Photogeology in Terrain Evaluation (Part – 2)
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Lecture – 17
Exercise on Identification of Geomorphic Features Related to Various Environments

In the last lecture, we learned about the structural attitudes in beds and different kinds of geological structure and how we can use them to map some area or to show some information in the form of the inclination of beds and the underground structure orientation of the beds. So in this lecture, I am going to explain you some kind of specific topographies related to some ground water activity or related to some volcanic activity or some kind of fluvial activity which is a very dominating depositional environment.

So it has some erosional landforms also and most of the landforms are related to erosion due to fluvial processes, but the basic things about this fluvial processes and the fluvial landforms these were explained in the first part of this course so I am going to remind you with some of the students those who have not attended the first part of this course for them I am going to explain some basic ideas of the fluvial landforms.

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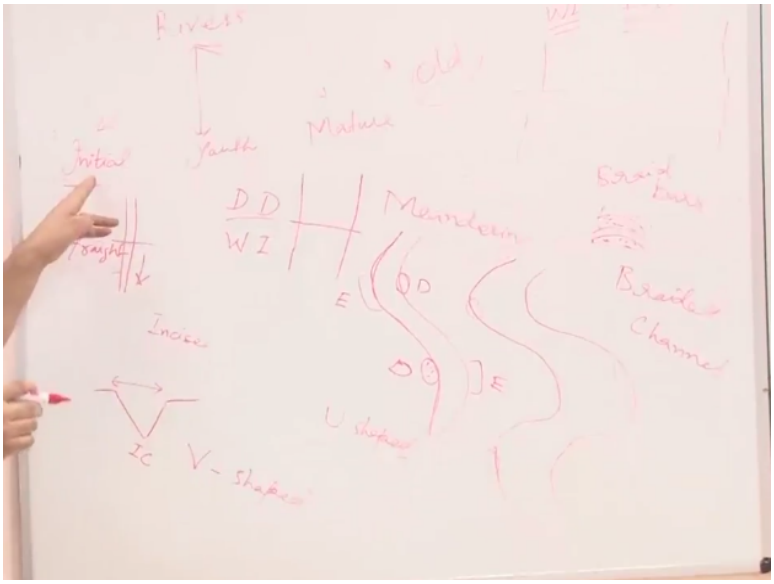

Fluvial landform; Fluvial means related to rivers. So when we talk about rivers, we know that there are basically 4 stages of a river. First is initial, second is youth, third is mature, and the

fourth is old. There are 4 stages of a river and in this stage the river has lots of energy and they are capable of eroding lots of sediments from the upland area or the in the case of India like from Himalayan region.

So when they flow from the up land to the plainer area like alluvial plain of the India or Indo-Gangetic plain of India so in that case they are having lots of energy and they are capable of eroding much of the sediments from the upland area and during transportation they deposit some of the sediments at the foot hill zone and most of the sediments in their mature stage and the all the remaining load in the older stage.

So initial stage you will find really straight channel. Straight channel, the width of the channel will be less and depth of the channel will be more. In case of youth, you will also find some similar kind of activity like narrow channels and incised or deep channel. Incised means the channel which do under cutting into the background so due to which the channel becomes incise. So if I take the cross sectional profile of this river this straight channel so I will find like this.

So very incise channel and it has a narrow width. In case of mature stage, channels become wider and less deeper. Depth decreases, and width increases. Depth decreases, width increases. So if I take the cross sectional profile of this channel so it will be like U shaped valleys in this case we get V shaped valleys and in this case U shaped. Because in this in the first case rivers have lots of energy and they are capable of eroding everything which comes into their way so they flow straight okay because they have lots of energy.

They are capable of flowing in a straight channel. In this case, the energy becomes slow and due to which river started meandering. So suppose this is the river channel, it will start meandering like this and where in this channel at these points it will cause deposition and on its outer beds it will cause erosion. Erosion at the outer bed while deposition at the inner beds similarly here deposition and here erosion.

So that is why in the later stages this channel becomes more wider because at the outer branch it continuously erode the it is outer lavie. So as this river got older it develops a profile like this

because there is an erosion at its bends. If we talk about the older old stage so in this stage river is very wide and very shallow. Width increases and depth decreases again and if you take the cross sectional profile of this channel you will have a varying shallow channel like this where in between these channel.

