Surface Mining Technology
Professor. Kaushik Dey
Department of Mining Engineering
Indian Institute of Technology, Kharagpur
Lecture No. 06
Phases of Surface Mining - I

Let me welcome you to the sixth lecture on surface mining technology. In this lecture, we will discuss the phases of surface mining.

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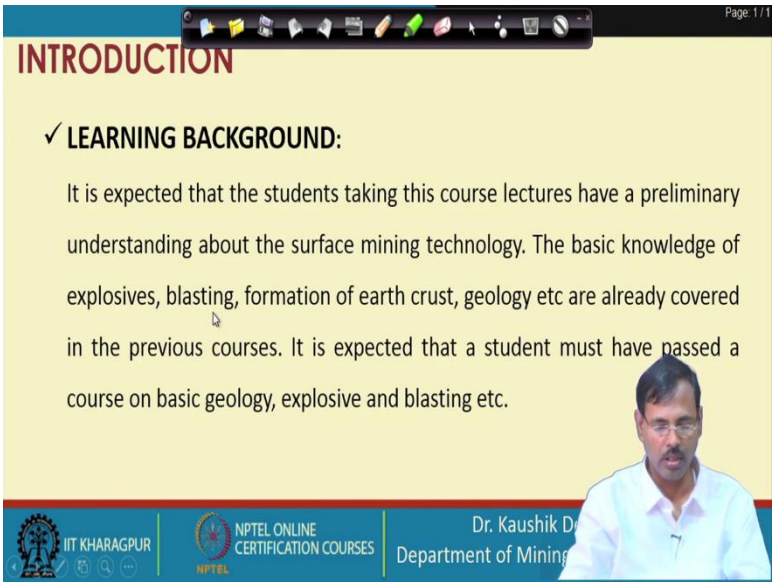

From the very beginning, phases of surface mining mean how a mining concept has come, and how we carry out that mining and at the end of the mining, how we are closing that mining? During this cycle, this total journey is considered as the phases of surface mining. So, let us give you a glimpse of the learning background of surface mining technology.

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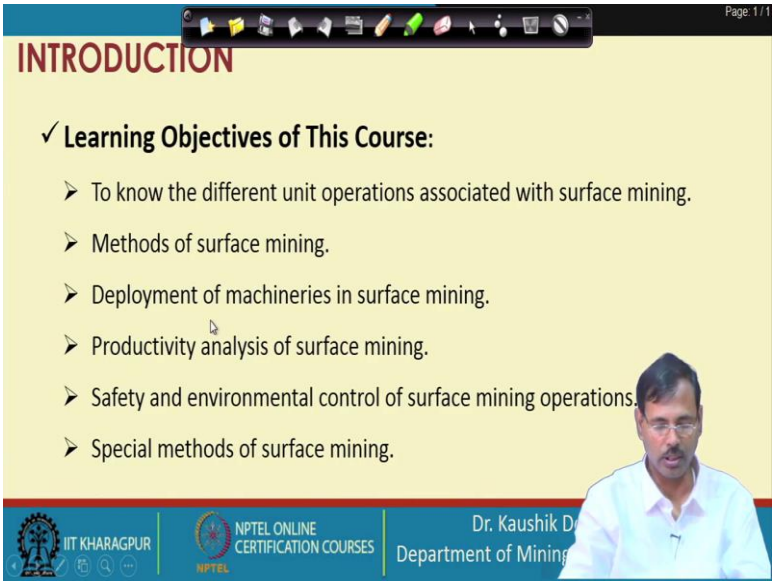

Then the learning objective of the course Surface Mining technology.

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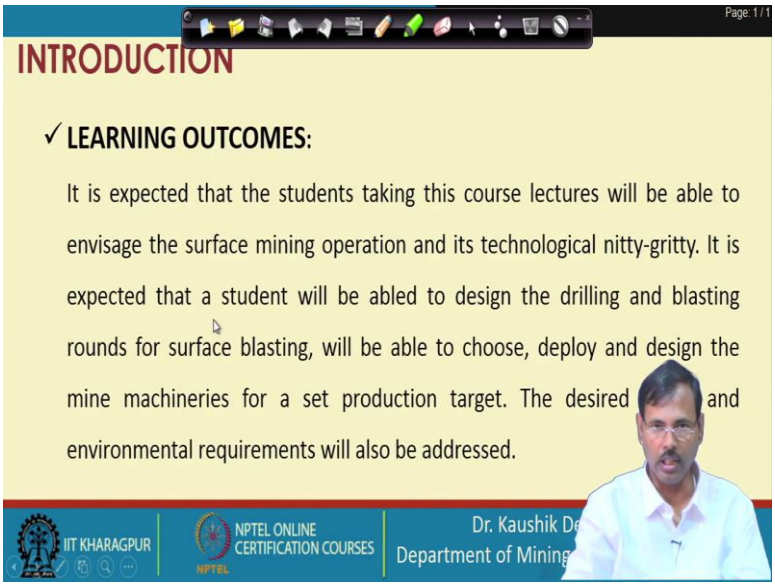

