Geomorphic Processes: Landforms and Landscapes
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Lecture - 18
Fluvial Process and Related Landforms (Part-IV)

Welcome back. So in last lecture we discussed about the relation between the carrying capacity and the discharge and its effects on the erosion.

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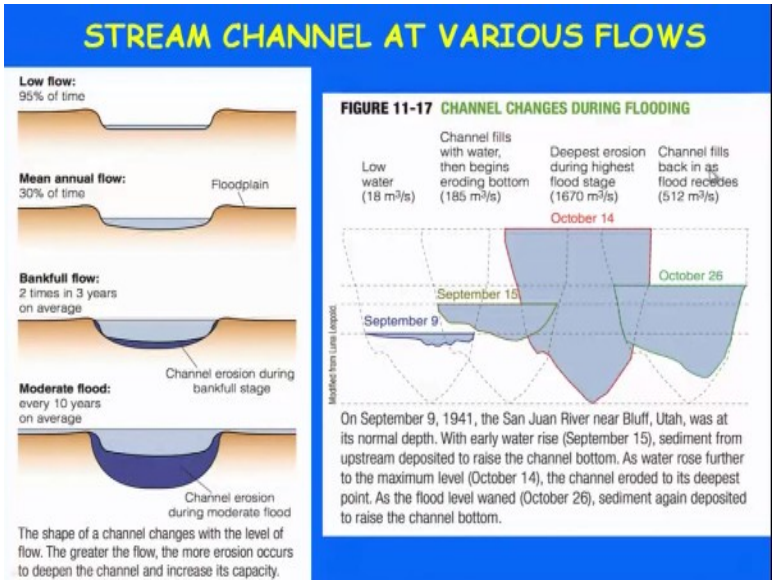

Now channel pattern basically if you see it will vary during the monsoon season or during the flooding state. Now this is what has been shown the channel depth and the shape of the channel as well as during the low flow, mean annual flow, bankfull flow and finally during the moderate flood and this is an example of San Juan River near Bluff Utah which shows that at different stages the shape as well as the depth of the channel changes.

So on September 9 which has been shown here 1941 it was the river was having the normal depth. With early water rise during 15 September, sediment from upstream deposited to raise the channel bottom. So the channel bottom was been raised as well as because of the more supply of sediments. Then as water rose further to its maximum level and this was during October 14 which has been shown here.

The channel eroded to its deepest point so it went right up to this one. So this whole what you would see is the boundary bay of the channel pattern which changes so it eroded up to the

deepest points. So more amount of water more erosion and the channel was deepen. Now on October 26 the flood level waned. So reduction in the flood level sediment again deposited to raise the channel bottom.

So the deposition raise the channel bottom and more water eroded and deepen the channel water. So these are the different stages which shows that how the channel changes during flooding state. Even if you see here the discharge increases. So during the lower water or the low water stage the discharge was 18 cubic meter per second whereas here 185 then increased to 1600 and then reduced to 500 cubic meter per second. So this shows that channel fills back in as flood recedes.

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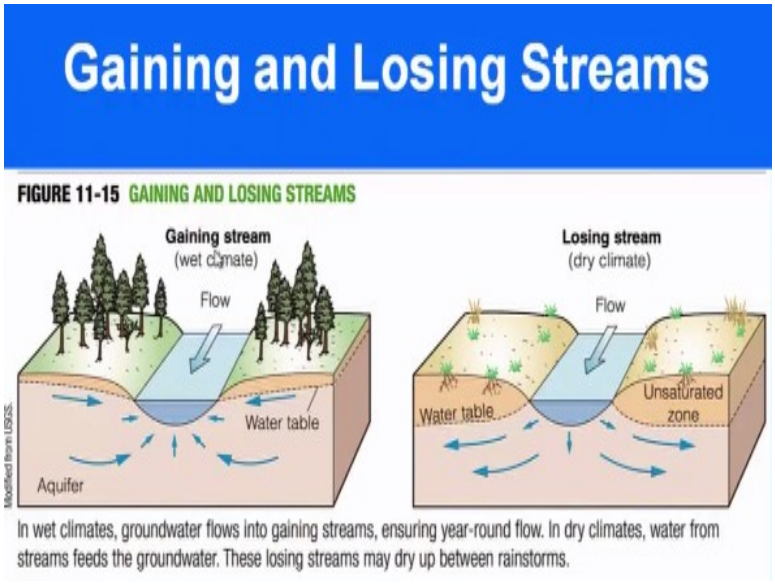

