Photogeology in Terrain Evaluation (Part – 2)
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Lecture – 16
Exercise on Identification of Geological Structures and Related Landforms

Hi all, I welcome all of you again in the second part of this course, that is Photogeology in Terrain Evaluation. Again, I am your teaching assistant in this course, myself Dr. Afzal. I am going to first brief you about the lectures which had been done until now and then we will tell you something about the structures and landforms and mainly the practical information of that how you are going to identify those structures or landforms on the ground, real ground or on the some with the help of some models.

So you have to understand the lithology as well the underground structures and the surface morphology in relation to landscape and its association with the environments. So with the help of all this information you will be able to identify in the final stage and to interpret the landscape and you will be able to interpret about the depositional environment into that area. The ongoing activities like there is uplift going on or subsidence going on or some strike slip motion or normal faulting, thrusting.

So these different senses of motions, ground motions actually. So this course is going to give you detailed idea about the topographic interpretation. How to interpret the topography if you are having some aerial data in terms of some aerial photographs taken by an aircraft or some satellite data which is captured by or collected by a satellite, like Landsat, IRS, and various satellites like MODIS and all. So first I am going to brief you about what you have learnt in your previous lectures, previous 3 weeks.

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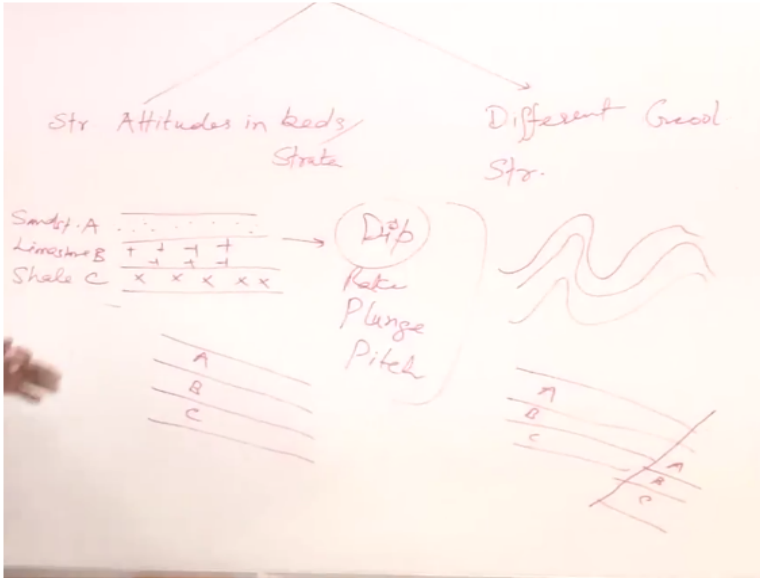

So in the first week, we started with structural geology. In this heading, you learn about the structural attitudes in beds or stratas and you also learn about the different geological structures. So, strata is basically the beds. Under normal circumstances or under normal conditions, the deposit usually in a horizontal manner like they will not have any type of dip or some plunging or anything so under normal conditions it is considered this is the thumb rule of the stratigraphy and principle of uniformitarianism so strata deposited in a horizontal manner.

So suppose this is bed A, this is bed B, this is bed C. So suppose this is sandstone. A is sandstone. D is limestone and C is shale. So they are related to different kind of lithology like sandstone coasters, limestone ijolite finer and shale is the finest type of finest containing the finest particle size of clay fraction. So but they deposit horizontally. So when there is some deformation or some kind of tectonic activity, or some upliftment or emplacement of some lava from the deeper portion or any kind of disturbances in the earth crust.

So in those conditions this strata, which were deposited horizontally now they will get deformed and they will have some structural attitudes like dip, rake, plunging, and some pitch. So they were developed some greater amount of this structural attitudes. So in those conditions they may got tilted under the conditions which I explained earlier. A, B, C they may got tilted. They may got folded or they may got faulted.

This is A, B, C, and this is A, B, C. So this part of strata has gone up with respect to this block. So there is faulting and many kind of geological structures may come into form when there are any kind of disturbances in the earth crust. So now these geological structures also have some different type of morphology as well as different kind of structural attitudes like.

