Photogeology in Terrain Evaluation (Part – 2)
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Lecture – 08
Photo Interpretations

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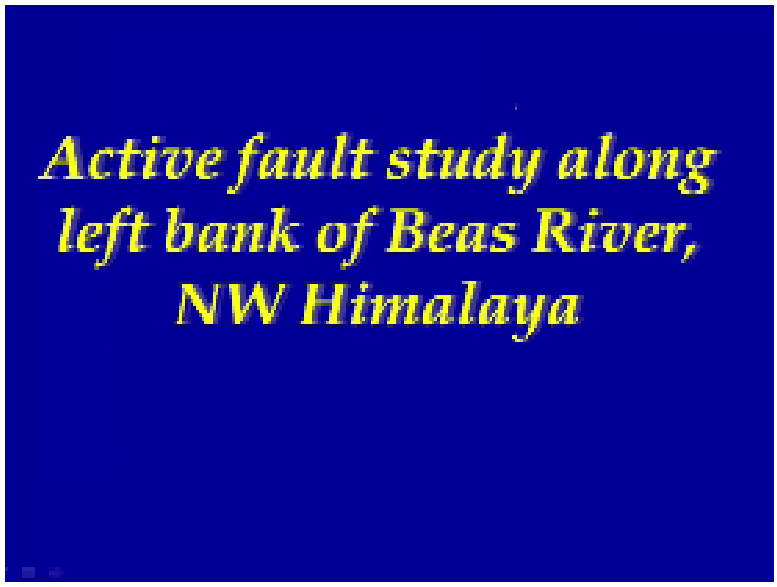

So, welcome back as I told that this is another interesting area which I would like to show you that where the construction has been done on the top of the active fault and again because of the unawareness and this area lies in the foothills zone again of Himalayas along the Beas river.

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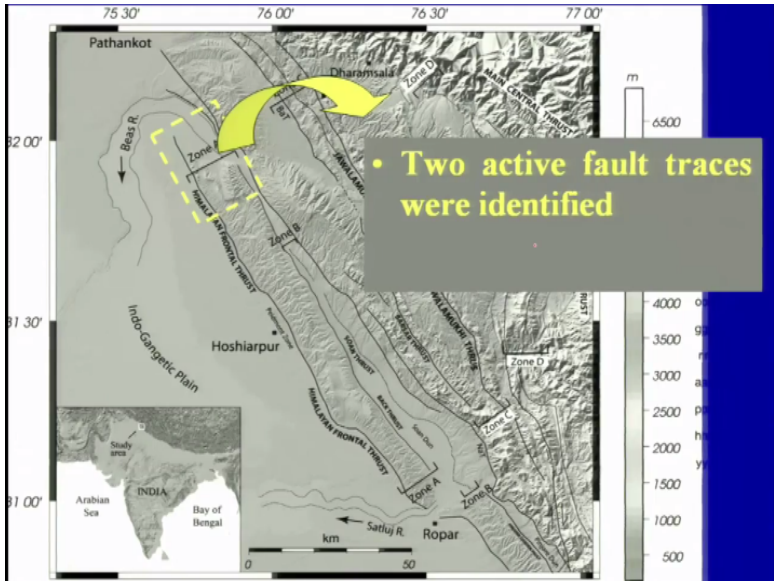

So, we have; this is one of the mighty river which exists okay, so this is one, inset map here shows the location of with respect to the Indian subcontinent of the study area and these are all

the; this is what we call the shaded relief map of the northwest Himalaya, some major cities which you can recall and try to locate yourself, one is Hoshiarpur and this side if you go this is Pathankot here, okay fine.

And Ropar of course, most of you must be knowing now, we have an IIT Ropar here, which is all in all these cities or the towns are sitting very close to the foot hill zones where we have the one of the most active fault system that is Himalayan frontal thrust. Now, coming to this part here, this in Sutlej river, which exit into the Indo Gangetic plain from the Soan Dun.

And another is here, Beas River, which comes out and flows on the Indo Gangetic plain and this two boundaries here of which is like cornering one side that is on the north by Beas and south by Sutlej, this is the structure which we call as Janauri anticline okay. So, we studied about the anticlines and syncline, so this is an anticline, then you are having a syncline basin here, then we are having an anticline and so on, okay.

So, let us see what I was trying to tell you okay from this area, so two active fault traces were identified again, this 2 were new active fault and we identified and published a couple of research articles on this and we named this as an Hajipur fault okay, so Hajipur is a town there and we named that as an Hajipur fault of course, this Hajipur fault or the active faults are the part of Himalayan frontal thrust.

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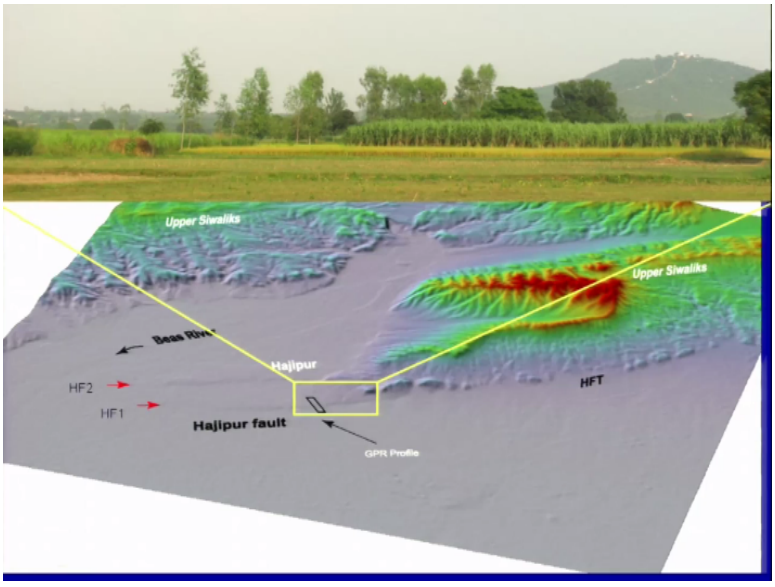

So, if you see in a digital elevation model, then you will be able to clearly mark the two very precise or prominent features over here, where I am putting my cursor okay, one is this, another

one is here okay. So, what has happened is these are the two faults; HF1 and HF2, this we say that this Hajipur fault 1, Hajipur fault 2 and then Beas river is flowing at the back of this and then coming out.