Then the learning outcomes, and this is the learning outcomes.

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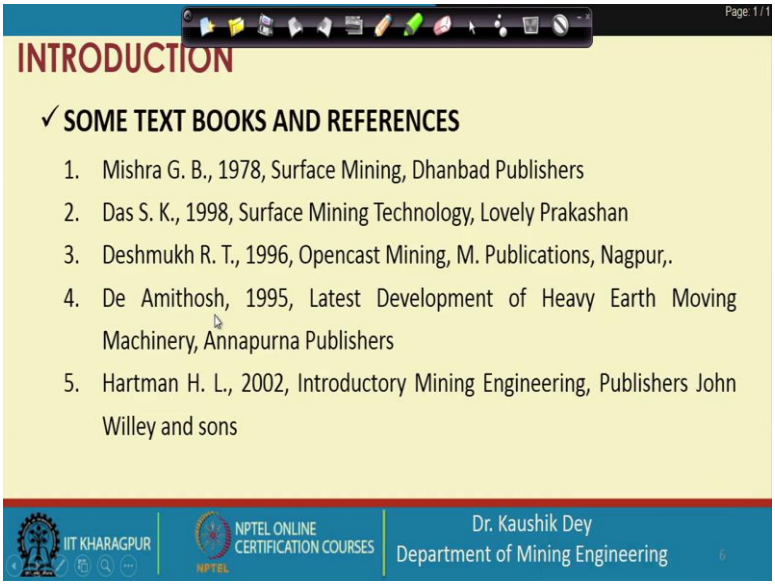

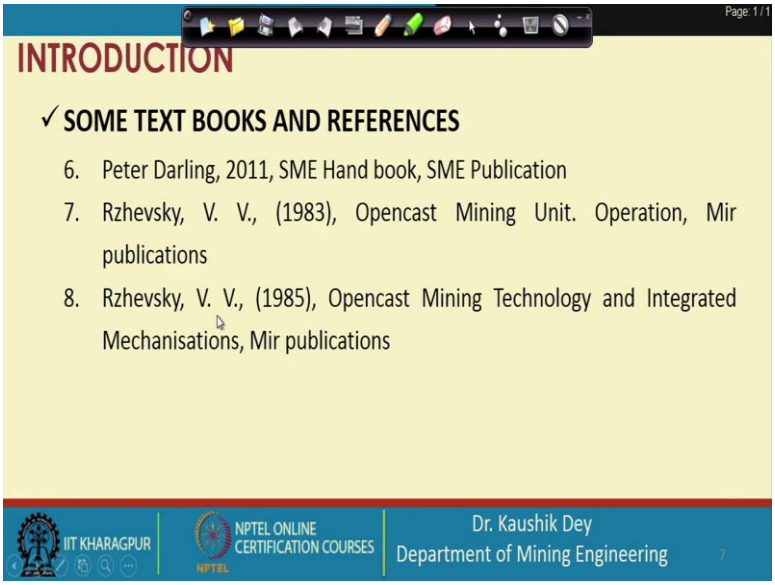

These are the textbooks and reference books.

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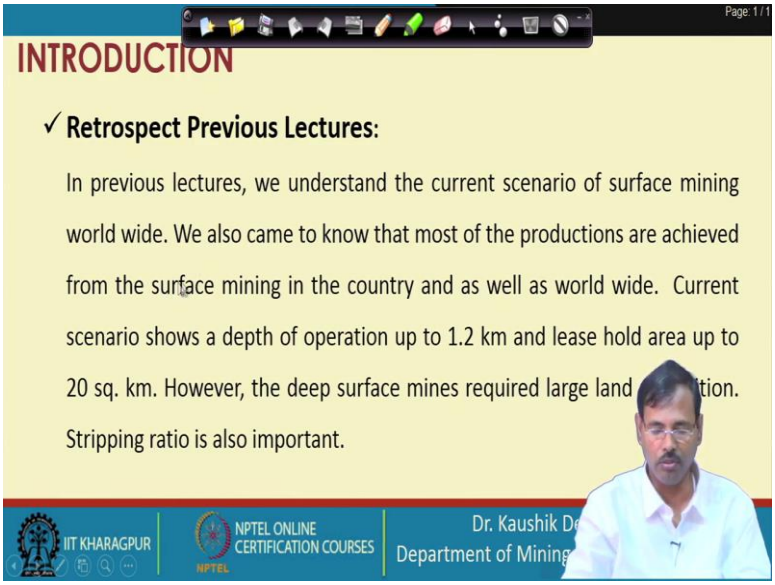