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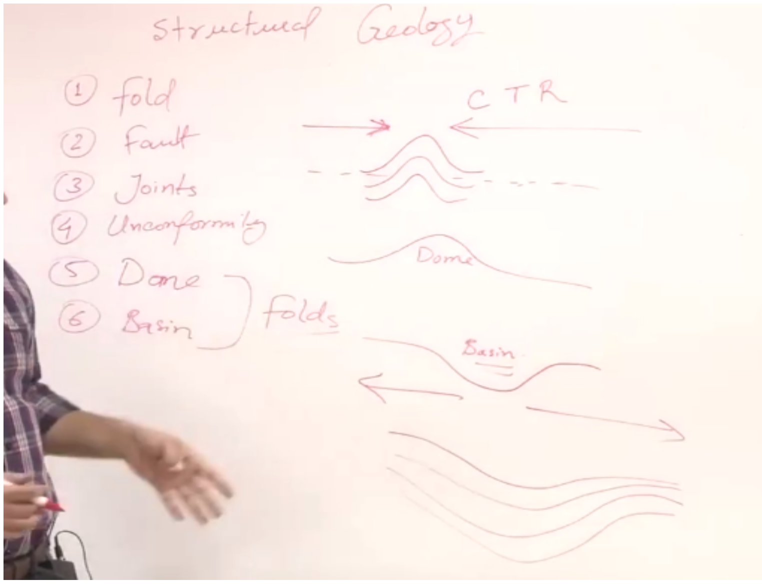

Number 1: Suppose the strata has been folded so it will develop a fold. Number 2: If it is faulted, so the structure known as fault. Third: There may be development of joints, but the difference between the fault and joints is only the movement of the blocks the fact both these kind of a structures are defined by the fractures between the blocks, but when there is no movement between 2 blocks that will be a joint and if there is movement between the 2 blocks that will be a fault.

So other structures like unconformity. So I will show the model for these all things. Another kind of structure like some structural deformation and the strata has been compelled and forming a dome kind of structures or somewhere there is an extensional tectonic regime in that case they may got a depression. So that is known as a basin. So dome and basin, dome. Dome are also a form of structure however they are mostly related to folds.

So in the compressional tectonic regime so there is compression or stress is acting from both the directions and strata becomes crenulated in this form and suppose other parts of this strata has been removed under some erosion, erosional activity. So only this part will be left out and it will be reflected on the surface like this in kind of a dome. Similarly, in case of this was the compressional tectonic regime or environment now I am talking about the extensional environment.

What will happen under extensional environment the strata becomes stressed out and will form the kind of depression. So in these places we find a kind of depression or basin so this is termed as basin. Well there is whole cross section available to us and there are beds older and younger. So then in that case, we can classify it as a syncline and we can classify it as a anticline, but in case we are just having some depressions and dome, domeless structures so in that case we can term dome and basin.

So they are basically related to folding activities. So this is in the case of extensional tectonic regime or extensional tectonic environment. So now in the second part of the week we have learned about the deformational structures like faulting and the active fault studies. So just to remind you, you have the active fault studies along the Pinjore garden and the second along the Chandigarh area fertile zone and there you also find some strike slip fault that is Taksal fault.

And in the Himalayan terrain near Hajipur you also find some faulting that is Hajipur fault and this fault propagating fold due to which Beas river was shifted and then another thing is to remind you the Kangra valley fault were we identified the surface rupture and fall trace or scarp related to the 1905 AD earthquake. So these were some active fault studies which you learned in the second week of this course.

And many other kind of deformational structures which are related to folding, faulting and their aerial photographs like horst and graben and some crenulated strata and morphology developed over the folding and faulting and morphology or landforms developed over a faulted terrain and vice versa.

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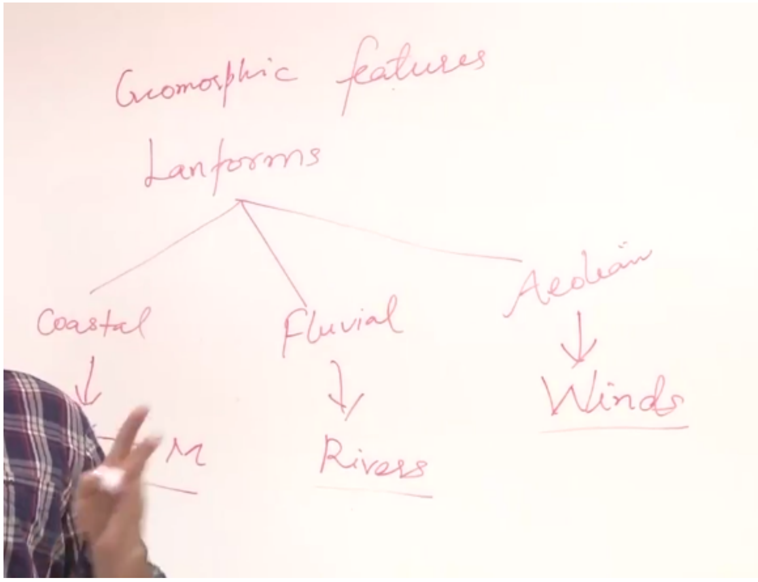