Now, there is a very interesting story here which I will talk about in the next few slides okay, so this is what we picked up and we were very excited to know more about it okay, so if you look at this one, this is the HF1, how it looks in the on ground okay, something like that so, this hill, a small hill over here is this one, okay and then we go right here, there is a topography and then we see a flat portion which is running here and this elevated portion is this one, this is your fault scrap.

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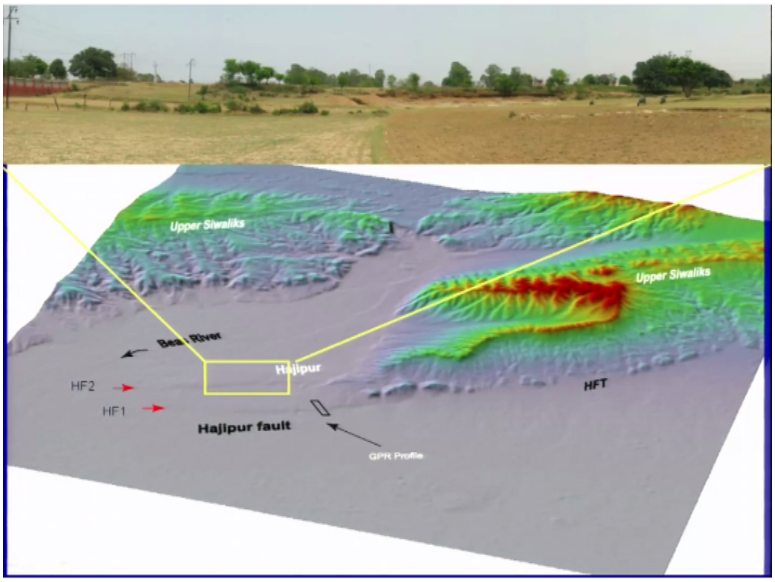

Another one over here, so this is HF2, you can clearly mark that there is an elevation here and a flat area here but this we did not pick up or identify on ground first okay, we used satellite data, we identified this features with an understanding that how the fault scrap will look like and then we visited the field and then we did the trenching and all that okay.

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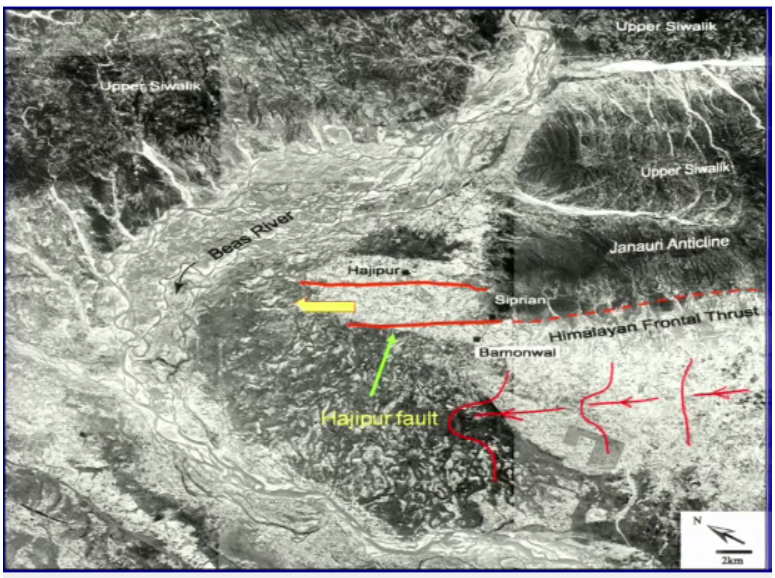

So, these are the two trenches which we did now, good story here like very interesting one and this is what you can identify using satellite data that what has happened in the past and how the landform has evolved over the time, okay. So, this whitish feature over here is the uplifted portion which I was showing on this, okay so, this is the uplifted portion this one, which you will see in the next slide, a very typical tongue like feature okay.

And this is one of the example of fault propagating fold, okay so there is folding taking place and that fold is propagating towards this side okay, whenever there is a displacement or the earthquake along this fault okay, so what has happened over the time is that this Beas channel which has been seen like in U-shape here was it existing right from the beginning because we have not seen that okay.

So, in last 200 years or 300 years or 400 years or we may say 1000 years okay, this Beas river; the question is that this Beas river flowed where it is flowing now, the answer is no. So, initially the Beas flowed directly through this, okay then because of earthquake, it shifted, next here, another event had shifted over here, okay. So, over the time the Beas River has shifted so, I could say just for example, this is not up to the mark, the sketch which I had drawn.

This is the first location or you can say the second and this is your third okay, so third one is the present day channel of Beas, okay but earlier Beas flowed through this area okay, so whenever there was an earthquake, then displacement along this fault, Beas was pushed and Beas was not capable of crossing this area that is an uplifted area, okay. Hence, Beas took a different course or you can say got deflected from its present position and that is what we see here, okay.

And this is absolutely right because we see the sediments which are suggestive of the fluvial channels flowed across this area, okay but now what you see is this is an uplifted area and because of the uplifted, this blocked; this area blocked the channel and channel quietly shifted acquiring the new course of it, so this is the story over here. So, this is one of the very good example of; so, I will just put it in a sketch that what exactly happened.

So, this Himalayan frontal fault existed, so Beas used to flow like this, okay so, then second stage the fault trace extended because of an earthquake and then it shifted like this, okay further moved, okay and then this what you can see okay here like this so, whenever there was a displacement and the fault propagation in this direction has resulted into the shift of Beas channel.

