Photogeology In Terrain Evaluation (Part - 1)
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Lecture - 14
Morphometric Parameters of Fluvial Channels

Welcome back, so this was the last slide which we were discussing about the different type of terraces.

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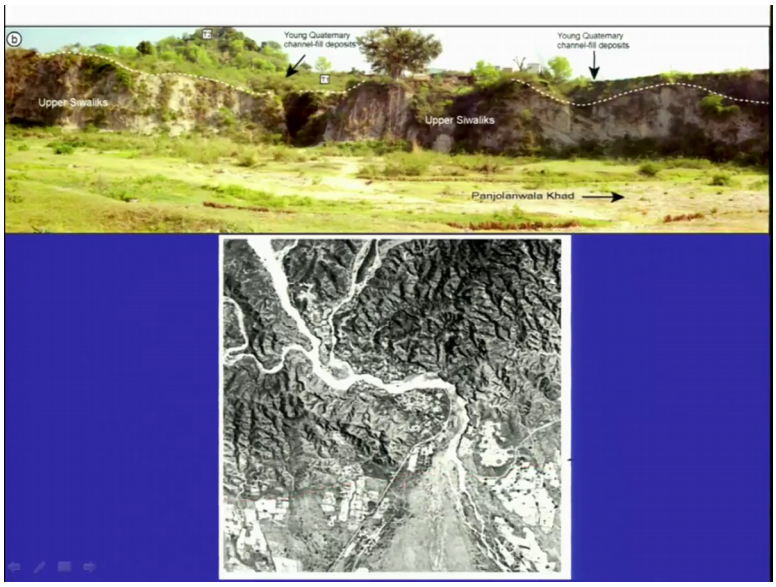

And there is another example from Himalayas I told that we have this in the foreground we are having the Indo Gangetic plain and this is your Siwaliks. And you can easily demarcate it because if you look at the tonal variation as well as the some features which are indicative of drainage or the smaller streams which are seeing here ok. So, this portion is comparatively elevated than this one and if you take the profile like this then you are having something like that.

So, you have an elevated portion here. The major channel you can easily identify which goes here, and then again you are having in very wide valley, which is indicative of again the braided river system here. So, you have what you have here is you have meander you have straight channel and then you are coming to the unconfined area from the confined one.

And this portion this is the white portion which I will trace here this one is the top portion and this blackish portion is your escarpment here that is the and then we are also having the incise valley. And the photograph which has been shown on the top was taken from this location looking this side ok.

So, what you see in the field photograph so you are having the incised channel and, on the top, you are having very young channel field deposits. Again, this land form can be classified as in strat terrace in the region, and why it has formed is because of the uplift which is going on along this line. So, this is the area is getting elevated as compared to the Indo Gangetic plain.

Now, in coming few slides we will try to understand that how we can identify the landforms using the or subsurface structures or lithology using the drainage pattern.

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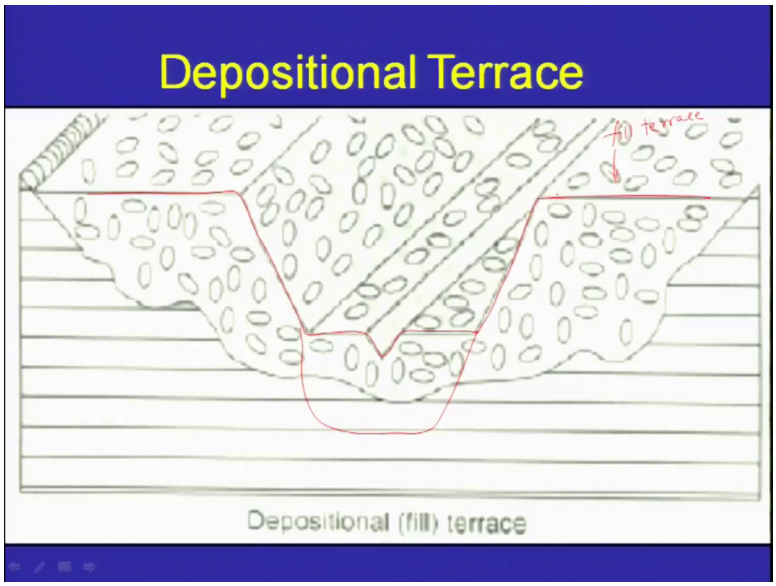

Before going to that let us just look at that what is it they we exactly mean by the depositional terrace. So, the previous photograph and the which from the field is of strat terrace, but this on depositional terrace and as I told that that the depositional terrace is the terrace which will formed by the incision within the value field material ok. And also, we term this as a channel fill or valley fill terraces ok.

So, this is the channel boundary and you have which has in size the bedrock, but then it got filled up and again in size. So, this is the terrace step and this is the escarpment here

and this is the here valley floor. So, this terrace is formed where the river has cut it is own deposit hence we term this as a channel fill deposit or fill terrace ok. So, this has been termed as fill terraces or you can say depositional terrace.

Now, if it cuts through here that is a bad rock then you will say this is a strat terrace.

