Photogeology in Terrain Evaluation (Part – 2)
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Lecture - 11
Photo Interpretations: Lithology of Sedimentary and Intrusive Igneous Rocks

Welcome back. So during our last lecture, we were talking about different landforms on this particular image.

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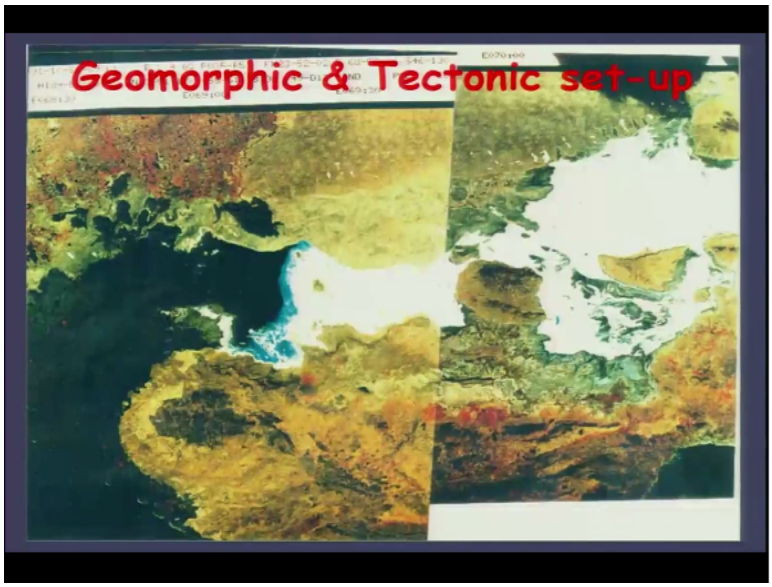

And as we discussed in the beginning that one can use the satellite data to identify different rock types as well as the landforms which we see on the surface okay. So as I discussed in great details in this whole area which has very diverse landforms is one of the most important to know the different environment okay.

So here in this satellite data particularly the Landsat data which we are looking at right now is a false color composite data which shows many different landscape okay which belongs to different environment what is what we discussed in North okay is your Thar Desert here.

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And this marks the boundary between the desert and a marshy land. So research which people have done in this area based on that people have talked about that this whole portion okay which you see from here this boundary and goes down is an indicative of ancient delta complex okay. Now this I would relate it with very much similar to what we are having is Sundarban Delta in Bengal area okay in Northeast India.

So this particular area is termed as the Paleo-delta complex. I am not going to get into the detail of the research which has been done on this but yes of course the research groups have talked about that there were mighty rivers which used to flow into this region particularly okay which was a part of the existing Arabian Sea okay. So this was a shallow inlet of the sea and if I go into little more detail about the Kachchh okay.

And particularly the landscape of Kachchh and then Kachchh itself in Gujarati is termed as Kachba. Kachba is like the tortoise okay and which used to remain covered or encircled by sea okay but now there is no sea there only the western portion is having the sea but the area which used to be inundated or remained under the shallow sea inlet was this your delta complex okay.

And where you see now the great Rann of Kachchh which is completely salt and crustated area okay and if you look at this location that is in Dholavira which used to be one of the largest settlement okay of Harappans. So now if you consider that this landscape which exists now absolutely cannot favor the settlement in this area but in the past as Harappans mostly

they use the way of moving from one place to another place transportation was through navigation and so water bodies definitely were there at that time okay.

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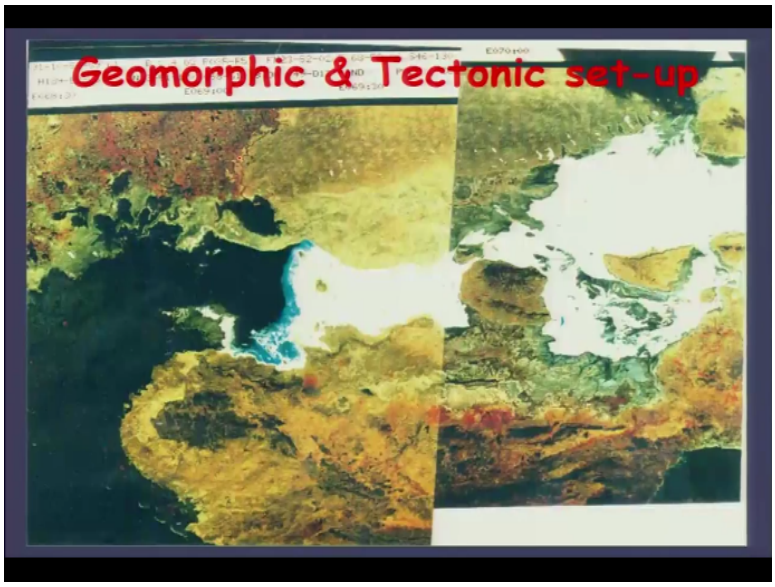