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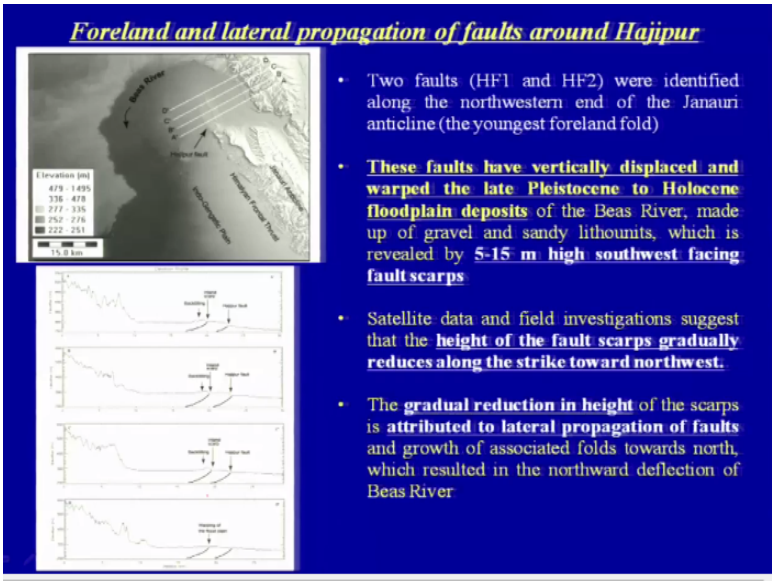

You can also generate digital elevation models or shaded relief maps and try to look at the elevation change or the topography of that area okay. Now, here if you carefully see you will be able to see some blur line which is indicative of the fault scraps, okay. So, what we did; we took, we generated the shaded relief map which also have the elevation details and based on that we extracted the topographic profiles, okay to understand that what is the variation of the topography over here; this is what we found, okay.

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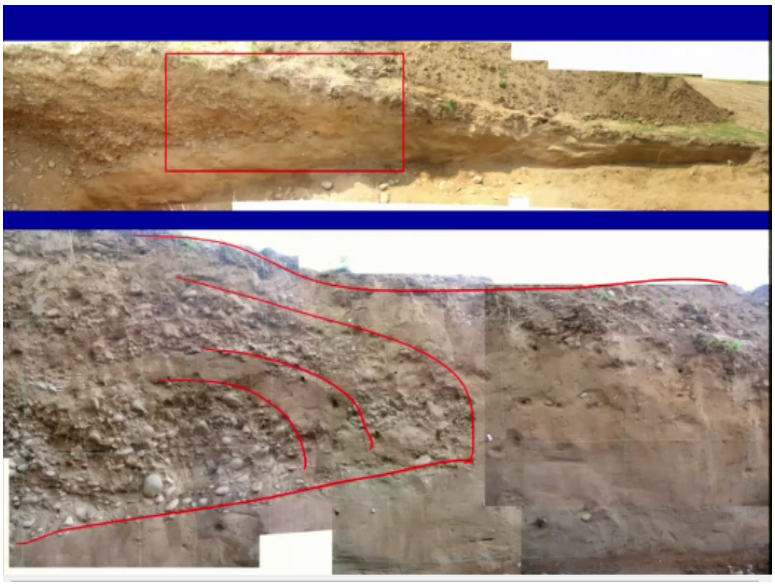

So, these are different topographic profiles which were been collected or obtained or extracted from the shaded relief map, okay. Now, the hazard part here, if you see this curve, if you see or the house sitting exactly on the top of that okay again a mistake, okay further, we opened up a trench and we confirmed that this is an active fault, so these are the signatures of that so, what we see is the fault scrap here and then we see that the formation in the section, okay.

So, this is the fault trace okay, so these are the folding which we see I was showing one of the figure of thrust fault, so this one thrust fault where the fault exactly if you nearly mark okay, then it passes through this contact here, okay, so there is one folding here and fault goes like that okay and it extended, so this is a trace of that.

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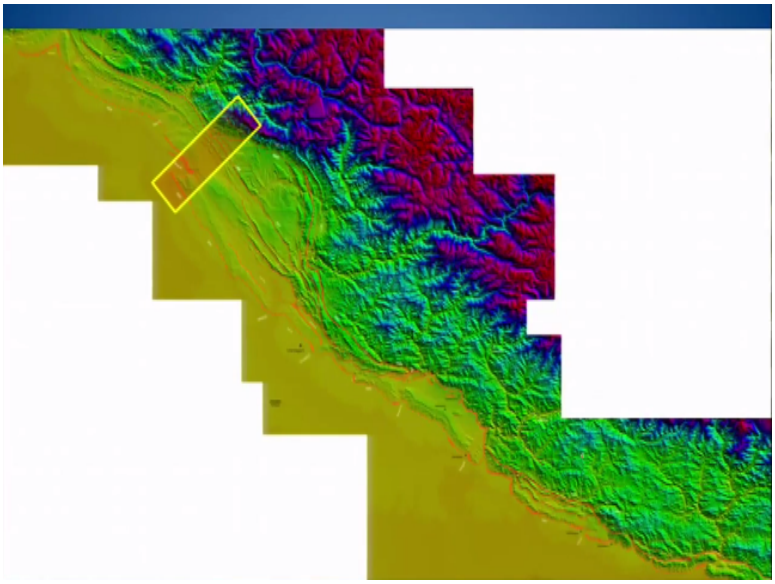

So, again some more interesting part okay, which we will take about so, what we have this previous figure shows us again, we have prepared in very detail active fault map of central Himalaya as well as the northwest Himalaya and some parts we are covering in detail, okay.

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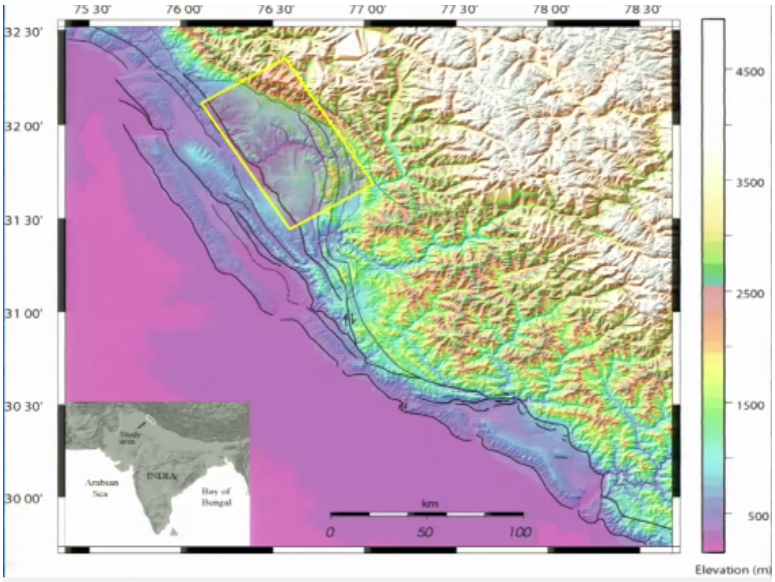

Coming to the further north and that is your area which is Kangra Valley where we were able to pick up more details of the active fault.