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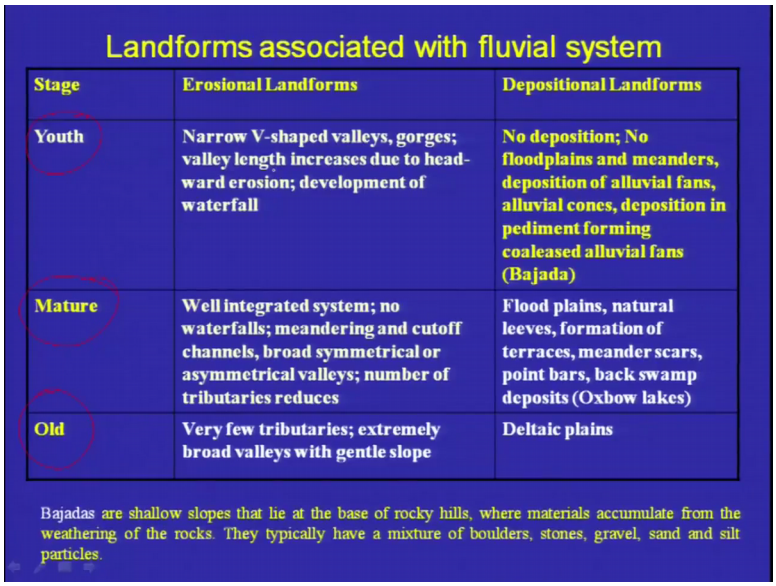

Now, if you consider the complete journey of a river channel from it is origin to it is mouth then you will come across different slant different landforms. So, we have as we have been talking about erosional landforms and depositional landforms.

So, if a river is considered in the youth stage then what type of erosional landforms you will come across, because when you are preparing a detailed geomorphic map or a landform map using satellite data and you are interpreting the satellite data, you will also have to classify the landforms ok. And you will also have to demarcate putting in standard symbols that this feature is indicative of a particular land form.

So, based on that you have different stages you have youth stage, you have mature stage, and you have old stage, and what are the related landforms here? So, in the erosional landforms we will see in the youth narrow V shaped valleys gorgeous valley length increases due to head-ward erosion, and this head-ward erosion will keep on adding more area to your drainage basin ok. And development of the waterfall this is like in a youth stage where you will find this type of features.

In the depositional landforms for the youth stage only; You will not see in much of the deposition, no flood plains or meanders will be seen in terms of the comparatively you will see less meanders deposition of alluvial fans in the foothill zones alluvial cones and so on ok. In terms of the mature you will have well integrated system no waterfalls because you have exposed the land form for a longer period compared to the youth one ok.

So, it will keep on eroding and you will not be able to see the features which you are going to encounter here ok. Then you will have of course, meanders then because of the channel migrations you may come across the cutoff channels. You may come across a broad symmetrical or asymmetrical valleys ok, number of tributaries reduces ok.

Then in terms of deposition we will have floodplains natural levees formation of terraces, meander scars, point bars, back marsh or back swamp we say and deposition which will be deposited in a form of it your oxbow lakes. An oxbow lakes are nothing but your having; what you see the cutoff channels mainly.

Then in old stage what you will see basically is very few tributaries extremely broad valleys and deltaic plains. So, mostly if you start this what you will find that if you are having the origin and finally, you are getting this channel meeting the ocean ok. So, you will have a very youth stage here you will have comparatively mature here and an old also of course, and then what you see is that this will be in the older one ok. And in terms of the valleys and all that what you see is that like if you have to look mark the V shaped valleys then you will be able to see clearly this type of, if you are viewing the satellite data in 3 dimensions you will be able to make out and the broader channels will be something like this.

So, you have a u shape valley and a V shape valley. So, this type of features also you will be able to mark using satellite data and then you can classify your area accordingly.

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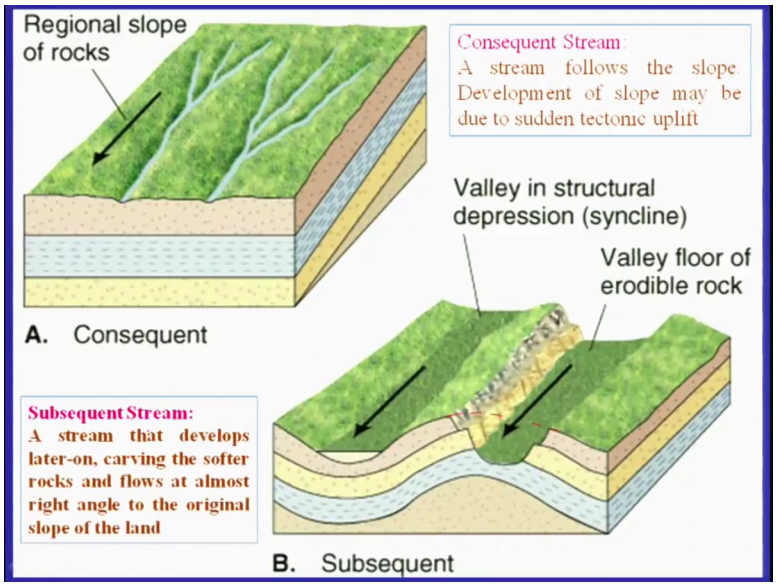

Few more things and terminologies which you will be this will be helpful in categorizing the landforms. For example, you have the consequent stream and the subsequent streams, but for this again some help will be required in terms of the field investigations ok.