In the third week, we learned about the geomorphic features and landforms. So landforms related to coastal, fluvial, and basically Aeolian environment. Coastal, fluvial, and Aeolian environment. The coastal is related to the shore line environment or transition zone between the continent landmass and marine environment like the off shore environment which is towards the deeper ocean. So this is the transitional zone between the landmass and marine environment.

This is solely related to rivers and rivers originated landforms. So I will show some models related to that also and related to this environment and the lastly Aeolian environment means erosional and depositional features formed by the strong activity of the winds. So these were the brief idea of the third week. So now we are in the fourth week. I am going to start with all this information which you are going to have some models where you will identify.

You can identify these features which were explained in the lecture. So let us move ahead with some models. Let us start from the strike and dip.

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With the help of this model so as you can show on this model there are some lines which are showing the apparent dip and true dip and if you want to see the beds so the beds.

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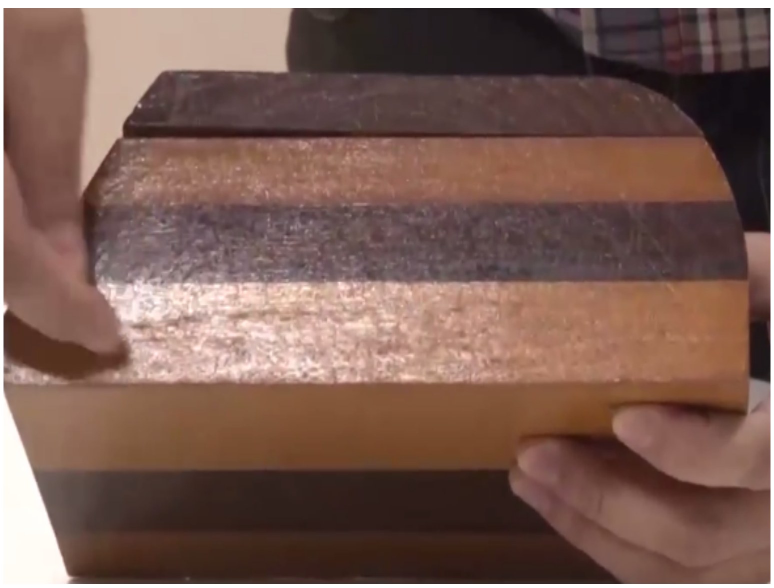

This is the cross section of beds or the strata, A, B, C, D and these beds are dipping if the beds are not dipping then the dip angle will be 0. So there must be some dip to on the inclined strata so that we can measure it with the Brunton compass. So if you see the cross section of these beds on this side you will get to know that these beds are somewhat horizontal. You will not be able to see the dip until and unless you are having some view inside to these strata, but if you see it from this side you can see that beds are dipping. So beds are dipping and this is the apparent dip.

This is the dip direction. So, what is this strike? Strike is the plane of intersection, the plane, which is dipping and the plane which is horizontal. So the intersection between these 2 planes this is called your strike. So suppose these are your beds and these are the inclination plane, inclined plane so the intersection of this plane with respect to horizontal plane this will give you this strike. So this will be your strike. So suppose I am standing in the north direction so your strike will be east west.

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And this is the Brunton compass. In this compass, you have some scales and this compass is used to measure strike and dip on the inclined pins. As you can see here there is a needle which is the needle scripted as n on it so this n is representing the north. So as we move our Brunton compass, this will this needle will also move because this is a magnetic north, magnetic needle. This is following the magnetic north.

And there are some scales on the outer boundary and the inside. So this is used to measure the amount of dip and the inclination of the direction of strike from the magnetic north.

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And inside there are 2 types of bubbles. One is the rounded circle and other is a cylindrical one. So in the rounded one this is called the Bulls eye. This we look for when we measure the strike and the cylindrical one we look for the bubble inside it when we measure the dip. So suppose we are going so we have to take these bubbles within this circle which is shown inside the laser bubble and in case of the cylindrical we have to take this bubble at the center where there is a mark that is known as carpenter error.

