no feldspar, if it is mainly pyroxene then it is Pyroxenite and if it is mainly olivine it is Peridotite.

Now, if minerals are inter grown and it is foliated then we have to follow this branch. If foliations are there, whether those layers are thin or more even then it is Schist. If those layers are thick and irregular, it is Gneiss. If the minerals are not inter grown, we have to follow this path then we have to see what is the maximum grain size, according to that, you can have gravel and we can identify that rock as Conglomerate.

If you have sand that means, of course, the grain size for sand is going to be less than that of the gravel. We need to see whether fractures are there or not. If the fractures are around the grains, it is Sandstone and if it is through grains, then it is Quartzite. So, you see, based upon the presence

of different minerals, this is how we can identify the rocks which have sufficiently large mineral grains or crystal which we can see from our eyes.

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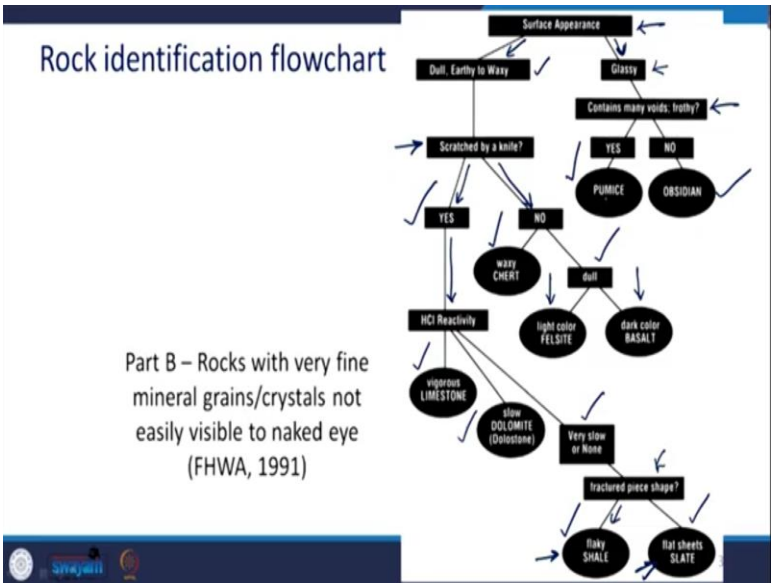

Coming to the next category, where we cannot see these grains or crystal by our eyes. There we have to take into account the surface appearance. Whether it is dull or earthy or waxy in this direction and if it is glassy, then we have to come to this direction. If it is dull, earthy or waxy, then the next step is check whether this is scratched by a knife or not. If it is scratched by a knife that is yes, then go here and check whether it is reactive to this acid or not.

If it is reactive and it has vigorous reaction, then the rock is limestone. If it is slow, then you have Dolomite or Dolostone, if you have very slow or none reactivity, then we have to check whether, what are the piece shape? whether they are when they are when the rock is fractured. If it is flaky, then it is Shale, if it is flat sheets, then it is Slate. So, you see, both these rocks Shale and Slate, they may look same because they all are foliated and all those things.

But then you see the difference lies here that what is the shape of the fractured pieces. So, first the appearance, then whether they are scratched by a knife or not? then HCl reactivity, and then fractured piece shape. If they are not scratched by knife, if it is waxy, it is Chert, if the appearance is dull, then whether it is light color, so it is Felsite, if it is of dark color, it is Basalt. If the surface appearance of the rock is glassy, we need to see whether this contains many voids

whether it is frothy. If it is yes, it is Pumice if it is no it is Obsidian. Pumice you must be aware; you must have seen this day to day use that pumice stone is the same thing as this pumice rock. This is how overall you can follow the flow chart and identify different types of rocks based on their mineralogical composition, HCl reactivity, whether they are scratched by the knife or not, shape and size of the grains.

Now, let us have a look on various types of rocks and some of their properties that we will be discussing further.

