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Photogeology In Terrain Evaluation
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Lecture – 12
Geomorphology of River Channels

Welcome back. So, in the last lecture we talked about deltas coming back again to the alluvial fans.

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This is one of the best example, which we see in the foothill zones of Himalaya the location here is Patna, and this river which debouches on to the indo Gangetic plain of the Kosi river joining mother ganga deposited, and result it into the formation of a large alluvial fan here, let us see some more details on this.

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So, if we look at the close up view you have the present channel here, and then you have multiple channels which are seen here and few of these channels are your value channels, they are not the channels which are active.

So, they are dried up channels, but of course, through this area once the river flowed in past, and this has an very different history here, because this value channels or the dried-up channels within the alluvial fan were periodically occupied by the same river. So, there is an history which talks about the shifting of the channel time to time in the past.

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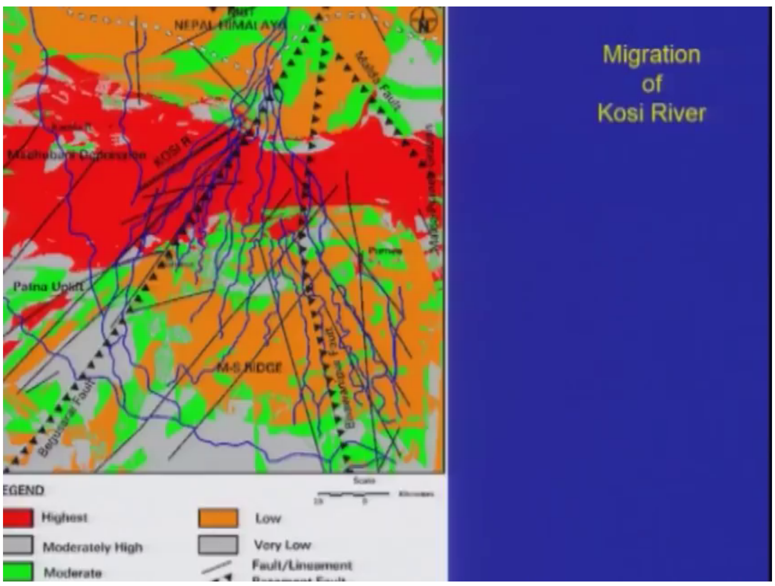

So, migration of the Kosi river, there are a few oscillations as well as the hypothesis which are then given, and the interpretations by few researchers that this formation of this alluvial fan, and the Kosi alluvial fan is controlled by ongoing deformation of the tectonic activities, where the 2 basement falls which are termed are given here, are controlling the formation of this alluvial fan this may be true, but there is no solid or concrete evidence to accept this hypothesis.

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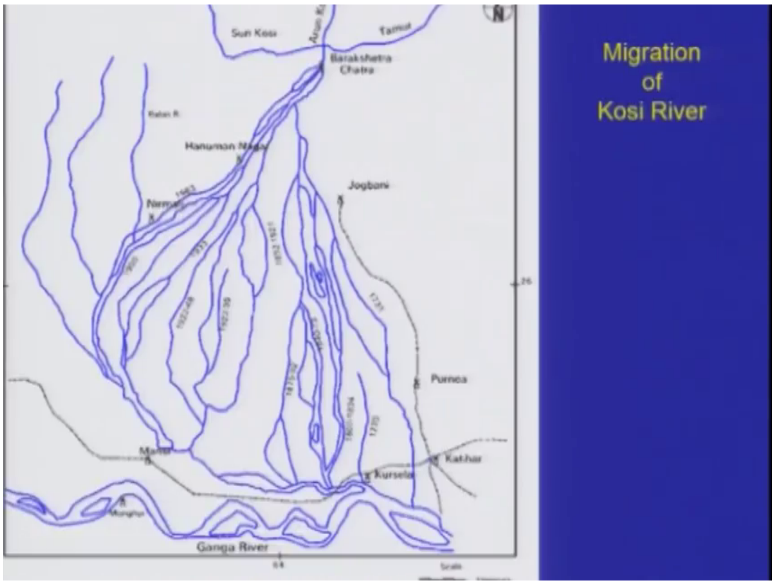

This is on map which shows the migration or the period of time, which is marked here that in for example, in 1950 the river was flowing here, in 1933 it flowed here, from 1922 to 48 it flowed here, and 1927 to 30 it flowed here and so on. So, you will find that this stream or the Kosi river it has shifted, or I would say that it kept on swinging from this point on to this alluvial plain.

Hence, still no one has an complete understanding, that which channel it will reoccupy in future during the peak discharge, hence this whole area is extremely vulnerable if you talk about the hazard from the Kosi river.