And this is the retrospect of the previous lectures. In the previous lectures, we understand the current status of Surface Mining not only in India but also worldwide. We have also gotten some knowledge about the rock and rock mass mineral ore deposits. And we have seen that surface mining can be conducted up to a depth of 1.2 kilometres.

We have also understood the mining can be carried out from the surface from the underground and their comparison we have understood, and we have got a detailed knowledge about the stripping ratio, which is basically the ratio of the overburden rock handled for per ton of ore body or per ton of overall minerals which are being produced by the mine. So, the importance of that stripping ratio is dictating the choice of surface mining and underground mining that we have covered in our previous lectures.

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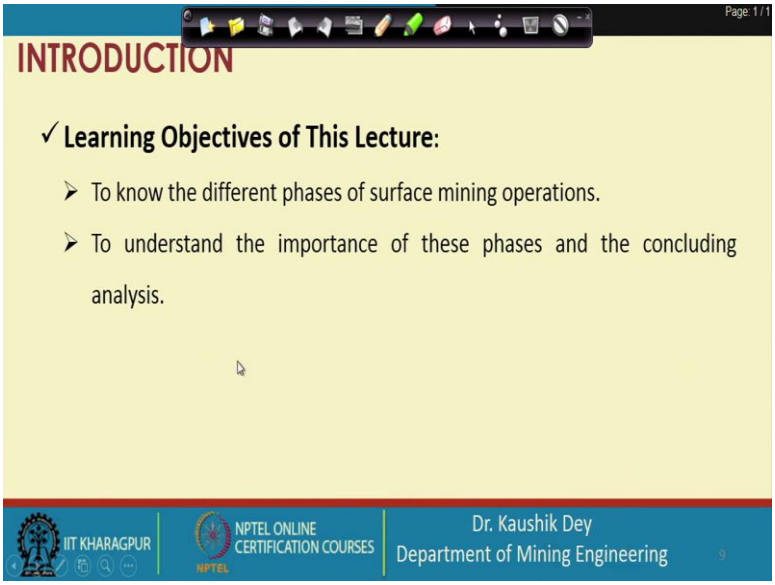

And the objective of this lecture is to know the different phases of surface mining operations to understand the importance of these phases and how we conclude the analysis after each phase to go for the next phase or not.

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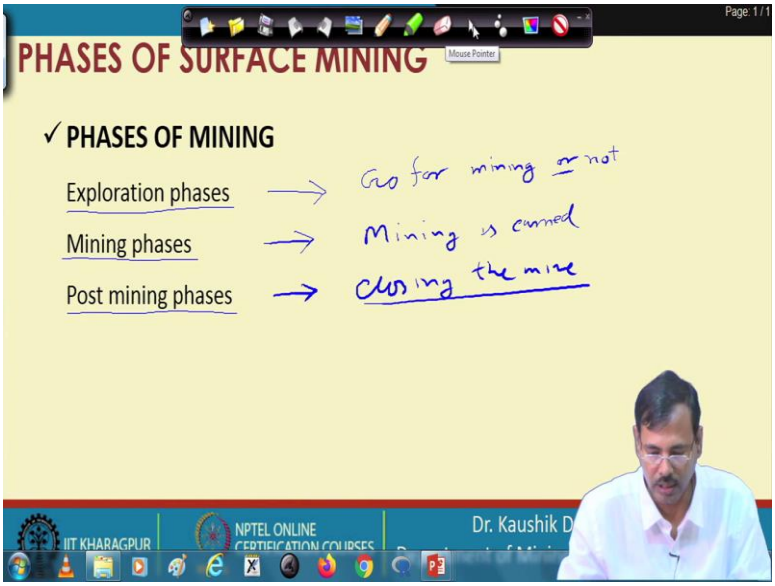

So, let us see the phases of surface mining. The phases of surface mining can broadly be classified into these three parts: exploration, mining, and post-mining. The exploration phase is basically dealing with whether we should go for mining or not.