You will have some sand islands also where you will be able to see some grass or vegetation over it in between the river you will have some small islands of sand or soil etc on which they grow some vegetation so this kind of channel is known as braided channel. Please browse all these terms on the internet so that you will have the correct idea of this.

So this is called the braided channel and the sand islands in between the channels are known are braid bars. So in this case in mature stage we got meandering channel. Here straight channel. Straight, meandering, braid bars. In initial, it is actually just like the youth stage initial means from where the river initiates so of course it initiates at the highest part of the mountains where glacier melts and supplies some water, some sediments too.

And that erodes and hit the rock and the material on its way and form a narrow a very narrow channel and incise channel. So that is the initial stage. Youth is somewhat the well developed part of this initial stage. So youth channel. So these are some basic. Now we will move with some models and will see how a topography of the fluvial land form look alike.

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First look at this model. This is showing some meandering. You can see that there are some beds here so there are some inclined strata. So suppose this is the highest part of the Himalaya or the part where the glacier melts and river originates. So suppose this is the highest part and here you can see that the river originates here at flowing like this by cutting the bed rocks. By cutting the material it is coming on its way and many other channels small, small channels will join it at a later stage where it will become a youth stage river.

There is suppose this is the initial stage so this is showing the V shape channel. So if you see the cross sectional profile here so where a channel develops here you will see a V, but this V is little bit shallow, but if you see from this side you will have a V, incised V, well developed V form of a channel. So this basically this happens in the youth stage during the youth stage. Now these are the bed rocks as you know and river flows by cutting the underneath bed rock.

And whatever material or sediments coming on its way it is capable of eroding everything and capability of removing everything because it has lots of energy because there is a topographic slope why high energy because there is a slope which is coming almost from a few kilometers up to the planar areas. So suppose this is the slope at some 6 kilometers or 5 kilometers and it is coming like this and joining any Indo-Gangetic plain.

So that is where it has very much energy and cause erosion and form the original and this shows the subdued topography like very curved areas has on the surface this is because of some activities like wind activities or storm over here and some type of rain and some type of vegetation activity which erode the surficial sediments and suppose the run off supply run off to these ongoing rivers.

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Similarly, in this model also you can see the same V shaped channel. Suppose this is somewhat at a lower height which are developed first here at greater heights, greater elevation then it comes over here and now it is flowing like this. Now you can see that the rivers or the tributaries are joining at a wider angle whereas in this case in this model the tributaries are joining at a very narrow angle.

But here you can see the tributaries are coming like this and joining and all these tributaries if you see the main channels so this is the main channel the major river and these are all the tributaries. So if you see the configuration of the tributaries and their arrangement and configuration with the main channel you will be able to see that there is a dendritic drainage pattern a tree like pattern on this topography, which is shown like this.

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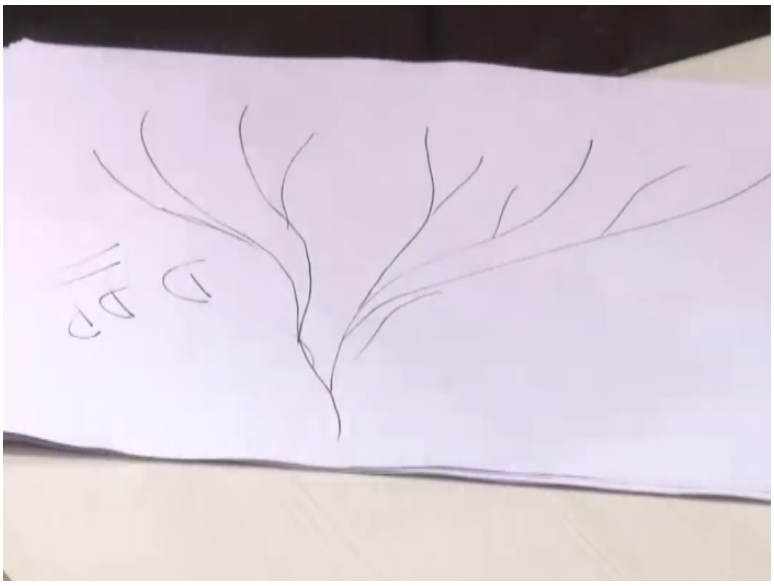

This you have already seen in your lectures there are number of examples in the lectures. Please go through the slides and you will be able to see a tree like patterns like streams are coming and joining the main stream. So this is a tree like branching over here and this is called the dendritic drainage pattern. This is with respect to this kind of topography, a sloping land. So that is why it also develops over some faulting terrain or some kind of high folded terrains.

