Photogeology in Terrain Evaluation (Part – 2)
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Lecture - 02
Photo Interpretation/Identification of Landforms Associated with Folds - 1

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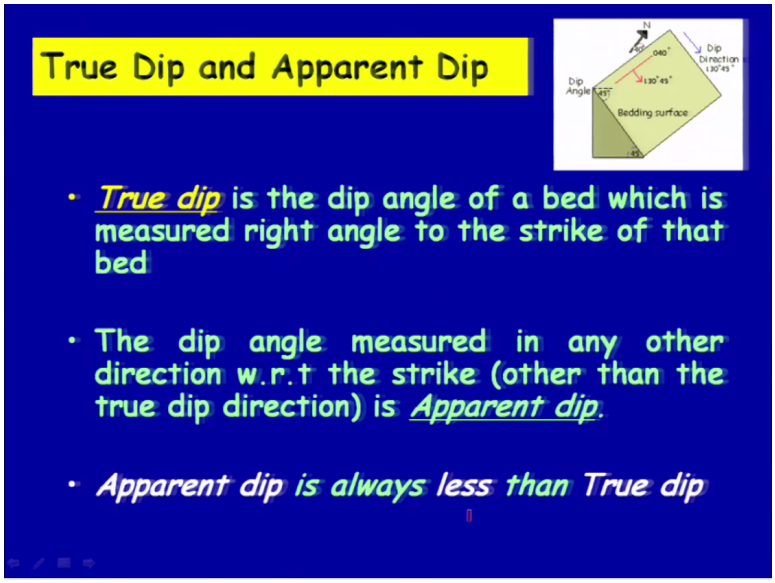

Welcome back. So in last lecture, we talked about the Strike and Dip that is the attitude of rocks; and we also discussed about True dip and Apparent dip.

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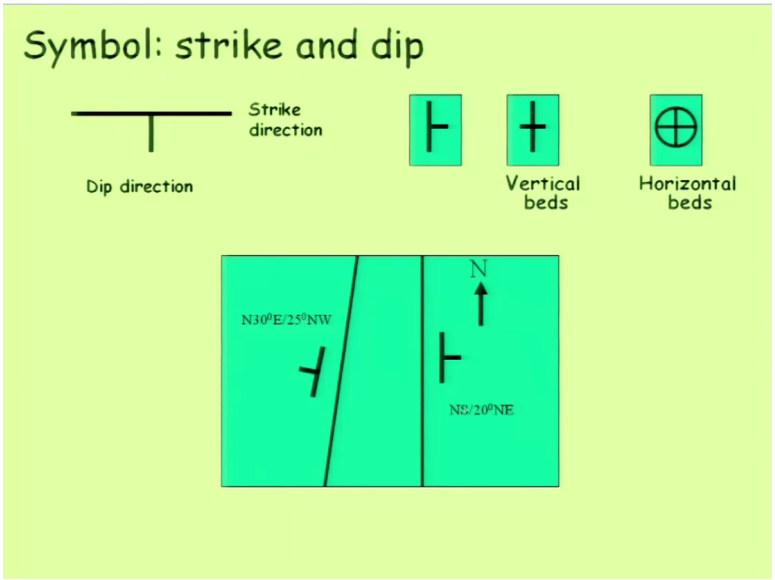

Now usually what you will see in terms of the symbol in most of the what we can call the geological map or the structural maps okay which will be made available to you or maybe

already published maps which are required to be looked at and examined before the any site is considered for the construction.

So you will find some symbols were very common okay which you should make note off, is the Strike direction and the dip direction; so you will have a symbols like T okay. So this is; these are the symbols which will be given. For example, you are having vertical beds so you can just put in the cross lines okay. And then a circle with the cross line where you will see that the attitudes not seen mostly the beds are horizontal okay.