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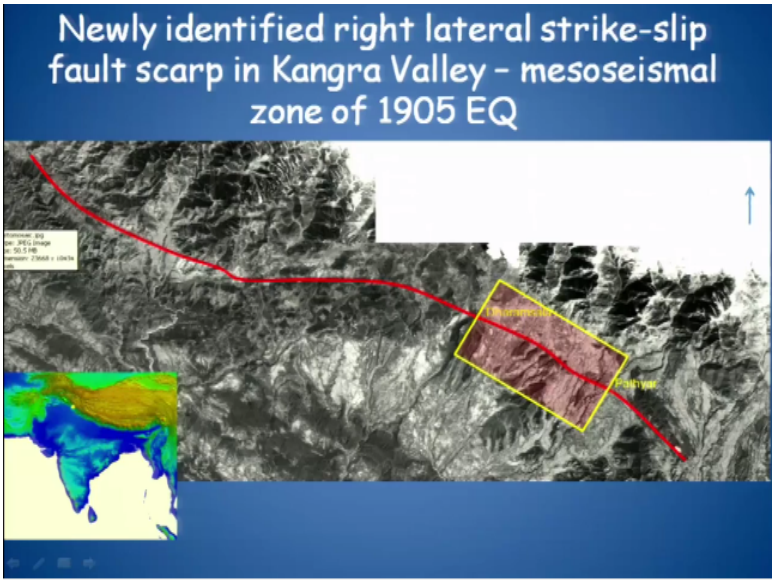

Now, again why I am showing this because this is also related with the photo interpretation or satellite data interpretation well, for identifying the active faults, okay, this was again an unknown fault which we picked up from the area, which we call as an mesoseismal zone of 1905 Kangra earthquake, so 1905 Kangra earthquake is considered as one of the major

earthquake which occurred in 20th century in India along Himalayan; in Himalayan region and which killed almost 20,000 people okay.

But now, if you see the hazard will be double fold in that or more than that okay because population has grown up in this area, in particular okay, so this was again unknown hence we named this as an Kangra Valley fault okay because it cuts through the Kangra Valley, so if I show you this photograph you will see that how beautifully you can pick up the active fault using satellite data.

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I think you can easily make out that where the fault goes okay because the faults, the active faults will cut the young surfaces or the terraces okay, the fault runs somewhere here like this and most prominent was for here, it goes like this and further aside okay, this was one of the very beautiful fault which we found and one strand which goes here okay.

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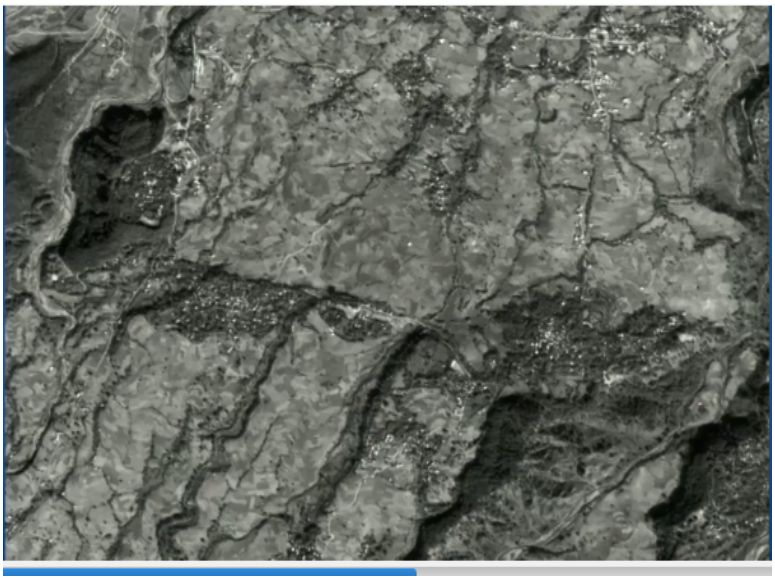

Close up of that and this I am showing is the CARTOSAT data which is having, orthophotographs and having the capability of generating 3d okay that is we are using stereo photographs okay.

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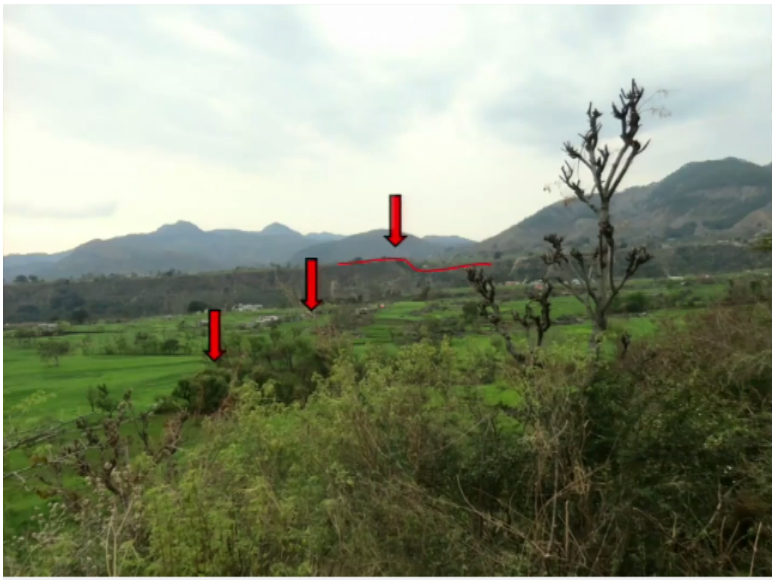

So, this is the ground photograph of that further coming to the other part here, we were able to pick up the displacement, the fault runs here and this part is down, this is down. this is up, if you take in profile here, the fault is running like that okay now, this goes like this okay further this sides.