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There is another example which shows the Hilly terrain and showing the V shaped valleys. There are 2 V shaped valleys over here and if you see here there is only 1 V shaped valley. So these 2 or 3 or 4 V shaped valleys which were developed over the higher elevation are coming and joining the main channel and here single V shaped channel with there is representing the main

channel like in our case like the Koshi river coming from Nepal and joining the plain areas of the Bihar.

So this is the main channel and this is the tributaries joining the Koshi river. So this is the surface expression of the beds in form of a parallel layers.

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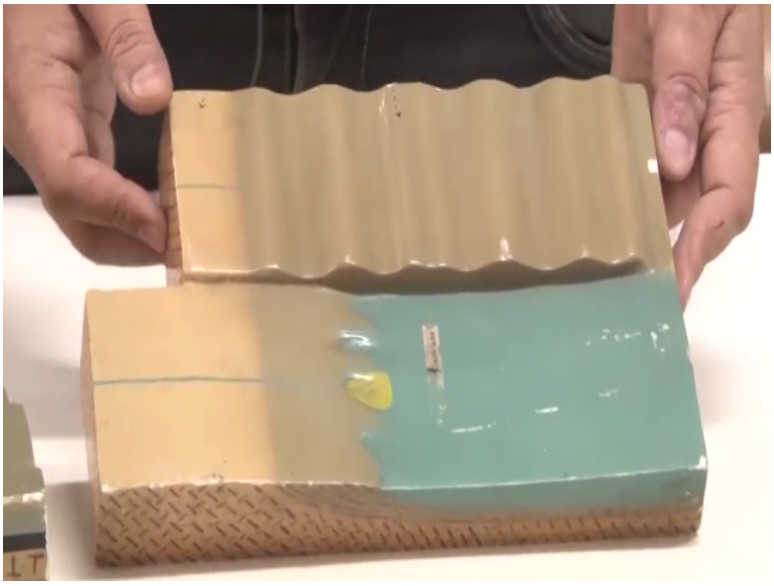

So this is the example of a mountain or a river coming from mountain and joining the folded terrain and the highly folded terrain and here the same river is running the oceanic part or a major river you can say. So this is the example of some mountainous terrain. Here you can see this blue line is indicating a stream which is coming from the higher elevation and joining these folded. So what will happen? This stream will cut these folds and flow like this. So this will be superposed stream in a form like it can erode all these materials.

All the folds or any structure coming on its way. It is capable of eroding it and it can flow like this. In another case, it shows like a river is coming and meeting the ocean. This river is coming and meeting the ocean part and where when a river joins the ocean it will form a delta or a fan. In case of a river, it will form an alluvial fan. The sediments which are deposited at the lower elevation due to some water body on its way so it will deposit all its load over here in the form of a fan like this.

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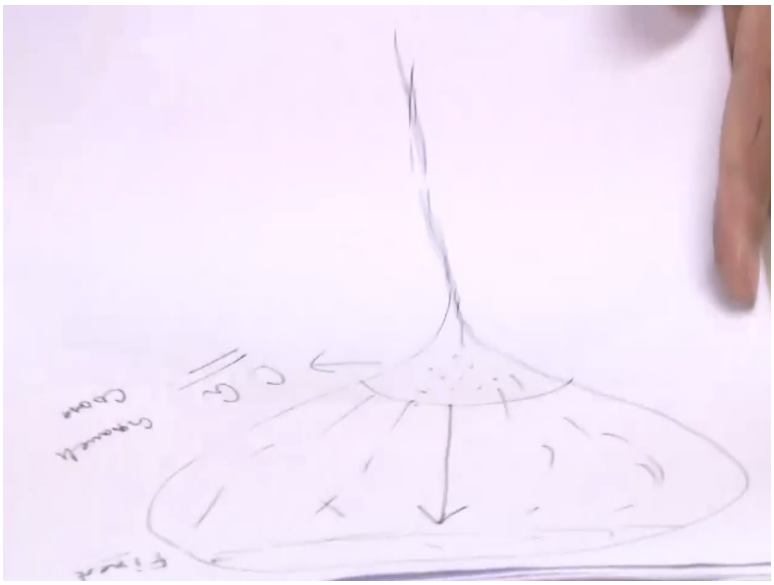

