Laboratory Practices in Earth Sciences: Landscape Mapping
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Welcome back. So, there are few things which are left out in the fluvial landscape part and so, this is the portion which last time we discussed about the first order and second order drainage and all that. So, this one is a very basic part which is usually used to understand the drainage density and that can also help us in knowing the subsurface material or the lithology which is present in the area. So, drainage density is calculated or obtained very in a very simple way with the expression here which is of the equation which is given here. So, D and sum of the length of the channel per unit area by area. So, you get this information by kilometer per square kilometer.

So, usually the overall like if you take this, this is if this is the basin area and whatever the drainage you have the length of the drainage area has been added and the area has been taken into consideration. So, that will give you. So, overall length of all the drainages or the streams divided by the area of the basin. So, this is one exercise which can be done and if time permits we will try to do that.

Other than that, as I said, if you consider the drainage density, that also helps in understanding that what exactly the material is in the existing subsurface and the drainage density will depend upon the property of the material and that is exactly the permeability. If it is permeability is high or the permeability is low that depend of or we can say the material is porous then we can have we will have mostly the drainage density will be low. So, that also helps in some certain sense to understand the overall landscape and of and to some extent hydrologist and geomorphologist they usually use this to understand the landscape dissection and runoff potential runoff potential is again that parameter can be helpful in the flood analysis and all that. So, on a highly permeable landscape with small potential for runoff ok. So, drainage density is sometimes less than this. It has been observed that it is less than 1 kilometer by 1 square kilometer.

So, that means, whatever the rainfall is falling on the surface or the precipitation or the water you can say it is completely seeped very quickly and that will not allow the drainage to form. Hence, we will see less amount of drainage or density will be less in that. On highly dissected surfaces the drainage density of over 500 kilometer per square kilometer is often reported ok. Closer investigations of the processes responsible for drainage density variation have discovered that the number of factors collectively influence the drainage density or the stream density and that what I briefly discussed a few seconds back ok. So, this factors are mainly of course, the climate then the topography that means, you are talking about the slope climate again you you indicate it indicates the amount of precipitation you will have soil infiltration capability that what I was talking about that it is porous if it is the material is porous you will not be able to see much of the drainage developed on that area.

But if it is less porous or or you can say the permeability is very low then you will be able to see that the drainage is more over there. Vegetation also plays an important role and of course, what we are talking about in total is the geology or the lithology of the area ok. If the infiltration dominates over runoff it tends to have lower drain density. So, this is mostly seen in if you take the sandstone if you are having ok or if you are having the sandy areas there you will be able to see that the density is quite low as compared to the other region ok. So, for example, this is just a sketch which shows that the sandy hills ok the area which is occupied by the sandy hills over here is having very low density ok that is drainage density you are talking about.

Now, based on this again to make interpretation easier there are further brief I would say that classification or the sub classification is being done which helps in again identifying what is the material available now. So, this example what we are looking at shows that the sand promotes ill filtration eventually resulting in low drain density. So, that also can be taken as one of the interpretations. This is what I was talking about the drainage texture actually we take the drainage texture is defined as relative spacing of drainage lines ok commonly termed as coarse medium and fine. So, coarser if you take then what it shows is that you have low drainage density developed on mainly hard rock resistant rocks or over a highly permeable material ok.

So, you will not find much of these streams if you do because we are talking about the low drainage density. Hence can be classified as showing a low drainage density which can be termed as your course drainage texture. Medium moderate density again develops on hard with moderate permeability. So, this parameter is playing an important role that is mainly the permeability. Then comes this medium then comes to fine if you say they are closely spaced ok.

So, in this case if you say they closely spaced this was moderate density ok. So, if you say closely spaced then it will have a very high drainage density in this case ok. So, mostly develops on loose or poorly cemented rocks or material like clay silt having low permeability. So, if you are having low permeability then this will allow the water it will not allow the water to seep down or infiltrate very quickly that will result in more streams development and that one of the examples for that is your shale. So, shale is again sedimentary rock and argillaceous sedimentary rock.

So, you will find a greater number of streams here. So, drainage density will be higher here and we can classify this as a fine texture because the streams are closely spaced ok. Similarly, different rocks like this is an igneous rock here and this is your intrusive igneous rock. This is sedimentary rock sandstone. So, they will have different drainage density and can be classified as in as we have discussed here. So, this will be coarse this will be you can say this is also coarse to medium or medium to coarse you can say this one.

So, you are having medium to coarse this one if you can say co medium and this one is fine. So, this you can classify accordingly ok. Now, we will move to another topic which is also again we are trying to put it with the drainage part. So, that we will see ok in the next one. So, this is another of course, I would say not a new topic, but it is aligned with what we have been talking about based on the landscape and how we can identify the influence of tectonicity that is ongoing deformation on that.