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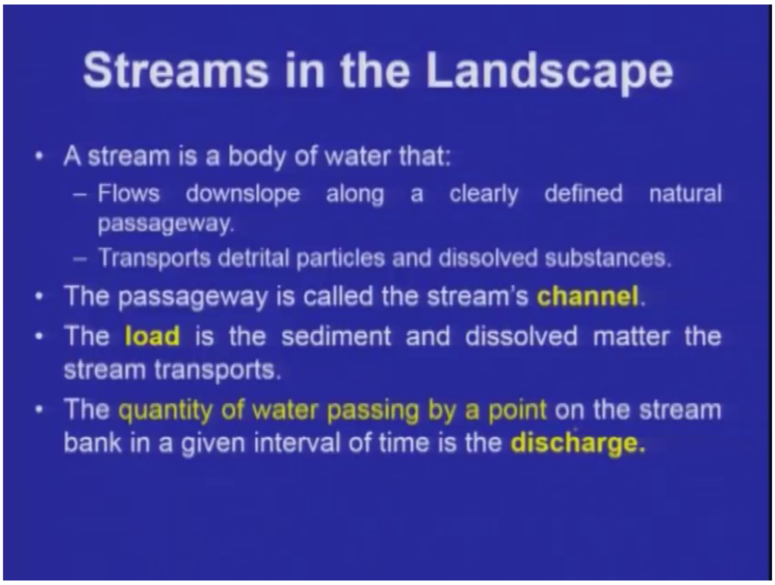

Streams in the landscape it is a stream which is a body of water that flows down slope along a clearly defined natural passageway transport the detrital particles and dissolved substances the passageway is called the stream channel; the load is the sediment and dissolve matter the stream transport the Quantity of water passing by a point on the stream bank in a given interval of time is termed as discharge. So, these are few parameters which are extremely important, when you are talking about the stream and it is associated flood hazard.

And few of them, like the channel geometry and then sediments as well as the discharge has played an important role in migration of the Kosi river.

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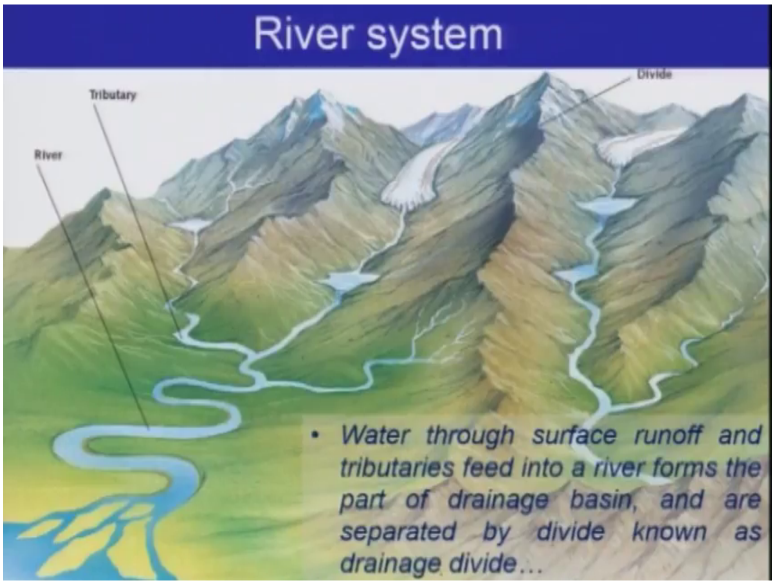

So, river system you have from it is origin here, it has been shown the glaciers or where it originates the drainage divide here you have tributaries, which are joining the trunk stream you have the ocean of the delta, and then they trunk stream which is very. So, water through surface runoff and tributaries feed into a river forms the part of drainage basin and are separated by divide known as drainage divide this we also discussed in previous slides.

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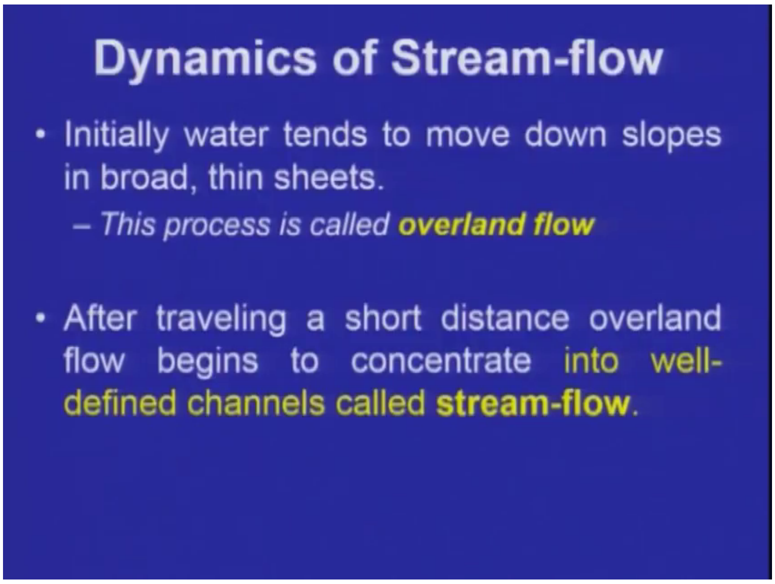

So, dynamic of stream flow further if you look at. So, initially water tends to move down slopes in a broader thinner sheets, this process is termed as overland flow after traveling a short distance overland flow begins to concentrate into well-defined channels called stream flow, because this now we are moving to the to the points, where we will be talking about the formation of drainage basins and all that.