So for example this again a plane view and you are marking two beds which are inclined in different directions okay. So if you consider this as a north, so one bed over here is your north-south and another bed is having in slightly different orientation that is in strike okay. And if you have the information of the dip then you can put this information that your this bed so this was symbol you are having okay of the strike and dip, okay.

And then you are having the direction that is your north. So you have this north 30 degrees east and then you are having 25 degree that is your amount and you have Northwest is the at the direction in which you are having the dip, okay so Northwest will be in this one. This is your Northwest; this is your east-west here, okay. So keeping this in mind you can even read out the maps in a way that how the information are been given.

And this is totally north-south orientation that is your strike and you are having 20 degree northeast dip here so that is in dip direction and 20 degrees your amount of dip, okay.

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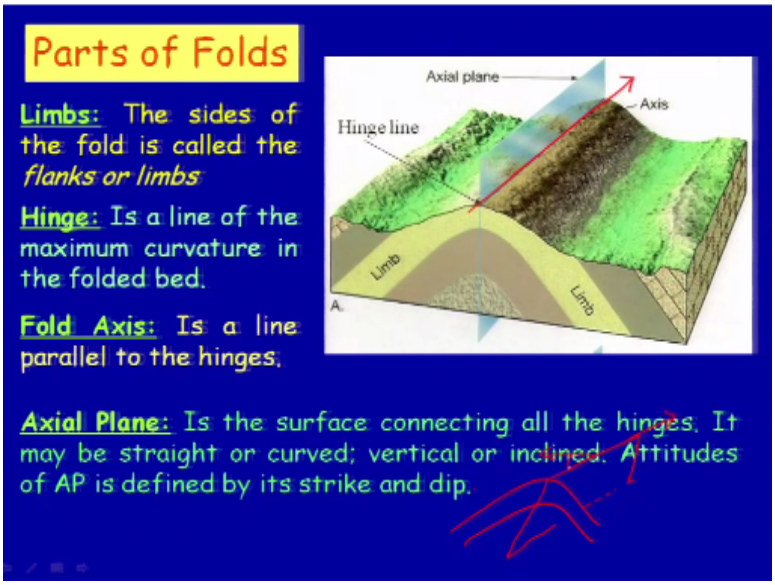

Now, Parts of Folds I discussed like what is Anticline and Syncline. So if you look at the Anticline part we have different parts of folds like we have two limbs, yeah and then we are having the Hinge line and we have the axial lane and we have the fold axis okay. Now these are important for example because I will talk in terms of you have been asked to put in tunnel then it is extremely important that what is the axis of the fold okay, in which direction it goes.

Because in nature it will not be always possible that you will have a very straight hinge line okay that is absolutely not possible in terms of; so for example, you are having the fold which you see from the front okay or from the top you will be able to make out the hinge line okay. So then the fold is going like this okay fine. So what you able to see is that your hinge line is changing okay at the direction or the orientation of the hinge line is not exactly the same.

So that will help you in aligning your tunnels or if you are talking about the roads also is okay. So this is very important part that we should know and keep in mind while interpreting the satellite data okay. That is the limbs and hinge line okay. Whether both the limbs are dipping having the same amount of dip or one is inclined one is not okay. And then what is the axis okay.

Because the another part which I can talk it like give a talk on that if possible but I have already covered in one of my course, that if you are putting or going to put a tunnel here okay you will be in a free bed idea okay. Because the rocks at the center that is what we call the core of the fold will be under tremendous pressure okay. So this is; the excavation of this area will be extremely difficult to define.

So this is another important part which one has to take into consideration. Second, that what is the strike of the fold okay; because you cannot put it in the center like for example this is not advisable; then what you will do you will put because you have to cross the fold then you even have to put your tunnels somewhere here in the limb, limb side okay. Now, you will avoid that if the beds are dipping higher their inclination is very high you need to avoid that.