The another important part which I would like to highlight here is that if you make a note here okay what you have is a very dark patch of course as the reflectance is different than the surrounding area and this is a small pond. Now this pond is getting the feed from this channel which still exists.

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And this was the Satadru channel or the Nara channel which used to flow through this across this landform and then getting into the Kori Creek okay but now it is not because of the upliftment of this landform along this fault plane okay or the fault line that is Allah Bund. So

this happened as per the information or the historical chronicles what it says that this landform got uplifted in 1819 and that was the event of Allah Bund.

But our research suggests that probably there were more events which happened in the past but the 1819 was the event which finally blocked this river channel and did not allow it to flow through this area okay. So now this exists as a small pond here where the stream comes or getting deposition to this area okay. So if you consider this that if this is blocked then definitely this area is up and this is down here okay.

So this also helps us in an understanding that okay what could be the landscape in this area okay and if you see the ground photograph of this pond, it is somewhere here like this okay.

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So you see the pond and very huge area okay which has been covered by this okay.

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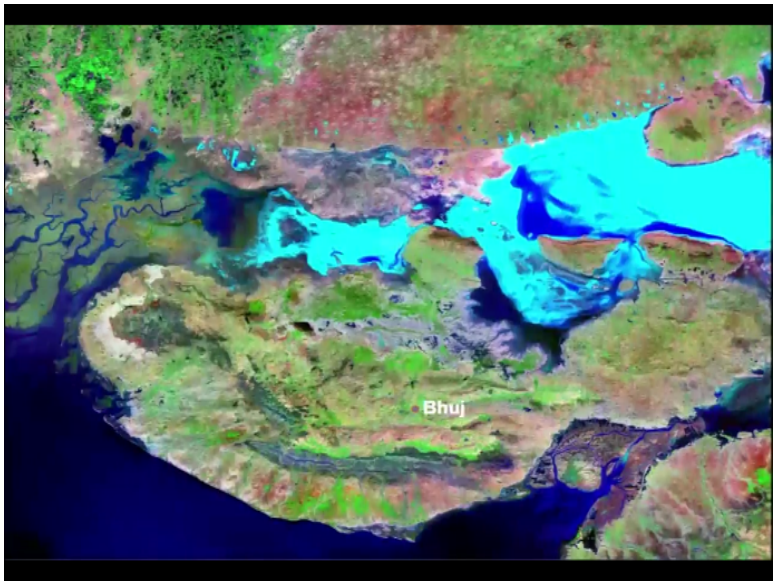

Now moving further this again on Landsat data with the different bands which also helps us in identifying the clear landforms okay which we can demarcate easily okay fine. So these are all like here if you see these are all igneous rocks and on the periphery you see all tertiary rocks and here also you are having this mainly this sandstone bodies and all that okay fine and in form of the landforms if you pick up these are all small islands which you can outline or track from this data.

And then as I was talking about there is a pond, very small pond and it is connected through this channel okay. So this channel is feeding this pond here but it does not allow the channel to flow across this brazed landform and here we are having the boundary between the Thar Desert and the marshy land here okay fine and the Creek area which I was talking about the Kori Creek you can see on this okay.

So this is another way to enhance the image and try to see and identify different landforms and do the terrain evaluation okay.