So, usually the consequent streams are been classified as a stream and that flows on the slope, development of slope may be because of sudden uplift ok. So, you have an gentle slope here and the streams which will develop over the slope are termed as the consequent streams ok. Whereas, the subsequent streams is are those developed later on so for example, you have an folded terrain here and then you have the streams which are when developed on that ok.

So, which are developed later on carving the softer rocks and flow at almost right angle to the original slope ok. Whereas, the consequent streams are flowing along the slope that is from the higher to lower whereas, this one this will be developed almost right angle to the original slope original slope is way, what is the original scope? We are talking here is this one this area is like this ok. So, if you if I extrapolate this one this will be something like that ok. So, the original slope is here this is the original scope, but the stream has cut through the software rock and flowed almost right angle to the original slope.

So, this type of streams which are developed in the folded terrains are termed as your subsequent streams.

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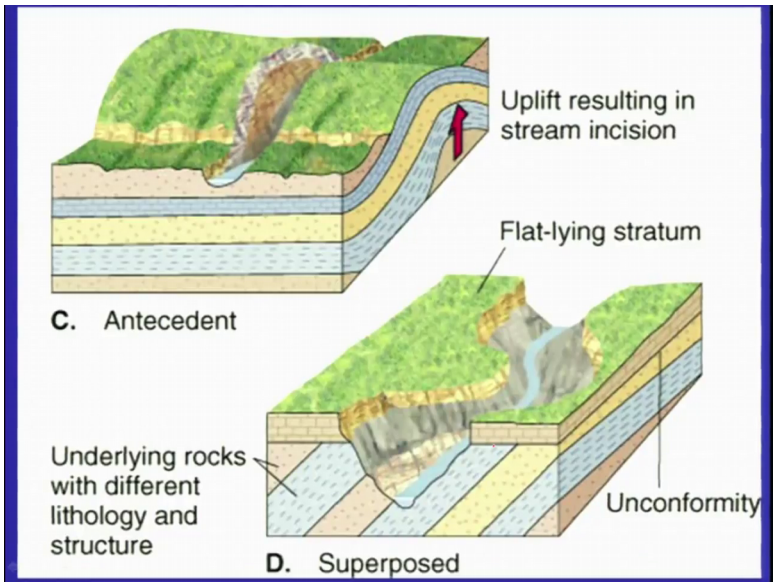

Then we have antecedent streams and this has been observed close to the mountain trance and the best example to see the antecedent stream is close to Himalayas; where the they uplift is going on which is resulting into the stream incision ok. So, one of the photograph which I was showing, where we were talking about the strat terraces if you refer that photograph, you will be able to remark it easily that close to the hill front or the mountain front you are having a deep incised valleys ok.

So, these streams have cut through this uplift here. So, these are termed as antecedent streams ok. Then few streams have been termed as superposed ok. So, what are those? They will develop or the underlying rock with different lithologys and they will flow across that actually ok. So, these are the superposed streams ok, and further one more thing which has been shown here is the unconformity ok.

So, you are having the inclined beds here and then you are having the horizontal material horizontal layers which deposit it later on could be related to the same stream, but they are the later on deposits ok. So, this has been also termed as the unconformity or we can also say on angular unconformity here so these are the examples of the superposed streams.

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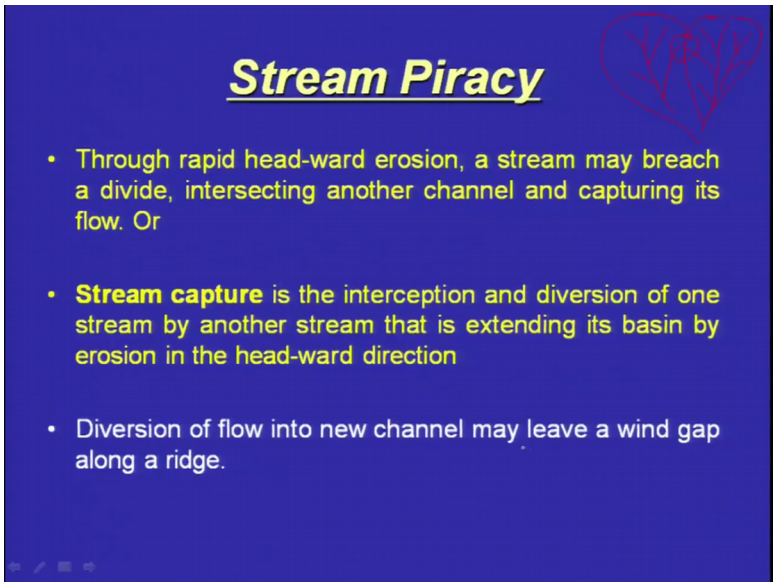

Now, one more feature our the signatures we often come across in the hilly terrain and as we were talking about that head-ward erosion plays an important role in the extension or the development of any drainage basin. So, stream piracy is nothing but the term which has been given for stream capture. So, what happens is in this process that due to the rapid head-ward erosion a stream may breach the divide ok. So, in one of the lecture we were talking about that we are if suppose we are having stream here, then we are having smaller tributaries running here and then another stream here and we are having small tributaries running here.