Now actually if you look at the streams mostly we have two types. One is what we can term as gaining stream and another is the losing stream. So in wet climate groundwater because this recharge of the river bed or the river channel will also have the contribution from the surrounding groundwater which is flowing or the groundwater which is getting recharge from the percolation of the precipitation of the rainfall.

So in wet climate groundwater flows into gaining stream so mostly the gaining stream conditions will be seen in the wet climate ensuring year round flow. So you will have the perennial channel whereas in the dry climates water from stream feeds the groundwater. So what will happen you will have the flow in dry climate for sometimes and this will the water into the channel will help recharging the groundwater.

This losing stream may dry up between rainstorms. So during one rain spell you will have some water in this, but this will recharge the adjacent aquifers. Hence, after the rain this channel will dry out termed as losing stream whereas this one in the wet regions mostly you will have the gaining stream so water will remain throughout the year. So please remember this the difference between the gaining stream and the losing stream.

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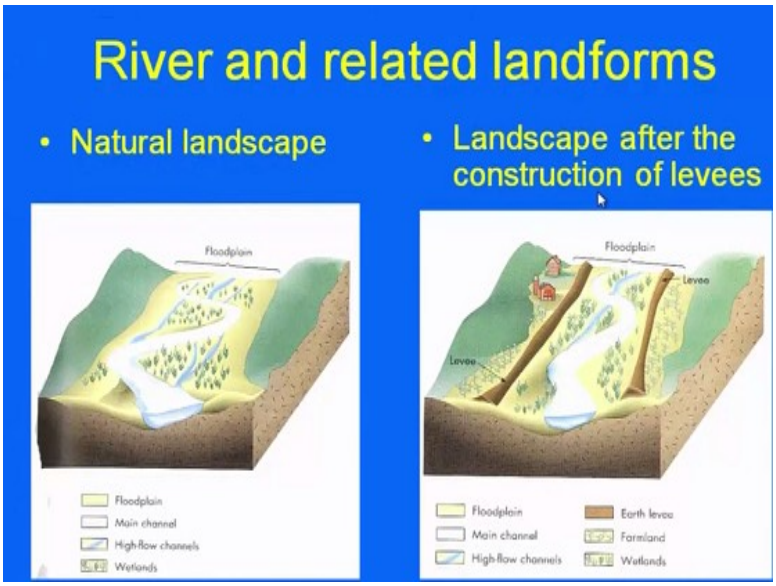

River and related landforms if we take natural landscape then mostly what we see is the active floodplain as I was showing in one of the aerial for satellite photograph of the Indo-Gangetic Plain. So we have the active floodplain where we have the channel which have tendency to move and this is the boundary active floodplain and the main channel has been shown here.

High flow channel are been seen here so during the high flow this channels will be occupied and then what we see in the associated surrounding or the nearby area within the active floodplain are the wet lands. So mostly you see the main channels and the channels which are been occupied during the flooding state that is in high flow state and then within the active floodplain we have the wet lands also.

Now this is in the natural state this type of configuration you will be able to see, but suppose you try to channelize the river that means you artificially do some construction along the channel then what will happen. Then what you have done is you have channelized the flow. So actually you have tried to construct what we say the levees on the side of the either banks and you have utilized the floodplain area for settlement.

And this is on very common practice. In most of the countries even including India we do that, but we never construct the levees, but in some countries this is mandatory. So what it helps this portion definitely will be lower than the levees and this boundary has been constructed so that during the flooding states no water spills over this one, but in most of the cases what has been experienced that if there is reaching of this levees.

Then the low lying areas which are utilized or which where the floodplains and utilized for the construction will be (()) (08:14). So now what we have here is we have all floodplain main channel, high flow channel and then we have the levees then because we have utilized this floodplain and floodplain are the fertile land which people will start using for farming. So we started have the farmland and within the flood active floodplain we have the wetlands.