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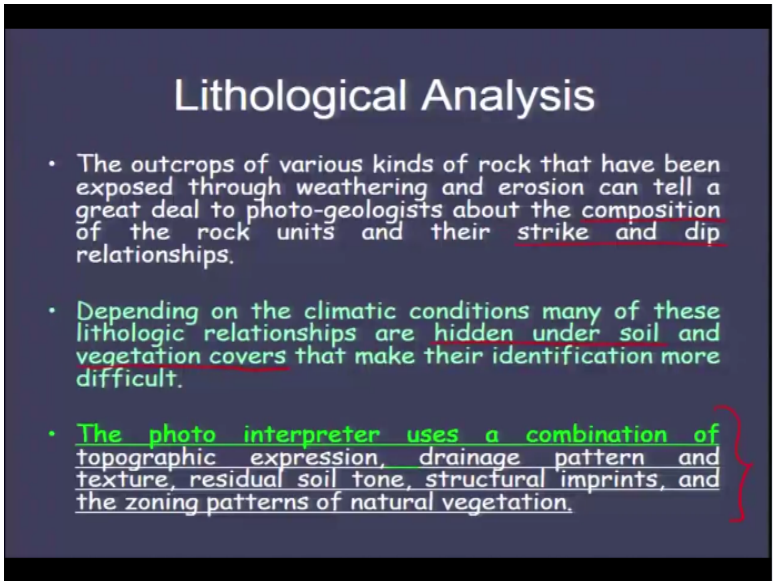

Now coming the other part of the lithological analysis, mostly what we look at the outcrops or the landscape okay of various kind and the subsurface either it is we see rock or maybe we come across the soil or loose material or alluvium okay. So they outcrop of various kinds of rocks that have been exposed through weathering and erosion can tell us great in detail about the composition of the rock units and their strike and dip relationship.

This is a part of the structural part but also it talks about so what basically we will be able to gather is one is the structural part here and another is a composition to some extent okay fine. This can be done using the land satellite photographs. Now depending on the climate again, many of these lithological relationships are hidden. So you will not be able to see the clear-cut landforms, which reflects the typical type of rocks or the environment.

Because they are hidden under the soil and thick vegetation okay. This of course the limitation okay towards the identification okay. Hence, it makes a bit difficult to identify the landforms or the subsurface features okay or the lithology you can say. The photo interpretation basically we use a combination of topographic expression, drainage pattern, texture, the tone of residual soil, structural imprints.

These are the geological structures and zoning pattern of natural vegetation. So these are few very important points or the parameters which you will take into consideration okay. Mainly the topography okay because not all areas which are having different type of rocks or the environment will have similar topography okay. Some areas you will have a very flat terrain; some areas you will have typical hilly terrains okay.

So that will also tell you about the environment of that particular area plus as I have been emphasizing since long that drainage pattern also reflects the subsurface little or mainly okay and along with that the structural elements okay what we are talking about either the area is folded or either the area is jointed okay that will also tell us to some extent about the terrain okay and it has been seen that not all areas on the earth's surface will have similar vegetation.

It will vary from place to place, it will vary from one terrain to another terrain okay, so these are the important points which you should keep in mind while doing the photo interpretations okay.

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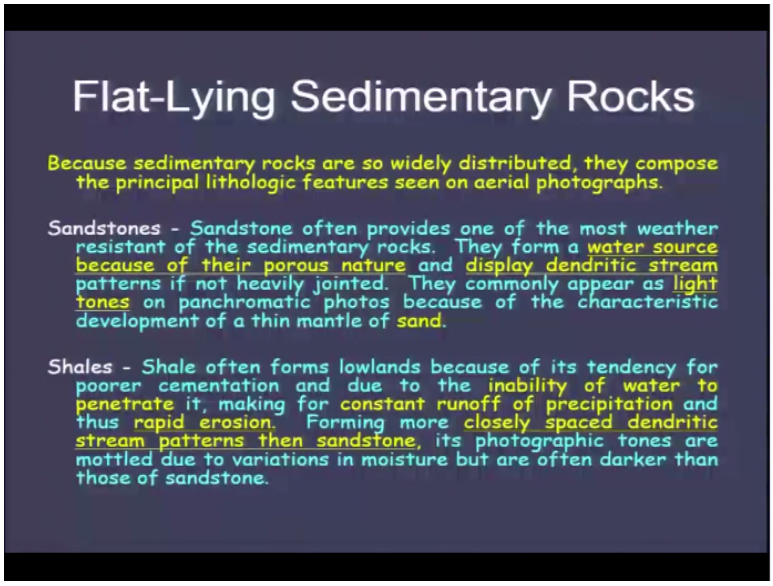

For example, flat-lying sedimentary rocks okay usually are seen because sedimentary rocks are so widely distributed. They compose the principle, lithological feature seen on aerial photographs okay. Coming to another part this thing the sedimentary rock, sandstone which we usually come across okay. Sandstone often provides one of the most weather resistant of the sedimentary rocks okay.