So, we term this as in this branch is a sub branch of the geology or geomorphology we can say tectonic geomorphology ok, where the tectonic influence is more than your climatic perturbations ok. So, tectonic geomorphology is the study of landforms that are resulted from tectonic processes ok. So, we usually look at the right from the plate tectonics 2 continents are colliding as in case of the Indian plate and the Eurasian plate or the the the 2 continents or we can say the oceanic plate or continental plate either it is subducting or 2 continental continental plate is colliding. So, based on this ongoing deformation we can also see the signatures preserved on the landscape ok. So, that can be identified through morphological analysis in tectonic geomorphology TGS we have just a chronicle of what we have put is tectonic geomorphology mainly refers to measurements of the topographic expressions from topo maps or satellite data.

So, again this can be done setting in the lab or on your PC you can have high resolution satellite data and then you can or you can even use higher scale of topographic maps like for example, 1 is to 25000 and that you can you can extract the information such like what we are showing here is the mountain front sinuosity and facet percentage ok. So, mountain front sinuosity is how much it is sinus. So, sinusitis basically the word comes from the river sinuosity also that is here how it has been meandering or how it has been curved in a sense ok. So, usually we we understand that if you are having like for example, if you are having this mountain and then you are having the this. So, this will be your mountain front ok.

Now, this is me . I am showing a cross section, but if you look at the plan view then you have this mountain front. So, this is like a luvial plane and this is the hills or you can say mountains over here. So, then if this is very straight this contact between the mountains is again we say the geomorphic contact. So, if you are having this very straight line then we say that this is very active, but suppose it is having dissected ok or sinus ok then we say that this is being eroded. So, this will be eroded by the streams flowing across it.

So, that is what we try to look at the mountain front sinuosity and of course, again this also gets associated with the facets ok. So, we say these are all triangular facets here. So, that we will discuss in the coming slides ok. Then we also look at the longitudinal profiles of the stream because if you take the longitudinal profiles then you are basically trying to incorporate the distance along the x axis and y axis you usually take the elevation. So, the river profile usually looks something like this ok where it goes and meets the ocean or any major trunk stream ok or or if it is a trunk stream then it goes and meets the water body either it is ocean or some water lake or pond or whatever it is ok.

But usually we take this typical river profile if there is some change in the river profile for example, if the profile is seen like this then this portion will have different land forms and we try to understand that whether the there is an sort of an a warp in the the profile or suppose you are you see something like this ok and this is what. So, we can suggest this as a sort of an area of subsidence and this will be the area of like we can say this is your uplift. So, we try to understand what exactly is going to happen in this area because mostly the stream or the channel will try to keep itself in equilibrium. So, it will try to put itself in equilibrium. So, it will be here to to get to this profile then it will be agreed here there will be deposition, but here to put itself in this area then it will sort of degrade.

So, there will be erosion here. So, you will see a deposition here and, in this area, you will see erosion because the river will try to keep itself in equilibrium. So, longitudinal profiles are also important when we are trying to understand how the tectonic influence is there. Then another point is the valley width to valley height ratio ok. Now, valley width to valley height ratio again if you are talking if you have a stream flowing like this and if you take this cross section for example, A B then what you usually see is that stream is having the profile like this.

So, this is the A point and this is the B point you are having. So, depending on this ratio, sometimes you will see that the valley is quite steep ok. So, that also suggests that there is some influence of tectonics ok. If you are looking at the wider valleys like this ok then for since like since a longer time this area has not been affected by that is ok. So, V shaped valleys and U shaped valleys of course, one can say that U shaped valleys are very common in glacial terrain.

Mostly in the alluvial plains or maybe at least in the hilly areas where the glacial influence is not much. If you are coming across such a signature that also helps because this whole process is involved in what we call incision and that is your erosion. So, this is again an important factor which we can look at ok. And pseudo-hypso-metric integral this also we will discuss at the later stage and you can use this parameter to identify the tectonic influence on the landscape. Then we will talk about the stream gradient index.

So, points like this parameter fifth one and second one can be used together side by side, which can help you in understanding the overall tectonic influence. So, for example, this is a topographic map of the foothills of the Himalayas. It is in Punjab Himalayas I would say or probably yeah yeah this is close to the Punjab region. Now, as I said, you can use the topographic maps as well as the high-resolution satellite data to identify or to work on your mountain front sinuosity one and second is your facets ok. So, we will see what exactly we are, how we are defining the mountain front sinuosity and how we are talking about what is the percentage of facet percentage.

So, mostly if you look at this front ok. So, this is here like if you look at this contour of 20 meters over here then if I draw this one here this goes like this ok. So, to some extent what I see is or maybe you can take the inner one that could be because this is this is getting into the plane, but if you take then you have I will just quickly draw this one here. So, then this is getting dissected here and this is the same one and the inner one we can take goes like this. So, this is I am, I am just roughly putting, but when you come here this is again slightly dissected, but as soon as you get into this one it is becoming almost straight ok.