So this two components we have added here one is the earth levee and the farmland. So landscape after the construction of levees artificial levees.

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So advantage of artificial or the natural levees are you can have the construction or you can utilize the area close to the flood plain which is fertile land. So this show the active floodplain and the levees which helps so as I was talking that this is slightly elevated portion and which slope down away from the channel towards the floodplain area so these are termed as levees. So the main channel of the river has coarsest gravel at the bottom over here.

So this is the bed load mainly and then you will have the suspended load over here. Grading to finer grains above the natural levees are still fine grains settled out in shallow water. So this will be mostly the fine grained landform which is formed as compared to the channel bottom and the floodplain consist of very fine-grained mud or silt or sand. So almost still water during the floods.

House built on natural levees along the channel this has been shown here and B the houses are being built here so this land has been occupied and utilized. So you will have houses as well as the farmland. So this has been used for the settlement.

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Now another important landforms which are associated with the fluvial system is the alluvial plain, alluvial fan and delta.

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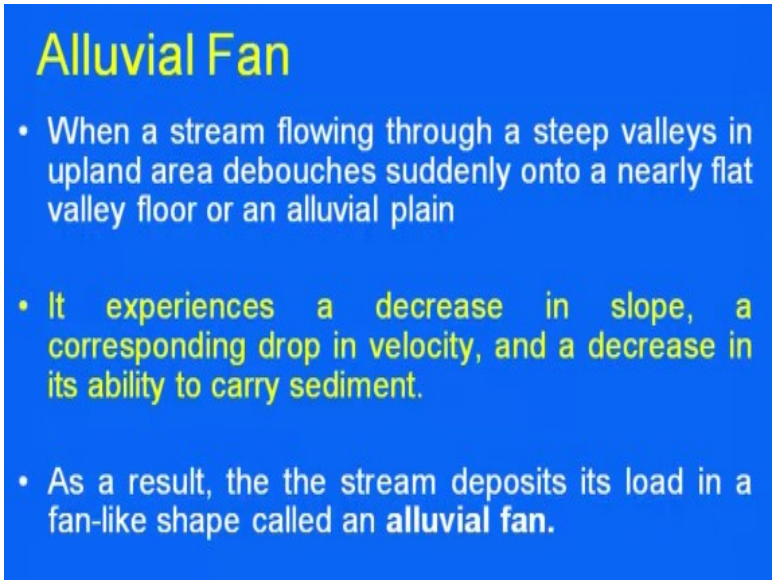

So alluvial fan mainly is the landform which comprise of sediments loose sediments may be coarser as well as finer, but mostly what we see is the debris flow comprised of the coarser deposits and when there is in (()) (11:16) close to the front or the hilly region and the plain areas and the shape of the landform is like a fan. Hence, it has been termed as the fan shaped (()) (11:32) comprise of loose sediments.

So alluvial fan when a stream flowing through a steep valley in upland area debouches suddenly onto a nearly flat valley or an alluvial plain. So in this case the best example is the Himalayan range front and the Indo-Gangetic Plain. So when a river debouching into the Indo-Gangetic Plain areas the valley slope changes because when it is coming from the Himalayan region or the range.

Then it has the steeper slope and it reduces to almost flat in the alluvial plain. So this will result into the formation of the alluvial plain and this happens because the channel experiences a decrease in slope from the steeper to very shallow or low angle. So the gradient decreases and corresponding drop in velocity will be experienced and it decrease in the ability of the carrying capacity.

So decrease in slope will drop the velocity and also will affect the carrying capacity and this will result into a sudden dumping of the material. So as a result the stream deposits its load so it will dump all the load which it was carrying from the steeper slope on to the flat surface and it will be deposited in the form of the shape is like fan. Hence called as alluvial fan.

