Photogeology in Terrain Evaluation (Part – 2)

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Lecture – 10
Photo-Interpretation: Lithology and Geomorphic Mapping

So, welcome back after talking about the active faults and the folds and other structures now, let us talk something which is also an important part about the lithology. So, as I was talking in the previous lecture that from one aspect okay, why the lithology is so important and we need to know before going for the site evaluation, so we will see that how best we can use the satellite data to identify the subsurface lithology.

Now, before I get into the detail, let me tell you the most one of the best and basic way which we have been using okay to know the that is subsurface lithology is the drainages, okay on the surface which have developed or you can say the credit system okay, the pattern of the streams and all that okay that is very important to understand and know the subsurface lithology, okay.

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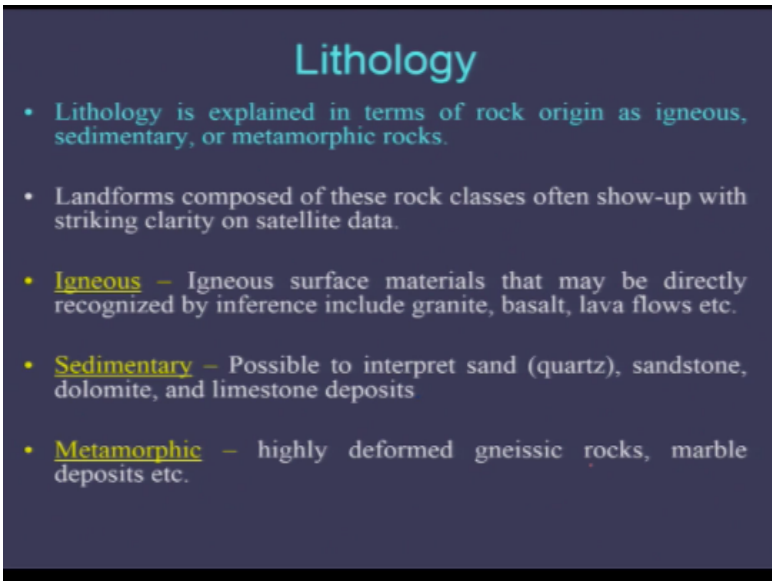

So, basically the lithology explained in terms of rock origin, we usually talk about because we have 3 type of different rocks okay that is igneous, metamorphic and sedimentary rocks, okay so, keeping that in mind because the crust what we talk the earth crust is mainly consists of this 3 rocks, okay and of course, the alluvium is there okay but that is an again the product which we get in terms of the smaller particles and loose material in the plain areas okay.

But mostly, the crust you will see, we have all this type; igneous metamorphic and alluvium we are having, so one sedimentary rocks okay, so mainly it explains origin as sedimentary metamorphic or igneous rocks. Now, landforms composed of these rocks okay can often show up with striking clarity on satellite data, you will be able to differentiate that this area of course, is having a different lithology than the surrounding one based on the some very striking features okay that we will see, okay.

Now, if you take the igneous rocks; igneous rock; igneous surface material that may be directly recognized by inference includes granite, basalt and lava flows okay, so this terrain or the surfaces which are in the igneous terrain okay or the volcanic terrain where you are bound to see the granites, okay which are again an intrusive rock okay but basalt and lava flows they are coming right up to the surface.

So, you will be able to easily pick up that saying that okay fine this features are indicative of granitic terrain or this features are indicating of basaltic terrain or a lava flow, okay fine. Sedimentary; coming to that possible to interpret sand that is quartz, sandstone, dolomite and limestone deposits okay because this deposit if you are having an sandy deposit, you will be able to pick up either you can talk about based on the tonal variations, you will be able to say.

And in the previous one also again based on the tonal variations, you can differentiate between granitic terrain and basaltic terrains, okay because the reflectance which you are going to get the tones which we are going to see the variation okay on the satellite data will be very demarcating, okay. So, similarly in sedimentary sand when we say quartz, so we will have very high reflectance, sandstone again is mostly comprised of quartz grains.

And dolomite and limestone will have different effect, okay and then for example, in limestone, you will have the karst topography or where you can say we would not be able to go for any construction and all that you will see and big pot holes' type things okay, so those are the indications of that. Now, metamorphic rock as soon as we talk about they are very highly deformed rocks or the; and the processes where these rocks okay, igneous and metamorphic rocks are getting metamorphosed, okay.

