Laboratory Practices in Earth Sciences: Landscape Mapping

Dr. Javed N Malik
Department of Earth Sciences
Indian Institute of Technology, Kanpur

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Welcome back. So, this was the last portion we were discussing about the different channel patterns. And we also discussed what all the possible indicators of active tectonics that we see in terms of the manifestation with along the river valleys and different channel patterns in the form of different channel patterns. So, we also discussed local meanders, local development of prated patterns, widening and narrowing of the channel, and local development of ponds. And these are the so, if we are not having consistently this sort of indicators of the channel pattern for a longer distance, then we need to check whether what are the reasons for this local change in the channel pattern could be related to your active tectonics. So, these are the two figures we have already discussed in the previous lecture.

One was about the channel pattern which has been given by Shum from 1 to 5 and then about the sinuosity and its relation with the slope actually. So, usually it has been seen again. I would like to emphasize here that at the initial stage when the river is subjected to even the river bed is subjected to uplift or subsidence in terms of the tectonics. So, in the last lecture I also had to explain. So, usually the channel profile is seen in a typical way like this, but suppose there is a change in the channel profile suppose it is going up or down and this is what you are having an uplift in this portion.

So, this portion is your uplift and this is your subsidence. So, depending on what channel pattern you have in the upper reaches and while it crosses the portion which has been affected either by the uplift or subsidence depending on that. So, suppose you are, for example, straight. So, you may see a different pattern over here and the channel and then further downstream you will have a different pattern. So, if you are having meanders then you will have different channel patterns.

So, that way I will talk at the end about what type of channel. So, basically what ingredients we are putting in and what we are getting out output as an output that will vary based on the ingredients we are subjecting to. So, in order to maintain the constant gradient because as I said, the channel will always try to keep itself in equilibrium. So, it will try to maintain its profile. So, if there is a sort of an uplift it will erode if there is a subsidence then it will be a grade that is in a very normal process which we will come across in such areas.

So, in order to maintain the constant gradient a river bed is being steepened by the

downstream tilt which will cause an increase in sinusitis. So, this basically says that if you are, if you are increasing the gradient, steepening the gradient means you are supposed to have a profile coming like this and then suddenly you see the fall over here. So, this you are looking at the steepening of river gradient. So, this basically you will have to keep in mind. So, this increases sinusitis.

So, channel if it is straight then downstream you will see that the sinusity has increased. So, this will also give an indicator of that increase in sinusity in the local region. Whereas, reduction in the valley slope when we are talked about when we say reduction that means we are uplifting the area. So, this means this profile as the steepness has reduced. So, that will reduce your sinuses.

So, here steepening increases the sinuosity and a reduction in valley slope will reduce the sinuosity. This is also experimentally proved and slide increase in valley slope with shift will shift the river pattern from left to right. So, this is the pattern. So, there is an increase in valley slope. So, the pattern will be from straight to braided or maybe braided straight and then you are having sinus channels and all that.

So, with greater change of the valley slope it will result in incision and increase in sediment supplies, that is change of mix load channel to bed load channel. So, this is again is it is been like what is been shown we have already discussed this that if you move from the from this portion to this side actually what we are seeing is that and this is also related with your shape of the channel or the pattern of channel pattern from straight to braided and that will be your due to greater change in valley slope. So, that will result in the sediment supply also increasing and which is going from suspended to your bed load. So, a gradation and degradation as I was explaining in the previous slide that if you consider this I will just change the. So, if you are looking at the gradient here.

So, the river will try to maintain this gradient ok, but due to the tectonic movement your area has like for example, this is the area which is subsiding, but this is this is getting uplifted here and then you are having the subsidence here. So, you see a sort of an uplift here ok. So, this component has the area in the region ok. So, what will happen here is that this portion will have a gradation and this will degrade and this will again have the gradation. So, a gradation is you can say this portion ok, this portion will degrade.

So, there will be deposition here in this area that is the process of a gradation and this portion will have degradation. So, this is in case you can say uplift. So, deposition upstream and downstream of the uplifted area and incision that is your degradation in your uplifted portion. So, this portion will have typical landforms which you can talk about the fluvial terraces ok. So, this will be because of the incision.

Now, in case of subsidence what will happen? So, this is again what you are looking at here, that is sort of we can say reduction in gradient. So, reduction in gradient we see. So, reduction is related to your uplift. So, reduction here will degrade this area. Now, in this case what we are having is steepening, steepening of valley slope or gradient.