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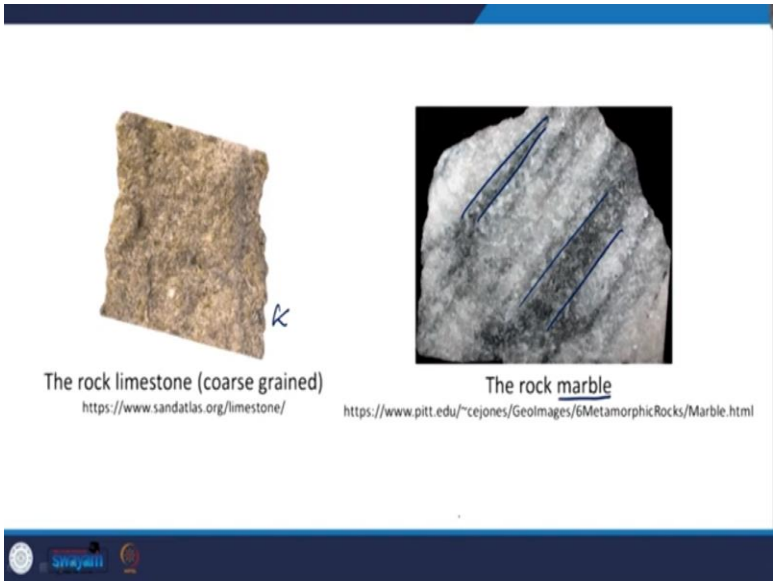

So, in this series first of all, I have the rock limestone as the picture is there, it is coarse grained limestone that has been projected here. Basically, Limestones they are sedimentary rocks in this case minerals they are scratched by knife and it has vigorous HCl reactivity. You can see in this picture that this one is a coarse-grained variety of the Limestone containing almost no limey mud. Then the next rock is the rock, marble which is metamorphic rock. This also has vigorous HCl reactivity.

There you can see that it is typically banded. You can see these bands typically banded marble, they are used as building stone. This banding comes from impurities in the original Limestone and is not due to any alignment of the calcite crystals. Hence, this banding does not count as foliation.

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Now, the next rock in this series is rock Gneiss. This Gneiss is a high-grade metamorphic rock. That means that it has been subjected to higher temperatures and pressures as compared to Schist. The Schist rock has also been shown on the screen. It is this Gneiss rock is formed by the metamorphosis of Granites or the sedimentary rocks and as the picture shows that this display distinct foliation representing alternating layers composed of different minerals.

So, unlike Slate and Schist, Gneiss does not preferentially break along planes or foliation, because less than 50% of the minerals, which are formed during the metamorphism they are aligned in thin layers. Because of the coarseness of the foliation the layers are often sub parallel, that is, they do not have constant thickness and discontinuous. And the texture of this rock Gneiss is foliated, grain sizes medium to coarse, and we can see the crystals with the naked eye. It is hard type of rock or the color is variable, but generally it is alternating lighter and darker sub parallel discontinuous bands. Generally, it is rough to touch and its use includes dimension stone for building facings and pavings etcetera.

Coming to the next one; that is the rock Schist. Schist is again the metamorphic rock which is formed by metamorphosis of mud stone or Shale or some type of igneous rock. It has been subjected to higher temperatures and pressures as compared to slate.

So, the resulting foliation is coarser and more distinct than that of Slate due to higher degree of crystallization of mica minerals, forming larger crystals. And this is often referred as, Schistocity. This is again its texture is foliated. This is fine to medium grained, generally hard and its color is variable often alternating lighter and darker bands and it is often shiny. This is a relatively smooth to touch. Generally used as decorative rock, for example, for walls, gardens etcetera. High percentage of mica group minerals precludes its use in the construction of highway industry. That means for the construction of roads this rock is not used.

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Coming to the next rock, which is the rock Granite. This is intrusive rock or igneous rock. It comprises some of the oldest known rocks on earth, and is the most abundant basement rock underlying relatively thin sedimentary rock cover of the continents. Granite is produced in volcanic arcs and more commonly in mountain building, resulting from the collision of 2 continental masses. Its color is variable, but then typically it is light colored.