So on this model, we have to now measure the strike and dip. So we know that there are beds we can measure the strike and dip here. So this is the inclination plane, dip, and the strike so this is the plane of intersection. So we have to measure strike by putting our Brunton compass like this and we read the readings along which this needle is aligned. This is aligning. The north is aligning at 70.

So this is we can say that it has a north bearing of 70 degree and the direction we give in the form of north 70 degree east or north 70 degree west whatever direction this strike is aligned. So from north how much it is deviating. Now you have to measure dip. For that we have to put it as this in this form so that you can look inside the level bubble, cylindrical bubble and there is a rotating handle behind this compass with the help you can rotate the inside scale in order to take this bubble at the center.

Suppose I am taking the reading of this. So, it is inclining around the reading is coming out as 30 degree. So suppose if this strike direction is east west so your dip the 2 dip will be either in the north or south means 2 dip will always be perpendicular to the strike, but if you are taking the reading of dip or dip angle any other direction other than the perpendicular direction so then it will be termed as apparent dip.

So that is why that this is the reason here this is scripted as the strike and the reading in the perpendicular direction is true dip and all other directions it will be termed as apparent drip.

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So let us take this example here you are having some beds. You must be able to see it from here. These are the beds and this is basically a syncline. This is the fold. Folding beds and this is asymmetrical syncline because 1 limb is larger than the other limb and with the help of this model you will be able to look inside also.

And so the beds are inclining like this and the center at this curve you are having some beds and in the outer shell you are having the beds. These are the outer beds. So you can measure the dip in any of the bed because they are inclining they will have the same dip angle. So similarly you can measure the dip and the strike on this model also. Now we will look at some normal fault.

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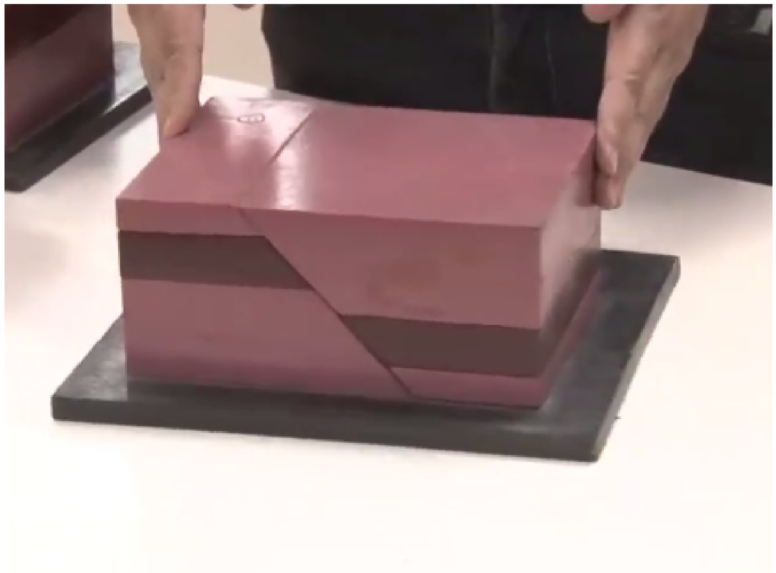

So in normal fault you know well that there is a hanging wall and there is a foot wall. A foot wall is the block which is stationary and the hanging wall is the block which moved with respect to the other block. So you can see here that this bed is different from these beds. Suppose this bed A and bed C these beds are sandstone and this is shell or any other type of lithology like granite or anything so this has been shifted downwards.

It means there is a clear appearance that this block has been moved down with respect to this block. So this is the reason that this is a normal fault.