So, this is the boundary or the drainage divide of one of the basin here and then this boundary is the another basin ok. So, maybe what will happen because head-ward erosion means it will keep on eroding this side this will keep on eroding this side, time will come this will this divide has been breached ok. And one of the channel will start flowing in different basin ok. So, this is what is we are talking about the stream capture. So, stream capture is the interception and diversion of one stream by another stream ok; that is extending it is basin by erosion in the head-ward directions ok. So, this is your head-ward direction and this divide will be breached and one stream will capture another one.

So, diversion of flow will take place, where the diversion of flow into new channel may leave a wind cap because the older channel will dry up.

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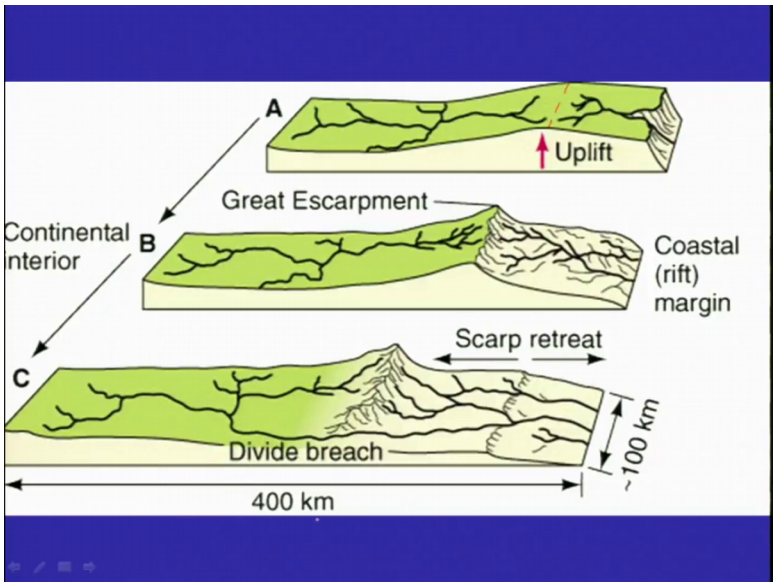

So, if you see this example here what it shows is that you are having for example, this area is uplifted. So, you are having the drainage divide over here. So, this stream is flowing in this direction of the stream is flowing in this direction, because of the head-ward erosion which is moving in this direction here and the erosion is taking place like that.

The time will come that some areas will be breached off and this is what we say breach of the divide and the whole drainage for example, is now taken up by this one. Some of the streams here may be dried up and that what we call the plaeo channels and it will be either in form of wind gap or paleo the water gap.

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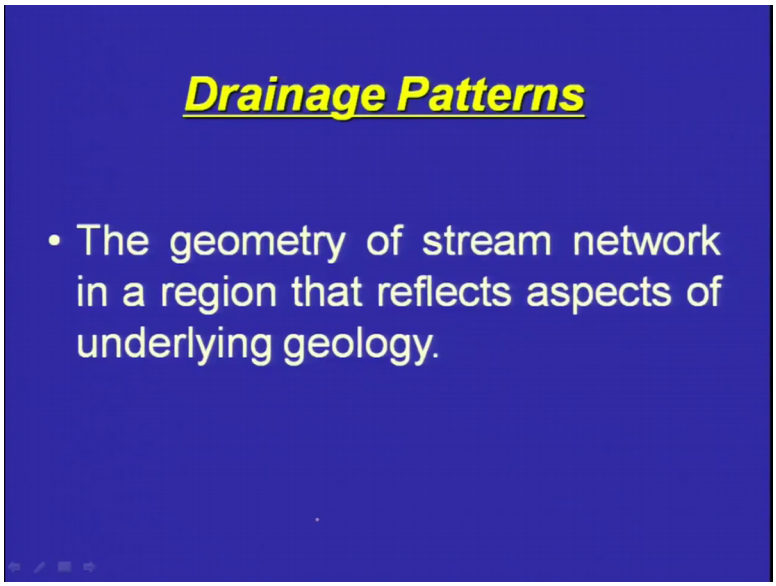

Now, this is another important part which you will be using for interpreting the subsurface is lithology either we can say or the structures based on the drainage pattern. Now the drainage pattern is the geometry of stream network in a region that reflects aspect of underlying geology. So, what are the different mythology of the area you will be able to make out easily based on the drainage pattern ok.

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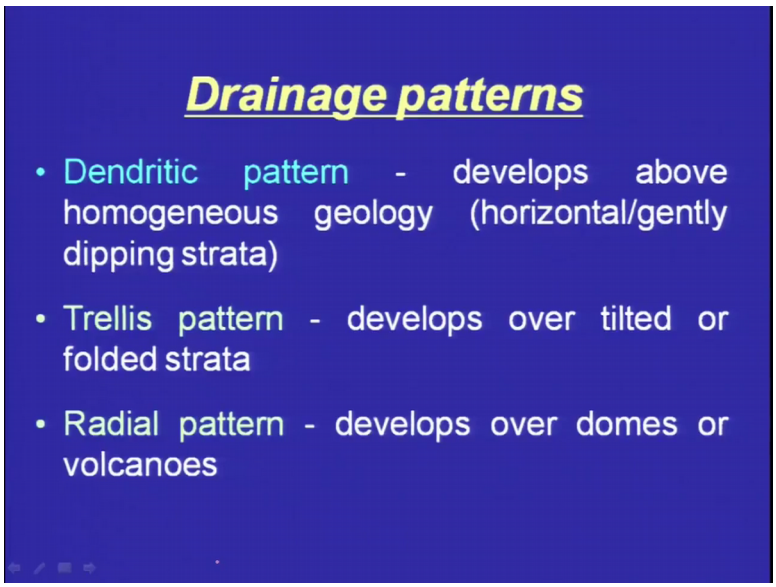

