Laboratory Practices in Earth Sciences: Landscape Mapping

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Welcome back. So, in the last lecture we were talking about the terraces and I also explained what is the importance of terraces and why they should be mapped. So, the main concern of mapping the terraces right now because what we are learning in this course is related to the hazard part. And of course, this is one of the most commonly found landscapes in the fluvial regime. So, what are the reasons and we can say the causes for the formation of terraces and what exactly we have of course, we have briefly talked about what are these fluvial terraces. They are basically the abundant alluvial flat planes which have been incised by the river and that resulted into the formation of step like feature which we call the terrace.

So, they are this terrace alluvial terrace or fluvial terrace formed due to incision or cutting into the alluvium or the bedrock. So, usually it has been seen because when the stream is flowing through different areas of course, it will initially start flowing over the bedrock also ok. And then deposition of the loose material will result in the accumulation of the sediments and that can also result in the alluvial terraces. So, in many locations if I have to take this section here suppose this is a channel here.

So, you have the incised bank over here. So, if you look at the section then you may come across that there is a bedrock in at the base and then you are having like the alluvium sitting at the top. So, this is quite common actually. So, incision occurs as a result of change in the base level. Now what is the base level that we have not discussed, but I will just briefly tell you what exactly we are talking about.

So, suppose you are having like a stream which is coming from the upland and then so, so you can say that this is your we have an upland here. So, coming from the stream or coming from the upland and then getting into the plane area. So, one this can also be termed as in base level actually. But more in general what base level we consider is that we have a stream flowing from the top to its origin and and through its journey finally, it gets into the and meets the ocean. So, the ocean has been considered as a base level.

So, you have an ocean here. So, this is what we can say the uplands, it is a source and then finally, it is ending up the journey over here in the ocean. So, the ocean will be your base level. So, as I also discussed , if you are having like so, this is your longitudinal

profile, this will be your elevation and this is your distance. So, I also discussed briefly in the beginning that the channel will always try to keep itself in equilibrium.

So, the point is that whenever there is a change in the base level if it for example, if it reduces the base level decreases because of the sea level fall then the channel will try to accommodate its profile in such a way. So, that that matches your base level that again we can say that it is it is it will try to bring itself in equilibrium. So, this is the important part. So, this usually we take as in general that this is the base level, but base level could be a local base level also and that can be seen close to the mountain trends. So, mostly what we see is that the Himalaya is always rising.

So, if this keeps going up Himalaya then this base level is changing ok. So, the earlier it was like this then of course, this remains the same, but then this rises actually ok. So, the base level keeps changing here. So, change in the base level here will also force the channels and the rivers to incise ok mainly. So, this is what we call the change in the base level and that will result in the incision or we can say the down cutting.

So, this is most commonly observed in active areas which we call tectonically active where local base level will result in the formation of terraces. And these terraces can be erosional or you can have the positional terraces. That means, that if we say that erosional then we can say the degradation and the positional we say gradation. So, this is commonly observed in tectonically active areas even though this process can be seen in normal conditions also ok. So, that we have we we should have an eye or we should have an experience to differentiate between whether this is tectonically driven incision or this is because of tectonics mainly we are talking about the ongoing deformation between the 2 plates or any deformation because of the plate tectonic moments ok.

So, change in the sea level that what I have I was explaining here that if your base level changes because of the change in the base sea level this is mostly seen as controlled like climatic fluctuations. So, caused by tectonic uplift or subsidence that what I was explaining here this is the the reasons or maybe we can say the causes for the base level change one is the sea level. So, this one is the sea level. This one we can say is because of the uplift or the subsidence. Then change in the discharge condition and load dis relationship load discharge relationship. So, I will just remove this part here so that you can see things clearly.

So, this is again related to, as I said, the natural processes can also result in the change in the base level. So, if you are having sudden influx coming of the sediments because of your erosion that can also result in the change in the base level. So, discharge conditions are changing where tributaries are pouring more of the sediments into that or maybe it is

related to some other reasons or increase in precipitation can also result in the discharge conditions. Then classification of terraces as I explained here. So, this is either you can say the erosional or you can say it is the deposition one.

So, in general terraces are erosional features because mostly the terraces if you initially say that ok this is your channel then second phase will be your formation of the terrace ok. So, you will see the formation of terraces. So, this is your T 0 youngest terrace and then you can have T 1, T 2. So, this could be a T 1. So, this we are talking about when typical this cross profile of the channel we will see when we are having sort of a paired terraces ok.