Second, the colour variation which has been shown here is indicating different type of rocks okay. Because when, when we were talking about that we are having the horizontal beds and these beds okay will be of different lithology. So you are having different type of rocks; the composition of the rock is different; hence, the strength of the rocks will be different okay. So that has to be studied well in detail before you select the site, okay.

Now if that you know and the other part important part is that you need to know the thickness of the bed okay, or thickness of that particular strata. So if you; for example, you put your tunnel here then how laterally that is along the strike this bed will behave, okay or maybe extend. So if your axial plane or the fold axis is very much straight okay then you will say okay fine, you will align your tunnel in this direction, okay fine.

Where you will excavate the same or the similar material or the rock, okay. Suppose you give an alignment somewhere like this okay, then you are moving across the fault which is not at all advisable. This is advisable; why? Because you are going to come across different type of lithology and depending on the strength of the rock or the material you will have to apply different techniques to strengthen the wall of the tunnels, okay.

So again there will be in problem in terms of the seepage and all that you will have lot of problems okay. So best is that if you find a thicker bed and which is aligned along the axis of the fold that is the best portion where you can put the tunnel or you can align the tunnel okay. So this is one of the portion which I have already covered but if you want maybe you can send the request maybe we will cover this in one of the lecture, okay.

So part of the folds, we have hinge lines; we have limbs and we have axial plane as well as the axis of the limbs; the side of two-fold is called the flanks or the limbs okay. Hinge line is a line of the maximum curvature and the folded beds; fold axis is a line parallel to the hinges

okay. So if you connect all the points of the along the hinge line that will give you the fold axis. As I told that fold axis may not be exactly straight or aligned in same direction okay.

It may curve, okay; it may take curve or it may be in the different direction because in nature it is not always possible that even have and completely aligned okay. Now coming to the other part is the axial plane okay. Axial plane is the surface connecting all the hinges; it may be straight or curved okay; vertical or inclined. The attitudes of axial plane are defined by this strike and its dip okay of any structure. So this is again a similar attitude okay.

So for example here the axial plane what you will be able to mark here is that the axial plane is almost vertical; it is not inclined but it has a strike okay. So you will have a strike of the axial plane or the fold axis but you do not have any attitude okay. Now suppose you are having the folds something like this okay then your axial plane is running like this. So what you are having here is that you have; this is this will be a strike.

But you are having the axial plane is inclined. So you will have again the dip direction one and then you will also measure the amount of dip here. So that will be what we call the attitude of the axial plane, okay.

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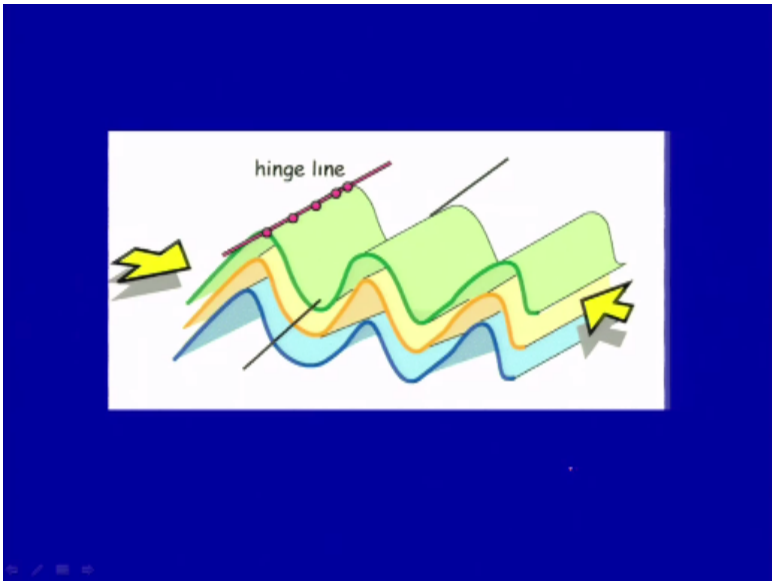

Now this is what you will come across the hinge line. So the point, if you connect the line along the points of maximum curvatures that will give you the hinge line; and of course you can if you connect this there is a hinge line and the axial or the axial plane will be if you draw

it across it okay, so that will be your axial plane. So there is a syncline; there is an anticline here okay.