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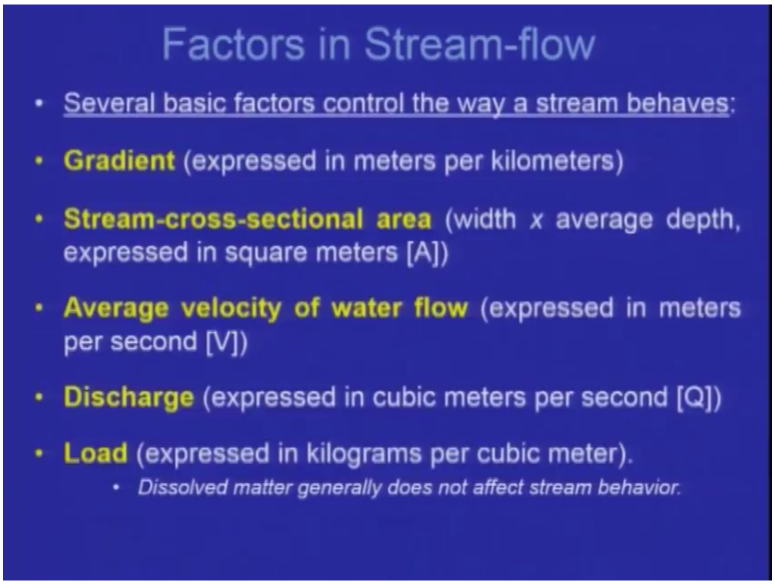

So, factors in stream flow, there are several basic factors that controls the way of stream, how the stream behaves one is the gradient which is expressed in terms of in meter per kilometer, stream cross sectional area width into average depth expressed in sQuare meter, average velocity of water flow expressed in meter per second discharge expressed in cubic meter per second, and then load expressed in kilograms per cubic meter.

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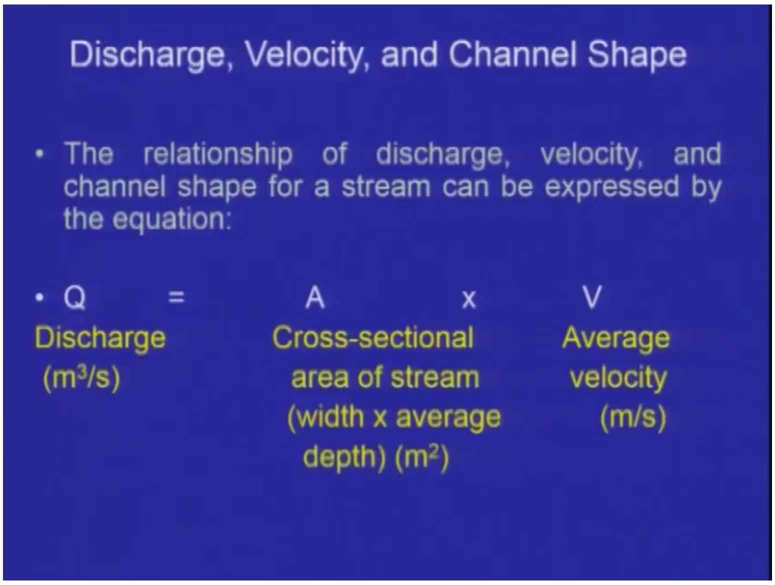

So, the relationship of discharge velocity and channel shape for a stream can be expressed by an equation here, where the Q is the discharge, A is the cross-sectional area of stream and V is the average velocity.

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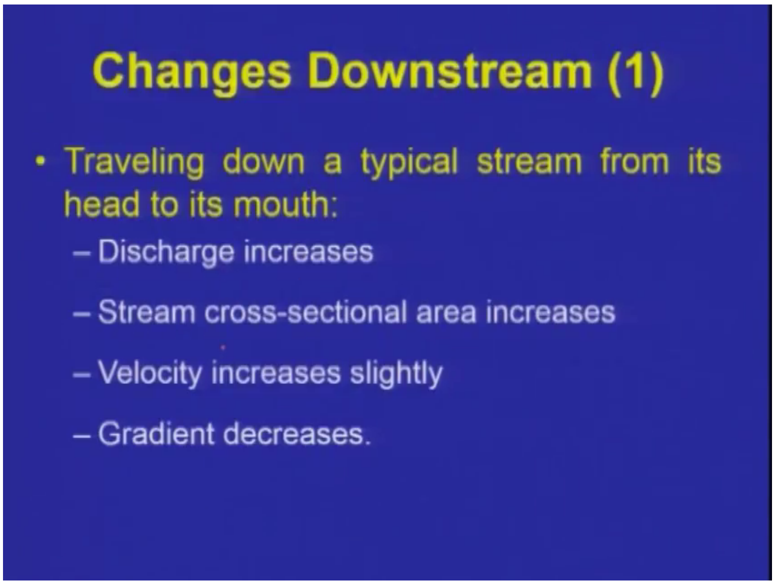

Changes downstream if you look at traveling down a typical stream from it is head to it is mouth discharge increases stream cross sectional area increases, velocity increases slightly, gradient decreases and why we are talking this because, when you will look at the 3D photographs or the stereographic photographs, you will be able to judge this easily of course not the velocity, but this is important for us you can remember this, and try to utilize if you are using this information elsewhere.