Texture is medium to coarse grained. It has a silica content of 69 to 77%. And it can be used as aggregate and fill etcetera in the construction and highway industry. It is cut and polished for dimension stone for building facings, bench tops and counters, then cut and carved into monuments, headstones, statues, and etcetera.

Next rock that has been shown here is the rock Gabbro. It is a dense intrusive rock that means igneous. This is igneous rock. This is a plutonic equivalent of Basalt, that is, dark gray to black and its texture is medium to coarse grained. Silica content in this case is smaller than that of the Granite and that is 45 to 52%. This has a use as aggregate fill etcetera in the construction and for road construction as well.

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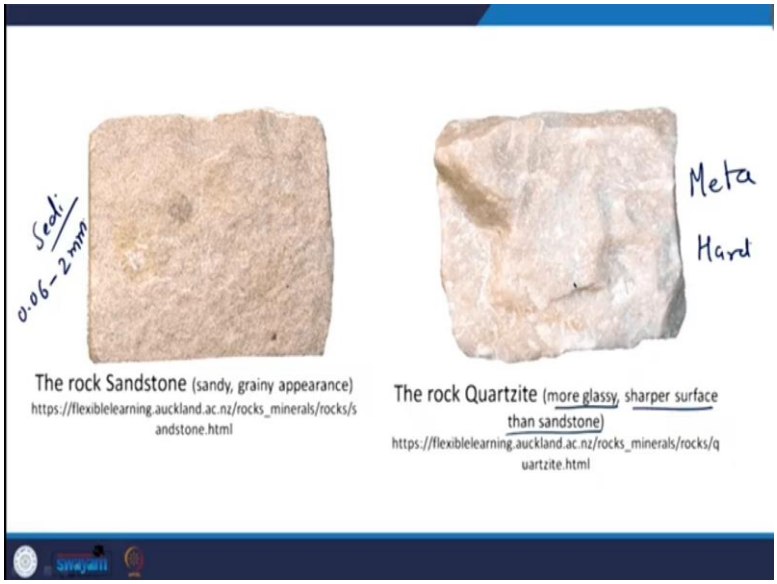

Then, we have the next one as the rock Sandstone. The Sandstone is basically the sedimentary rock, it is formed from cemented sand sized clasts. The texture is plastic that means it is noticeable only with the help of a microscope. The grain size varies from 0.06 to 2 millimeter. Clasts they are visible to the naked eye often we can identify them. Its hardness is variable. So, you can have the hardness from soft to hard depending upon the Clast 10 cement composition.

Color is also variable through Gray, Yellow, Red to White, reflecting the variation in mineral content and cement. It is gritty to touch like the sandpaper. If it is soft then generally of no use. But if it is hard, then it can be used as aggregate or fill etcetera in the construction and highway industries, dimension stone for buildings and pavings etcetera.

Then the next rock which has been shown in this slide is rock Quartzite. As you can see, if I compare these 2 rocks that is Sandstone and Quartzite, this is glassier and it has sharper surface as compared to that of the Sandstone which had sandy or grainy appearance. So, this Quartzite is

metamorphic kind of rock which is formed when quartz rich Sandstone or Chert has been exposed to high temperatures and pressures. Although these Quartzite can sometimes appear superficially similar to Marble.

A piece of Quartzite will not be able to be scratched by a metal blade and Quartzite will not fizz on contact with dilute hydrochloric acid. So, that is how you can identify between Marble and Quartzite. Its texture is granular. It is medium grained. It has hard rating on the Mohs hardness scale. Its color is a variable because pure Quartzite is white, but Quartzite exists in a wide variety of colors. Of course, it comprises of main mineral quartz, and it is generally gritty to touch. This can be used for the metallurgical purposes as it is a source of silica and for the manufacture of brick, as aggregate in the construction and highway industries.