So, I am not going to go into the detail of the plate tectonics and all that and what is the relation of the plate tectonics and the rock cycle here, you can refer to that in my previous lectures okay.

So, basically the metamorphics are highly deformed rocks okay and one of the rock which we can easily pick up is gneissic rocks and the marble and all that okay, so this deposits or the rocks succession, if they exist on the; in any area, we can be easily picked up, okay.

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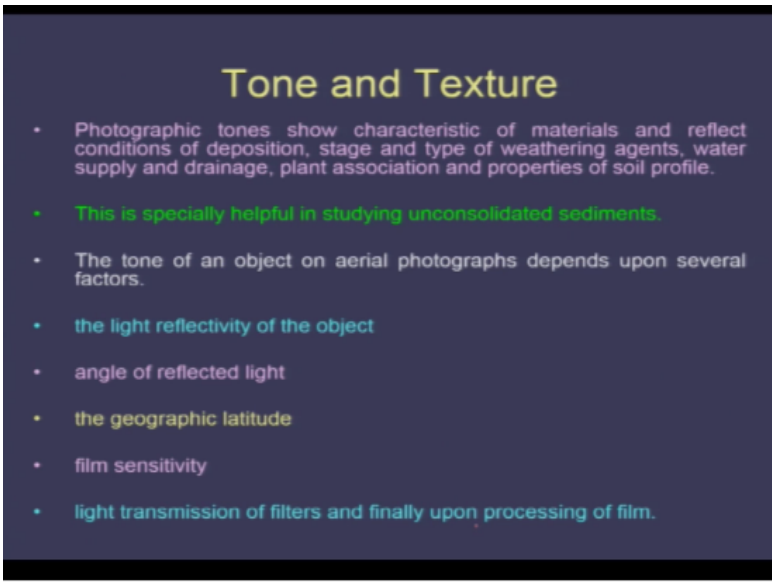

So, tonal and texture variations basically, we emphasize on that because we are not going physically to the field but we are using the high resolution satellite data for identifying the terrain okay or the rock types, okay. So, photographic tones show characteristic of material and reflect conditions of deposition, okay, stage and type of weathering agents, so this you will be able to identify and then we will see some examples.

And we will also come up with labs also where we will be at least doing three exercise for identifying sedimentary, metamorphic and igneous rock terrain, okay. Then, it also tried to tell us about the water supply in drainage, plant association and property of soil profile also okay because not all terrains or the all areas if you take will have similar vegetation; vegetation also will depend on the subsurface lithology or the soil type, okay.

So, this is specially helpful in studying unconsolidated sediments okay, the tone of an object on aerial photo depends upon several factors which are given below; one is the light reflectivity of the object or the surface, second; the angle of a reflected light which your data is going to collect or the; and then geographic latitude, film sensitivity, light transmission of filter and final upon the processing of film, okay.

So, there are factors which will again affect the tonal variation so, the point here is to that of course, we understand to some extent that different material will have different reflectance, okay but sometime, the other factors which will play role in getting you different tones are listed here okay, so that at what angle your light is reflected back, okay and then who and what latitude you are in okay because that is an angle will have different sun rays will have different angle at different point okay so that is again an important point.

And then, what type of film you are using either you are using a simple film, a normal film or you are using a panchromatic film okay, where you will have a different shade which are; which will be recorded based on the different reflectance okay and the light transmission; what type of filters you have used and all that okay. So, along with that one has to keep that in mind when you are getting the data with you and trying to interpret, okay.

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So that whether there is any artefact which has been added because of this factors okay, now this is a very simple colour photograph and again to show that the features you can pick up looking with photograph because of the change in tonal variation again here, okay fine. We have blue which shows the sky and this whole hill, which has been shown, has covered with have a very thick forest, okay.

But do you see a very brighter unit here, okay and very; so this is what you are able to pick up is the slide okay, landslide and this was during an Uttarkashi earthquake okay, so based on the tonal variation easily you can pick up many things, okay fine.