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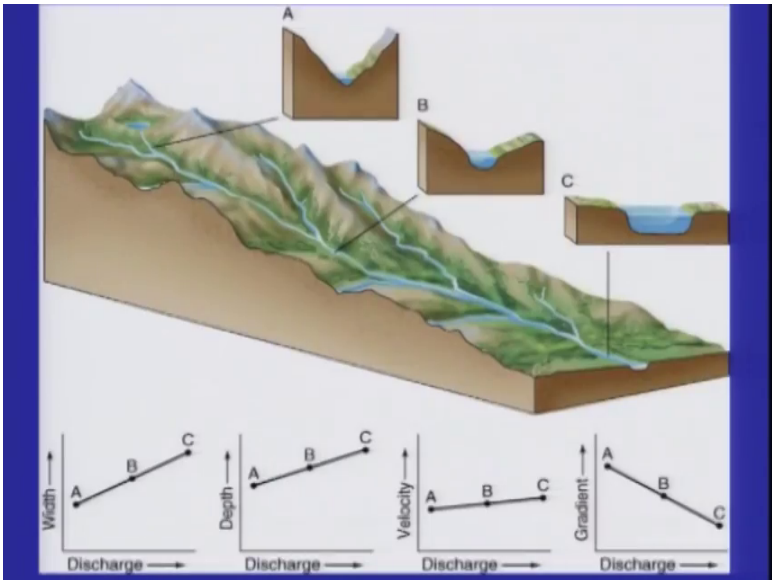

So, here what has been shown that with the gradient decrease from source area up to the mouth the landform also changes. So, you have in the upper reaches you will have narrow and deeper valleys whereas, in the middle part you will have the shallower and broader one further downstream, you will have further like more broader valleys, this is what has been shown here is the gradient of the stream.

So, if you compare this with respect to the discharge the width increases at different points, where A B and C depth also increases, A B and C velocity is not increasing so much, but of course it increases with respect to that and the gradient decreases.

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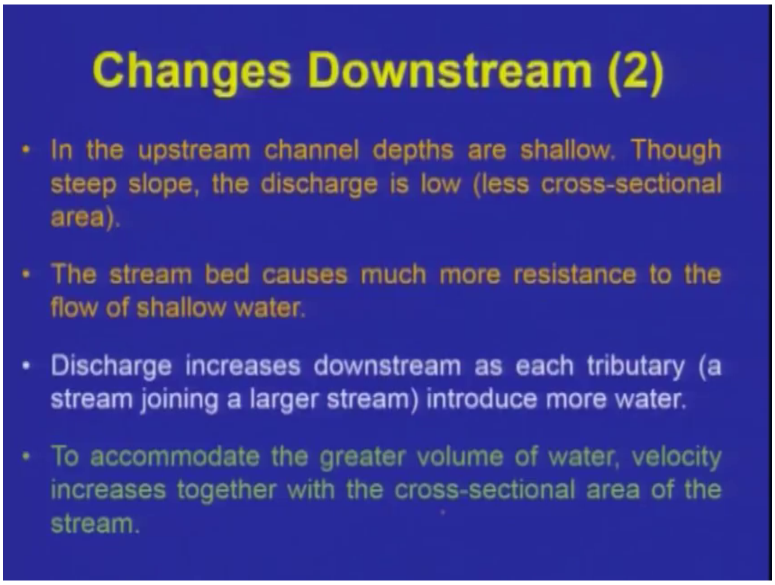

So, change is downstream what you will observe is that in the upstream channel depths are shallow, those steep slopes the discharge is low less cross-sectional area you will identify, the stream bed load causes much more resistance to the flow of shallow waters, discharge increases downstream as each tributaries introduce more water. So, each tributaries joins the main trunk stream will introduce more water here. So, hence the discharge increases downstream.

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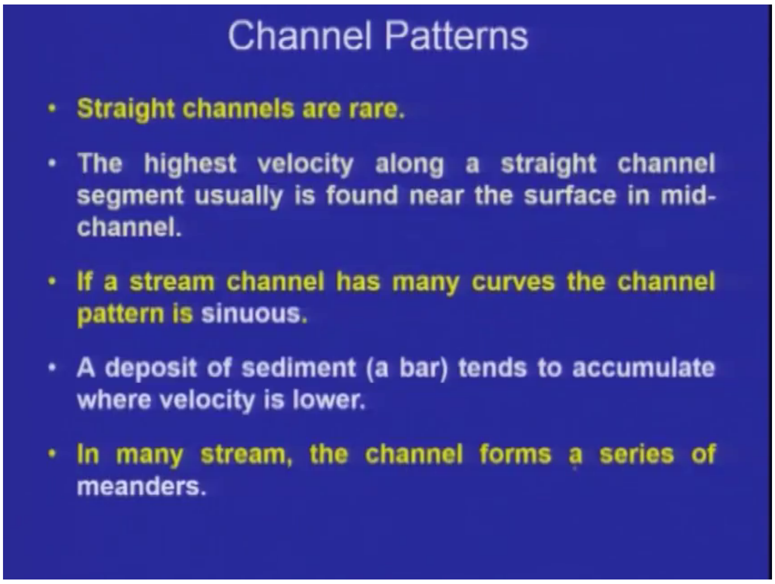

To accommodate, the greater volume of water velocity increases together with the cross-sectional area of the stream. So, in downstream you will have wider valleys channel patterns, usually the straight channel patterns are rare, in which the highest velocity is seen near the surface in the mid part of the channel, in straight channel if the stream channel has many curves, then those streams are termed as sinus streams and a deposit of sediments which is termed as a bar tends to accumulate where the velocity is lower.