In mining phases, we basically deal with how the mining will be carried out, its production cycles, etcetera. And in post-mining phases, it basically deals with how we are closing the

mine, which has to be carried out properly in this, and the details of those studies are fully discussed here.

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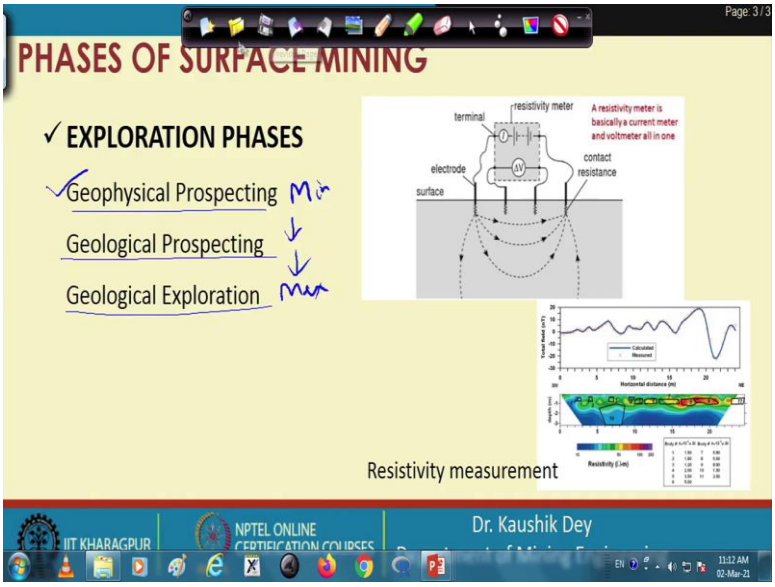