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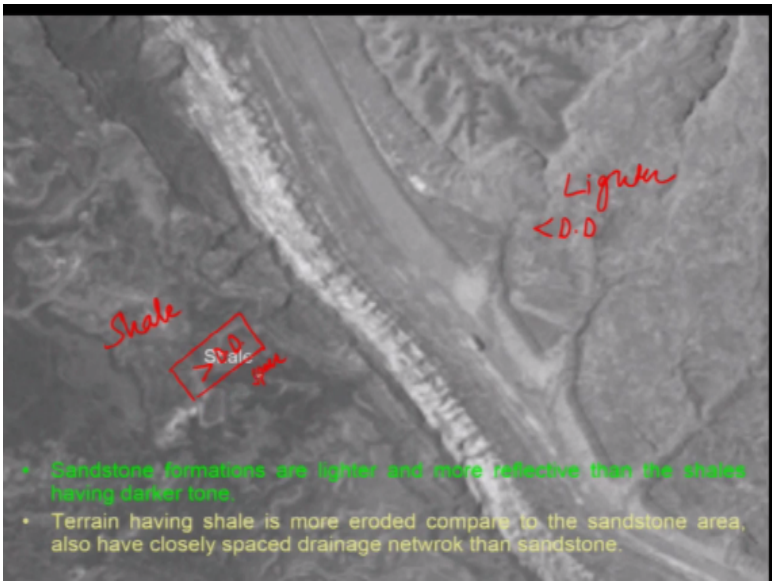

Now, coming to the other part is at this photograph, if you look at again, you can mark the structure on this and the another part is again the tonal variation, okay fine. Now, if you see you can easily demarcate that for example here okay, you have a very sharp structure which is coming here okay, so this is one boundary here and then you have a very sharp boundary here okay of course, it looks like a part of a fold.

The another part which you can pick up here is that this area is dark as compared to this area, this is lighter okay, plus another additional thing that this region or this portion okay which is that is left and right, which I am putting lighter and darker okay, the drainage density is comparatively less as compared to the darker part, okay. So, what we have taken into consideration here is that one, we can pick up the linear features.

Second is the drainage and third is your tonal variation, so let us see what exactly we are able to gather from this photograph, okay whether we are able to talk something about in terms of the lithology or not. So, the sandstone formation is lighter, so I am just removing these lines okay, so that you can have much clearer idea about, so the sandstone formation is lighter and more reflective than the shales, okay.

Now the shale and sandstone are the sedimentary rocks, both are sedimentary rocks okay. Sandstone as compared to shale is coarser, okay and will comprise mostly the fine particles; clay sized particles okay, so what it says that; that sandstone is lighter and shale is darker, okay. Another one; terrain having shale is more eroded compared to the sandstone area also have closed space drainage network than sand stone.

Now, why this area is more eroded, when I say the clay sized particle, they are; they will not allow the water to percolate down okay fine, so as we were talking about that the lighter tone and the darker tone and all that now, shale another important property which one can look for is because we have the; shales are comprised of very fine material mostly, the clay and clay have a tendency to hold water okay, fine.

No doubt it is porous but it is less permeable as compared to the sandstone; sandstone is also porous but permeable okay, so it will not hold water in terms of the sandstone, so in filtration will be very fast whereas, infiltration in shale will be very slow okay, so it will; it has an tendency to hold water and that is one of the reason that you see a closely spaced fine drainage okay.

Whereas in sandstone, you are having widely spaced and coarser drainage, network okay, we will say the drainages are very less okay, so this point you should keep in mind okay, hence this will have what we call the; of the less density okay. So, the drainage density is less whereas, here the drainage density is high okay, also you will see that there is very closely spaced drainage, okay.

Now, here you have very; I would say the closed coarse drainage because the whatever the water comes on the surface is getting percolated okay down, so this area will show comparatively less erosion okay, the lighter part which is of sandstone is less eroded as compared to the shale region, okay. So, this is a very important aspect where we have used different parameters as I told that we use the tonal variations, we use the drainage, okay which can help you in identifying the different terrain, okay.