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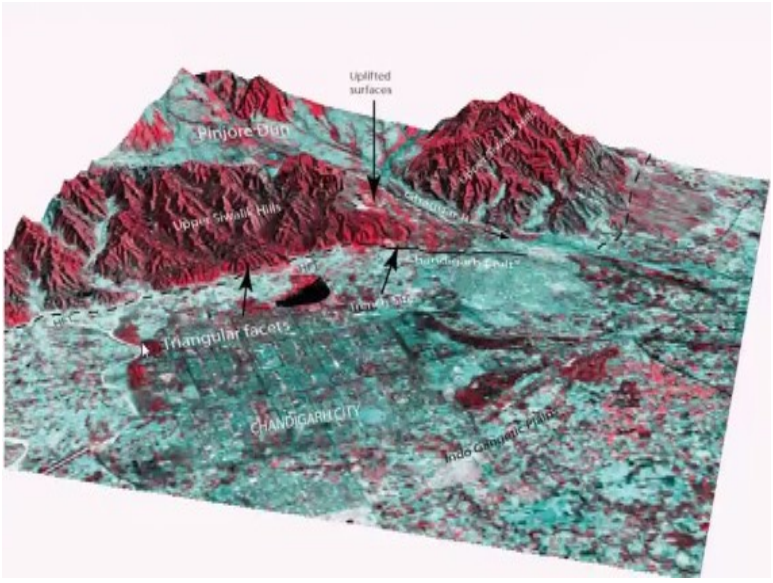

Most of the mighty river this is the picture or the satellite data on 3D perspective view of the Indo-Gangetic Plain and Himalayas which has been seen here and this city which is in Chandigarh city. So what we see is the upper Sivalik Hills or sub Himalayas the (()) (13:46) mountain change and the contact between the Indo- Gangetic Plain and the hilly range the Himalayan range. It is a youngest mountain range of Himalaya.

And the contact between this two marks the Geomorphic boundaries and this Geomorphic boundary plays an important role in the formation or the deposition of the material here resulting into the formation of the alluvial fan. So most of the streams which are flowing here at the base have deposited or dumped their material because of the change in the slope from steeper to shallower and resulted into the formation of alluvial fans.

And this shape here which you see the boundary which is roughly I can mark because it is already disturbed by the construction is your alluvial fan by Ganga river. Now fans are typically seen at the slope or the breaking slope where they reach channels if you see in the previous slide it shows that what is happening here that we say that the channel is confined in the hilly areas.

So this is the confined channel, but when it comes and the slope is also steeper so when you flow the water from the confined conduit and try to allow the water to flow on unconfined surface then it will spread out and this is very much similar to the distributary network which will be developing here. So multiple channel will result into the formation of the alluvial fans.

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So deposition fan now the hazard which is related to this is the closer to the front that is the proximal part will have higher hazard and as you move away from the front mountain front then the hazard will reduce and this is mainly because the energy conditions will be much higher here. So if you say the energy condition is much higher here because the stream or the channel is debouching from the steeper slope to the lower slope.

And this will result into the dumping of the coarser material. So the hazard is much higher here and as it moves further downstream the carrying capacity decreases and it will carry mostly the finer deposits the velocity also decreases here and it will deposit it carries finer deposit as well as deposit the finer material here. So in terms of the hazard it has the higher hazard or close to the front and it reduces the hazard reduces as you move away from the front area.

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So same what we see this is the proximal part and then we have this is the shape of the alluvial fan.

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Now this is the picture of again the satellite photo of the Himalayan range and the Indo-Gangetic Plain. So the color tonal variation if you see and the carving of the landscape or the landform or the surface of the earth which can be seen over here and these are all small drainages and the small drainages here as well as the major channels which have sculpture or carved or eroded the landforms or the landscape.

And resulted into the formation of different landforms. Now this is the contact between the Himalayas and the Indo-Gangetic Plain and as I was talking about that the channel remained confined until this point and as soon as it debouches onto the flat surface it is divided into

multiple channel. So close by channels have resulted into the formation of the coalesce alluvial fan.

And all the channels if you see you will be able to find that there are alluvial fans which have been formed at the base of the mountain front. Even this is wide one and this exist like this. So there are multiple alluvial fans which have been seen close to the front and this will happen whenever there is change in the slope that is from the hilly areas to the plain areas. So this is one of the best example.