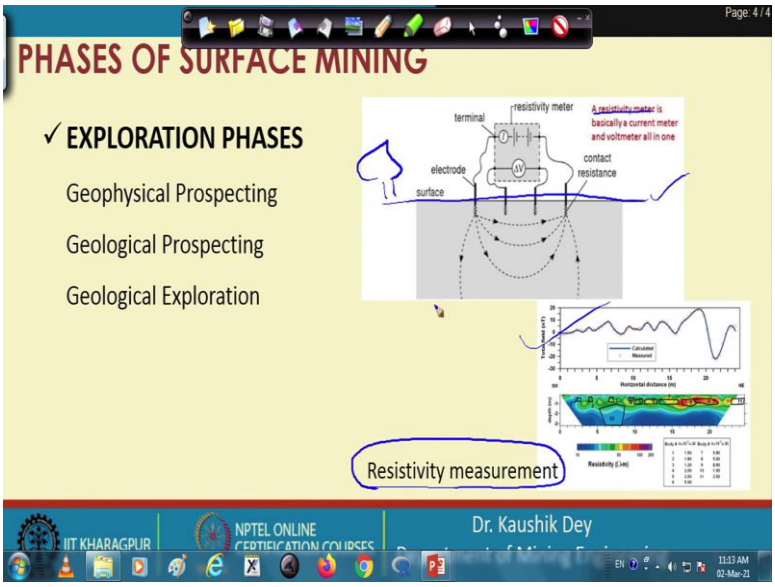

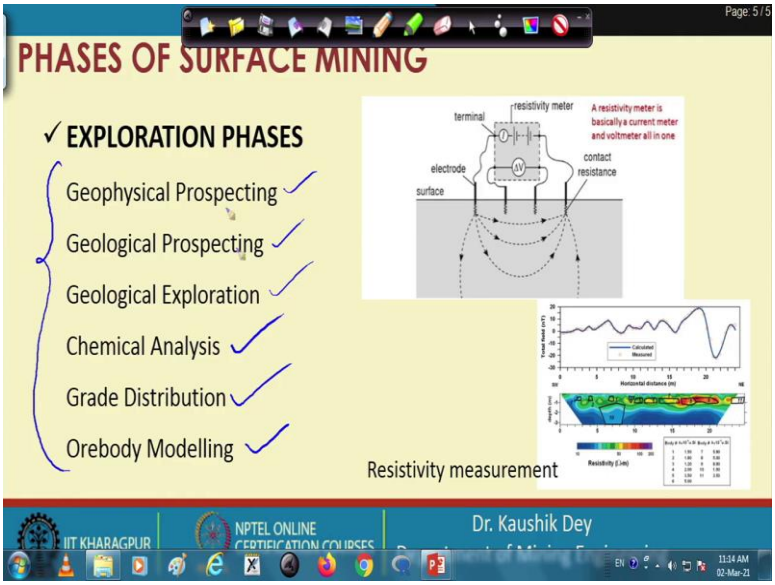

Now, first, the exploration phases in exploration phases. Basically, what we carry out here, the first part is that we carry out the searching of mineral and you remember one thing which is very important at this stage is that you are carrying out mining to earn some profits. So, the mines are opened. It is a business, and it has to be carried out with a profit.

So, while you are spending your money or on searching, it is basically the investment you have to make so that in future you can earn some money by carrying out mining. So, always your idea must be that these expenses should be minimum, and you will go for the next stage of work only if this result is interesting or you can say positive or attractive. If the results are attractive, then only you must go for the next stage of investment.

So, that is why, when we invest for the first time. The investment is carried out for the geophysical prospecting. Our investment is as minimum as possible. If you are considering this geophysical prospecting, geological prospecting and geological exploration, if you are considering these three parts, these have the minimum investment. This is the minimum, and this is the maximum investment.

So, that is why this investment initially starts with the minimum investment, and if the results are found interesting encouraging in that case, we go for the next stage. If it is encouraging again, then only we go for the next stage. So, like that way, we proceed. So, first, the search of mineral is carried out using the geophysical techniques, where geophysical tools are used for searching of the minerals and if it is found in encouraging, then only we go for the next phase of prospecting that is geological prospecting.

So, what is what are the geophysical tools we are using? There is n number of physical physics-based methods available. One method is shown here is resistivity measurement. This is the resistivity meter, which is used to measure the resistance of the ground. So, we are basically if this is the earth surface, if this is the earth surface, then inside the earth surface in the rock mass what is the resistance we are measuring using this instrument which is called resistivity meter.

And this resistivity meter gives an output similar to this from which we find out what are the resistance, and this resistance is basically converted into the possible rock types, which is possible there. From there, we search out whether the mineral is available there or not. So, resistivity is one geophysical tool that is used which are used for searching the minerals.

These are the different exploration phases: geophysical prospecting and then geological exploration. After this exploration, we go for the chemical analysis of the minerals. We go for the searching of the or modelling of the grid distribution inside the rock mas and finally, we derived the ore body model up to this is considered as the exploration phase, and this is basically to identify the deposit inside the rock mass which is carried out in the exploration phase.

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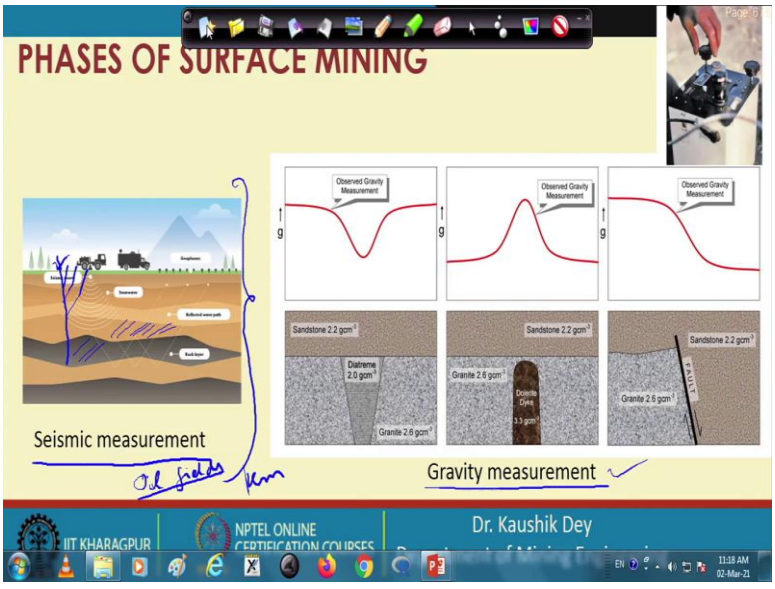

Now, the other geophysical tools available are gravity measurements. In the last slide, we have seen the resistivity meter. A resistivity meter is commonly used to search the groundwater, search the cold deposits, etcetera. Gravity measurement is where the gravity of the area is measured. If the area has some heavy minerals deposited in that area, then the local gravity is increased a little bit.