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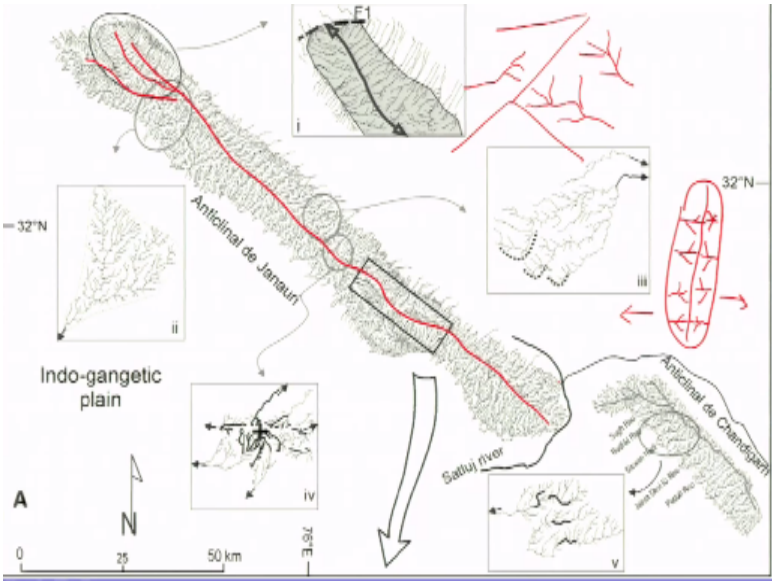

Now this is very important and interesting. This is in the figure from one of the paper by Alkaline which is been from Himalayas but this also you can easily start the information. This is how one can even look at the fault okay. Now because in interpretation of the landforms we will bring the combination of that how they; the drainages look like.

Because if you are having any inclined surface and if you are having the rainfall or the precipitation in that particular area you will try to see the development of the streams or the drainages okay. As for example, people are very much keen and finding out on Mars or the surface on different planets whether they are having the water there or not and/or if they find some sort of and channels or the small streams then they are very excited talking about;

(()) (12:07) find this, this planet might be having water in the past or presently they are having similar climate like earth and all that, okay. So any inclined surface if you have okay then that will always result into the formation of the drainages and if you are having the precipitation, okay. Now this is a very simple way to identify the fold or the inclined surface because the streams or the water will flow along the slope okay, fine.

Now, for example, if you are you have extracted the drainage from the satellite data and you want to put the hinge line or maybe you can say the axis of the fold you can easily put that okay and that is what we call the hill veins divide okay. So this is the top here and then this

side since the surface is dipping this side you will have the drainages which are forming on this side, okay.

So from the top view if you see what you will be able to see suppose there is a fold boundary or you are having the anticline then you will have the drainages which are coming here and flowing this side; these are the drainages which are coming and flowing in another direction okay. So what you are able to see is that there is clear-cut divide over here. And the streams are flowing in this direction; streams are flowing in this direction.

Again, we will take into consideration the smaller order streams joining the higher order and that will mark the direction okay. So here if you see in this; this is your hinge line of the fold. And as I told this is not straight, okay. This goes here and then you can able to see you are able to see some probably it goes like this okay and another one is goes here, okay. I will repeat this when we are talking more on this part and I will show that how clear it is to mark this okay.

So you are having these streams which are flowing in this direction and which are flowing in another direction, okay. So this is one way to identify the different landforms okay on the surface. This we will do one exercise where we will talk about that how we can easily make out the different landforms based on that, okay; based on the drainage pattern also that what we can say.