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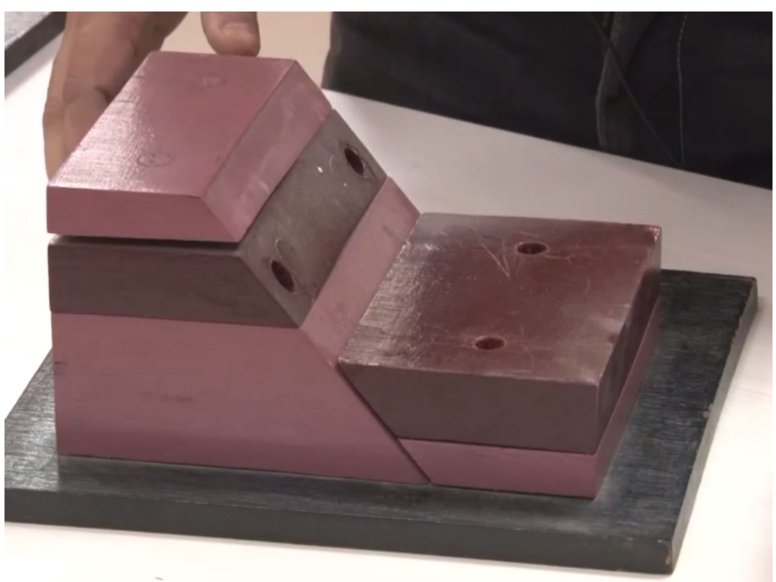

And when you have only this remaining on the surface because this block has moved down. So if you take the thickness of this bed in the same bed here it is of 2 centimeter so put this bed here like 2 centimeter. So in that case suppose I am taking this bed up to here only. So in that case, this will be your exposed topography.

So in that case this will be termed as a fault scarp. Fault scarp is a topographic expression which is exposed above the surface when there is a faulting. So this block is a stationary and this block moved down so this is your foot wall, this is your hanging wall and this is your fault scarp and this whole thing is your fault plane which we are not able to see in the field, but here with the help of modern you can see it.

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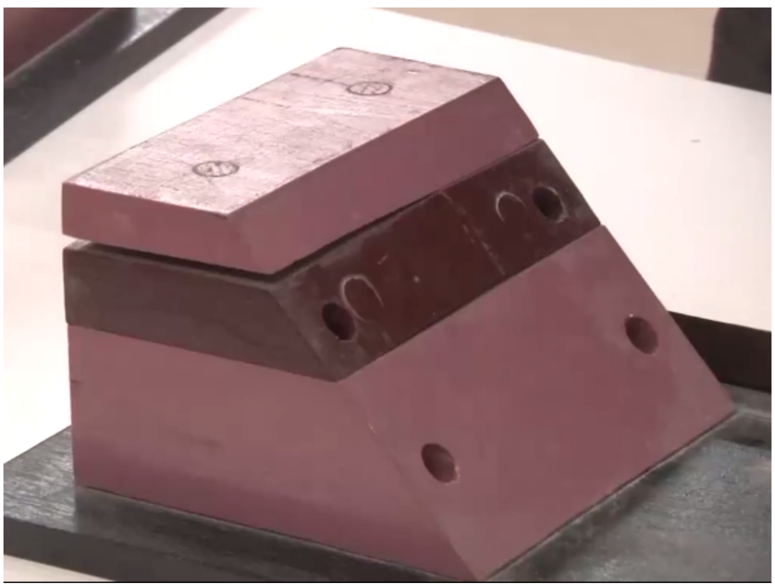

This whole thing is fault plane. Now we have another example of the model that is the reverse fault.

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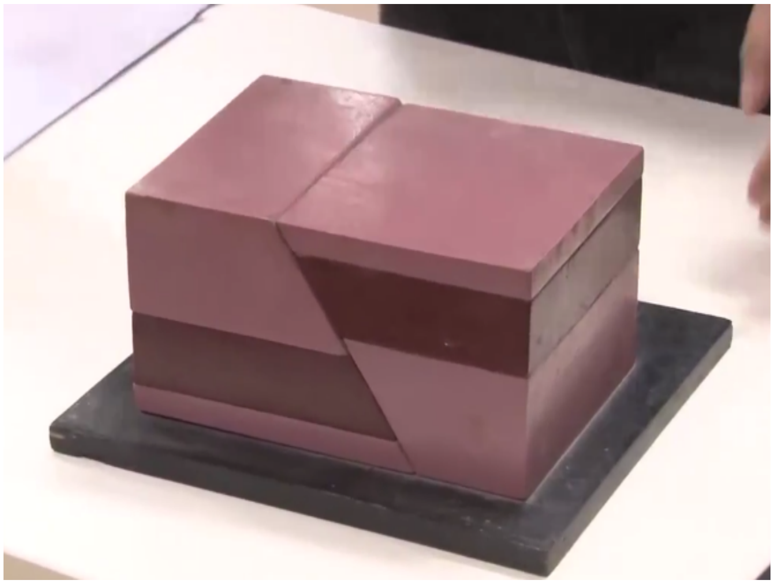

In this case, the things are different. So in that case, the 1 block move down in this case this block appears to move up with respect to this block. So in this case this is the stationary block and this is the moving block and this is the foot wall and this is the hanging wall. So suppose because this has been moved up so we should have some bed which is covering this part. So suppose the thickness of this bed is around 5 or 6 cm.

