Photogeology in Terrain Evaluation (Part – 2)
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Lecture - 12
Photo Interpretations: Lithology of Metamorphic and Extrusive Igneous Rocks

Welcome back and we were discussing in the previous lecture about the different type of rocks and now tilted sedimentary rocks okay.

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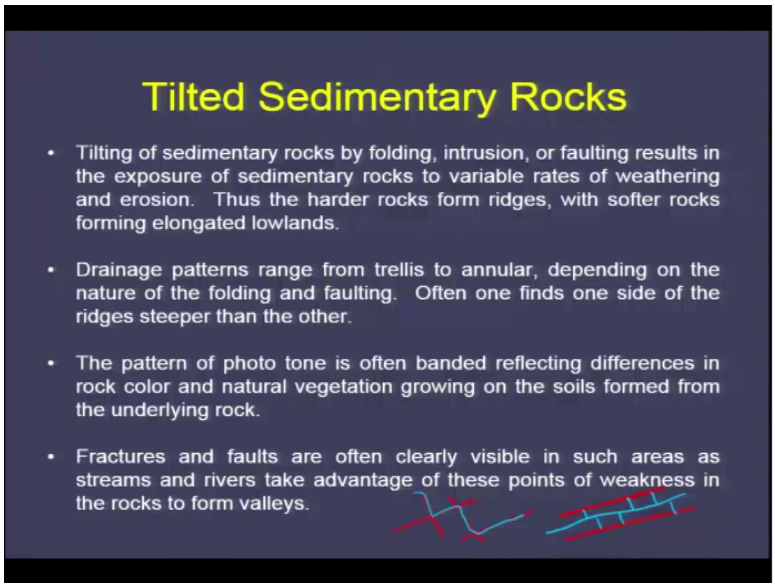

Now this is typical of because as we have learned that the sedimentary rocks will form or get deposited initial deposition and then finally the cementation will lead into a very horizontally stratified sequences okay. So tilted sedimentary rocks by folding intrusion or faulting result in the exposure of sedimentary rocks to variable rates of weathering and erosion. Thus, the harder rocks okay form ridges whereas the softer rocks forms elongated landforms okay.

Then, drainage pattern ranges from trellis to annular depending on the nature of the folding and faulting okay. So this we have already discussed in the type of drainage pattern. You can refer to that and this will help you in identifying the different terrain okay and there often one usually can find one side of the ridge is steeper than the another one okay. So typical pattern like this okay you will be able to see.

Because this is because of the tilted rock layers okay. Now the pattern of photo tones is often banded reflecting differences in the rock colors okay and nature of vegetation growing on the

soil formed from the underlying rock okay. Fractures and faults are often clearly visible in such areas as the streams and rivers take advantages of these points of weakness in the rocks okay and forms the valley okay.

Now this particular point what it tries to pinpoint is that if you are having fractured rocks okay and typical fracture pattern is there then the drainages will try to follow this line okay or I may take a different color here. The drainage which will try to follow this pattern okay and this will give you a typical rectangular pattern or you can say if you are having the folded terrains okay for example then you will come across if you are having the linear folds like this okay.

Now when we say that they are folded then the resistive rocks okay will form the ridges whereas the non-resistive which are easily eroded will form the valleys okay and trellis pattern usually you will see that you have the flows like this okay and then you have the drainages which are joining from here okay like this. So please refer to that what we were talking about and we have already discussed this and the different type of drainages okay or drainage pattern.

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You can easily make out this is on coastal area but you can look at the different layers okay or the different stratas in sandstone or the sedimentary rock here okay what we see and we can easily make out the tilt and then different beds okay and then easily eroded rocks are here what we see are forming the flat platforms okay.

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Another important feature okay which you can look at different typical drainage here okay and a very flat-lying terrain okay in a typical sedimentary rocks okay. So you can identify based on different tonal variations, the different lithology where you have sandstone and you have different material or the rock which has been seen here and also you can see this beds okay which are aligned here.

Here I have seen in the previous photograph that was in sectional view where we were looking at the horizontally certification in the sandstone or the sedimentary rock okay which is seen here but suppose you are looking the terrain which is folded and deformed area comprised of the sedimentary rocks okay. So this is an example of the (()) (05:33) satellite data which you see here is in Cartosat data.

And what we were talking about right from the beginning that we should look at the tonal variation, we should look at the structural elements which are preserved on the surface and then the drainage density and all that okay. Now this is a Cartosat photograph from Himalaya which tells us that we may face slight difficulty in identifying and strictly following the parameters which we have talked about okay.

But nevertheless based on the other parameters which we can use to identify the terrain you can use that okay. Now if you see on this area particularly okay what you are able to gather okay that we have a very typical feature which reflects of course that there is a drainage here and then you are having a closely spaced drainage on this side whereas you are having very sparsely space or widely spaced drainage okay.

So these 2 portions clearly indicates that these two having probably different lithology okay. Now another thing which you can make out here that this is we were looking at the vertical or the face of the sedimentary rock cut along the coastal zone. Here you can see the small or you can see the linear lines okay which are oriented in one particular direction okay. Now these are typically of folded sedimentary rocks which the top has been eroded.

