

Laboratory Practices in Earth Sciences: Landscape Mapping
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Welcome back. So, in the last lecture we stopped here where we were talking about the mountain frontosity. And as I told that you can use these two measurements what you are having here is one is the straight length of the the front and the dissected one and that you can use having in very simple expression you are having $L M F$ by $L S$. So, mostly as I also suggested in the previous lecture that for mountain front if you need to define that then it is a topographic escarpment bounded by major faults with measurable relief exceeding one contour interval of 20 meters. So, if you are using topographic maps you can use the 20-meter contour in that and that interval has to be 20 meter around 20 But nevertheless as we you can also use the high-resolution satellite data which can help in identifying different and extracting different. So, nowadays what we do is that we use high resolution stereo pair photographs and in one of the exercises or the lab you have done that generation of an algorithm.

So, based on that you can generate a digital elevation model or you can say a digital surface model and from that you can extract your mountain fronts. So, you can do it on the digital platform. So, mountain fronts are classified as internal fronts. So, suppose you are having like for example, you are having contour here and then you are having the streams which are flowing across this.

So, internal fronts could be away from the main mountain fronts. So, this can be classified as an internal mountain front. So, internal and external fronts as I have explained now depend on whether they occur within the mountain terrain. So, mountainous terrain that based on that you can classify whether it is internal or external. So, for example, if we take further as I was mentioning that you have this is your frontal area and then internal fronts could be something over at the hinterland side.

Now, usually it has been taken that this marks as a boundary between the mountainous chain and the adjoining alluvial or the coastal plains. As we have seen one of the examples of the sub Himalayas and the endoclinic plane. Now, the values of SMF approaching 1, if they approach 1 are considered to be the most active fronts. So, depending on the values of what you get, S is equal to LMF and by LS straight length. So, then if it is approaching 1 then you can say this is these are the most active fronts.

So, that will again depend on if the fronts are less dissected. So, that again and so that will yield less sinuosity in that way. So, the mountain front sinuosity index LMF or S you can say you can take as LMF by LS is a measure of degree of irregularity of sinuosity at the base of the topographic escarpment. Where LMF is the length along the topographic mountain front and the Piedmont and LS is the straight line. We have already discussed the morphology of the mountain front depending upon the degree of tectonic activity along the front.

So, active fronts will show a straight profile with lower values of S or SMF and sinuosity of the mountain front. Inactive or fewer active fronts are marked by irregular or more eroded profiles with higher values of S or your SMF. So, this is the most important key part that you should remember ok. So, if you are having active fronts then you will have straight profiles. If you are having less active or inactive you can say then you will have irregular or more eroded profiles ok.

So, for example, if I draw here again then in case of your straight front it will be something less eroded, but if you are having more irregular fronts then you are inactive. So, this is your so this will yield you higher values and this will yield you lower values. So, these points you should keep in mind when you are extracting this information. Now, coming to the facet as I already mentioned in the previous lecture that we call this as a triangular facet ok. So, the facet is the triangular to polyhedral shaped hill slopes.

So, what we were looking at in one of the satellite data is that it will be something like this or it can have. So, this will be short of a very similar shape it will give that resembles a triangle ok or it can have the polyhedral shape also that lies between two adjacent drainages. So, one drainage is coming from here another drainage is coming from here ok. So, this will be your faceted front. So, this is what we have looked at.

So, if you look carefully then these are the two drainages which are coming here. So, these are the two drainages which are coming from this side here and one is coming over here for example, this two and in between what we see is your mountain fronts ok. So, these are the triangular or you can say polyhedral shape you are having this can be two here and then again you are having over here this one ok. So, tectonically active fronts display prominent large facets that have been generated by recurrent faulting. That means, the faulting continues and it is not showing any sign of questions.

So, that is your short suggestion of an active front. So, tectonic activity is more in that area that means, the front is less dissected ok. So, this as I said goes side by side to the mountain front sinuosity also. Less tectonically active front contains fewer smaller facets whereas, means more dissected fronts because of development of more drainage across the

front. So, if you are subjecting the area quite , no tectonic movement is taking place.