So let us put some bed over here because this has moved up with respect to this. So this will be your fault scarp in this case. Let us put it like this so in this case this will be your fault scarp because this block has moved up this is your foot wall and this is your hanging wall. So you can similarly take the readings over this plane also and this will be your fault plane in this case the whole plane.

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So this model shows that there is a series of faulting series of normal faulting. So if you see this then this block is stationary and this has moved down. Suppose this is full land scarp so first faulting occurs here. So, because this is the extensional tectonic environment, so the first faulting was here and this block is stationary. This has moved down and again the secondary faulting was this. So now this block has moved down so there is a step-like features.

So these are representing the series of normal faulting and when these series of normal faulting in a form of some kind of the normal as well as some blocks there is a series of faulting suppose but the sense of motion or the sense of stress has changed a little bit because of that there is a graben or basinal structure inside this and there is an up lifted or elevated structure on the other side. So that kind of faulting will form the horst and graben type of structure which were explained in the lecture.

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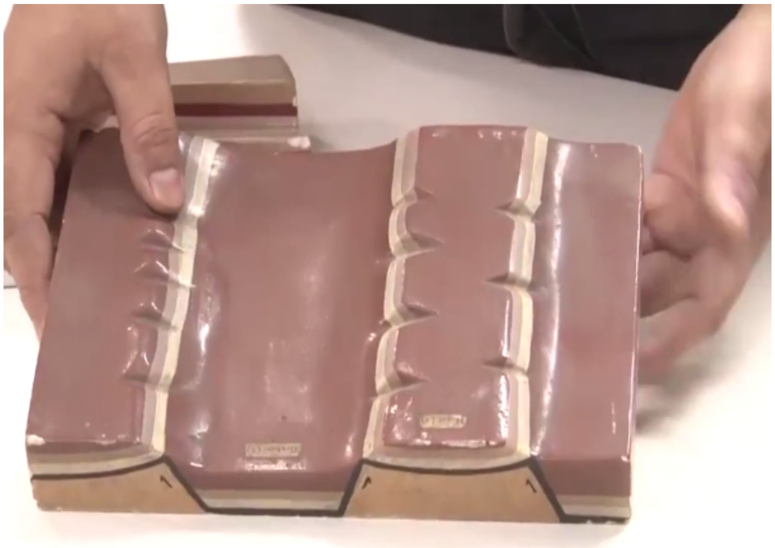

So in this case this will be your graben and this will be your horst. So there will be series of faulting as in the case of this model so the series of faulting but in such a manner and there is a basin followed by the horst. Graben followed by horst. So, horst and graben structures.

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Another type of very interesting structure that is known as blind fault so this you got to learn in the lecture that how blind fault is look alike. So this fault has a trace inside or the underground up to a greater depth or up may be up to some shallow depth, but it has no trace on the surface. So this fault is blind fault. So what kind of a structure you will find over a blind fault.

You will find some kind of step like structure like there is a surface where this fault has moved, but there are capping layers, capping units like some alluvial matter or some soft gravel or some soft sandy material anything is covering this fault. There is a thick layer of alluvial. So you will find a surface expression in form of this step like so this part is the original surface and this will be because of this block has moved up so step like feature.

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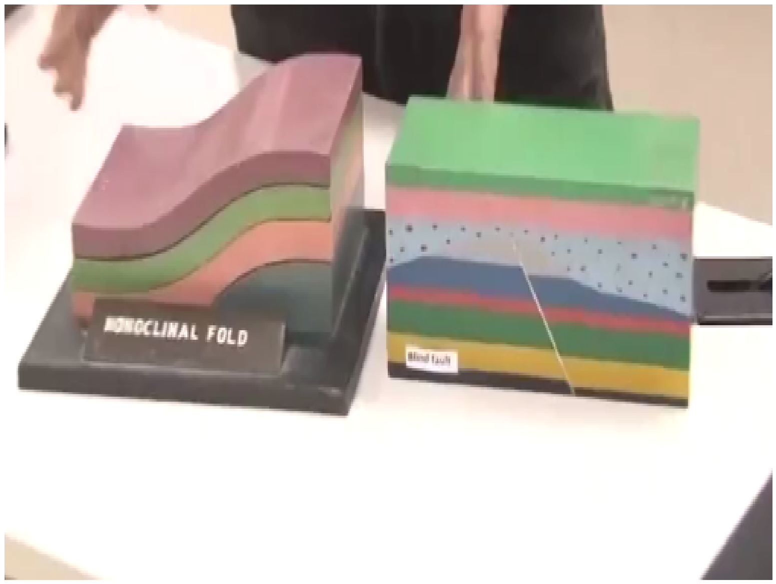