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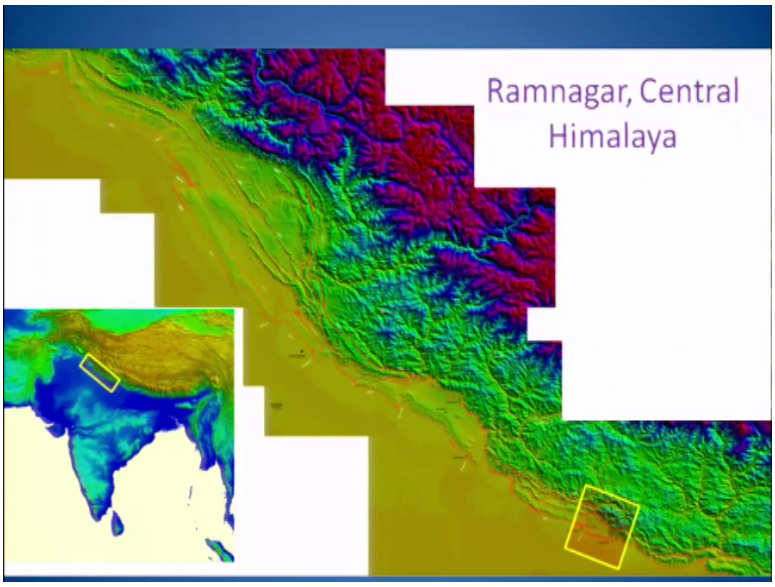

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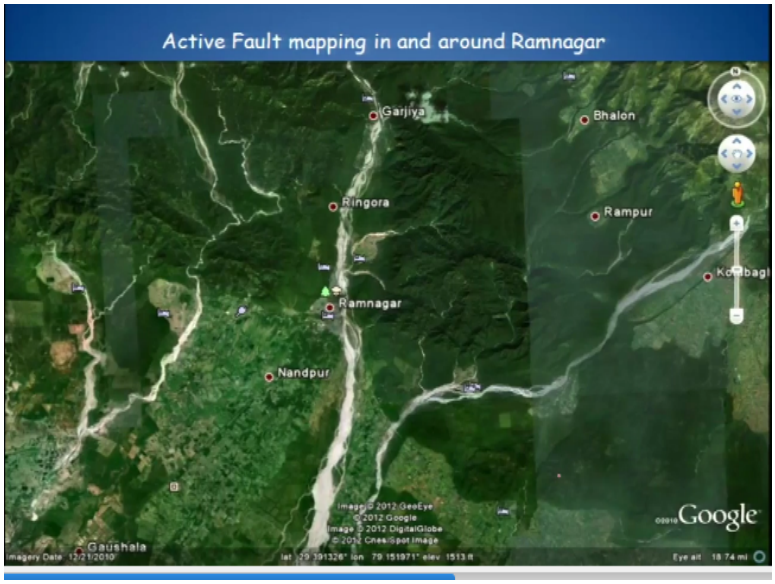

Coming to another part, this is a very well-known area that is your Ram Nagar where you have the Corbett Park, okay, so they are again very beautiful example of the shifting of channels was been screened and this is the contact between the Indo Gangetic plain and Himalayas okay that is the boundary of the active that is active fault or the active plate boundary over here, the side is Indo Gangetic plain and there you get into the Shiwaliks and the other land forms.

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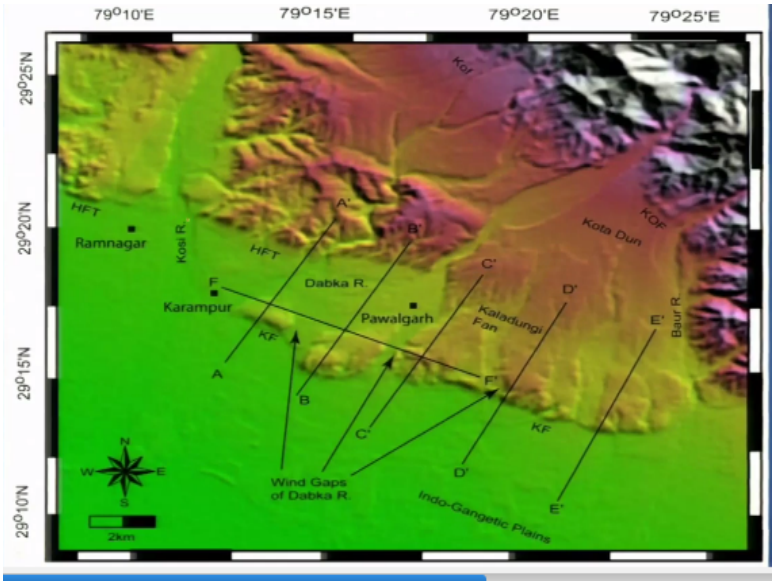

Again, we did a very similar thing, we extracted the data, there is again SRTM data we did, we took and we identified a different contact which are important for us to identify the active fault trace as well as we obtained or extracted topographic profiles out of this, okay.

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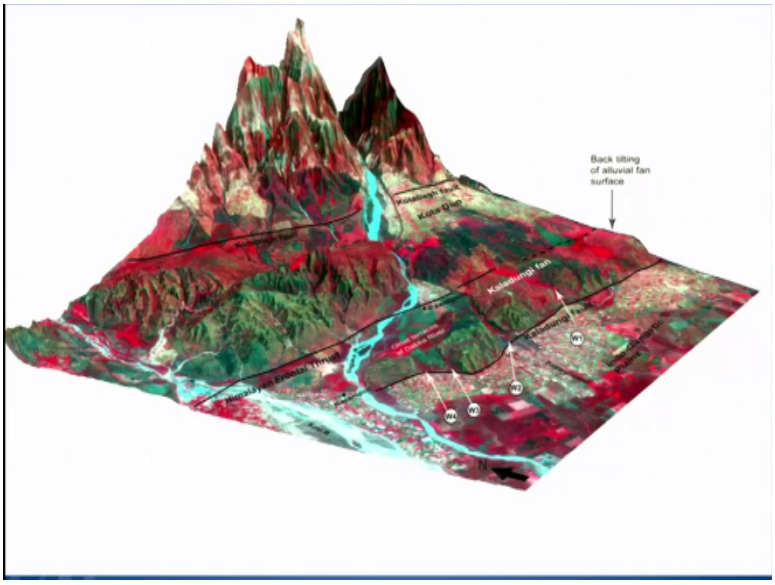

Now, this is what we found with that on the surface, we see that this channel flowed through this valley once upon a time, okay and this we named as a wind gap 2, okay, this belongs to there is a Dabka river which is exist, which is present, it flows through this area over here but this earlier flowed through this one, then second flow was across this, third was across this and now it is present again, this is an example of fault or related fault propagation, okay.

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And this is another one is of the Bow river, which flowed through this region, okay. So, in field, you can easily make out the hanging valleys okay, so this is a false scarp here, so you are sitting here, this is an Indo Gangetic plain and then what you see here is the false scrap, so within the false scrap, if what we were talking about the channels which were left out or the paleo channels, this is atypical of that okay.