It will deposit suppose this river is coming like this and joining the river so it will deposit all its sediments in form of a fan. So, on the last part of this fan the end or terminal point of this fan you will find the finest sediments like silk clay and on the top part you will find the coarse grains like bolders, subgraded. Coarse, sand, this is a range of sediments with decreasing size. The largest particle to finest particle. So similarly in this case it will form alluvial fan of this topography.

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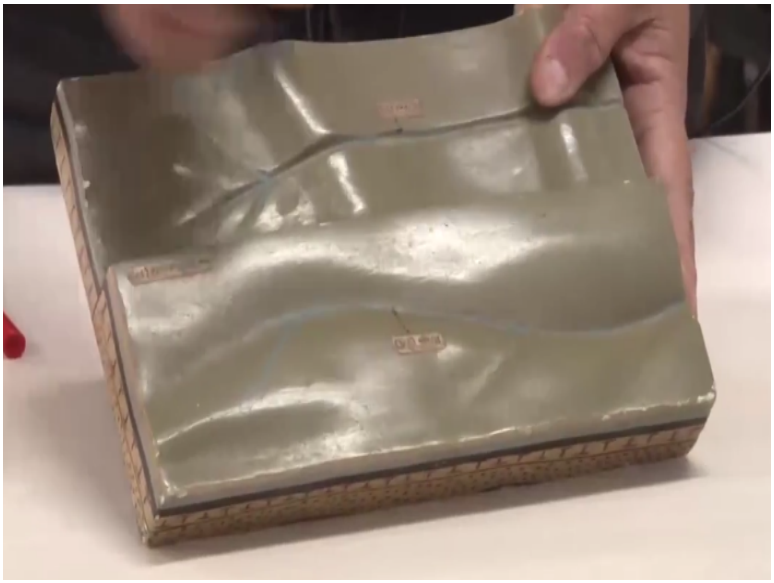

Now here is an example of superposed stream. We can see that on this model a blue line represents the stream and it is flowing at higher level, but now in other case the stream is flowing like this and it has got incised. You can see here. This is the shallow channel and this is the incised channel which is coming like this because tributaries join under normal conditions.

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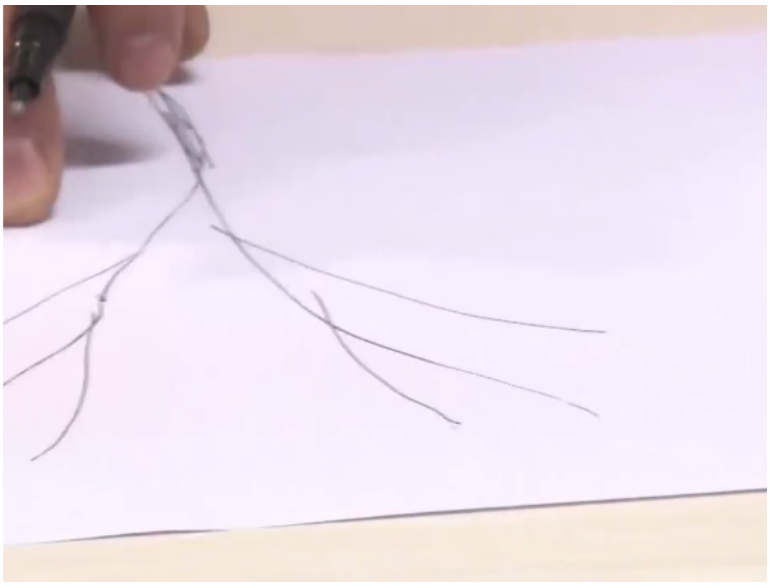

Under normal conditions a river flow like this. Many of the students may get confused between this pattern of the river.