So it depends on the drainage basin because these are the small drainage basins or the drainage system are smaller in terms of their area which originates from here and just flow down into the Indo-Gangetic Plain. Hence, it has deposited or resulted into the formation of smaller fans which have been seen here because this stream originates here and gets debouched into the Indo-Gangetic Plain over here resulting into the formation of smaller fan.

And then mighty rivers like Ganga, Brahmaputra and all that they have deposited larger covering larger area and larger alluvial fans. We will see one in coming slides.

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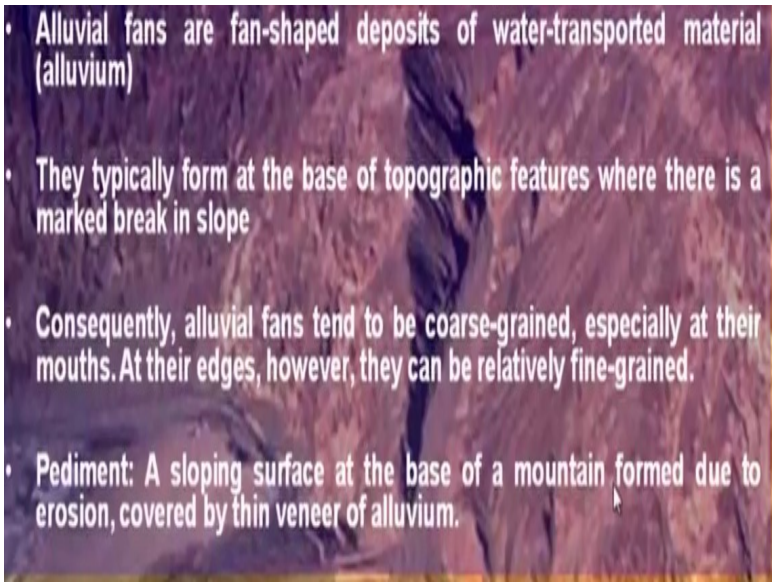

So further alluvial fan are fan shaped deposits of water transported material or alluvium. They typically form at the base of topographic break or the topographic feature where there is marked break in slope from steep to shallower. Consequently, alluvial fan tends to be coarse grained especially at their mouth that is the proximal part and at their edges however they can be relatively fine grain.

So close to the mouth they are or we can see the proximal part they have the coarser deposits and as you move further downstream at the edges you will have finer deposits. This is the term which has been used for the area that is pediments. A sloping surface at the base of the mountain formed due to erosion. So this portion basically is termed as pediment area and it is covered by thin veneer of alluvium.

So mainly it is formed due to erosion along the sloping surface or the base of the front mountain front. So we were talking about the alluvial plain, alluvial fan and the pediment.

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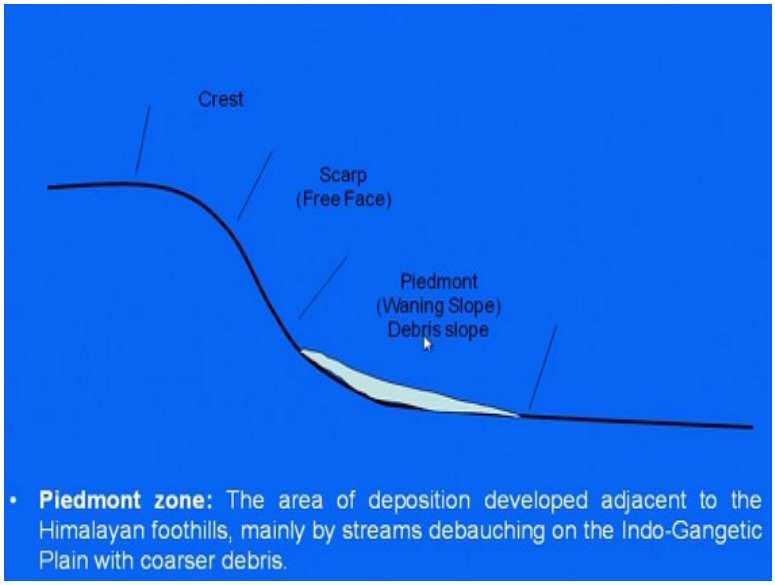

Now this is the crest of the hills and the free face scarp or you can say the slope steeper slope along which the river will get into the or deposit to the shallower slope in the alluvial plain and the portion where the deposition is taking place comprise of debris material is termed as piedmont zone. So one is pediment, pediment is erosion whereas the piedmont area is basically the deposition portion where it comprises the coarser debris at the base of the (()) (22:18).