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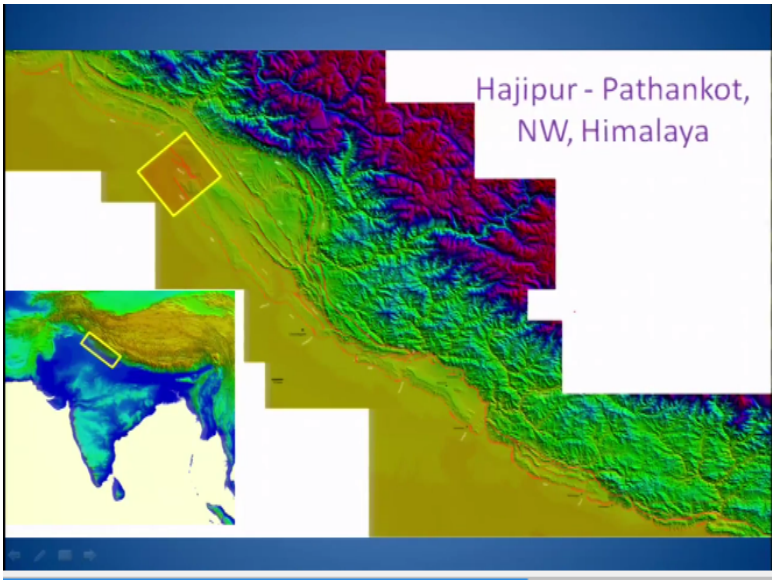

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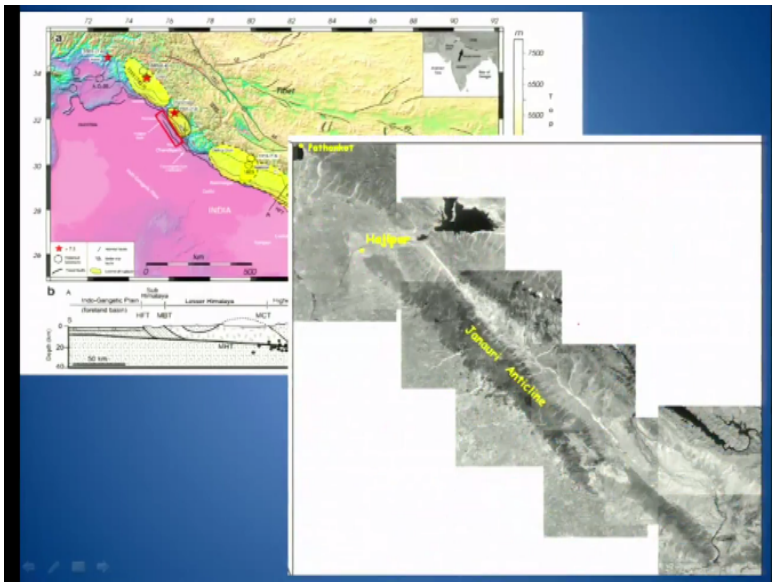

So, this is a one cliff of the Dabka channel through which it flowed okay. Now coming back again to this the area which I talked about the Pathankot are exactly the Hajipur area and Pathankot region.

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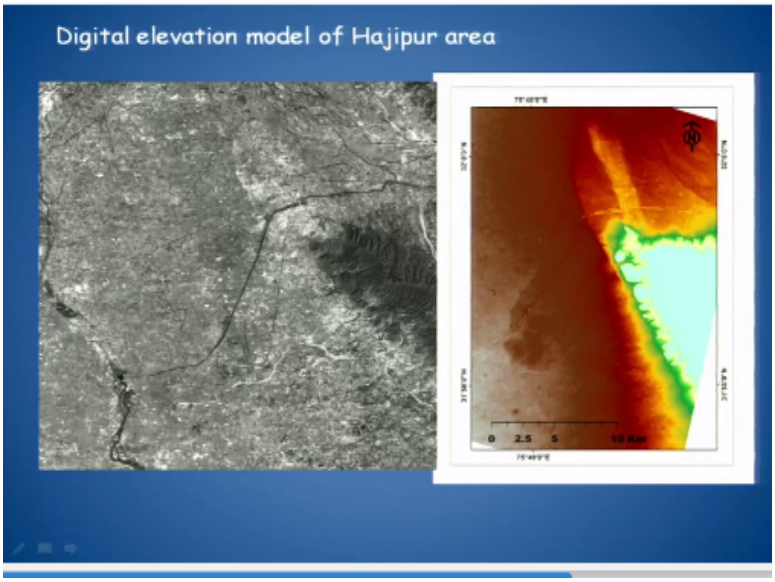

What we found was that 2 hydro power stations are sitting exactly on the top of that okay, at the same time I would like to emphasize here that what we did was; we generated digital elevation model, okay so this is a different form of using the satellite data and trying to pick up your features or the prominent features which exists on the Earth's surface okay. So, what we were talking in the previous slides that a tongue shape feature is this one here.

Now, if you see this in the digital elevation model, you will be able to make out easily that this tongue shape feature is over here, okay and clear cut fault traces.

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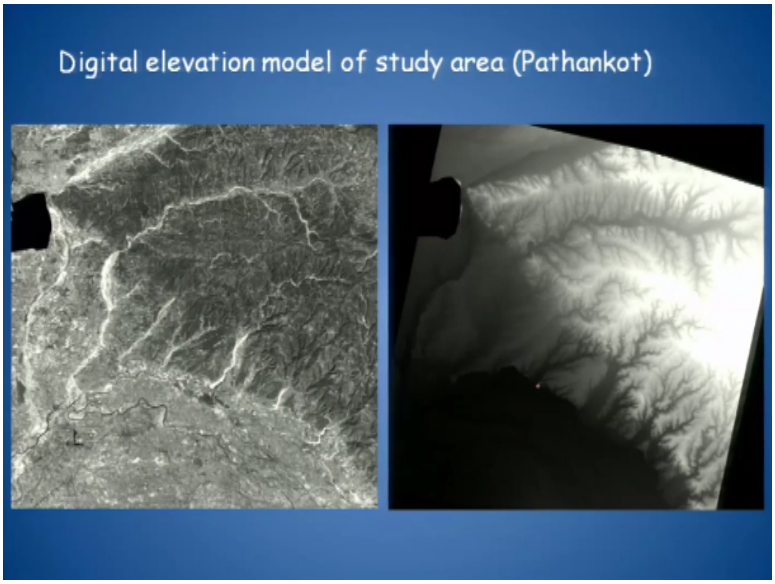

Another we tried with generating the digital elevation model which you can use where you can extract the drainage, this was again using the high resolution satellite data particularly, the CARTOSAT data okay, so this is a raw data and this is what we generated using 2 photographs

that is after and forward stereo photographs and we generated using the anaglyphs, okay. So, this also you can do using the satellite data, okay.