So, you have this portion as a result of the subsidence actually. So, the original profile as we were talking about will be just shown with this one ok. So, this is the original profile and because of the subsidence of this portion. So, basically this will cause the river to try to bring itself along in this line. Actually that is what we were talking about, that it will try to bring itself in equilibrium ok. So, since the valley, the slope has changed.

So, this portion will be agreed ok. So, deposition will take place, but this portion will be eroded. So, this will have what we were talking about incision and this will have erosion actually. So, this is no sorry this will be having a deposition. So, these are the two cases which helps us in understanding what will happen when there is a sudden change in either by the reduction or steepening of the channel slope.

So, rivers incision the region of steep slope due to faulting and a grade downstream as it enters into the area of subsidence. So, this is the area of subsidence we are looking at. So, such cases can be well studied if we come across the landforms and if we are looking at some degraded areas or sudden degradation is seen. So, that can help us in also identifying the and of course, the channel pattern will also help us in identifying whether this area is affected by the tectonic movement or not ok. So, again this is what has been shown how it will react : the channels will react to the uplift and the subsidence area.

So, depending on what type of pattern you have that will result in for example, you are having an uplift here. So, you may see a short of and this is an example here that you have an anastomosing channel here which will get into the downstream it will become sinus ok. Similarly, here if you are having a sinus channel then it becomes anastomosing and so on ok. So, these are the indicators. So, change in the channel pattern is caused by increase or decrease in valley slope due to uplift or subsidence of the area respectively ok.

Decrease in slope will cause river- like river's braid to meander actually that what I was showing here braid to meander too straight actually. So, from the braid then you will have to go straight. So, depending on what type of pattern you are having before the anomaly like either it is uplift or this it is you are having subsidence here ok. So, based on what you have , you will see them. So, the most commonly observed stream adjustment from the meandering channel is for the meandering for a meandering channel.

So, increase in sinuosity increase in sinusitis in response to increase in slope or decrease in sinusitis in response to decrease in slope ok. So, we have one example from the US which shows clear indication of this effect even from India. Also, we have marked certain examples looking at the response of channel patterns to tectonics. So, let us see that. So, like, but before we go into that detail we can also just look at what. So, this is the area which is like I will just explain this first.

So, this is your Himalayan frontal frontal region which demarcates the boundary between the Himalayas and the youngest mountain chain. This one is your Jainawari anticline which marks the plate boundary. So, this is your Jainawari anticline and this is your plate boundary which is between the. So, this whole area is the plate boundary between the Indian plate. So, this side will be Himalaya , this side is Tibetan plate and this side is your endo gangetic plain. So, the example which I was talking about is the change in the sinuosity and how it will affect.

So, let us see the example from here in this region what we have we looked at ok. So, this is the fault line just behind the Rainawari anticline. The Rainawari anticline is this one here. So, that what I was showing not exactly Jainawari anticline is here, but this is this is your Nahan thrust ok. We call and this the whole picture which you see is from this area.

So, this is the reservoir of. So, this one is this reservoir of Sutlej and then. So, this image has been shifted . We have changed the direction we see this information, but here also you can if you carefully look at you can see this sinus channel ok. So, let us see this and that. So, what we identified was that there is a thrust here. So, if I put the cross section across this then it will be something like what we see that this is coming up and then you are having like this one ok.

So, there is a thrusting which is taking place. So, what we see in the hanging wall side as this is a tight meander actually. So, if you check the sea, look at the channel and check its sinusity then you will be able to understand that. So, we have like almost more or less straight channels, but close to the uplift what we are able to see is the incision also as well as we see meandering here tight meandering is seen here. I am not able to draw here because it is not clear, but yes, if you tilt a little bit more you will be able to see.

So, what we have here is straight and then downstream also what we see is straight ok, but in between here we have an increase in sinusitis. So, basically the meandering loops are increasing here and they are tightly meandered actually. So, these are typical indicators of active tectonics ok. Now, if you look at the common drainage pattern and geological significance then these are the types which have been given dendritic description and geological significance ok. So, for example, a dendritic channel if you are having then you

have irregular branching of the stream and basically it looks like a tree ok.