So, right now this is what we see. These are all these. If you have this type of profile then you can say that this is your typical paired terraces. So, the erosional terraces because both have been formed because of the incision that is why we say that in general they are the erosional features. So, erosional terraces are those cut into the bedrock ok. So, this is what I initially talked about: that you have an if at the base of the alluvium you have bedrock here and if there is an incision in the bedrock and then you are having the alluvium here then we say this as an erosional terrace ok. So, where of course, this alluvium for the alluvial deposits is also deposited by the same channel and it has incised for that within the bedrock also this is your bedrock.

So, this type of terraces are termed as strat terraces ok. I will show some examples of that ok. Depositional terraces are those cut into previously deposited alluvium. So, valley filled deposits are ok. So, usually the channel will have a tendency to a grade.

So, graduation will be a common process. So, if you are having like the deposition taking place and then finally, the whole channel is filled up with the sediments. So, for example, if you are having the channel here and this channel is getting filled up. So, this is what we call a gradation and then there is an incision within the channel ok. So, these deposits are incised and you are seeing the formation of a terrace here.

So, this type of terrace is termed as your depositional terrace. I am just putting D t, but if it is incising suppose here you are having the bedrock and if it is incising bedrock also further down. So, that will become your erosional terrace. However, this like you will not be able to differentiate when you are mapping this terrace using the satellite photographs or high resolution satellite data whether it is erosional or depositional, but our aim is should be that first to map the terraces ok, but just keep this in mind when you are extracting such features while doing the labs. Now, this is a photograph of on the way to Nainital and one of the tributaries of the major river and what we see here is that these are all like purple color and grayish color material inclined in like this ok.

These are the shivaliks and this is what we call the bedrock and on top of that this part where I am putting in very roughly a line here this is alluvial. Now, this alluvial deposit if you look closely at it looks something like this. I think if I am not wrong I am not. I do not have the close up photograph, but anyway this is all made of ravel plus sand and all other materials. So, mainly this is all what we call fluvial deposits. So, below is your bedrock. So, we have just discussed what type of terraces we can call.

So, this is the surface here on which you can see the tall vegetation trees that are termed as Strath terrace. So, scientists also take into consideration that if there is an incision of so many meters this could be related to your tectonic related base level change. This is another photograph of the same channel where you can see clearly what you have now. So, there is a bedrock here you can see this is bedrock this one and on top of that you have the alluvial material and this is the surface here this is the surface. So, again this is your alluvial or alluvial material or alluvium and this is your bedrock.

So, this again you can classify this as a Strath terrace or you can say erosional terrace. Similarly, here you can see that this is are all, but this one in particular we say this will be a depositional terrace because we now this is this is also can be classified as an a Strath terrace because there is an incision here within the bedrock and then you are having on the top the alluvium and this is your bedrock. Lateral migration is as we have also learned in very common process in the meandering pattern and in such cases what you see is that you will get in sort of an, but here we can be we do not need to because we would not be able to see the section on the photographs. So, anyway this is something that looks like this actually if you see the topography then this portion which is in the depositional side and this is an erosional side. So, you will find that a typical like section will be something like this actually and that is what we see.

So, from the top also you will be able to judge this very clearly on the fact that this is one side here having a cliff. So, if I am trying to put this in 3D. So, this is what you will be able to see from the top ok. So, you have this going on like this and this will be in a slightly flat area, but not very much incised as compared to this one. So, this will be having a very prominent cliff.

So, this will be a cliff bank. I will just change my pointer color. So, this is your cliff and this side will be sort of in very low topography. So, this you can make out of course, along with this like you will see that. So, this also marks the surface or the terrace ok, but typically you will be able to see this when you are looking at the meanders. So, when you are looking at the meanders.

So, this side will be your cliff bank actually and this side you will have in the shallow side like this ok. So, we have already discussed that if you are having the alluvium and the bedrock then we mark this as an erosional terrace. So, this is an example of the erosional terrace. This is the front area of the Himalayan front over here and the photograph which you are looking at on the top is from this area actually. So, this is the photograph which has been shown here which shows clearly that you are having the upper shivaliks this is again a bedrock and on the top you are having the young channel filled deposits that is your alluvium. So, again these are typical of this terrace.