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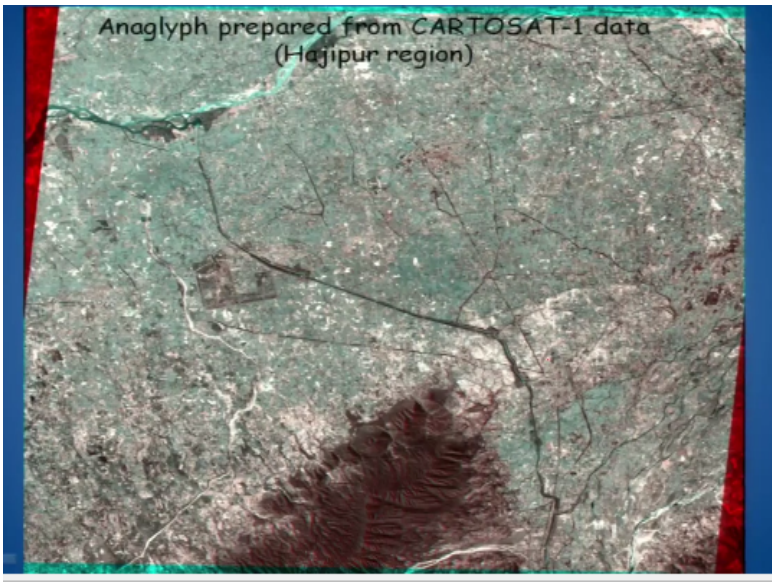

Again, this is an example of anaglyph, which you will be doing one of the exercise, we will give you in a form of a lab where you will use this anaglyph and try to identify the landforms okay.

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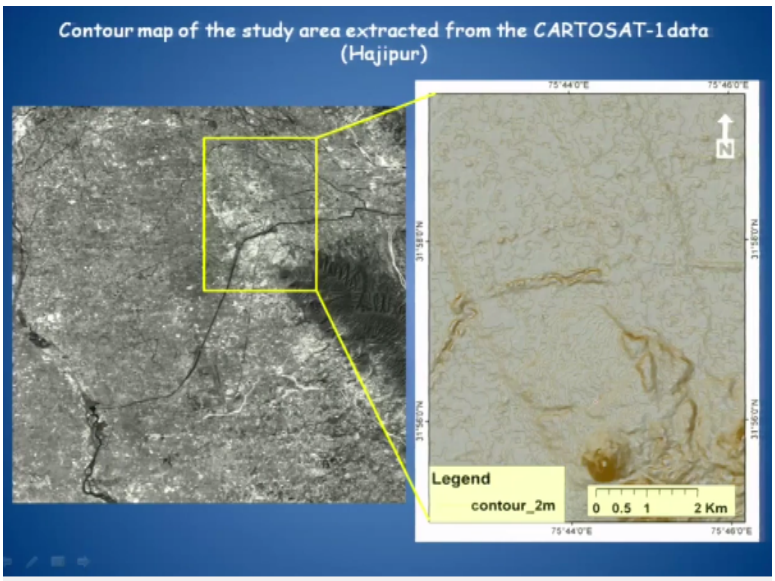

Even you can generate the contour map using the same data, okay.

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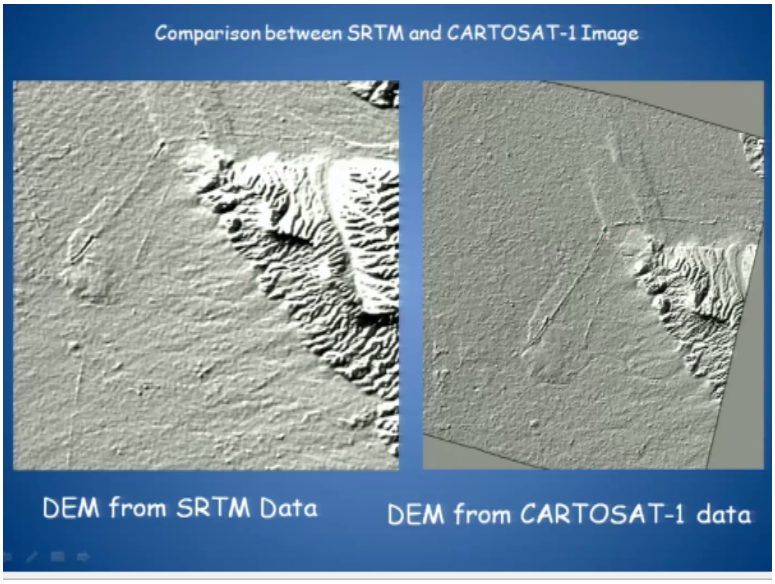

Now, this is just in comparison which we did and what we found between the SRTM data and the CARTOSAT data and what we found was the CARTOSAT data was much more like better in the sense in terms of the precision okay also, it gave the; the resolution was much better as compared to the SRTM data.

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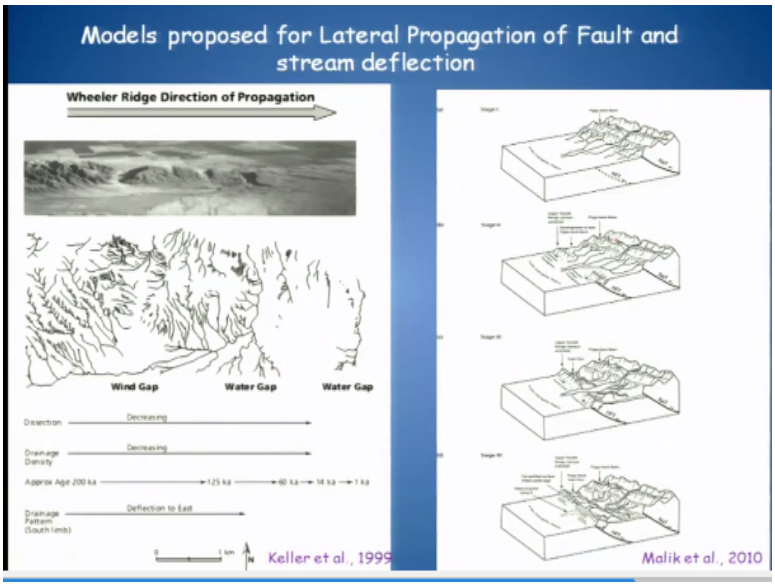

Now, this is what I discussed already, so I will move further little quickly about the Hajipur fault, these when compared with one of the example from US, which talks about the similar propagation of the fault and related fold leaving behind the wind gaps or the water gaps, okay and the same example I was discussing from the central Himalaya that is close to Ram Nagar for the Dabka River, okay.