So, that little interest in gravity is measured. By that way, the search of minerals is generally carried out in chromite mines magnetite mines. These minerals, which are heavy minerals, are searched and searched out using this gravity measurement. Seismic measurement is carried out very common to find out the rock mass's seismic velocity.

Each and every rock mass has a distinctive seismic velocity, and the by knowing the seismic velocity of the rock mass, we can guess the possibilities of the mineral occurrences there. The main benefit of the seismic measurement is that it can be carried out at kilometre depths also. So, as it is carried out up to kilometre depths also, this is very commonly used for the searching of minerals which are possibly in deep-seated.

So, that is why seismic misalignment is a very, very common searching technique for ore deposits. In this case, generally, we provide or generate a seismic wave. We generate a seismic wave and allow that to penetrate through the rock mass, and in every phase where the different mediums exist, that is reflected back, and these reflected waves are, waves are received.

And from these signals are analysed and based on that it is determined that what is the possible basically mapping is carried out for the whole area and based on that it is identified what the possible seismic velocity of that and zone is and from that zone, it is if this seismic velocity of this zone which is given in a colour code like this and from that, it is identified this is the possible mineral.

So, by that way, it is basically used and very commonly used for deep-seated deposits. In fact, for the searching of the oil fields searching up oil fields, seismic measurement is very, very common. So, seismic measurements are carried out to search the deep-seated one.

Also, you must remember using the hammering technique. We can penetrate up to a smaller depth for very deep-seated deposit searching a very deep-seated deposit generally blasting is carried out, and you know blasting is a good source of seismic, generation of seismic wave. So, this is another method geophysical method that is commonly used for searching of minerals.

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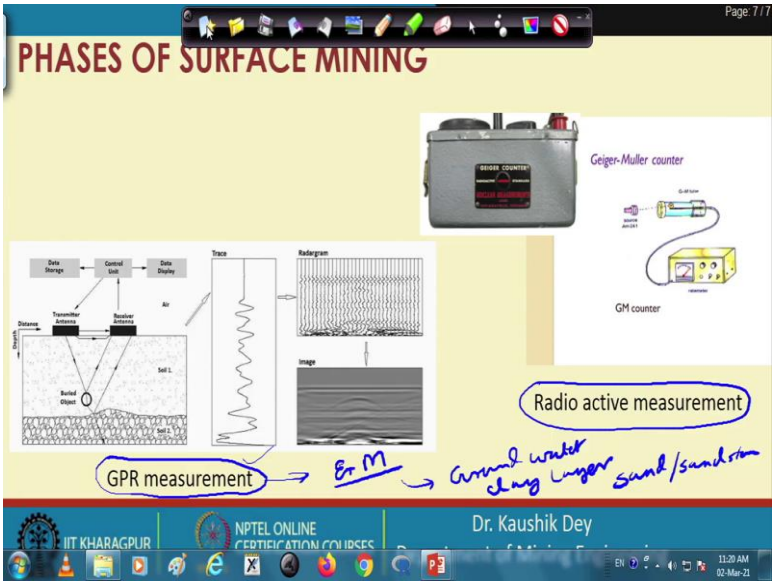

This is GM counter Geiger Mueller counter. So, this Geiger Mueller counter is commonly used to measure the radioactive occurrence of the radioactive minerals. If the radioactive minerals are there, in that case, a GM counter is used, which gives the radiation levels. From that, it is we can guess the possibilities of occurrence of radioactive minerals. Another method is also available, which is called Ground Penetrating Radar.

This Ground Penetrating Radar is basically operating on the just in seismic the seismic velocities measure. Here the electromagnetic velocities measure, EM velocity is measured and based on the EM velocity of the in-situ mass, it is trying to find out the occurrence of the different objects inside the rock mass. So, it is easy to identify the different layers, especially where the conductive layers are very easily detected like groundwater.

Groundwater, clayey layers, sand layers, sand or sandstone layers. This can be easily identified by the Ground Penetrating Radar. So, this Ground Penetrating Radar is also another very important geophysical tool that can be searched out which can search out the minerals very easily in the earth's crust without any penetration at the depth. So, that means you can understand all these geophysical tools. They indicate the occurrences of the minerals and deposits from the earth's surface itself.