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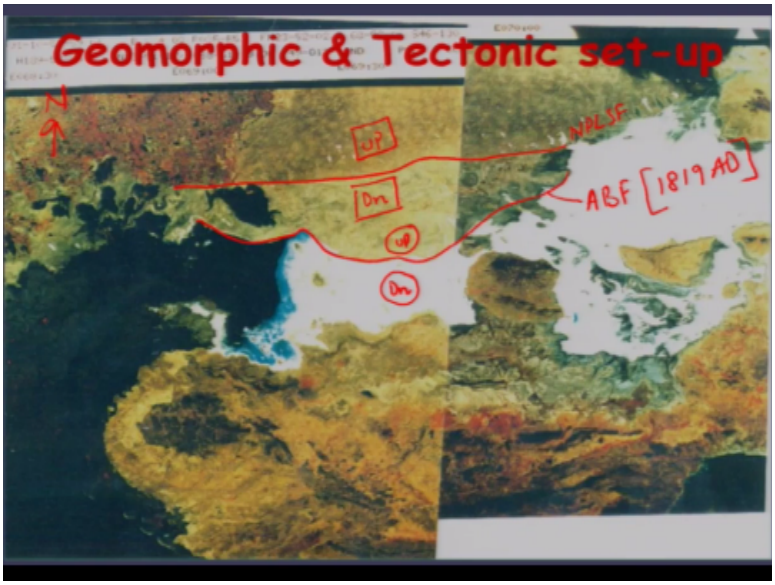

So, this is one side is shale, another is your sandstone now, maybe I might have shown you this Landsat data, okay but this always fascinate me actually, whenever we talk about the tonal variations and the landforms which we can pick up based on this okay and what are those landforms are having a different origin or they are indicating of different like environment that is extremely important for us.

Now, this is one of the best areas okay, which gives you an idea or an understanding of different environments, okay. When I say different environment is whether the environment is alien or a desert or the environment is marine or coastal areas or you are talking about the terrestrial areas or not okay, so this gives a complete broader prospective of the different landforms in this particular region, okay.

I hope, if you looking at this image, you can easily make out that which is this area I am talking about okay but those who are unable, let me tell you that this satellite data which has been shown right now on your screen is from Kutch, okay, so this is western India Gujarat and Kutch region, so what we can make out from this image? Again, this is a Landsat data, very old and this line here just is nothing but we have tried to mosaic paper print data okay.

At that time, we were not having even the; and this I am talking about when maybe in 95 or 96 okay, now just based on the; this is false colour composite data but just based on the features which we can pick up easily and we are; they are very distinct and based on the tonal variations, the boundaries which one can pick up between the different landforms, okay that is what we call geomorphic boundaries, you can identify several landforms, here okay.

So, I would like to spend some time on this image because this is very fascinating to me and but of course, you will also love to see that okay, and how we can pick up okay the different environment here, I will keep on putting some lines and then removing also over here. Now, if you see this line here okay, which is coming from this part maybe I can put that very quickly now, if you put this line on the international borders, this will match exactly with the borders of India and Pakistan okay, fine.

But for us, for the geologist's geomorphology (()) (19:01), this is merely a topographic boundary or geomorphic boundary where we have 2 different environments here okay, this completely desert what we called Thar desert and this side we are having a marshy land, okay so, there are 2 things. Now, you can question that how we have picked up this of course, we have been working in surrounding areas or nearby areas.

And but if you are given that okay fine this is an unknown area for you, how we will be able to identify that okay, if you see this here maybe, we will come like in future we will show some slides or the pictures which shows how sand dunes looks like okay, you will be able to see a very typical alignment okay of this black lines here okay, these are all indicative of sand dunes and but here, you do not see that okay.

So, you have a very clear cut indication of a desert which is comprised of prominent sand dunes okay. Now, if you move from towards west, you will say something is different here actually, yes of course, the tonal variation is different, this shows in reddish part and this is like light brownish and all that okay fine and what is the demarcation between these 2? You can pick up this line here which is like going like that okay.

Now, one thing which will come in your mind or our mind should be that this line is not straight, why it is having some curves and all that okay and having lightly slightly darker these things, this is because of the water contained, okay and this is a meandering channel which comes and get like merge with or meet this reservoir okay, so this dark colour is your pond, okay or maybe a water body.

Again, so coming to this, this is an area which comes under Pakistan and this is thickly populated or you can say at least the reddish part because in false colour composite the reddish

part is indicative of vegetation, okay, so it is the thick vegetated area okay, so nobody stays here in desert because no water of course, this could also have formed the part of the desert but water supply is the arid irrigation is there so this is has remain green, okay fine.

And then, same thing if you go in Rajasthan okay, in some regions you will find that you are absolutely not looking in the or you are not travelling across the desert area, okay, it is so green and that is because of the water supply there through the irrigation canals and all that. So, this is 2 things which you can easily demarcate; one is the Sand dune areas, desert vegetated areas or the cultivation is their population definitely sure must be there in this area.