So, this portion is having higher sinusitis and this is having low sinuosity. Now, so what exactly it is indicating even if you take this one here this quite straight ok. So, this portion we studied in detail with the help of high-resolution satellite photographs and also, we did a detailed field. So, what we found was that this area is of course, this is a sub Himalayas you are having and this is your endo gangetic plain IGP is your indo gangetic plain and we very well understand that this contact what you see is the plate boundary ok. Now, within this there is along this plate boundary the contact and the fault which runs here has been termed as Himalayan frontal thrust.

So, this is a thrust fault. So, we know that this is one of the most seismically active plate boundaries in the world, but at the same time if you want to identify which area of this boundary or the fault line is more active as compared to the other one, ok. So, in the nearby region that also helps if you can do it by these two parameters ok. So, this a more or less straight line not much dissected whereas, this one is dissected one this shows the presence of the signature on the surface that is your active fault that does not mean that the faulting will not occur over here, but this is this give a very prominent example and this example if you see is over here ok. So, this is the front which we are talking about exactly in this area ok and if I carefully try to locate this then this stream is this one here ok and you are having this one is probably you are you are flowing through this one ok this stream. So, the landform which you see here is you can mark somewhere over like this ok and this is the uplifted terrace.

So, we can also like to denmark it easily. So, this whole area is shown here and this stream that you see is coming like this and then flowing down is this one ok. So, this is the area which has been marked in this portion. Now as I said that if you have to differentiate between the active and inactive front then this is the best photograph which you can look at ok. So, this one is an inactive front where we see a diffuse boundary between the alluvial plane and the hills whereas, this one is showing very sharp contact ok very sharp contact.

So, this is the active front and another part which I was talking about the mountain fronts ok mountain fronts and the triangular facets ok. So, we usually call them a triangular facet. So, if you carefully look at this one they are producing or showing some sort of a shape which resembles triangles ok. So, these are typical facets ok and we call this as a triangular facet. So, depending on the percentage of facets also you can judge whether this area is active or inactive or moderately active and so.

So, how this triangular facet is developed is basically based on the or it will be resulted based on your erosion of the stream which are flowing on the either side from the hill from hills debauching into the plane areas. So, this image is from the foothills zones of Punjab Chandigarh this town is here Chandigarh and this is your front. So, if you immediately look at what we have discussed in the last one last slide ok then you can easily make out that this front is quite active and this shows that there is a default which exists here and this portion we have named as Chandigarh fault. Of course, it is part of Himalayan frontal thrust.

So, that you can see here. So, it shows a very clear demarcation or geomorphic boundary between the sub Himalayas and the Indo-Gangetic plain. Another one here you can see. So, basically, we try to use the remote sensing data and along with that of course, at a few locations you need to do the field and try to confirm what you see on the satellite data. So, this is the area the topographic map which we have prepared is not a topographic map. We can say from the satellite data we have prepared that this is a geomorphic map ok. And since we have incorporated not only the landforms in this, these are all landforms which have been marked with the pink yellow and different colors.

So, these are all terraces we are having marked here alluvial fan surfaces as well as the terraces along with that we have also marked the with the red line you see is the faults which are displaced. So, if you see this portion here this one is exactly this area ok and this line which I am putting is bold is this one. So, you have so, instead of just talking about this as a geomorphic map we say this as a tectono geomorphic map because we have included here the tectonic features also. Similarly, this one here what we see is that there is an echelon fault which is running ok and then we have a back tilting over here at Mandhala which is again a part of the Punjab Himalayas we are having ok. So, I will show you that if I am having the photograph of how it looks in the field this is back tilted ok.

So, usually what happens that if you are having like for you have a flat like you can say the the surface and then there is an faulting here reverse fault you can say it is not reverse exactly, but mostly we see thrust fault then if there is a movement here then the land form will be developing something like this ok. So, there is an uplift over here and then there is a back tilt we say because the usually we see that in such areas the slope will be in this direction, but the slope here is in the opposite direction that is the reason why we call this in back tilt ok. So, mountain front sinuosity is the sinuosity of topography of the mountain fronts. Mountain fronts are defined as topographic escarpment bounded by major faults it is an index of degree of irregularity that what I was talking about that if you are having the sinus that is the degree of irregularity if you take this is not the whether it is straight or not ok. The degree of sinuosity of this front provides authentic and dependable evidence of active tectonism in arid and semi arid areas.

If it is in the humid region or where the system is very dynamic that is the fluvial system then you may see more erosion of the desert section there ok. So, mountain front sinuosity is denoted as S is the ratio of the observed length along the margin of the topographic mountain front that is the piedmont junction and L M F 2 that is the ratio between S is equal to L M F that and L S ok. So, this is how it has been given S is equal to the L M F by L S, L S is the over the straight line ok. So, this we will see quickly.

So, and then we will end here ok. So, suppose this is the straight length you are having and this one is the mountain front ok and that has been denoted as S is equal to L M F by L S. So, I will stop here and we will continue in the next lecture ok. Thank you so much. Thank you.