So, as soon as the velocity drops out at any point of the river valley, then you will have the deposition and the formation of bars. So, in many streams the channel forms a series of meanders.

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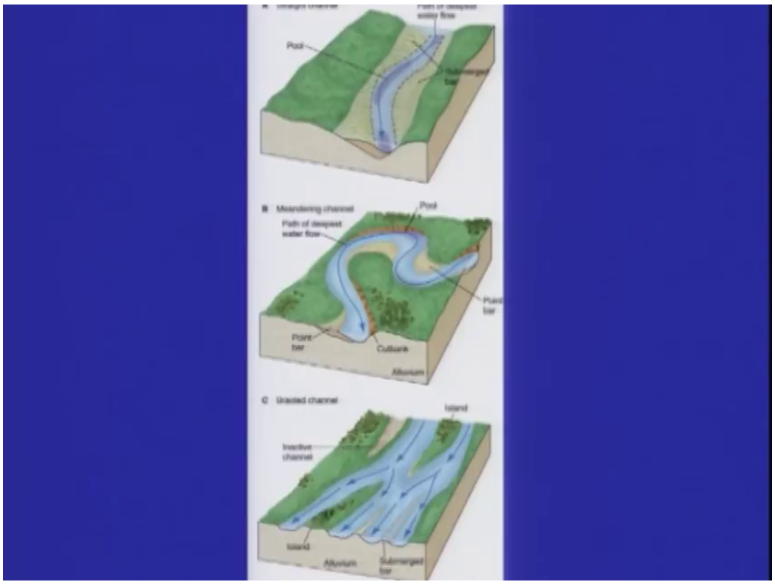

So, let us see how this straight meander and other channels looks like. So, straight channel the middle part will have a higher velocity here, and will have deepest portion in the meandering the deeper part will be on the outer side, inner side will have least or lower velocities, hence you will be able to see the deposition here whereas, higher velocity and deeper part you will have erosion, here this portion will be shallower invaded you have multiple channels.

So, the bars which are been formed between the 2 channels are termed as braid bars or islands. So, we have mainly 3 type of channel patterns so one is straight here meandering and braided. So, this you should keep in mind while interpreting the photographs.

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So, braided streams or the river exhibits numerous channels that split off and rejoin each other to give a braided appearance and this type of rivers braided rivers are typically carrying coarse or grains elements down a steeper gradient. So, here if you look at you have multiple channels or the channels which are splitting and rejoining in the downstream, another photograph which shows splitting of channel and joining to the single channel.

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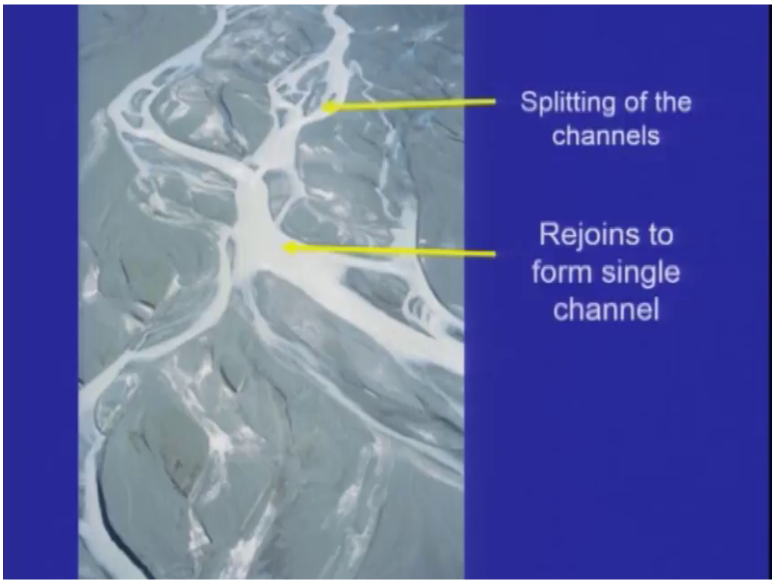

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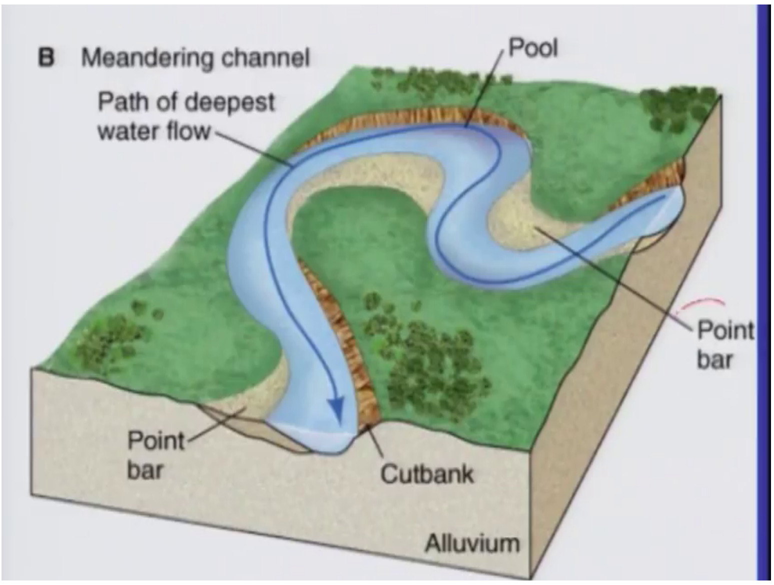
Similar one. So, here in the previous slide if you carefully look at these all are the smaller islands, these are termed as braid bars here, you can see this one these are all small braid bars similarly, here I am coming to the meandering pattern.