So, drainage pattern for example, these are few which are very prominently seen and commonly seen one is dendritic pattern develops above homogeneous geology either you

are having very horizontal or gently dipping strata. Then you will have trellis pattern develops over tilted or folded strata. Then you are having radial pattern which develops over the domel or volcanoes. So, if you are having domes or volcanic areas you will be able to see the radial pattern.

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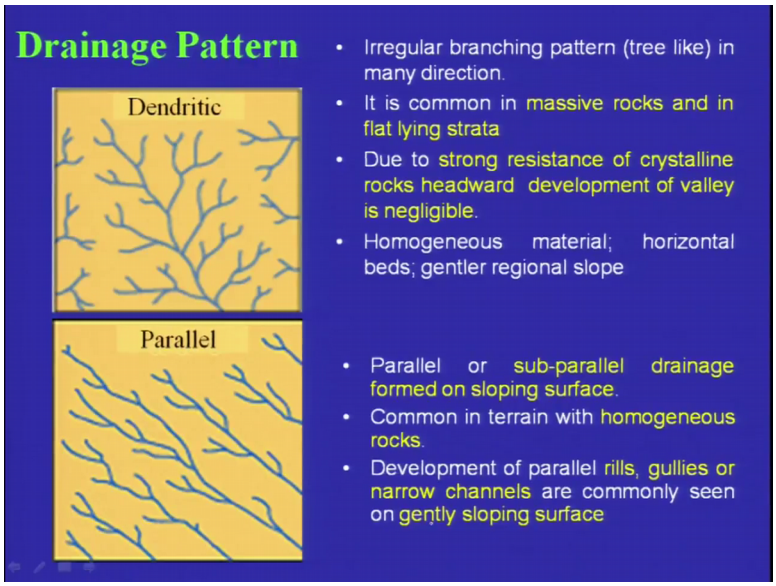

We will see a few of the examples of this ok, but before that let us look at the pattern in detail ok. So, dendritic pattern it is irregular branching pattern tree like in many directions. It is commonly seen in a massive rocks and in flat lying stratas or on the flat lying stratas due to strong resistant of crystalline rocks head-ward erosion development of the valley is negligible, or you are having either the homogeneous material and a gentle slope you will be able to see the dendritic pattern. Coming to the parallel it will develop over the sloping surface very much similar to what we were talking about the consequence stream.

Then common in terrain with homogeneous rocks, but mostly what we are looking at it will develop along the slope, development of parallel rills gullies or narrow channels are commonly seen on gentle sloping surfaces.

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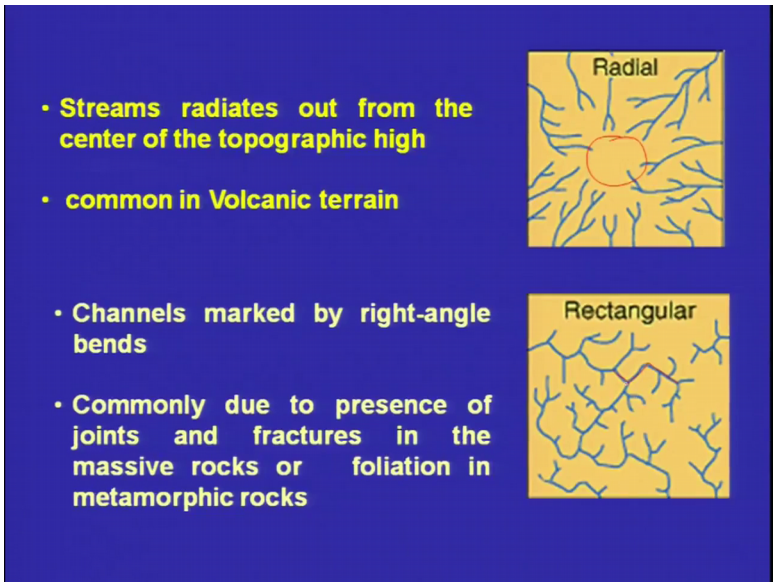

Coming to another one radial, so this portion the center portion is elevated here this is the higher place stream radiates out from the center of the topographic high, common in welding volcanic terrains. Then you have rectangular patterns usually such types of patterns are marked by right angle bends ok. So, you have very typical right-angle bends.

Commonly seen due to presence of joints and fractures, in massive rocks or foliation or the foliated metamorphic rocks ok; So, you will be able to see similar pattern ok, which we call as an rectangular pattern. So, we will do one or the 2 exercise on this which will help you in understanding the subsurface lithology based on the drainage pattern, as well as you will be able to identify the landforms which are associated with such drainages that is the drainage basically reflects what exists beneath.