So, it resembles a tree. So, if you take the tree trunk here like and then if you try to put the small stems it will typically resemble a tree actually. So, and this I am drawing, this is the upstream area. So, this is typically like a branching nature you will see. And what is the geological information you can generate from this that the material is homogeneous ok. And if you are having like crystalline rocks, older harder rocks you are having and also if you have the horizontal beds then you will see this and then the slope is a gentle gentler regional slope ok.

So, and then you have sub dendritic peanuts but I will if you see rectangular for example, so I will just talk about a few and rest you can read out again. So, streams have a right angle bend. So, you will find that the streams are flowing in typical right angle bending ok. So, and this is mostly it has been controlled by sets of fracture ok or joints of fractures and very common in sandstone and quadratic areas.

Then you have again angular. So, you have acute angle in this right angle. This is acute angle again parallel trail is also important. So, very most commonly you will be coming across this one which I am putting with a radial then you are having even centripetal also is there, but mostly you will come across this type of tranages ok parallel. So, most of the channels will be parallel and this is indicative of steep slope also in areas of parallel elongated landforms. So, parallel elongated landforms are something like this and if they are having steep slopes you will see that the tranages are almost flowing in a parallel fashion ok. Then the trail is actually where we usually try to look at the trunk stream and the tributaries actually.

So, that main stream is a trunk stream and the tributaries that are observed usually join at right angles. So, for example, you are having a trunk stream which is flowing like this ok this is your trunk stream and the the smallest streams that is a tributary will keep joining in an almost right angle to that ok. Now, it has been seen that if you are having the area which is folded ok, folded sedimentary rocks are seen and folded sedimentary rocks if you are talking about then mostly you will come across the sand and sand and sandstone shale intercalations ok. So, that also will be so, mainly we are having harder and softer rocks that will result in the formation of truvies pattern ok. Then radial mostly you will find that you have like they are originating from the center and then flowing away in different directions ok.

So, this is again and sort of an you have and a domal area at the center ok. So, if you come across the center part is uplifted. So, if you see the cross section then it will show something like this ok. So, mostly in the areas where you are having and domal regions that will show

your radial pattern ok. Now, I just wanted to show that this is how we can extract the drainage and this has been done using SRTM data and the shaded relief map. Of course, the dam is there.

So, we were able to extract the drainages from this and the bold blue line is the main major stream ok that is your trunk stream and then you are having the minor stream. So, these are all fold belts here and if you carefully look at this is what I was talking about this is a trunk stream and almost it is coming and meeting then at right angle streams and all that ok. Even this stream is meeting the because for this stream this will be trunk stream and for this stream this is a trunk stream here. But based on the drainage one can also try to understand what is the landform we can identify ok. So, if you carefully look , I am just putting a line here ok.

So, because based on that there are this these streams are flowing in this direction and this stream is flowing in this direction ok. So, what we have been talking about right from the beginning is that if you are having the slope in any area that will result in the on that slope. So, for example, you are having a slope in this direction here and this stream will flow in this direction if you are having a slope over like this ok then this stream will flow in this direction ok. So, it will follow the slope and this line which I have drawn here is exactly what we say is the drainage divide here ok.

So, this is your drainage divide. So, I am drawing very rough figures over here. So, this is your drainage divide and this is your slope of the area ok. So, again if you draw here then you have the streams which are flowing on and similarly in most of the areas you will be able to identify. One such area if you see closely than this one ok what we are able to judge is that is some sort of a radial pattern which we are able to see over here ok. I will come to that part if I have a slide and, but the previous one which I was showing one of the slides where we have seen the tight meander that slide is having.

So, tight meander was over here in this area and then just above that if you see here this area is almost the radial pattern that. So, radial pattern as we have discussed in the previous slide. So, it talks about something like a domal portion. So, slightly uplifted or and circular. So, this is the area actually what I am talking about ok.

So, this area is the warped area which we are talking about and I am showing it ok. So, this is the area. So, this is basically showing a typical radial pattern here because the streams are flowing away from the center. So, again as I said, there are a couple of patterns which are most common. So, out of that is dendritic and as I was talking about it appears like in tree trunks and the streams which are bifurcating from the main trunk stream.

Then you have a rectangular trail as we have the main stream and then you are having these tributaries which are following the softer rocks mainly and these are the resistance rocks and the resistive rocks ok. So, these are harder rocks, but these are softer rocks. So, mostly you will find that the valleys have been cut and they join the trunk stream at right angles. And if you are having radial then either you are having a volcanic cone or a domal portion. So, with this I will stop here and we will discuss a little more in the next lecture. Thank you so much.