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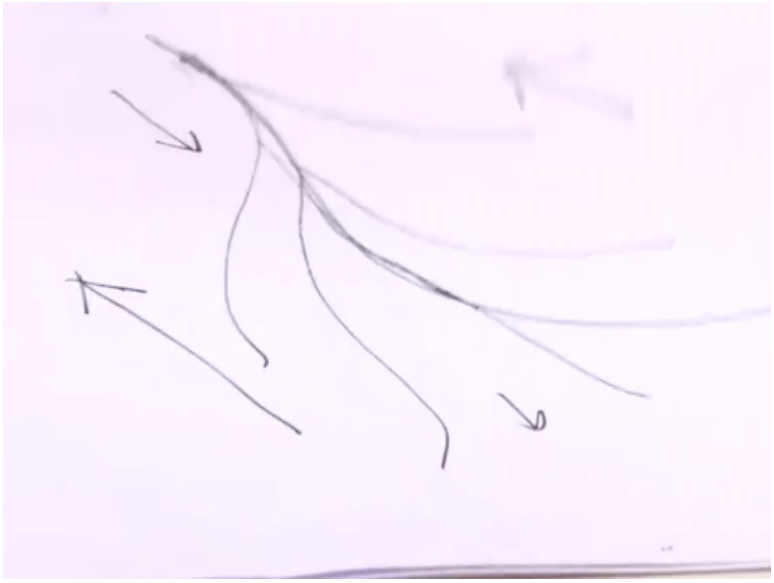

So if we see this pattern from here on the images on the satellite data or anywhere or the Google earth images so we suppose that a river is flowing like this because it is eroding and going on its way. It is branching its channels in this bed, but under normal conditions it flows like this. This is the normal trend of the river. Many tributaries come and lie in the main stream that is known as trunk stream in the main stream.

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So here in this case this is an example of superpose stream and a superpose stream is a stream that forms over horizontal beds that over lie folded and faulted rock with varying resistance having cut down through the horizontal beds this stream retains it coarse and pattern as it perceives to erode the underlying rocks. So, here as you can see that it has eroded the sediments and going like and coming like this.

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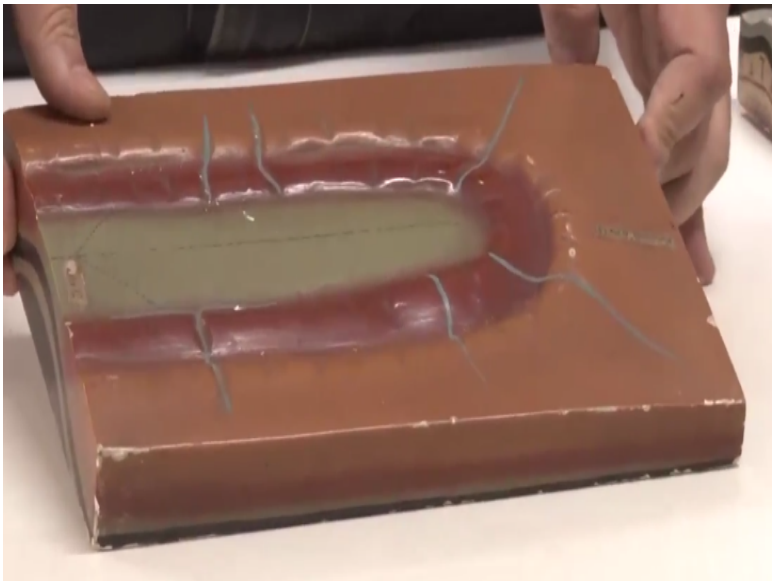

Next model shows some synclinal bends and anticlinal dome here. This is an anticlinal dome and as you know that it was explained in the lecture also you will find some radial pattern whenever you have a dome or a volcano or any cone or any type of domal structure. So this is basically a

cross section representing here of the anticlinal dome. So this is in form a dome and this is the highest part in this dome and this is the lowest variation.

So rivers are flowing like this from here to down slope. So they are forming a radial pattern everywhere all along its sides they are coming like this along the cross section where the 2 beds are joining each other and then they are cutting down slope across the limbs of the fold. They are forming the radial pattern.