So this case you can say that this is the contact between the Indo-Gangetic Plains and the Himalayan front. So the area of deposition developed adjacent to the Himalayan foothills mainly by stream debauching on to the Indo-Gangetic Plain with coarser debris. So please remember about the piedmont and pediment.

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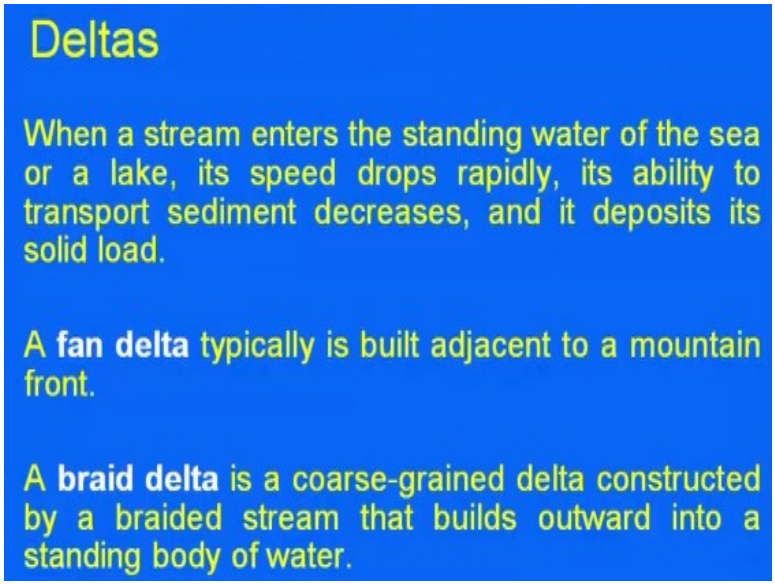

Now coming to the deltas when a stream enters the standing water of the sea or lake. Its speed drops rapidly, its ability to transport sediment decreases and it deposits the solid load. So this is very much similar to what we were talking about when there is change in the gradient from steeper slope in the hilly terrain and debauching on to the gentler slope in the plain areas the alluvial plain areas.

So similarly where in terms of the formation of delta again it is the channel or the levee is going and meeting the erosion or water body. Again this slope changes and change in the slope will also affect the carrying capacity. So it again debauches but here deposit the material or dump the material similar to the what we have seen in the alluvial fan (()) (24:07), but the location of the formation of this to landform is different.

One it is at the base of the mountain front and one where the channel goes and meet the ocean or water body. So a fan delta typically is built adjacent to the mountain front where it comes in contact with the ocean or a water body whereas the braid delta is coarse grained delta constructed by a braid stream that built outwards into a standing body of water.

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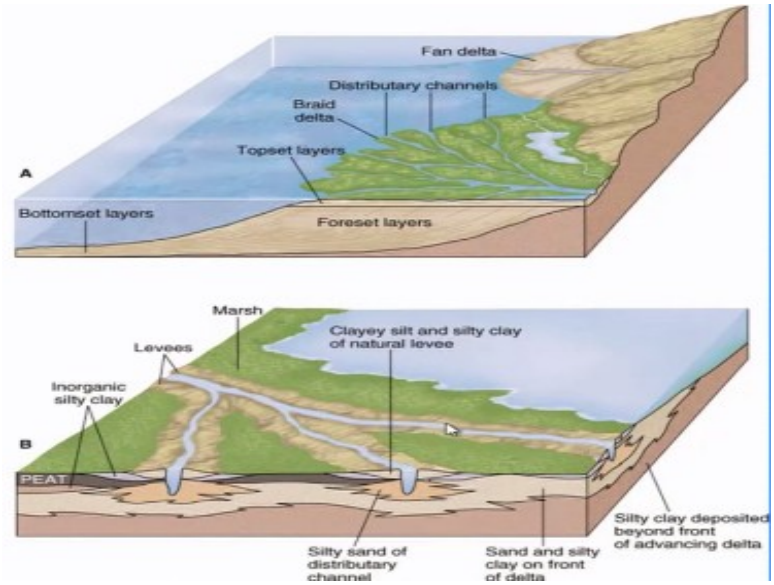