And this is the geomorphic boundary, I will just remove the line here, so that it is more clear to you and then we remove this okay, so easily make out okay and this boundary is like you can when we visited the field, this side is up, this is down, so one is the geomorphic boundary, another is that this boundary also indicates an active fault okay, so which we have known that this is Nagarparkar Looney Sucre fault, okay.

And there is in town here, some; which is known as Nagarparkar, so based on that this fault line was been identified or marked okay, nobody works there because of lot of reasons, political reasons and all that between the two countries but we have been able to work until this point, okay, at this point where we have been doing some stuff on archaeological part, okay. Now, another important thing is that this darker body here okay, is a water body okay.

And then similarly, we have a darker body here okay fine, so this is all; this part is not an ocean but this is ocean here, okay fine and there is a boundary which comes here, okay, so this is indicative of your high tide and low tide, so tidal range okay, so you have in deeper part, so why; if you refer one of the lectures which we talked in the previous one, light will not get reflected from the water okay.

So, if you are having shallower waters, then you will see some brighter colours, okay but if you are having deep waters, the light will not be reflected. Now, if we just consider that point and then say that okay fine, what is happening here in this area, so this portion is completely white. Now, if you recall the albedo effect and all that okay, if you are having a blackish area or you can say the roads and all that the reflectance will be like, it will absorb light okay fine.

But if you are having in white area, like snow okay, then you will have the light is getting reflected very fast okay and it will need will not absorb okay, so similarly this is what we see here the whitish part is the well-known your great Rann of Kutch, so this whole area is salt and crustated region okay, so this is an only land form which exists in India okay, salt and crustacean and known as great Rann of Kutch, okay.

So, over the time this of course, the landscape changed over the time here because they say whole area which is now considered or which we have demarcated as the great Rann of Kutch okay was the part of the Arabian Sea and there are records which in the historical data and all that, the Alexander the Great took the path through this way, okay along with this team and all that okay but that I am not going to talk here.

But I of course, whenever I talk about Kutch, this is very important part, now there is another demarcation here which goes like that okay fine, now this is another; let me correct this, so one was this here, now this is marshy land, this is here, salt and crustacean, so great Rann of Kutch of course, which also includes this one but this area a relative to this is up and this is down, just recall what we were talking in Himalayas; the relative up and down, up and down area okay.

So, with this, this is up and this is down area, okay and for this relative this is down, this is up and these both are governed by this topographic boundary or the geomorphic boundary is governed by faults, okay and this one is your Allah bund fault and this resulted in to traumatic landscape change during this is what literature says okay, during 1819 AD Allah bund earthquake, we visited this area, this is if you look from here okay, then this is higher and this is lower part, okay.

And because of this uplift okay, along this boundary, this channel which used to flow through this and getting into the quarry creek, okay, there is an area here which is known as quarry creek okay, got deflected or we can say disrupted completely okay, when which is left out with the spawn okay. Now, can you imagine that a stream which is a tributary of Indus coming here and just stopping, getting stopped here okay, so why it was not able to cross here okay.

So, if you use high resolution dam and all that you will be able to know the terrain that how it looks like but let me tell you that what exactly it looks like, if you take in section here for example, this is A and B, okay along this line, then you will be able to see something like this

okay, so you are having this separation here, this goes up and then you are having an back tilting here, this goes up and then so on okay fine.

So, the pond which has been formed here, so this is this point is here and this point is over here okay, so again you have in faults here which are dipping towards, so this is north and this is south okay, so this side is here north, so again this, the back tilting okay did not allow and then result it into the formation of pond here, so I will take in different colour here and let us see if I can put that okay.

So, the first is cross section here, okay and you have a faults, which are going like that anyway, I am not take into; but this is the area of the back tilting where you are having the pond or the water body. So, what it says okay about the terrain that because of the tectonic movement, this whole area got transformed okay and force the people to leave this place because still if you go in this area, you will be able to find the old settlements okay, fine.

So, find this is a one part of course, I am talking about the tectonics here but we will talk more in the next okay that what are the different dark and lighter tones are indicative of from this image, okay and then, move further talking about different type of rocks and the part of the factors, which we need to consider while identifying different landforms, okay, so thank you so much.