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There is another model which shows the stream capture. This is also known as stream piracy where a river flowing on a higher terrain joins the river flowing at the lower terrain, lower and higher terrain means the higher the terrain at a higher elevation and this terrain at a lower elevation.

So you can see that the river is flowing here, but in the initial stage you will find this type of surface morphology where a river cuts down slope and joins any of the tributary or any of the channel of the major river, which is flowing at a lower elevation. Then this terrain becomes more mature or the river grows on its way towards the down slope it will form a more matured topography.

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This you can see here. This is this diagram shows the river capture soon after the capture. So there is a river flowing like this. These are draining these rivers. So this is the slope here this is down slope area. So you can see that how deeply incise this channel is. Deeply incise means it has undercut all the rocks bed rocks and flows across this down flow and joins the major stream flowing down slope. So this is the more mature topography of a stream piracy or river capture.

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There is another model which shows some more mature terrain. This is long after the stream capture. So long time after when stream capture the stream going at a lower elevation you can see the tributaries are coming and joining like this and here you bifocusing it here you can see

that how deeply incised this channel is and why it is so? Because this river was flowing at a higher elevation and it has gone down slope.

And because of a base level which is maintained here because of this base level it has cut underneath and it continuously cut the bed rock until it meets the base level, base level means the level of this terrain. So it will continuously cut the whole terrain until it will reach the base level of this step because it has joined this channel and because of this slope a grater slope it will cut all the rocks whatever hardness is there or whatever steep rocks are there.

But it will be able to cut down all the topography review. So this is also called the surface relief the ups and downs on a topography.

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So you will see such kind of topography at the higher elevation where is a glacial terrain because of the higher elevation there is ice melting over here these white patches are showing basically the ice and when this ice melts then it supplies water down slope and it form the stream. Then you can see the newly formed streams here and all these newly formed streams are joining the main channel which is coming from the somewhat upland area.

So this forms of terrain you will find in the initial stage and it will join the youth stage at a lower elevation.

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This is the example of some river or river land forms actually. You can see this is a meandering channel and it will have this white parts are showing the deposition over here in the inner bends of the river. It will deposit the sands. So these will be the sand bars or point bars and outer bends it will have erosion. Here there is an oxbow lake which has separated from the main channel first it was flowing here.

But now it has shifted towards this direction and left over some part which is the oxbow lake. So this is the topographic slope from where all the waters are coming and joining this river if there is precipitation or any kinds of water supply over here so this will join the main channel.

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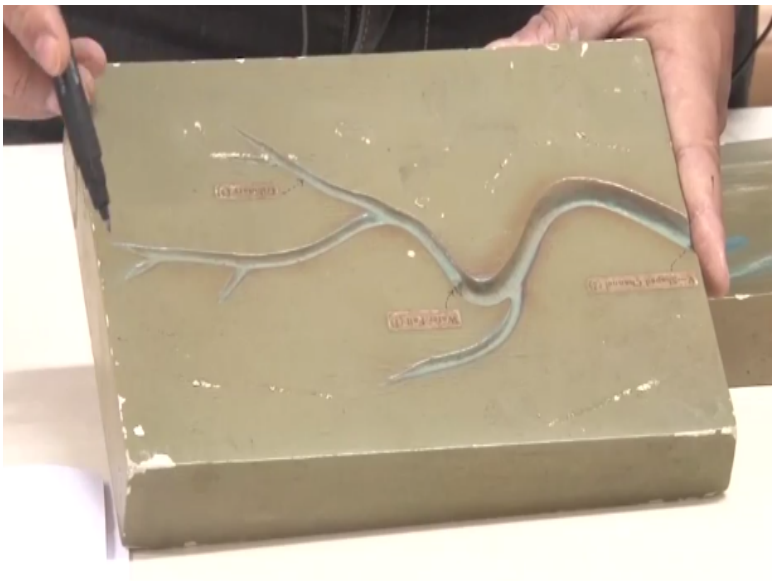

Similarly, this part shows this model shows deep and more incised river and it shows the dendritic drainage pattern where tributaries are coming like this and joining the main channel or it trying to stream. So this is the more incised channel it means it has formed the youth stage of a river. Then this stage becomes mature.