They form a water source because they are porous in nature and display a typical pattern of drainage which we term as dendritic pattern. If not heavily jointed okay, then you will be able to see the dendritic pattern and if they are heavily jointed or fractured then you would not be able to see a typical drainage which we term as a dendritic pattern okay. They commonly appear as light tone okay on panchromatic photos because of the characteristic development of thin mantle of sand okay.

So thin cover of sand usually will give you a very bright tone as compared to the other rocks okay. Now in comparison to that so we have shale okay often forms landform lowlands okay mainly lowlands because of a tendency for poor cementation and due to the inability of water to penetrate okay through it making the constant runoff of precipitation and this rapid erosion okay.

So in terms of the sandstone what we learn was that it is a porous rock okay whereas this is not porous okay. So this will result into closely spaced dendritic streams okay or a pattern as compared to the sandstone. So sandstone will have slightly widely spaced streams okay or the drainage pattern but this will have very closely spaced dendritic pattern, its photographic tone are mottled due to variation in moisture but are often darker than the sandstones okay.

You can consider these two most commonly seen or engraved rocks in sedimentary environment okay then you can easily make out the difference between this two okay. Now let us see how it looks like on photographs okay.

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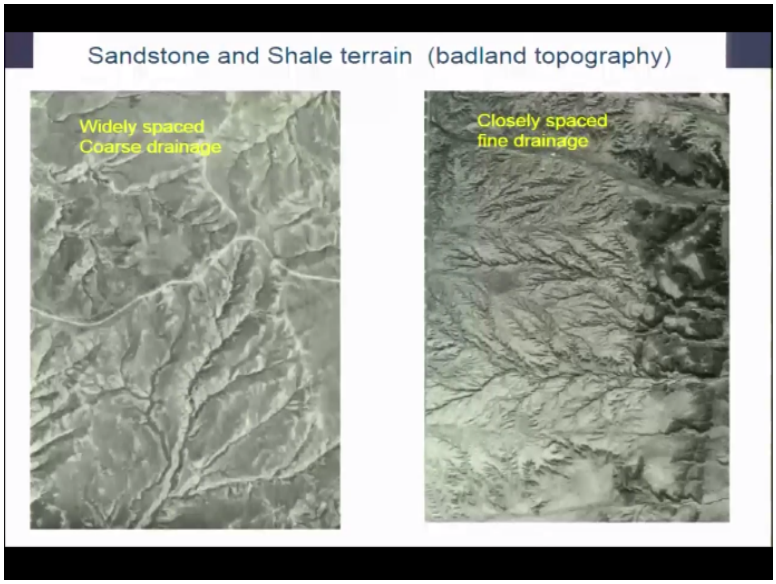

As we discussed, one will be having visible so the sandstone is porous whereas the shale is not so much porous as compared to the sandstone okay. Sandstone will appear brighter; shale will appear darker okay. Sandstone will have widely spaced drainage, shale will have close spaced drainage okay because of it is not allowing the water to penetrate or percolate down and allowing the constant erosion okay.

So on your right is your shale and on your left is your sandstone okay. So you can easily make out at least looking to these two photographs, our similar type of photographs to identify the subsurface lithology okay. You can see the drainages are widely spaced where here the drainages are very closely spaced, very fine drainage okay whereas this we say very coarse drainage okay.

So these are the two very good examples which can straight away tell you about the subsurface lithology. Now here what we have done, we have simply used the drainage pattern as one of the criteria to identify the different land lithology. If we look at the further details of sandstone and shale okay what we need to keep in mind while identifying the sandstone terrain okay or the terrain which is composed of sandstone okay.

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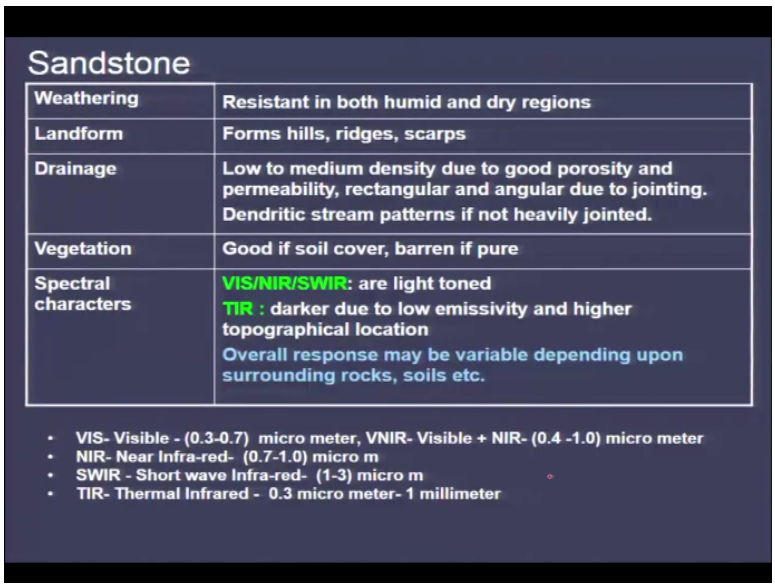