So, these are the features which are very commonly seen in fold and thrust belt of a mountain building activity or any region which is seismically active or having the on-going deformation okay.

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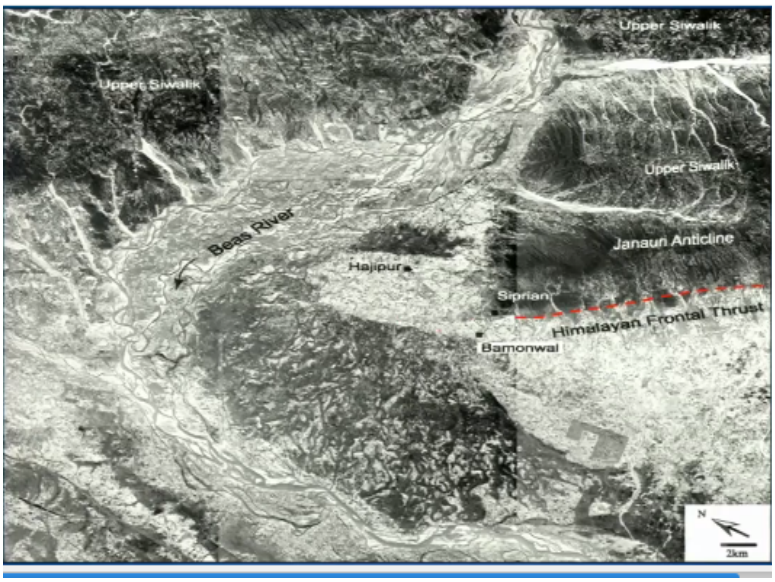

So, again directly coming to that now, this is one thing which I was talking about that if you carefully see, if you want I can remove the features here and one can look at that what exactly one can identify using 2 different types of photographs okay and 2 different type of photographs I would say in precisely that of different time span, okay. Now, this photograph I will just delete for your understanding but we can have this later on if you required.

Now, this photograph was taken, this is corona satellite photo which was taken almost like 45 years back okay, so we have a very clear indication here of the tongue shape, which I was describing in couple of slides previous slides but we do not see any structure on top of this okay but when you see the recent photographs that is CARTOSAT photographs what you see in this area it alarming okay.

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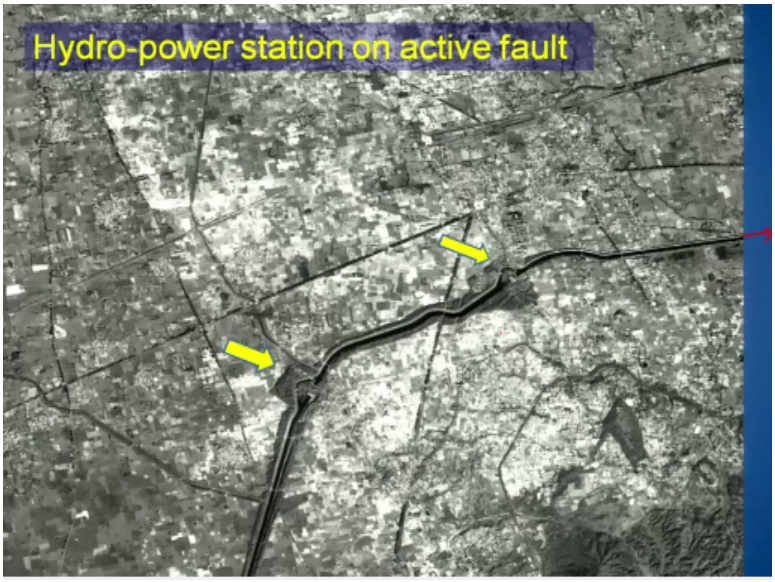

This is what you see okay now, to just orient yourself, this is the tongue shape feature here which goes probably from here, this place and then it goes like over here. Now, these are 2 hydro power stations sitting on top of this fault, okay. So, if you trace back this in the previous, so they have been constructed here and another one is over here okay and this figure or this photograph does not show the existence of Beas Dam; Beas Dam came much later okay.

So, maybe in 70's, the Beas dam was constructed and then, so this is a reservoir which exists and what they did was; they took the canal from here, put one hydro power station here and another hole here and then they came out okay, so this was the trace which you see here okay. So, Beas Dam is somewhere this side okay, so this is a tongue shape, so this is one fault trace over here and there is another fault trace, which is over here.

I will remove the lines after I finished this okay, so if you see this, you can easily make out that this is a big mistake which has been done putting two hydro power stations exactly on the top of that okay which is absolutely not allowed and not permissible, okay but this has been done by the civil engineers and I would not say that it was their mistake, the mistakes of where of the geologists okay.

The geologists were not able to pick up this fault and they were unaware of such deformation that exists, okay but it is now our duty to at least inform the government that this is what it has been done, okay and should not be repeated in future, we cannot dismantle the complete system here, it is difficulty, so hydro power stations on active fault.

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This is the close up of that so, you see in Google Earth, there is a hydro power station, the fault runs here and this is the canal which is cross; which crosses the hydro power station, okay so, whenever there will be an earthquake now, our studies it says that the displacement which is expected on this fault will be almost like 9 meters okay that is the slip on the fault and 3 to 3.5 meter will be a vertical displacement.

Now, this will surely rupture or destroy or damage this canal as well as the hydro power station because hydropower station is sitting exactly on the fault okay, so the local area will be surely affected by flooding unless and until they close the gates of the Beas Dam, okay, so this is one of the important part which I wanted to tell you and show you that how important is to identify the active faults and active structures before going for instruction, okay.

I will stop here, we will continue in the next lecture with a different topic or maybe few slides if they are left out we will talk on the, this particular part okay, thank you so much.