As I was talking, that the outer part will have deeper part of the channel the side will be shallower and here the velocity will be higher as compared to this one. So, in meandering this portion the outer portion will have capability of eroding whereas, here you will have deposition and this are termed as point bars termed point bars.

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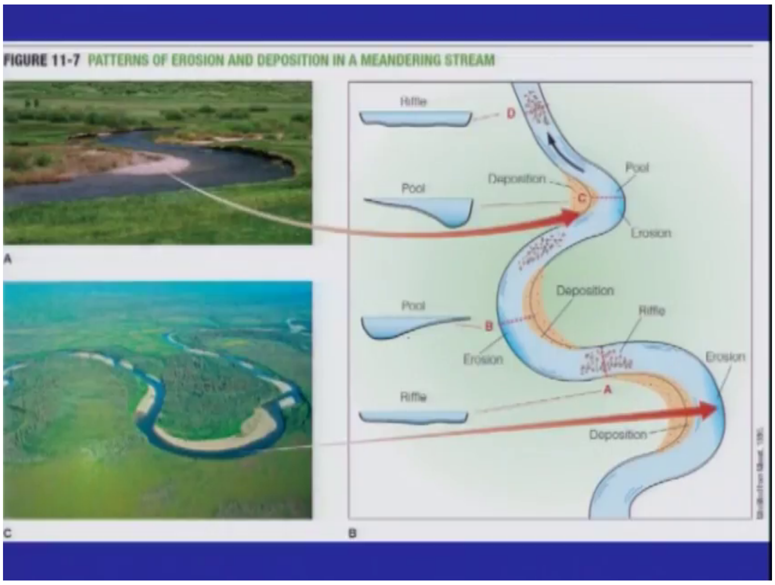

So, these are few photographs of the meandering channel. So, if you take the cross-sectional areas this is a straight channel here whereas, this is in part of the meandering channel. So, you will have the deeper portion is over here and this side you are having this shallower, similarly here there is an outer part will be deeper inner part will be shallower and again going back to the straight channel.

So, straight portions will have this morphology whereas, the meandering will have a less morphology. So, the outer side will have erosion and then inner side with the velocity is less as well as they are shallow, they will have deposition here hence if you look at the meandering streams or the river channels, then you will have cliff or banks seen here actually on the outer side, which you can see here these are the riverbanks.

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Along with that you will have few associated landforms, which you will find along the meandering streams, because meandering streams have capability of migrating from 1 place to another one. So, you will have wetlands, you will have back swamps, you will have natural levees close to the banks.

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So, this is another example of the meandering river and this portion is the previous channel which flowed through this area, but now it has shifted to this darker one here.

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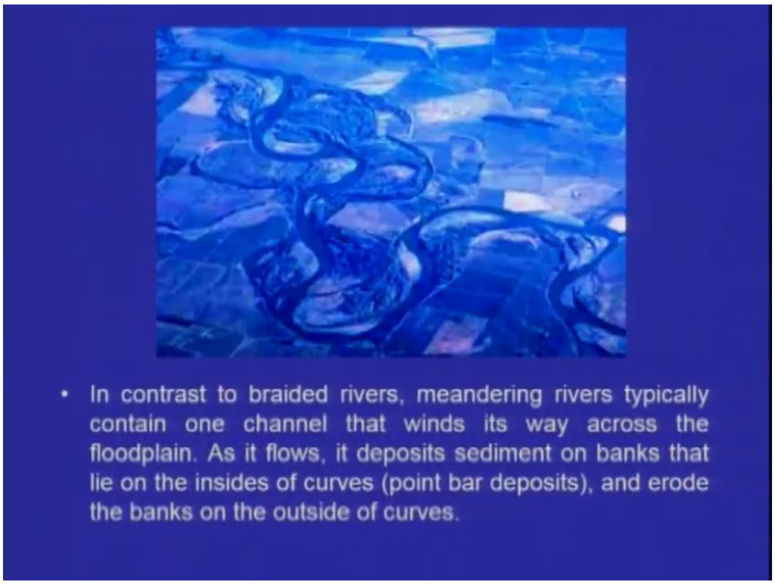

So, in contrast to braided river, meandering rivers typically, contain one channel that winds it is way across the flat plain as it flows it deposited sediments on banks that lie on the inside of the curves and these are termed as point bars and erode the banks on the outer side of the curve. So, it will erode outer side it will deposit here in the inner side.