Now we have several parameters here which we can keep in mind and there is the one is the spectral characteristics so we are not going to get into the detail but I feel this is important because we see some tonal variations and use the tonal variation to identify different rocks okay. Now for example weathering if you take the sandstone are resistance to weathering and mostly if you look at either it is in humid terrain or in the dry regions okay.

And in terms of the landforms which will be a form because of the erosion in the sandstone terrain will be like hills, ridges and scarps. Drainage is what will be reflected on the surface will be low to medium density and that is due to good porosity and permeability because of water, it will not allow water to flow over it okay. So runoff will be very less and it has a

tendency to show rectangular or angular drainage pattern and that may be due to the joints which are present okay.

So jointed terrain will have rectangular and angular drainage pattern okay. Dendritic stream pattern if not heavily jointed okay, so unless and until if you are not having very fractured rocks or the sandstone terrain then you will come across the dendritic pattern. Vegetation good if soil cover, barren if poor okay. So there is no like in dry regions you will see and barren landscape where you are having sandstone okay.

Now spectral characteristics as I told in the previous slide also they are light toned okay, darker due to low emissivity and high topographic locations okay. So in some places you may come across the darker tones and that will be because of the low emissivity and higher topographic locations. Overall response may be variable depending upon the surrounding rocks and soil etc okay.

So as we start that we can have multiple parameters which can help us in identifying, so if one does not work then we can activate another one to identify the lithological variation. Now these details are given below you can refer to VIS okay and then near infrared or shortwave infrared and all that okay. So the details are given here.

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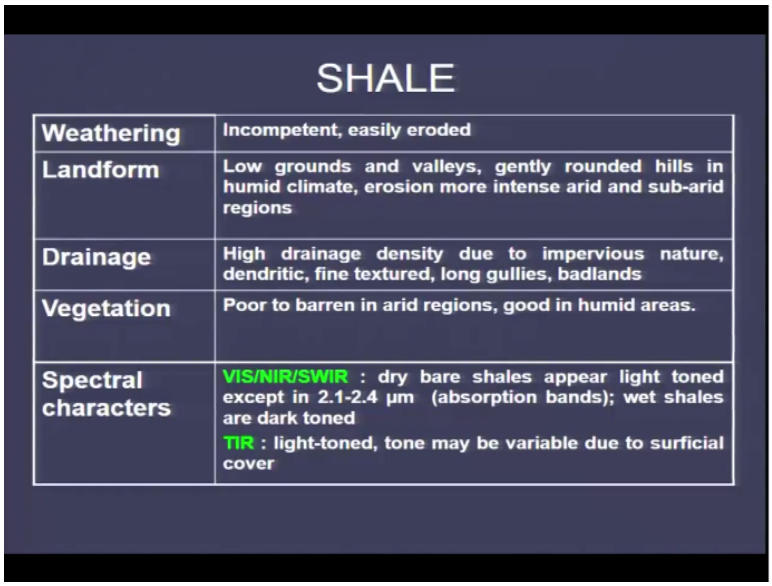

So moving further like what we have the second one is shale okay. Now in terms of the weathering so incompetent, easily eroded okay. In terms of the landforms, low grounds and valleys gently rounded okay, hills in humid climate because of the erosion is more or intense

and erosion more intense in arid and sub-arid regions okay. So we can have low grounds with rounded hills okay.

Drainage density will be higher as compared to the sandstone and that is due to its impervious nature okay and the drainage pattern you will see dendritic, fine, long gullies and what we say badland topography okay as you have seen in the previous slides, go and refer that okay. Vegetation poor to barren in arid region, good in humid areas okay and then further other details have been given here which you can refer okay fine.