So, how it looks in the photo if you are viewing the 3 dimension view of this area that we will be talking about when we are doing the labs is actually ok. So, depositional terrace is done which we have discussed briefly ahead also that mostly this will not incise the bedrock ok. So, no incision in the bedrock, but this you will be able to judge when you are doing the field. So, you have to check the terraces which have been mapped using the satellite data and then you go into the field and check whether this is an erosional terrace or depositional terrace. Now, landforms associated with the fluvial system there is a classification which talks about the different stages, that is if it is youth mature or old and what are the erosional landforms associated with the youth stage that is the young landscape and matured and old one and in the fluvial system.

So, usually we say that ok fine if the valley is young then it will have like it has just started the erosion and all that. So, initially we will have V shaped valleys deep gorges and so on ok and this what we have discussed in the beginning is how the drainage basin evolves ok. And here the deposition landforms are shown here that mostly you will come across the alluvial fans ok. No floodplains meanders and the deposition of the alluvial fans will be there, but as you move towards the mature and older what you see is that of course, this is matured has been shown for the for the ocean side also, but usually in the mature and older system you will see the flood plains natural levels are developed terraces are developed. So, this is a process which clearly indicates even what we have talked about the ox pulled because just this the drainage has formed through you will not be able to see the formation of ox pulled it needs time to to keep because it will take time to flow through an area.

For example, if you are having a meander here so it is not an overnight process it will take time and then it will develop the ox pulled and all that ok. So, this is what you can even judge based on the landforms whether you are seeing the terrain in a matured stage or you are looking at the terrain in the young stage ok. So, this part we have discussed, but we will just look at the because as I told that morphometric analysis we will be doing. So, we can quickly look at what is the importance of the bifurcation ratios and the drainage density in the basin ok. Now, this is the photograph from a great run of Kutch ok where we barely see any vegetation.

So, this area is like it gives a very good example of how the drainage has been evolving in that area. So, this is an area with great runoff from Kutch. So, if you carefully look at the drainages where I am putting my pointer, these are the small drainages which are coming and then we see in the drainage basin evolution ok. So, what we were talking about is on a very miniature scale and one can walk through this region ok. So, these are all like drainage basins. We see smaller ones and then slowly they are.

So, whenever we go after a couple of years we see that there is some sort of an extension of the drainage because of the ongoing evolution of the drainage basin. So, this is also you can see here this is evolving like this ok. So, then typical of the smaller or the stream joining here and getting into the trunk stream. So, these are typical of how we see the evolution of the drainage here. So, this is what we would like you to understand and then try to extract this information and give your views that are your interpretations ok towards the landscape evolution.

And so, this one is the major one, this is the major stream which is flowing and smaller streams that are the tributaries which are joining it ok. There is another example which I just to show you how the landscape evolved, but this is on a very quick time scale because this is not taking time, but this is just to also this beach in Andaman. So, and there is a slope over here ok. So, ocean water comes in. So, this is during the high tide and low tide ok and even during the tidal fluctuations you will see that.

So, water was coming right up to this and going back ok. And what I saw when we were doing the field in this area was that they wanted a very miniature scale. The landforms were developing ok. So, this is what I found and whatever we have learned or discussed so far about the different channel patterns is ok. So, one is your straight, then second is meander and third is your braided and in combination of both all. Then we talked about the terraces, then alluvial fans and delta.

So, these are the landforms which we were talking about ok. And of course, connecting to this one we talked about the point bars, then rate bars. Now you can see these are all small rate bars here. And then you have like because the water is just loose sand and the water is coming and going down and then we have like over here we see a sort of a meander and then the formation of terraces here because there is a migration here in this direction ok. This is again in the rate bar here on this very small scale ok.

So, this is a close up photograph so that you are able to see. Maybe I am having another photograph I will just show. So, this typical process which we see here is operating on a very large scale on the landscape and that is how the landscape has been shaped up ok. So,

if you probably yes you have the close up of that. So, you see that there is an erosion bank here, there is an erosion bank and then we have terraces here. So, there is terrace 1, there is terrace 2 and terrace 3.

So, on a small scale we can see that it is ok. So, as we have learned about the channel pattern based on the channel pattern also you can talk about the bed load ok. So, what type of bed load you will expect if you are having straight channels, you are having meandering channels and so on ok. So, this is a detail which has been given about the different channels ok and what will be the bed load. So, you are having the bed load here, mixed load and suspended load you will be looking at differently and then we have also discussed the anastomosing channels and we were talking about the braided channels also ok.

So, you can go through this one also ok. So, I will stop here and we will come back with a few more slides on this topic and then move to morphometric analysis. Thank you so much.