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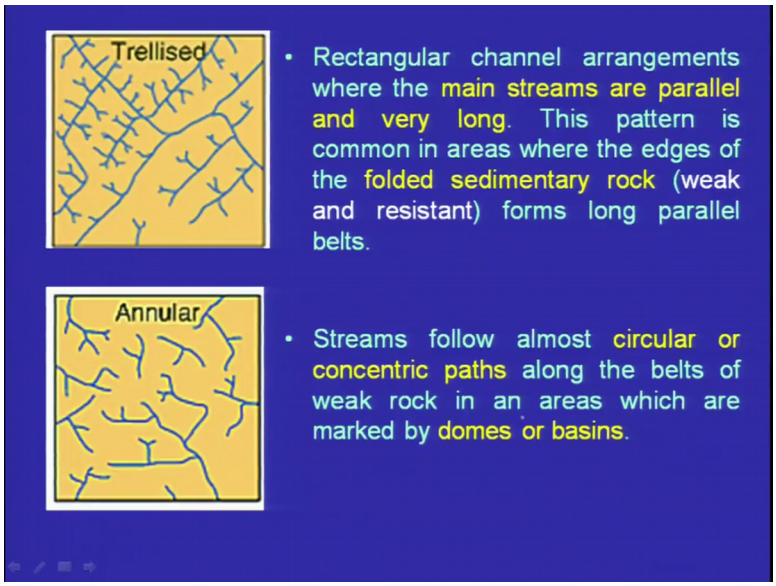

Then we have trellis pattern, again rectangular channels are channel arrangement, where the main stream are parallel and very long ok. This pattern is common in the area where you are having the edges of folded sedimentary rocks and this folded sedimentary rocks will have weak or resistance rocks. So, these types of trellis drainage are mostly seen in that reasons.

So, what will happen the folded sedimentary rocks which are with weak and resistant rock layers and that the edges of the folded one this will form a very long and parallel belts. Then you have annular drainage pattern stream flows almost circular or in a concentric path along the belt of weak rocks in an area which are marked by domes or basins.

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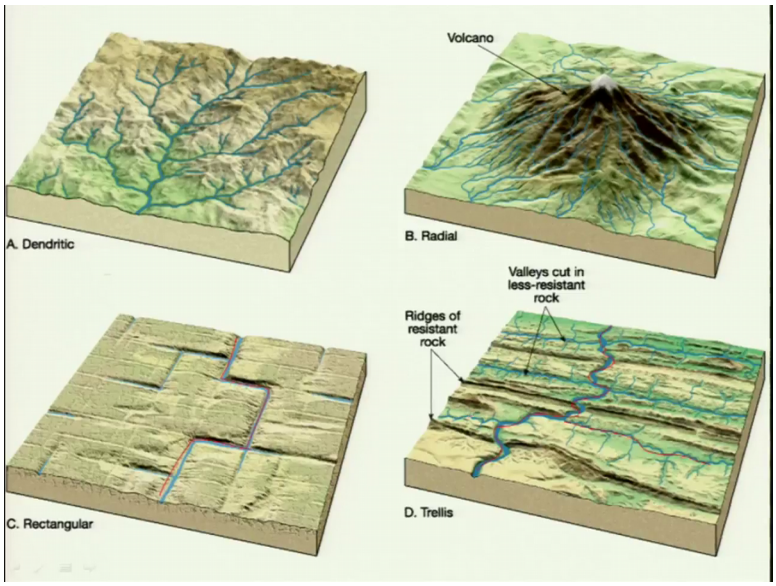

So, let us see few example of further of the dendritic pattern how it looks like. So, you have very small multiple stream and it keeps a tree like pattern, radial you are having an elevated portion here. So, either this is a dome or a volcano then you will have a radial pattern which are radiating away from the center which is the higher point.

You have a rectangular pattern because of the fractured rocks. So, you have almost in triangle pattern you will see whereas, the trellis one this is what you see here is that the main channel is very long flowing across the folded regions and this will be also parallel to the folded region these are the tributaries. So, you are having resistance rocks here and then you are having this soft one ok.

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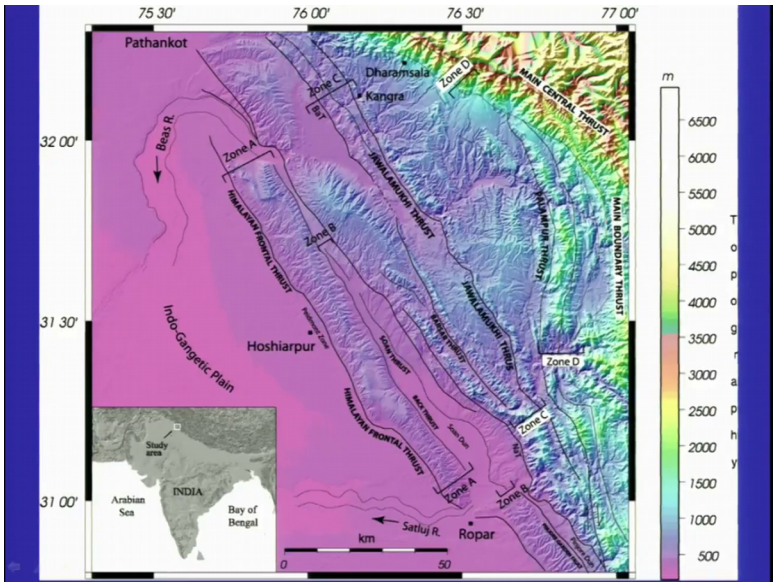

Now, if you look at the Himalayan terrain this is a foothill zone and this portion what you are looking at is your anticline. So, you have multiple folded belts here as you move towards the high Himalayas.