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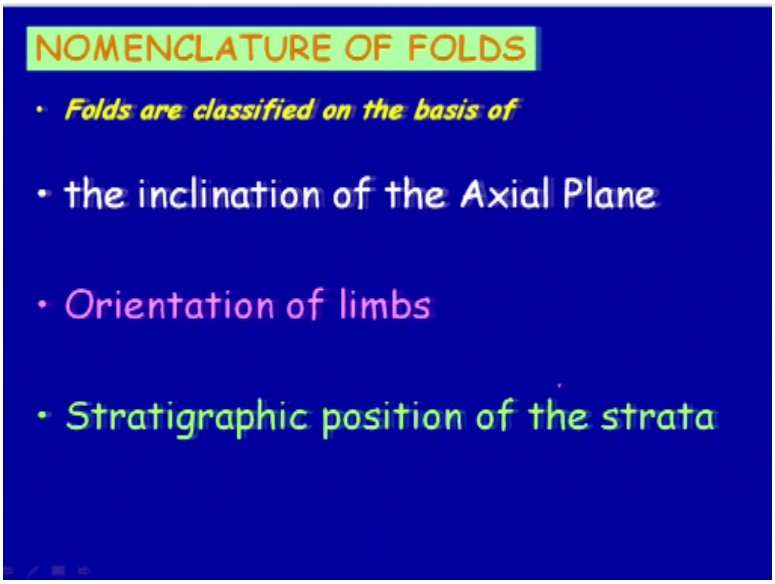

So usually the folds are classified on the basis of one that is the inclination of the axial plane and then send over orientation of the limbs okay. Now this is important because you will be able to when you interpret the that satellite data you will talk about whether the folds are symmetrical folds or it is asymmetrical; that is if one limb is dipping within higher angle as compared to another one then you will mark that as an asymmetrical fold okay.

And then of course the stratigraphic position of the strata, okay. So stratigraphic position the next slide will; we will talk about. So these are the main three points on which you will be able to classify your folds okay, whether it is an Anticline or Syncline; whether it is symmetric or asymmetric that we will be able do okay.

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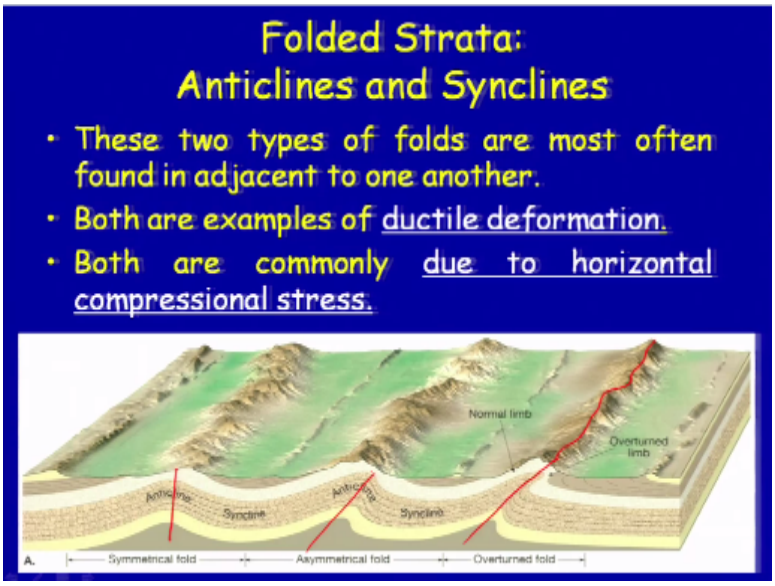

Anticlines and synclines okay. These two types of folds are most often found in adjacent to one another okay. Because this will go side by side; if you are having anticline you cannot say thatyou will not have syncline, okay. So you will have Anticlines, you will have Syncline both you will see okay. Then the other point which we were talking about the based on the stratigraphic or the strata because what the thumb rule says is that,

The first deposition will take place and then another will come and another will come; so that you have in stratigraphic, so older, younger and youngest okay. So if you fold that you will be able to see the up and down like stratigraphic location or the place or the position of that particular strata. So coming to that both are the example of ductile deformation, okay. Both are commonly due to horizontal compressional stress.