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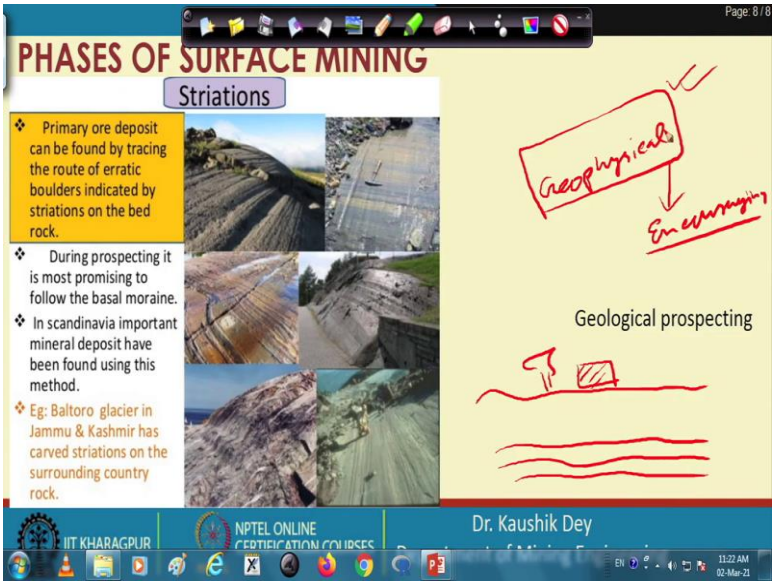

So, that means, if this is the so, if this is the earth crust, if we are using some geophysical tools at this position without penetrating the without moving into the depth or digging this rock, etcetera, we can find out the occurrence of the deposit inside the earth. So, this can be identified without penetrating the earth's crust. So, that is the benefit of the geophysical tools. And that is why geophysical tools, geophysical tools are not costly.

We can carry out geophysical prospecting with very little investment, and that is why this has to be carried out beforehand. Before we invest a lot for this geophysical prospecting and geological prospecting and geo geological exploration, we invest a little bit in geophysical prospecting and if the results from the geophysical prospecting is found encouraging, then only we must go for the next phase of searching of minerals that is the geological prospecting.

So, once the geophysicist claims that this area probably has a good deposit source, then geologists will come and geologists will search the area so that they can see the traces of any occurrences of such minerals there. So, geological prospecting is carried out this also carry out the field visit, they search to find out whether any tracing of the deposit is found or the probability of the occurrences of these hydrothermal depositions or maybe metachromatic depositions, whether there is any indications of those are available or they are or not, that is generally tried in geological prospecting.

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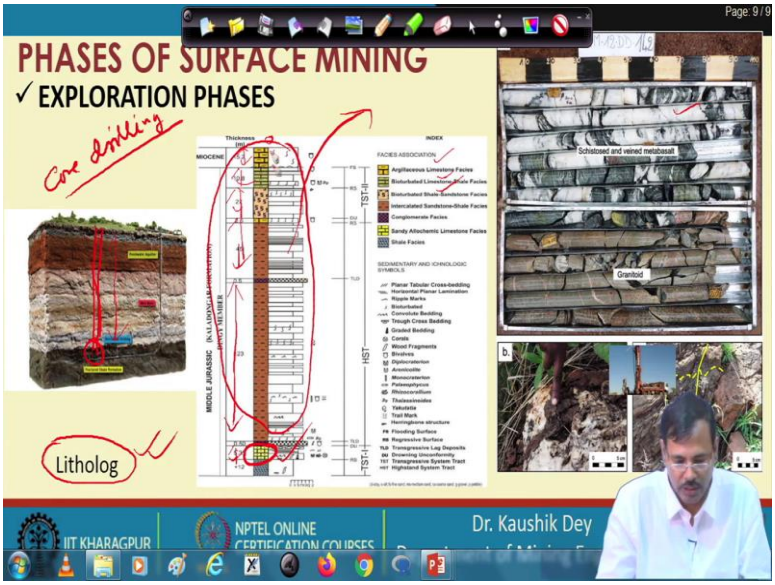

And if they found that in geological prospecting, the results are encouraging, they go for geological exploration. So, what they did in the geological exploration, they try to search or take some samples from the in-situ. So, for taking the samples, what they do, they go for a core drilling. So, they go for drilling from the surface to the into the rock mass, and they take out the core, take out the rock core from this place, and this is the core you can see in the figure.

So, after drilling, the rock mass is basically taken out in terms of core those cores are properly maintained, and the chronology of the core is properly maintained like this in a core box, and they are analysed and when these cores are obtained by drilling the core is represented in a scale that is called litholog. In little lothilog you can see this is the surface is indicated as 0, and then each and every thickness is given at this position.