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Now the next rock that we will discuss is the rock Conglomerate. It is a sedimentary rock, that is formed from rounded gravel and boulders size clasts. They are cemented together to form a matrix, as you can see here in this figure, that these gravels are there, you see, all these gravels are there. The rounding of the clasts indicate that they have been transported some distance from their original source, maybe by a river or glacier or that they have resided in a high energy environment for some time.

For example, on a beach which is subjected to wave action. The cement that binds the clast is generally one of either calcite, silica or iron oxide. The matrix can consist solely of the cementing material, but it may also contain sand or silt size clast cemented together among the coarser clasts. It is the coarse-grained rock, where the grain size they are more than 2 millimeters. Hardness varies from soft to hard; it depends on class, composition and strength of cement.

Color is variable it depends again upon the clast and the matrix composition. Other features of this rock include that the clast generally is smooth to touch and the matrix variable. This kind of rock is used as a dimension stone for decoration of walls and floors. If it is hard, it can be used as aggregate fill etcetera in the construction and highway industry.

Now, the next rock that is being shown here is the Limestone and a variety having fine grained rock that has been shown here. So, this is also the sedimentary rock, which is consisting of more than 50% of calcium carbonate although there are many different types of Limestone which are formed through a variety of processes. These Limestones can be precipitated from water, can be secreted by marine organisms, such as algae and coral, which is the biochemical limestone or it can form from the shells of dead sea creature bioclastic limestone. Some limestones form from the cementation of sand and or mud by calcite.

And these often have the appearance of sandstone or mud stone. Because calcite is one of the principal mineral components of Limestone, it will fizz in dilute hydrochloric acid. So that is one of the major procedures to identify that this rock is Limestone. Its texture can be clastic or non-clastic. Grain size can vary as here I have shown you the fine-grained example, but then you can have coarse grained limestone as well.

Generally, on most hardness scale, it is rated as hard rock. Color is variable but generally it is light colored gray through yellow. It is smooth to rough to touch and dependent on this depends on composition or the modes of formation. Its uses, you see, that it is very important that it is a base for cement as dimension is stone for decoration of walls and floors. It is used in the production of line fertilizer, paper, petrochemicals, pesticides, glass etcetera.

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Next in this category is the rock Shale and rock Slate. So, both the rocks I will be discussing maybe together. So, the rock Shale is lithified mud both these rocks that is Shale as well as Slate they are sedimentary rocks composed mostly of clay and silt sized grains. Now, you see that this is as I mentioned that these are both metamorphic rock and generally formed by metamorphoses of mud stone or Shale or some time Basalt, under relatively low pressure and temperature condition.

For this rock, Slate, clay minerals in the parent rock metamorphose into mica minerals, which are aligned along defoliation planes perpendicular to the direction of the pressure. This Slate is characterized by fine foliation along which it breaks to leave smooth or flat surfaces. Sometimes original bedding is visible on foliation planes. See, Slate when struck, it will ring; the sound kind of ring will come unlike Shale, which will make a dull sound as thud.

So, when you break it, then this has crisper sound as compared to that of Shale and that is how you can identify these 2 rocks from each other. They are foliated as you can see here, in these 2 pictures, very fine grained and hard and brittle. Color can be variable, black, shades of blue, green, red, brown, and buff they are available or they can be found. Usually they contain mica minerals, which typically impart sheen on foliation surfaces. It is smooth to touch for both these

rocks. These, the uses of Slate include roof and floor tiles, construction, blackboards, standard material for the beds of pool, snooker or billiard tables.

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Next rock which we are going to discuss is rock Rhyolite. It is the igneous rock and in igneous rock, we had learned that there were 2 subclasses; intrusive and extrusive. So, this is extrusive subclass due to high silica content, this Rhyolite lava is really very viscous. It flows slowly, like toothpaste, when that is squeezed out of a tube and it tends to pile up and form lava domes. If Rhyolite magma is gas rich, it can erupt explosively, forming a frosty solidified magma called Pumice along with ash deposits.