This is what you will see okay fine on the surface and the section okay. So you have anticline; so these are marked by hill or the hill ranges and then you are having the synclines okay which are the incline mountain depressions between the two okay. This is what you can say okay, fine. And some place you will say that this is a very symmetric anticline okay because both the limbs are dipping away from on one another within same angle okay.

So amount of dip is very much similar. So you can say that this is an asymmetrical anticline. But suppose you are having something like this okay, so what you can put is because you will of course connect the hinge line here and then axial plane if you have to draw you will put somewhere here okay. So this is your axial plane where the axial plane here will be somewhat like this okay.

So this is almost vertical but here you are having an inclined or axial plane okay. And my hinge line will be somewhere here okay. So inclined; so this will become and either you call an overturn fold or an asymmetrical anticline which has been shown here, because with some amount of inclination if you have okay then you will be able to get into the overturn fold okay. Again, here if you put the axial plane you will come across somewhere here okay.

So this you will be able to gather only by satellite data interpretation that can be done okay; if you are unable to even see the section. Because one portion of or the one side of the fold for example, this will be steeply dipping and one will be gentler. So you will be able to make out based on the drainage network also; because steeper the part you will have shorter the distance of the streams okay.

And gentler the part you will have the drainages are spreader and covering larger area. So this is another important part which you can you should keep in mind when you are viewing the terrain from space or we can say using the satellite data okay.

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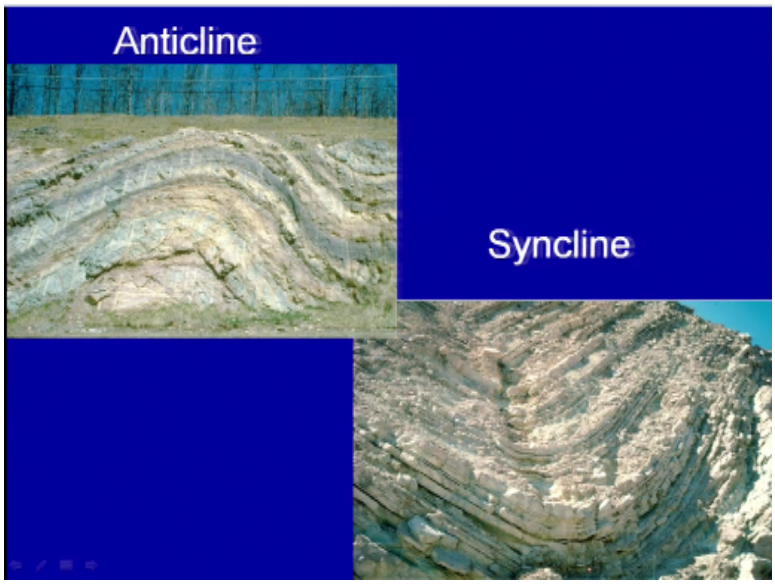

So this is a sectional view of anticline where you are having different beds, okay. And if you keeping in mind that this was the oldest because this is this was deposited first and then further you go up with the younger ones okay. Then for anticline you can also say that the older ones are in the core and the younger ones are at the outer side of the core. And in terms of the syncline it is exactly opposite okay.

The younger ones are in the core and the older ones are in the curvature side okay. So this is the completely in opposite things which you can see. And if you if you carefully look at here, okay; so what you are having the older ones are here. So if you move here the younger ones are at the top but here younger ones are in the core and older ones are in the core in terms of the anticline, okay.