This is the different rock types are mentioned. So, depth-wise occurrences of different rock types are basically shown in the pictorial form here and that is called litholog. So, in the exploration phase, geologist comes, and they and these geologists go for the exploratory drilling. This is the core drilling is carried out. So, this core drilling is carried out and in this core drilling, they take out this core, and this core are basically represented in a litholog.

So, if suppose this is the interesting mineral we are searching for, then we can understand this interesting mineral is situating as at this place and the above this, this is the different types of other minerals other rocks are available. So, to take it out, you have to take out all this for some of rock, you have to take it out then only you can get this beneficial mineral which for which you are interested.

So, this is the geological exploration is carried out here. This has another benefit: as we have already got the rock samples or mineral samples, we can go for the chemical analysis.

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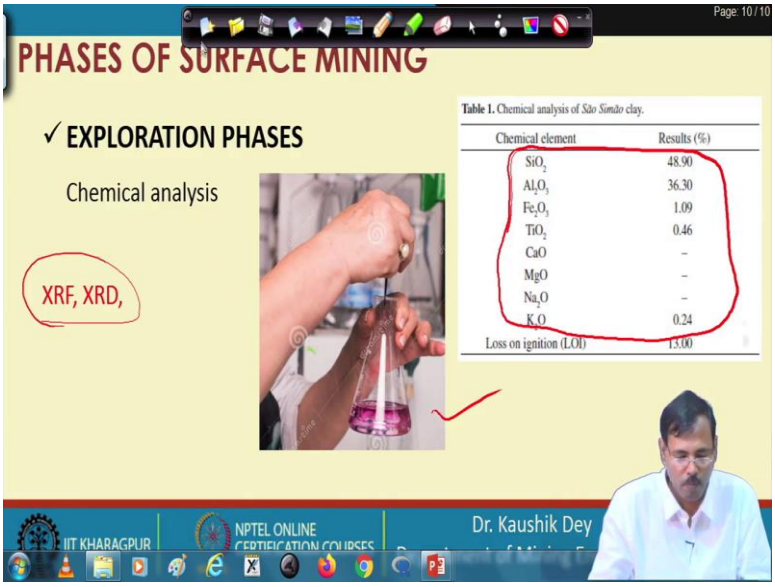

So that we can get the actual chemical compositions of the same, this is one chemical analysis of one set of samples carried out in this case. So, this chemical analysis you can having the option as the minerals are available with you due to the to the core drilling you can go for chemical analysis using direct chemical based analysis or you can go for XRF, XRD those are the electronic devices that can give you the detailed idea about the chemical compositions of the rocks.

So, that is why these are very, very important and these exploration phases are very, very beneficial in this case.

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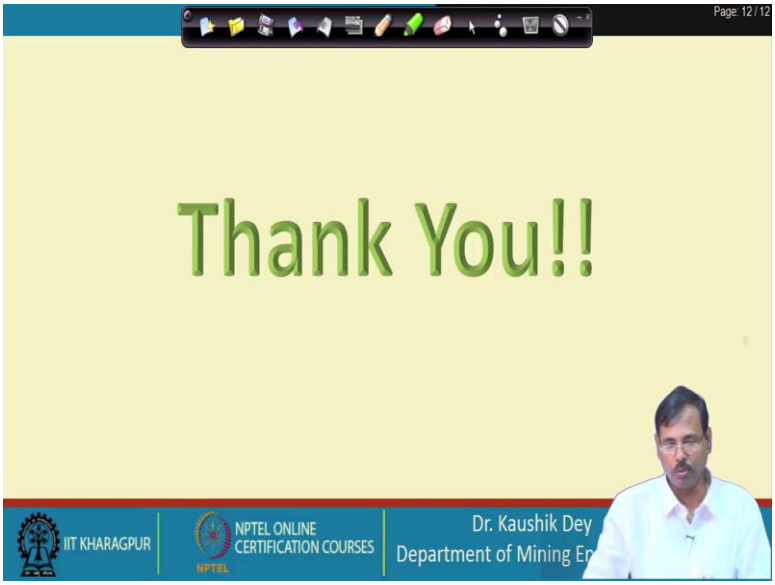

You can directly get an idea about the ore body and minerals. So, let us stop this lecture at this point. We can continue this lecture in the next class, where we will get an idea about the mineral compositions of the ore body. Then, how we can find out the difference? We can mode out this ore body for mining purposes. Thank you.