So shales usually in dry bare shale appears slightly lighter tone okay otherwise usually if it is rich or enriched with water okay. If it is wet, then you will be able to see a very dark tone okay fine. This also can help you (()) (20:34). Now if you say that no, no that you said that sandstone is light tone but then you can look at the drainage okay, the high density but drainage density will be seen in terms of the shale.

So that is what I would like to emphasize that you can use different parameters to identify the terrain very carefully okay.

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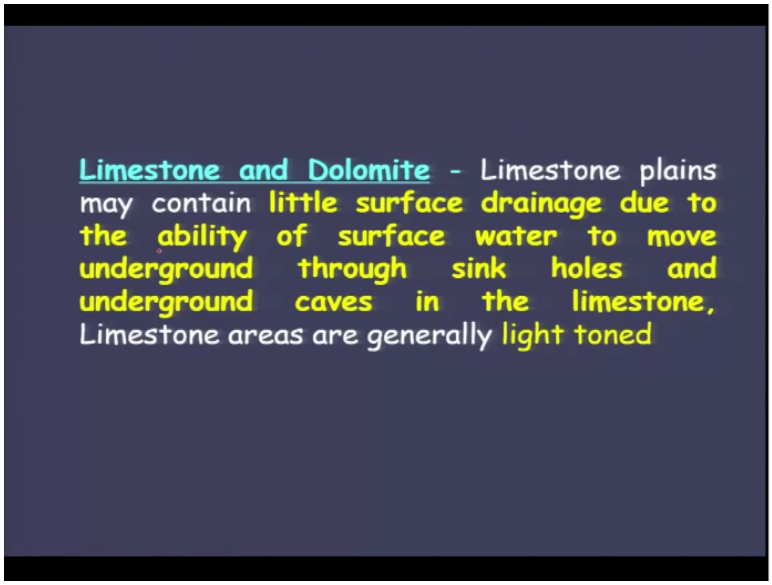

Moving further in terms of the limestone or the Dolomites okay. Now limestone plains may contain little surface drainage okay due to the ability of surface or the ability of surface water to move underground okay. So it will move underground through sinkholes and underground caves in the limestone okay. So this is a typical of a limestone terrain.

Limestone terrain you will have very poor drainage okay on the surface and mostly you will see Karst topography which usually we look at that it will have lot of potholes okay or we can say sinkholes in that okay because the subsurface dissolution activity will not allow the water to flow on the surface but it usually flow subsurface and it keep eroding okay. So formation of the caves underground is basically related to your subsurface dissolution activity okay.

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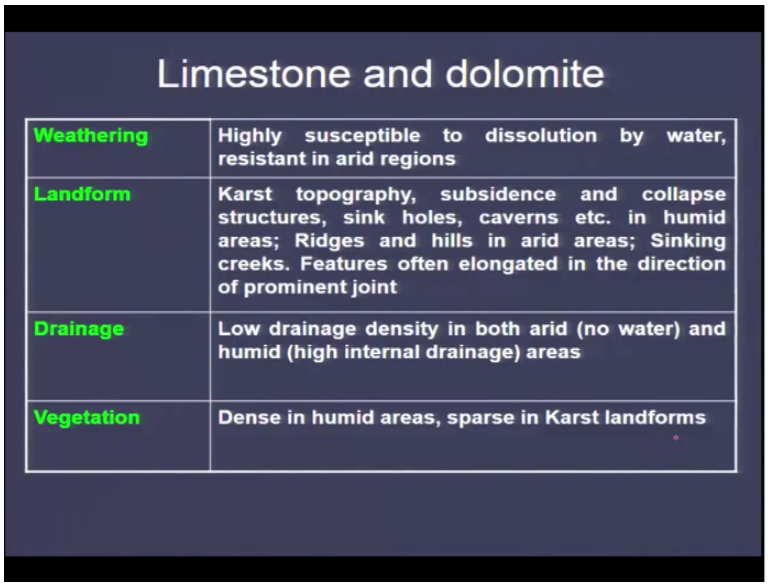

So in terms of the limestone weathering part if you take highly susceptible to dissolution by water resistant in arid regions and the topography which we see is termed as Karst topography okay. Subsidence and collapse structures are very common in such areas okay and it will show a formation of sink holes okay in humid areas ridges and hills in arid areas, sinking creeks etc in the coastal regions features often elongated in the direction of prominent joints okay.

So these are one of the most common topographic features which you will see in limestone terrain okay. Then, in terms of the drainage low drainage density in both arid and humid regions okay. Dense in humid area and vegetation has sparse in Karst topography landforms okay.