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So the river will transform into more mature landform or mature topography where it shows major meanderance on both the sides so as soon it goes downwards in the older stages the meandering of the channel or the sinuous activity hence the sinuous channel will be lose out and there will be an older channel of a broad U shaped valley where you will find braided channel or braid islands or great sand bars in the middle of the river.

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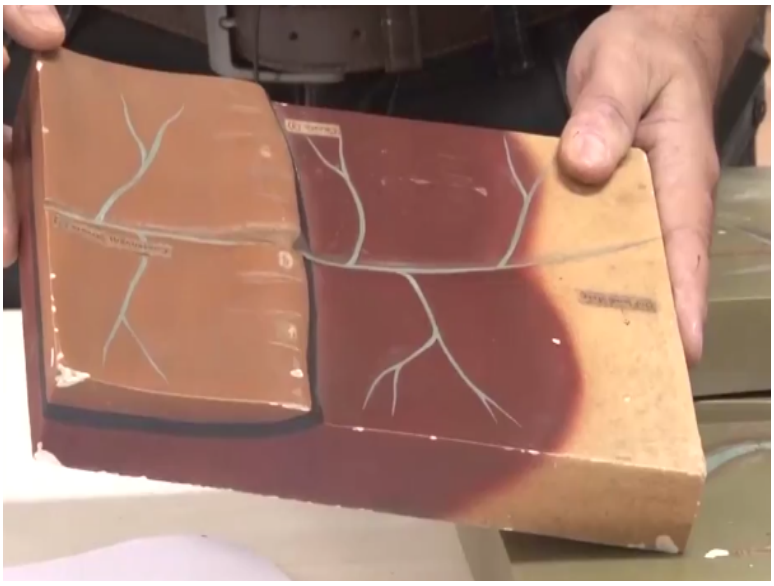

And regarding that this is the last model which shows geomorphic land form like cuesta where a river is coming from up land area and joining the river at the main alluvial plain. In our case in case of India you can say that at the foot hill zone where consequent stream is coming like this and joining the alluvial plain where this part shows some dendritic pattern of the channel. So this part basically is the cuesta where there is a break in the topography and river continues to flow downwards.

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This type of river is known as antecedent stream. It flows against the topographic relief if suppose if there strata from highly molded strata it is capable of eroding and cutting down the

domes of the foldable strata. So these are the antecedent stream it flows regardless of the topography or the topographic slope.

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This is another example of the river piracy where stream captures the other channels flowing at a lower elevation so you can see that the tributaries coming from a higher elevation are joining the main stream. These are the tributaries and this is the main stream water trunk stream. If you see here, so this is also showing a synclinal bend or major synclinal fold, where rivers are coming down slope in the mid part of this synclinal bed, because its limbs are sloping towards the center.

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There is another geomorphic land form related to shoreline as I have earlier shown in the last lecture. This was explained in the lecture of week 3 that when there is emergence of the shoreline so then you will be able to see some features beyond the range of the represent a shoreline. So like this is the offshore bar, this is the lagoon area and this part is showing the beach ridge. The beach ridge is a form of sand dune which maybe of marine origin or which may be of Aeolian origin which divides topography from the sea to the inland.

So this is the shoreline and these are some shore bar because of the emergence of the shoreline.

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This model explains the cast topography and I have earlier shown lots of photographs, aerial photographs as well as satellite photographs related to this kind of topography. This form of topography develops when underground water dissolves the calcitic material like the rocks made up of limestone or some subsurface lithology of having limestone the density composition so because it is capable of eroding and dissolving all these fractions there is formation of some cavans like features and holes.

These holes are known as pot holes, sink holes and some where there is a formation of natural bridge also where there is erosion or the dissolve, dissolution activity on both the sides so there is formation of a natural bridge. So these are specifically related to karst topography which is solely

dependent on the lithology. So I explained earlier as it is in the case of limestone and dolomite type of lithology which you can identify.

Based on the geomorphic land forms, which you are getting on the surface. So in this lecture, we will stop here, and we will continue in the next lecture with the Google earth where I will show some images and different kind of landform and those landforms may be related to fluvial, Aeolian and coastal environment. So in the next lecture we will continue with the google earth. Thank you so much.