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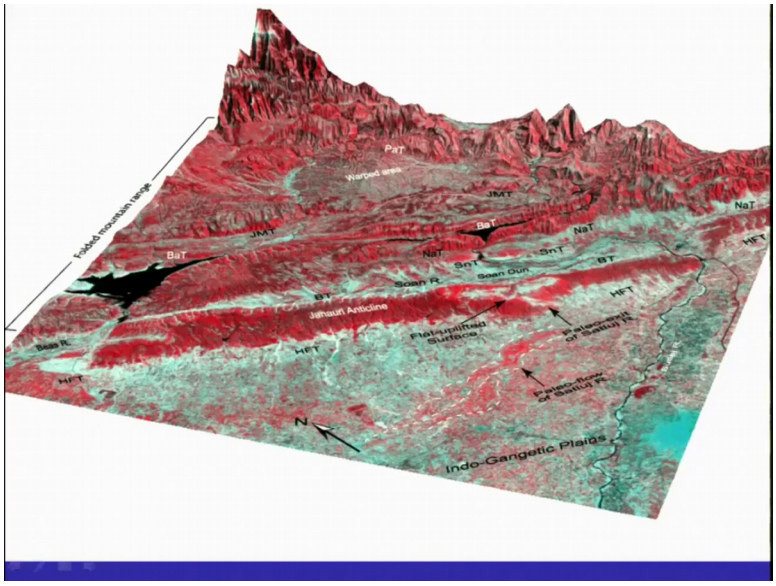

So, one of the example if you look at this is the 3 D perspective view of the same area looking from here towards this side and what we see in terms of the elevation change here; that you are having an very sharp demarcation over here ok. You have an Indo Gangetic plain and this data which we used was SRTM data satellite through the

topographic mission data and landsat data. And we generated this prospective view 3 D perspective view.

So, what we found was that of course, there is the elevation changes here and this portion is a very flat area which is sitting in the on the top of the anticline, and then we are having in basin or we can say this is an inter mountain valley between the two mountains. And further if you move ahead this area what we have marked as a warped area and this we interpreted based on the drainage.

So, let us go back and look at what exactly, if you look at this drainage this small stream these are all deeper part here are indicative of smaller streams ok. So, what we found is the streams are flowing like that these are the going in this direction. This is what we have marked as an warped are ok. So, this is something like domal area of which we are we were able to pick up from here.

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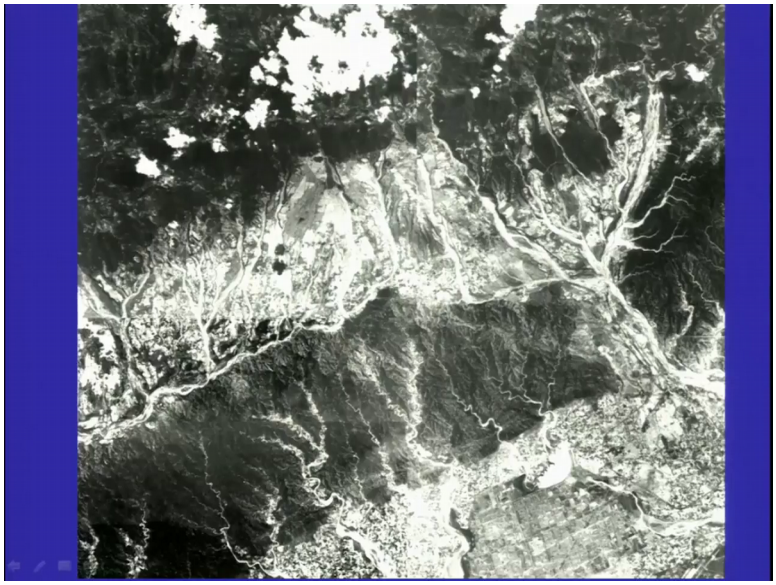

Now, coming to this probably I am having the next slide this is what you can mark easily you are having the darker portion here is again in corona satellite photo the lighter ones. And you can see some settlement indications this is Chandigarh area. So, this is a boundary between the Indo Gangetic plain and a upper Siwalik. And what drainage pattern you will be able to pick up as we have seen in the previous slide is typical of a drainage which is indicative of dendritic, very closely spaced and then we are having a very tree like system these are white portions, which I have been seeing here or the

stream these are the major streams which are flowing, but in terms of the tributary and whole drainage basin if you mark for even for the individual on you will be able to mark this as an dendritic pattern.