So, that area will be subjected to more erosion over time. Hence, you will see more dissected fronts ok and this is for the case of less tectonically active regions ok. So, this points you can keep in mind along with the mountain front sinuosity what we have done. So, you can even try to obtain the S or you can say SMF ok and then percentage of facets ok. So, these are the two parameters one can use to understand the influence of tectonic activity.

So, this is a mosaic photograph from Himalaya, but this is a hinterland site of course, these are all what we see is the lesser Himalayas. This is lesser Himalaya and if you carefully look at it you will be able to observe that mountain fronts are ok and showing triangular facets. Typical triangular facets you are able to see here. And then what we were talking about is that this triangular facet will be in between the two drainages. This is what we see here. So, these are typical field examples, but as I said that you can use high resolution satellite photographs and then can identify what is the percentage of the facets available in that area.

Depending on the regular or less dissected or more dissected front you can judge the intensity of the tectonic activity in that area. So, we have seen that this is what we observed along the front and these are the parameters which one can take, but for faceted one you can use this one here that is your left front and this is your right front ok. So, based on that you can talk about the percentage of faceting along the mountain front and that is your L f and L s that is you. So, you can add these two and take the overall length of the complete facets. So, that will give you the percentage how much it is dissected actually.

Now vector tectonics and reverse morphology again is a very basic and important topic which we will just discuss. So, active tectonics usually has been seen that the modern ongoing deformation is termed as active tectonics ok. However, there were three different terms which were used, one is neo tectonic and we usually call this as a transition boundary between tertiary and quaternary neo gene tectonism and young tectonics, mainly what we are looking at in the Holocene. So, this is around 10000 years if we take from present. So, this is the youngest tectonic domain and we call this a late period which has prevailed during the late Pleistocene and Holocene time ok.

Recently there is also a term which is coming up that we call the in the last few 1000 years or we can say the upper Holocene portion that we generally, but mostly we use the term active tectonics ok for our description or describing the tectonic influence ok. So, in spite of the practical significance of understanding active tectonics only a few investigators have considered its effect on alluvial rivers because it is it has been seen that these active

tectonics whether it you say young tectonics or recent it has shown significant manifestation of the ongoing deformation seen in the alluvial rivers ok. So, the alluvial anomalies are mainly what we are going to do you look at in this one. So, that the alluvial channels are a sensitive indicator of changes taking place in a particular region either due to climatic or tectonic fluctuations. So, mostly it has been as if we are not very much influenced or biased by the tectonic perturbations and how they have been seen in terms of the landscape evolution, but the climate has also played an important role.

So, one has to be extremely careful when we are talking about whether this landscape was influenced by climate or it was influenced by tectonic fluctuations. So, these two major parameters are clearly reflected in change in their river or you can say in the hydrology or and the sediment load pattern. Because any morphology of the channel will be affected by its hydrology that is your amount of water available whether it is high flow regime or low flow regime or we along with that we say the sediment load or the bed load which is coming in ok. That will change your channel pattern or drainage system will evolve accordingly ok. So, experimental as well as field studies have proved that change of valley floor slope will cause change in channel pattern ok.

So, what we have to consider is your longitudinal profile. So, this is your profile of any channel or the river profile we can say. So, if there is any change in this that will also affect your change in the channel pattern. However, the change will differ depending on the type of channels and the amount of rate of deformation. So, this is again we need to take into consideration because you may have for example, mostly what we have learned in previous lectures that we will come across one is the straight channel another is your meandering channel and then third one usually we see is the braided one ok.

So, if we have, we consider these three types of drainage this straight, then meander and braid. So, if we consider this then what is the change we will be able to observe if there is the change in your valley floor slope ok. So, that part we will see and best examples which were given was by mostly the Shum and this paper which has been written and there is a book also which talks about the influence of active tectonics over alluvial rivers ok. So, channel pattern this is again by Shum which talks about that if you have major 5 you can divide into that depending on the your suspended load, mix load or the bed load and combination of what we have discussed in the previous slide that is your straight meandering or braided depending on the in the combination of those also you can have further division which has been shown here that is 3 B and 3 A and 3 B ok. But in total we will see that there are mainly 3 types of drainage and as discussed that we can say the channel pattern or you can say change in channel pattern will depend on your climate climatic fluctuations or you can say tectonic activity and then second one is your sediment supply.