So the second very interesting this is the folding. The second part is folding that is the faulting and now we are moving to fold. So this blind fault often founds related to monoclinal folding. So as I explained earlier as you will find a step like feature so when there is a single limb in a fold that fold is known as mono means single clinal. One limb is inclined whereas other limb is horizontal or it is original position.

So this is called the monoclinal fold. We can also find some surfaces where you can take readings and why these readings are actually necessary and what is the use of these readings.

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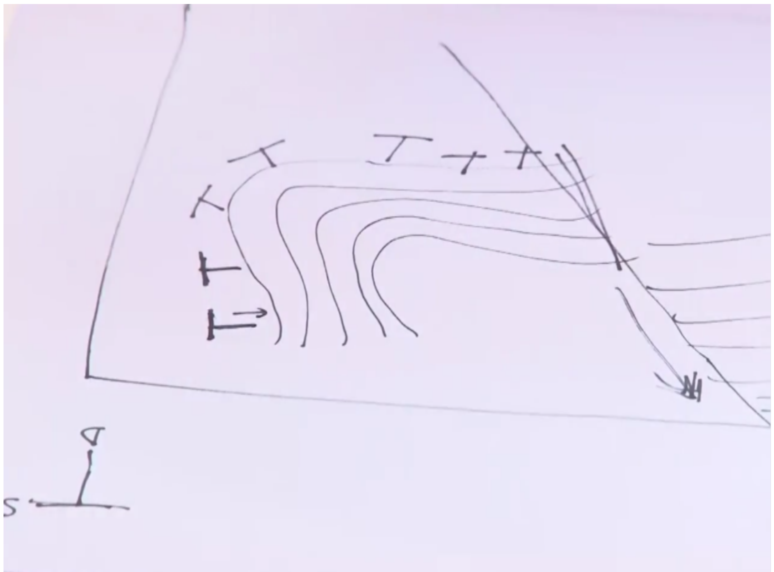

When you are going to present information of an area in form of structural geology, so you are supposed to make a map, structural map. So you are asked to present a structural map so that is some structure like some construction like tunnels or anything is going to help out there. So suppose so then in that case if you want a structure you have to represent your data.

Your ground information on to a map. So you are having some beds like this because when you look it from the upward side from the air or from a space on a satellite or photograph so then you will find this kind of a structure. On surface we are able to see this is a fold like this and from cross section.

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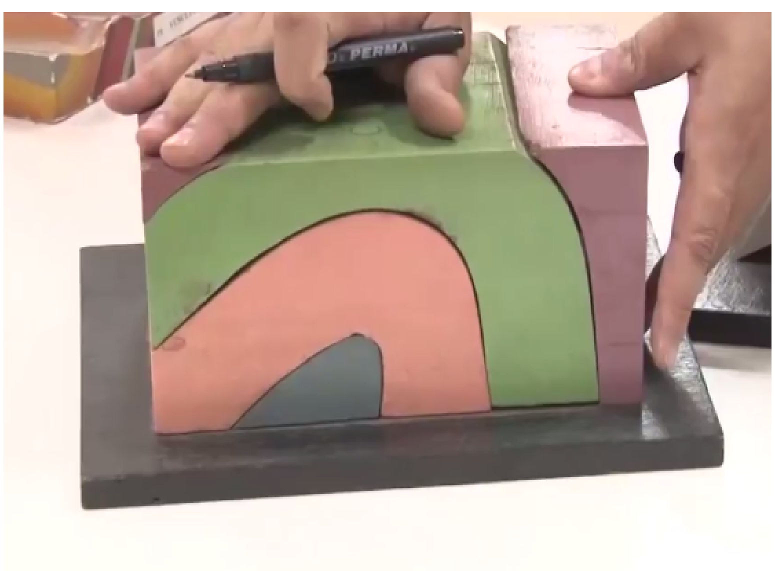

We are looking that this is a fold very clearly we are able to look over it and this is the fold, but when you are on the ground so in that condition you have to map your structures by looking if you are having some satellite data or some aerial photograph then you will see these structures in form of this and there may be some faulting so that the limb of this fold has been shifted to here. Suppose there is a faulting.