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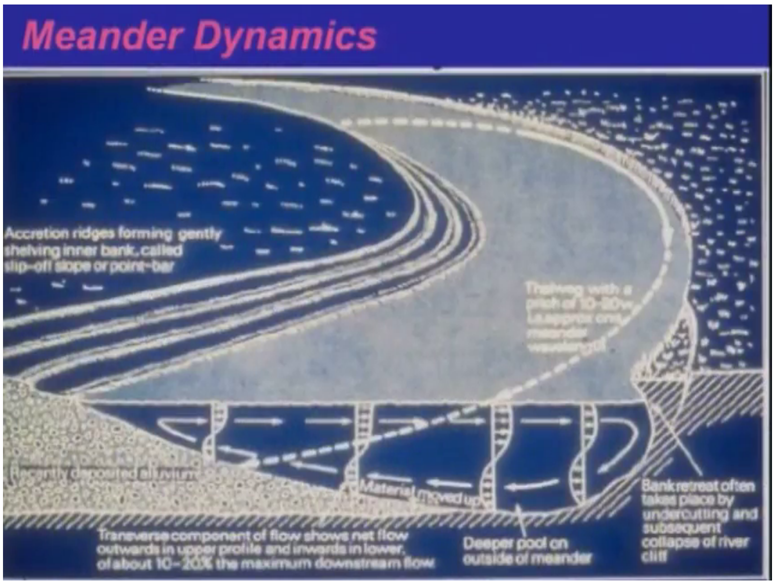

So, if you look at the meandering dynamics, then this portion that is the outer portion will be deeper and will have higher velocity as compared to the inner portion, which will have shallower gradient or the slope as well as it will have the capability of depositing the material velocity will also be comparatively less.

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This is the photograph, which shows the example of the present-day channel, meandering channel and also the remnant of the previous meandering channel.

So, if we look at here and this is the boundary of the previous channel, and this is the present one, and this what you see is the point bar. So, the outer part is of the present is over here as you can see the cliffy bank here, you can see the cliff a bank here, what is this portion as the portion of depositional one.

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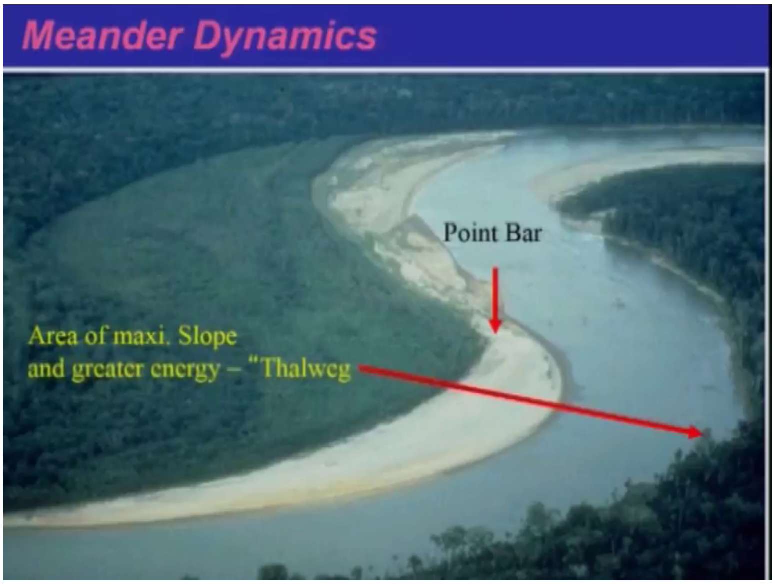

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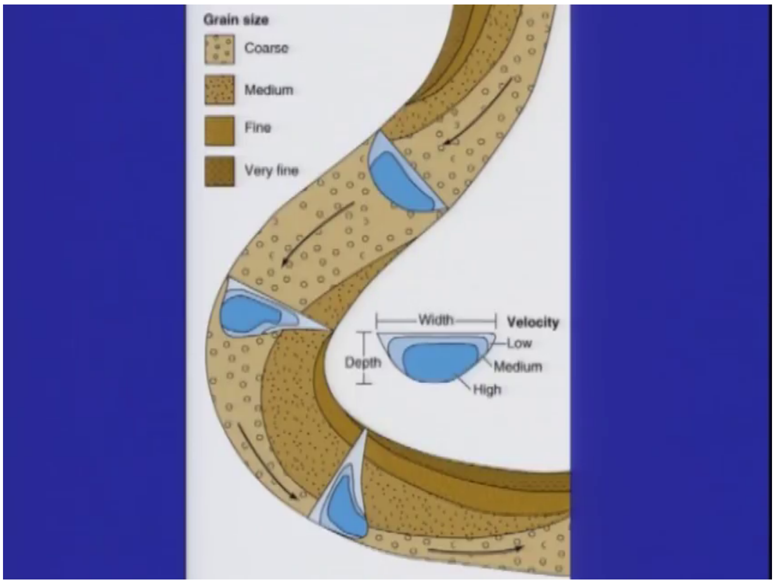

So, this is your point bar, this is yours the idea of greater slope. So, the area of maximum slope and greater energy that is when velocity is termed as Thalweg. So, if you look at the cross-section channel morphology here as well as the grain or size, which will vary from the deeper part to the shallower one.