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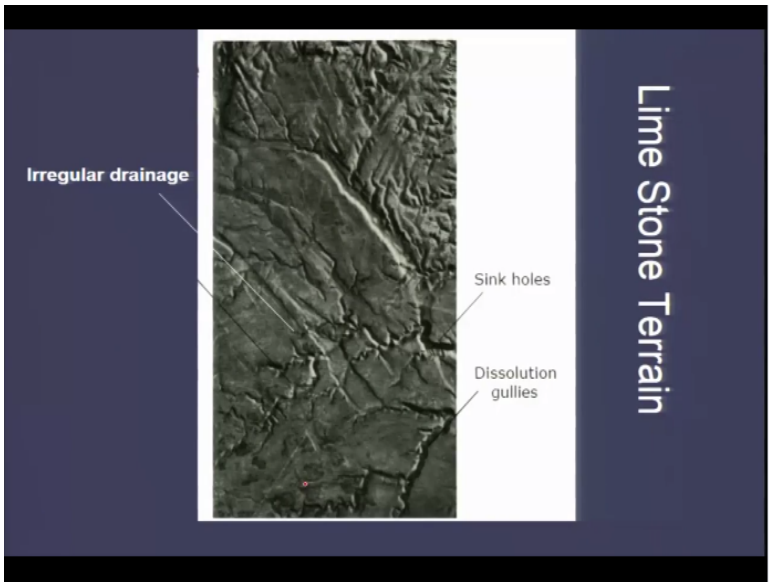

So this is an example of limestone where you can see the typical collapsed structures, sink holes, dissolution gullies okay and then to some extent you have you can see the very linear joints okay which exist on the surface. So again the drainage which you see is highly irregular here, irregular in the sense sometimes you see the drainage exists and then further you will not be able to trace out the drainage okay.

So this is again a very typical of a limestone terrain, so this photograph shows a typical gullies and then you have irregular drainages as well as the linear joints or the fractures which runs very straight okay.

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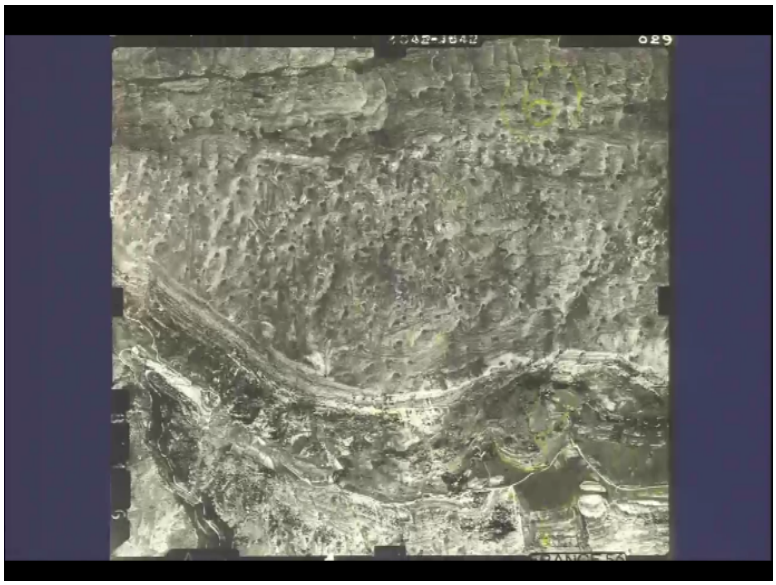

Another photograph as I was talking about that you can easily make out if you are having the subsurface limestone terrain of course the drainage is extremely poor here but we see very

small dark patches here, these are all sinkholes, a typical of the Karst topography okay. Now such areas should not be used for constructing a lifeline structures okay and even if you are going to have the construction should be ready to face the consequences. In future, you may come across the collapses okay.

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So these are typical of the potholes, so very subdued topography you will be able to see okay with rounded hills and ranges okay in a limestone terrain.

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And as I told that we should be ready to face such type of sudden subsidence or the collapse because the subsurface erosion is continuous okay and you may come across because in typical of the development of the sinkhole, now this big sinkhole which you see here you can make out the size based on the motor cars which are sitting here okay fine. So really a huge

sinkhole which was been developed okay because of the subsurface erosion in a limestone terrain. I will stop here and we will continue in the next lecture okay.