So these are the examples where have been shown here that one you have the fan delta which are close or adjacent to the mountain front. Another is braid delta which have more distributaries or distributary channel and then third one what has been shown here is the shape of the delta where the distributaries are less and they are comparatively fine grained whereas as this braid delta will be coarse grained as compared to the bird foot delta this has been termed as bird foot delta and they are mainly the fine grained delta.

And the best example of this delta you can see or experience is in Kutch region where the ancient settlement used to be there or the presence of the (()) (25:58) settlement was along the bird foot delta.

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So the deltas many of the world's largest streams have built massive deltas at their mouth. One is Ganga, Brahmaputra, Huang-He Yellow river, Amazon, Mississippi. So mainly the distributaries are long, finger- like channel that branches from the main channel in a delta. So this is one of the largest delta.

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So close to the hill front basically the shape of the landform is like triangle. Hence, it has been given the word it comes from Greek letter. It is termed as delta.

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Formation of delta in a close water body.

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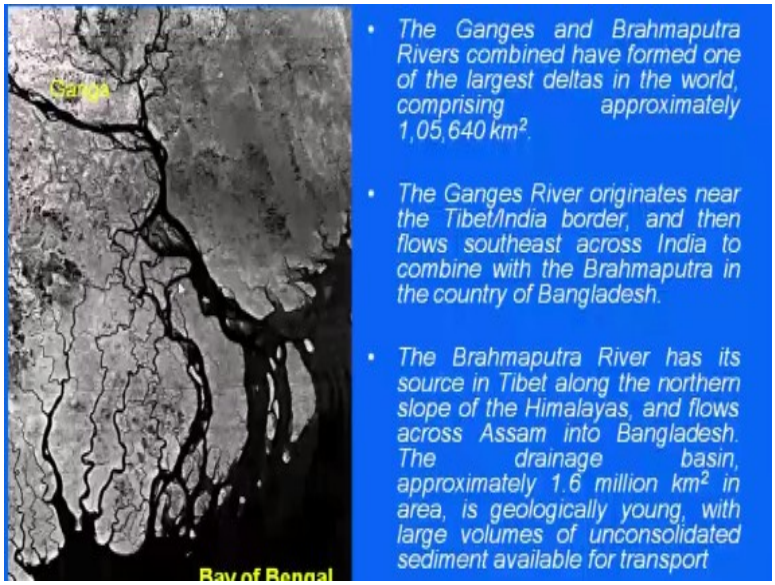

So one of the largest delta in the world the Ganga and Brahmaputra river combine have formed one of the largest deltas in the world which covers almost 1, 00, 000 square kilometer region. The Ganges river originate near the Tibet and India border and then flows southeast across India to combine with Brahmaputra and resulted into the formation of delta. Now this delta of course the region of Sundarban.

And if possible I will give one lecture on that how the settlement got affected because of the change in climate and losing out the channels or the water in the channels. In past it is not very old story, but it has happened in Gujarat the Great Rann of Kutch which has dried up and lot of well urbanized settlement were present in the delta complex of what we call the ancient Saraswati.

We have named it as an Paleodelta complex of ancient Saraswati or Paleo Saraswati and this portion which I am talking right now the Ganga-Brahmaputra delta is also under threat because if the sea level changes here or there is an sea level rise the elevation of this region that is in Sundarban is not very high from the (()) (28:58) and the indentation will be sure shot.

So it is going to affect the habitation here and lot of area will be lost because of the increase or rise in sea level. So I will stop here and in the next lecture we will discuss about the alluvial plain and the formation of the alluvial fan by river and its complication. So we will talk in the next lecture. Thank you so much.