So, this will be your sediment supply that is your bed load. So, depending on these two you will have a change in the channel pattern. So, that is what has been shown here. So, you have like as I said that you have broadly 3 categories you have straight, you have meander and you have braid, but then it depends upon again what we were the load ok that is sediment load that is mix load or bed load here. So, depending on that this will change ok.

Now, usually this is for the meander, but that you can you can I have already discussed this in one of the lectures. So, let us see how these 5 basic drainage pattern channel patterns are telling the story about the influence of climate and tectonics. So, 5 it has been shown here like this as I said that there is a combination of this one where you have the meander with the same width and here we are having a meander with wider width and all that ok. So, 5 basic channel patterns if you take straight channels with either migrating sand waves pattern 1 this is your 1 here 1 here the second one is pattern 2 you have this one. So, you have migrating alternate bars with sinus thalwege.

So, it will show some sort of a sinuosity within the straight pattern then 2 types of sinus channels which have been shown here. So, this is that you are having 3 the channel is a highly sinus channel equal width you have. So, this width has been taken into consideration. So, they have the equal width and a channel which is wider at the bends. So, this is wider as compared to this one here ok.

So, this is wider at the bends ok and the pattern 4 is your meander braided ok. So, you have meander as well as you have braided because they are separated by the small islands here ok. And the fifth one is the typical braided stream which are rejoining streams, but are separated by your bars here ok. So, rivers exhibit various channel patterns that can be related to one variation: the water discharge. This is what we were talking about. This will also depend on the climatic fluctuations. You will have different discharges here. So, this is one point you have and then another in this variation this sediment loads ok.

And the presence of the bedrock because if you are having the channel in the bedrock area then you will definitely have to be careful about that. And third one is your human influence ok. And fourth is your presence of or you can say that because this we are taking together. So, then tectonic influence and then of course, you can say these two you are talking about the climate. So, these are the parameters or the points which are considered to be influencing the channel pattern you know in an overall sense ok.

So, now coming to what we were talking about, if you are having the slope and then you have the sinuosity, how they have the relation and how the channel pattern changes if there

is a change in the slope is actually ok. So, experimental relation, here if you look at then what we have is you have the slope on the x axis and sinuosity then what is the relation between these two oks. And what it has been shown that as you increase the slope here. So, the channel which was straight will get into meander and then finally, it will break actually ok. So, this is the channel pattern overall changes as the slope increases ok.

So, experimental relation between the valley slope and the sinuosity the channel length by valley length you are given and then in the mainly the alluvial channels ok. So, the relative stability of this channel in terms of their shape and gradient are related to relative sediment size load, velocity of flow and stream power ok. It has been possible to develop this pattern experimentally by varying the gradient and this is what we are talking about the slope actually. So, varying the gradient sediment load stream power and that will be related to the velocity of the water and type of sediment load transported by the channel. So, if we look at that, what are the possible indicators of the active tectonics?

So, let us quickly look at this ok. So, local development of meanders. So, for example, if you are having so, suppose you have a straight channel and then suddenly you get into the local meander ok. So, this is what we see is the local development of meanders in the channel local development of braid pattern. So, you are getting into from the straight or then you are having meander and then you are straight away you are having like a braided pattern here ok.

So, you have the braid bars and then braided. So, this when you can say that this is your local meander and this will be your local braid braided pattern ok. Then local widening and narrowing of the channel. So, this is what we can say that fine local widening and narrowing is that you have a narrow channel and then suddenly you see a short of a channel is widening up here. So, you have this again of course, it will be short of a slight some bars will be there, but this is your local widening of the channel and then local ponding of the channel ok. So, when the local ponding if you if you take the this the slope or the gradient it usually shows like this ok, but if you are having some area where so, the stream is flowing like this is your elevation and this is your distance here, but some portion if suppose this profile is something like this ok.

Then this area is blocked actually by this rise ok. So, this will show a ponding condition. So, local ponding also can be taken as an indicator for your tectonic evidence ok. So, I will stop here and we will continue with more details in the next lecture ok. Thank you so much.