And then we have alluvial here is a basin area again we are not having the dense drainage as we see here in this portion the blackish one, this is a whitish again this is an flat region and then there is an boundary here further going up we have a different drainage pattern here. Further if you look at here what we can be able to pick up you have meanders here whereas, here you are having almost straight channels and this you can classify this channels as all parallel channels ok, or parallel drainage which have developed over the slope.

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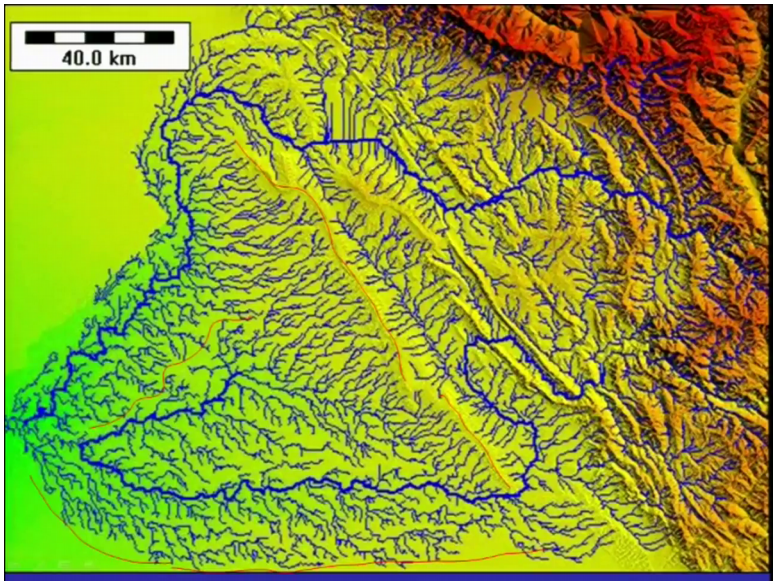

Further when you start the drainage from the satellite topographic that is SRTM data satellite topographic mission data, having understanding that what type of drainages drainage pattern we can classify this pattern can be again classified as an same as a dendritic pattern ok. So, you have darker blue is your major channel which is flowing along.

So, some places you will say that fine this is a trellis pattern then it is crossing this ridge lines so, this is your antecedent drainage again similar to that you are crossing the ridge line here, that is a folded belt this is an antecedent drainage. These streams are flowing on this direction in this one because we are having the smaller stream joining the bigger

one or the higher order streams. And here we are having these streams which are joining the trunk stream here.

So, if you draw the line here and you will be able to keep clearly demarcate boundary ok. Now what is this? This is your drainage divide and for this you may able to mark the basin area for example, for this let us mark this one here, it may come here and this one is of course, over here. So, these are the basin areas you are having so, drainage basin and you are having the drainage divide here ok. And the drainage pattern which you are looking here is typical of the dendritic pattern.

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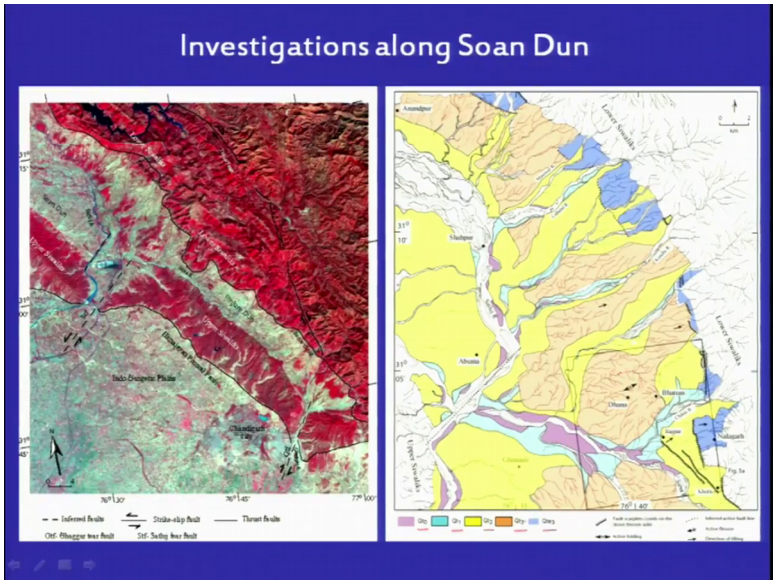

Now, we based on like we when we were doing some of our studies here in this region, we come across very interesting thing and that like we were very much inclined to go and feel and check, what we have been able to identify from this satellite data is correct or not ok. So, this is again a landsat data of north from northwest Himalaya. And these are the clear-cut boundaries which you can see this is false carroll composite.

So, you are having this darker green colors are thickly vegetated areas and this is in Chandigarh anticline and then further you are having an valley here which is termed as Penjordun; similar like what we are having Dehradun and then we are having the lower Siwalik hills.

So, when we were looking at this region, what we found in particularly there is ok, now this is what is the; geomorphic map we are having ok. So, as we were talking that you can classify the terraces other landforms as t 0, t 1, t 2. So, here we have marked as qt 0, qt 1, qt 2, qt 3, and qt 4. Now this is just a few streams which we have picked up here ok.

So, we these are the major streams and we are having the smaller tributaries, what we can do is we can come over in the next lecture and we can talk in detail about this, I will stop here.

Thank you very much.