So, in the deeper part of the meandering or meander you will have coarser and as you move to the other side, it will become finer up to very fine. So, in terms of the velocity if you find this will be high, here on the outer side it is lower on the inner side.

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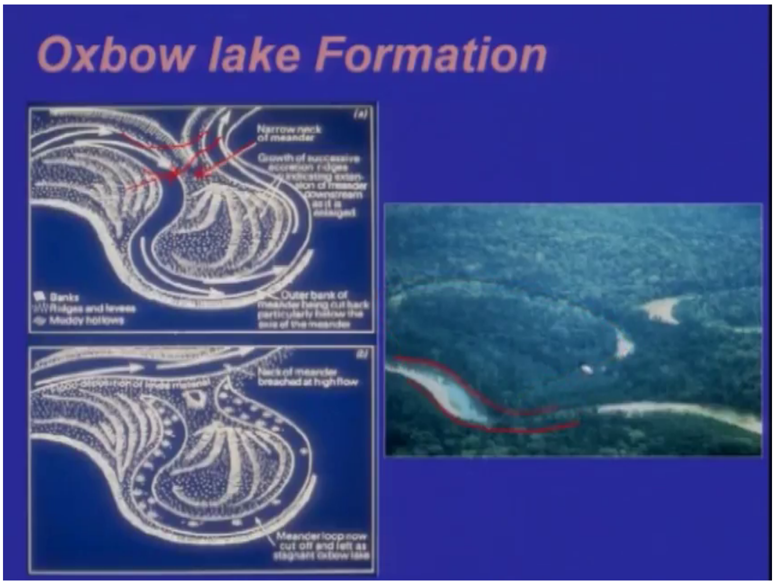

Now, the formation of oxbow lake is very common in areas of alluvial plains. So, what exactly is happening here is that you are having the meander, which has an outer as well as the inner portion. So, the outer portion has an capability of eroding, hence it will keep on migrating; so, it will keep on moving.

So, this portion of the channel it will keep on depositing here and will keep on migrating in this direction and this portion will keep on migrating in this direction. So, the time will come that this channel will join this one here, leaving out this portion as an form of and cut off channel, which is termed as the oxbow lake because the shape is almost like an Oxbow, this is an example of the oxbow lake. So, stream earlier flowed like this, but due to the constant erosion it is joined here, leaving behind a cutoff channel.

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So, another the radial photograph which shows the information of oxbow lake. So, in future this will also join straight here and you will have the cutoff channel left out here.

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One of the best example which is available, along the Ganga near Kanpur. So, if you look at this portion here close up of that we have an oxbow lake, which is sitting here it is very large, if you look at the scale here you are having almost like 20 kilometers or so maybe around that here. So, this portion close up of that. So, we have the present channel here and few of the smaller streams which form of graded one, here and you are having an oxbow lake which is left out here so is very old.

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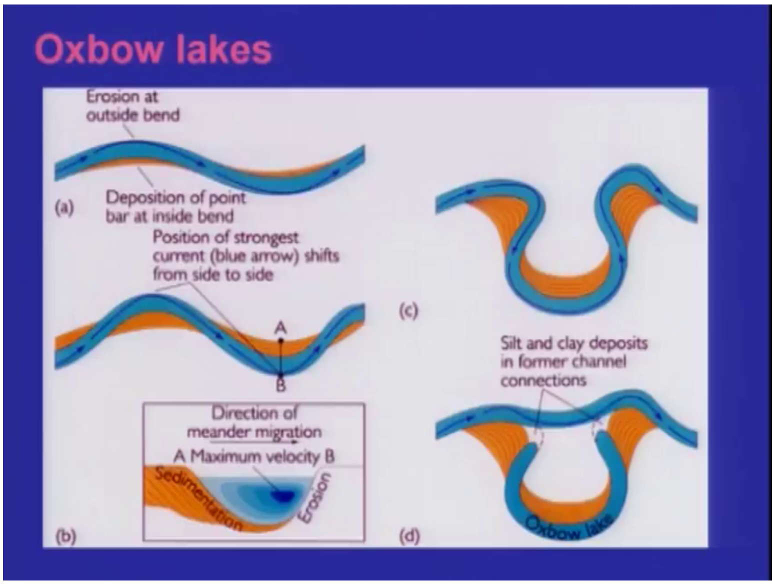

So, this explains the process of the formation of the oxbow lakes. So, this outer sides have the capability of eroding this will keep on migrating and finally, it will join the same channel leaving behind the oxbow lake.

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Another example here, which is a bit interesting in this is the south of Kanpur the place known as Hamirpur, and what will happen here this channel is a straight channel whereas, this is having meander. So, this has an capability of eroding this side here. So, this will keep on moving and then time will come it will join.

So, probably, if this is not stopped you can stop the erosion by putting the concrete walls have to channelize the flow. So, in future what we can see is that this channel will join here, leaving behind this one. So, this is in threat to this harmful town or this will become like you are having a straight channel here, and then this joints here like this and this becomes an island here this is also an possibility.

So, using high resolution satellite photos or images you can identify different landforms and try to interpret, that what will happen in future for example, in this case of the meandering river, this will keep on migrating here and will join at this point.

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So, I will stop here and we will continue in the next lecture.

Thank you so much.