In certain situations, extremely porous Rhyolite lava flows may develop. So, the extreme porosity of such flows allows the gassing and subsequent collapse of the flow forming dark colored volcanic glass. It belongs to group volcanic; color is variable but in general it is light colored rock. It is usually the texture is porphyritic but it can be aphanitic also. Silica content in this case is 69 to 77%. This rock can be used as aggregate or fills etcetera in the construction and highway industry. Pumice is used as an abrasive especially in the cosmetic industry and can also be incorporated into lightweight building materials.

The next rock again it is of igneous type of rock, that is, rock Andesite. It is the kind of intermediate rock in composition between Rhyolite and Basalt. The lava for this rock is of moderate viscosity and it forms thick lava flows and domes.

Color is variable but typically it is bluish gray or gray. The mineral which this rock is of made up of is pyroxene. Silica content is 52 to 63% in this case, and this can be used as an aggregate fill etcetera in the construction and highway industry. Often it is not ideal for concrete aggregate because of the high silica content.

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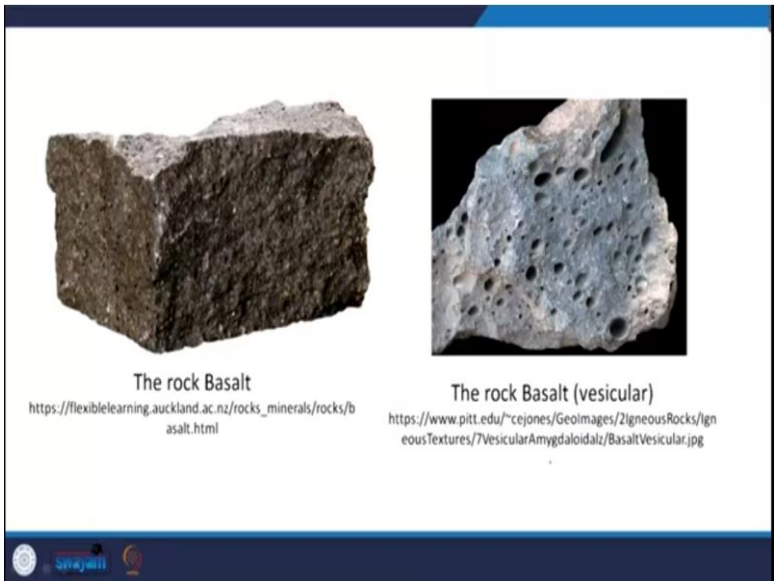

Next rock that I want to discuss with you is the Basalt. So, you can see that this slide shows 2 views. One is that on Basalt, and another one is again the rock Basalt, but it is vesicular. So, what do we understand by this vesicular? So, you can see these kinds of formations are there in this rock. So, what happens this is an igneous rock. So, when the magma erupts there, so lot of gas may also be present.

And if it is not able to escape in just cools down in the rock and that gas portion, it creates this kind of vesicular kind of structure. So that is the difference between these 2 Basalts. So, it is the extrusive rock. It is the most widely spread of all igneous rocks, and comprises more than 90% of all volcanic rocks. Because of its relatively low silica content, Basalt lava has a comparatively low viscosity and forms thin flows that can travel long distances.

It is also found as intrusive dikes and sills. Many moon rocks brought back by Apollo astronauts are of Basaltic composition. Basalt is a volcanic equivalent of Gabbro rock. Colors vary from dark gray to black. Groundmass generally has pyroxene mineral. Silica content is in this case is 45 to 52%, and it can be used as the aggregate fills etcetera in the construction and the highway industry. It is best if olivine content is low.

It can also be used as armor rock for sea walls, dimension stone, for example, stone walls, carved stones and paving stones etcetera. So, this was all about that I wanted to discuss with you with respect to rock identification procedure followed by some of the rock types. I tried to give you the idea, what some of these typical rocks they look like? Roughly what are their some of the salient features that you can identify these rocks?

What are their usages in different industry? So, this is all about rocks and minerals. In the next class, we will have discussion on geological structures, which include faults, bedding planes, folds and unconformity and then we will see that how we can represent these geological structures in the graphical form. Thank you so much.