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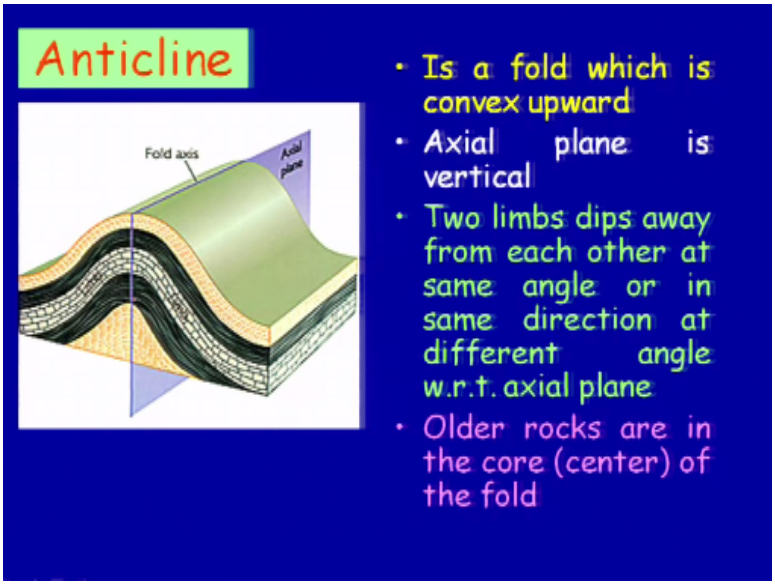

So anticline is in fold which is convex upward; axial plane is vertical; two limbs away from each other at the same angle; so if you are same angle then you can classify as a symmetrical anticline, okay. Older rocks are in the core that is center, okay.

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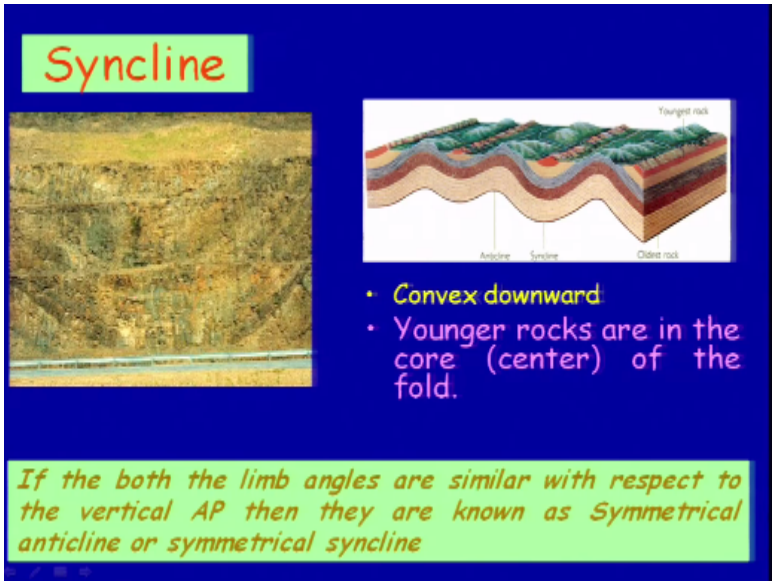

And in terms of the syncline you have the Convex side is downward; Younger rocks are in the core that is center, okay and it looks like something like this, okay. So if both the limbs; both the limb angle are similar with respect to the vertical axial plane then they are known as symmetrical anticline or symmetrical syncline.

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So this is another example of the section again you can identify this, how the syncline and anticline look like. And as I told thatalong this goes side by side; so you will have anticline; you have syncline and you will have also fractures here or the faults, okay. So this is a fault

here andyou can view if there is a moment oridentify if there is a movement alongthis four faults on the surface okay, the surface manifestation.

So this we will talk in the next lecture, that how we will use; whatever the information we have learned to identify the fold, anticline, syncline as well as the faults okay. And what; why we want to identify such features or these geological structures and whatrole it will play in terms of the societal benefits okay. So I will stop here and will continue in the next lecture. Thank you so much.