So in that case you have to like you are willing to represent some information of the dipping of beds. So in that case suppose there is a fault so then on your structural map you will put a sign like this which is showing this strike and dip so this symbol represents strike and dip where this is a strike and this is dip T. So here this symbol represent that the strike of bed is like this and this is dipping this side in this direction. So bed striking like this and dipping in this direction.

So for this purpose we use the strike and dip readings and to present some structural attitudes of an area or to map some folds, faults or structural attitudes of an area so that we can put if we are willing to put some civic structure or some construction like tunnel or a railway line or a railway tunnel or anything any bridge. So in that case in case of dam also we have to look for structural maps or structural information of an area.

We have to consider it because it depends on the dipping of the bedding planes whether we should consider that area or not. So the seepage of the water and other many conditions depends on this structural attitude of the beds.

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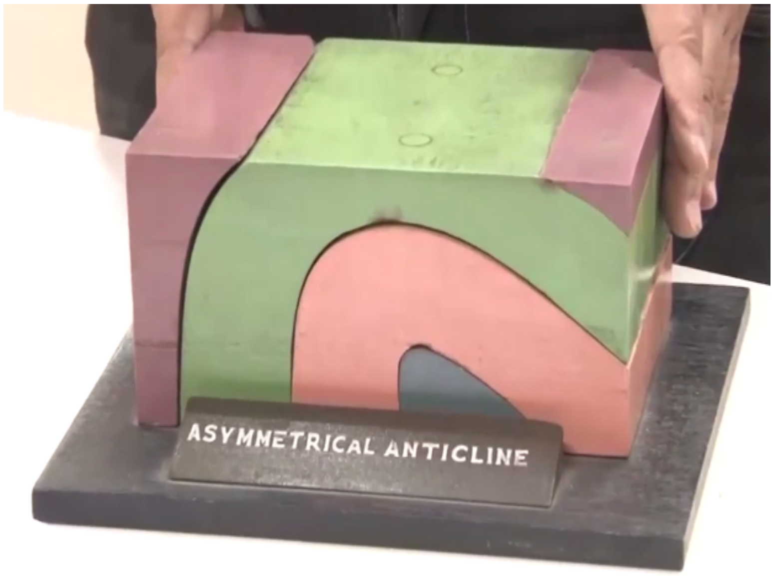

Similarly, this structure if you see this is asymmetrical anticline. The first structure where I showed you the dip and strike that was the asymmetrical anticline, but this is symmetrical anticline. So I am talking about this structure. In this structure you can see this is the asymmetrical syncline because the beds are dipping like this and there is a bed at the core and here in this case the older bed will be at the center and the younger beds will be at the surface.

So this is known as asymmetrical anticline and you can again take readings by on these surfaces and on all the limbs of the fold and you can make a structure you can show this structure with the help of your dip, so here what you will do you will show strike and dip like this as the beds are dipping in this direction. So these are the strike of the beds if you measure the strikes then you will put your compass like this. They are dipping in this direction. So this is for example.

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Another kind of fold a very intensive compressional tectonic regime it shows highly stressed strata which has crumpled so that its axial plane has become horizontal however under general conditions under normal circumstances and actual plane is vertical or inclined forms some vertical direction. So but in this case when there are the intensive stress is acting on so in that case there will be highly compelled strata.

In that case, there will be a horizontal shift and you will look out so this is known as recumbent fold somewhere it is also termed as overturn fold and under this topic faulting and folding.

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This is the last model I want to show that this model shows the cross section from the surface like if you see the fold on the ground you will see like this, but from air from above, from space or from sky if you are looking on to the ground so then you will see you will be able to see your synclinal axis in the form of this fold this structure shows the syncline structure and somewhere there may be anticlinal fold.

So that will be represented as these beds will be at the outer core and older beds will be at the inner core. So I will stop here with this information and in the next lecture we are going to have some fluvial landforms and some coaster and some topographies which shows the information which you have learnt about in the lectures. So thank you so much.