So you see that they have all vertically stacked okay, so this also helps you in identifying this okay. At the same time if you see on this side, you are having quite different lighter tone whereas this is darker okay so this darker tone is just because of the thick vegetation okay. So this is a thick forest area or the forest cover but based on these bedding planes vertically stacked okay you can talk about that this on sedimentary terrain and this is modified areas by the local people and used for the cultivation okay of the agricultural lands okay.

And then if you again see here in a very small portion here okay this one, you can easily make out that this area is folded okay, very small folds are fencing here and then you have again very vertically stacked units okay and similarly you can see this one also here. So these are in typical of a vertically stacked sedimentary terrain or the sedimentary rocks okay and this can happen only if the whole layers okay like for example you are having a very horizontal deposited layers okay.

And then when you fold it okay, you are able to do that okay and then finally if you erode this from the top okay then on the surface you will be able to see those vertically stacked units okay and that what we are able to see in this area. So similar exercise we will keep doing for this particular course and you will be given some lab exercises where you can try to do the photo interpretations okay.

So this was basically for the sedimentary terrain and few more examples we will talk at the time of when we are doing the labs.

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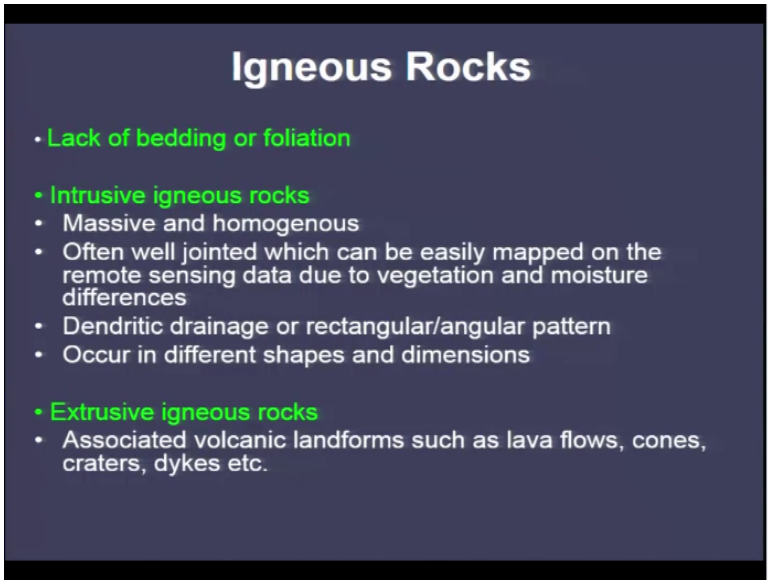

Now coming to the igneous rocks particularly okay, now the igneous rocks we usually do not see the typical beddings and the foliations okay and in terms of the massive like the intrusive rocks which are usually massive and homogenous okay, these are typical what we see in granitic terrain okay. They are often well jointed which can be easily mapped on the remote sensing data due to vegetation and moisture differences okay.

Then, it will also show dendritic pattern or you will have rectangular or angular pattern depending on the jointing pattern okay. Occur in different shape and dimensions okay. Now in terms of the extrusive rocks okay, so these are the intrusive rocks typically granite. Extruded rocks you will see like for example basalt okay associated with volcanic landforms such as lava flow, cones, craters, dykes etc. okay.

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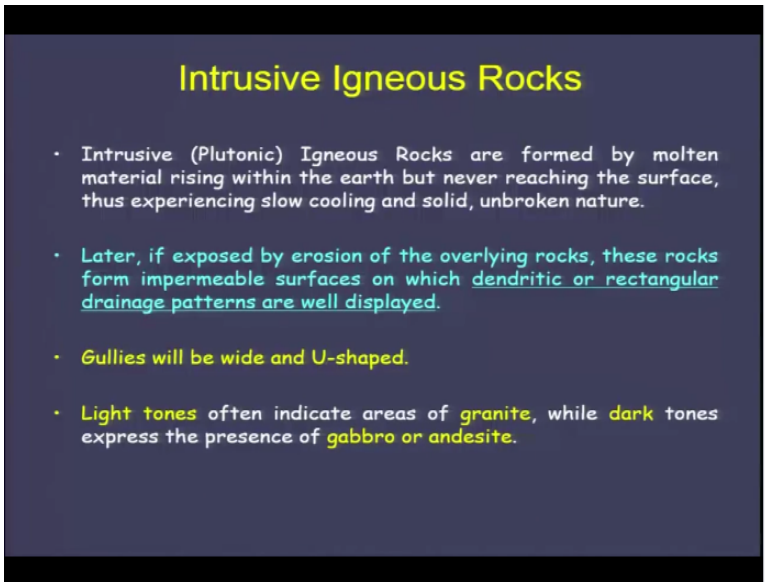

Intrusive igneous rocks in particularly okay we talked this, we also turn this as plutonic igneous rocks and they are formed by molten material rising within the earth but never reaches the surface okay. Thus experiencing slow cooling and it remain solid and unbroken nature okay. Later if exposed to the surface by erosion of the overlying rocks okay, these rocks form impermeable surface on which dendritic or rectangular patterns are well displayed okay.

Gullies will be wide and U-shaped okay. Light tone often indicates area of granite while darker tones express the presence of gabbro or andesite and this is also a type of an intrusive rocks okay.

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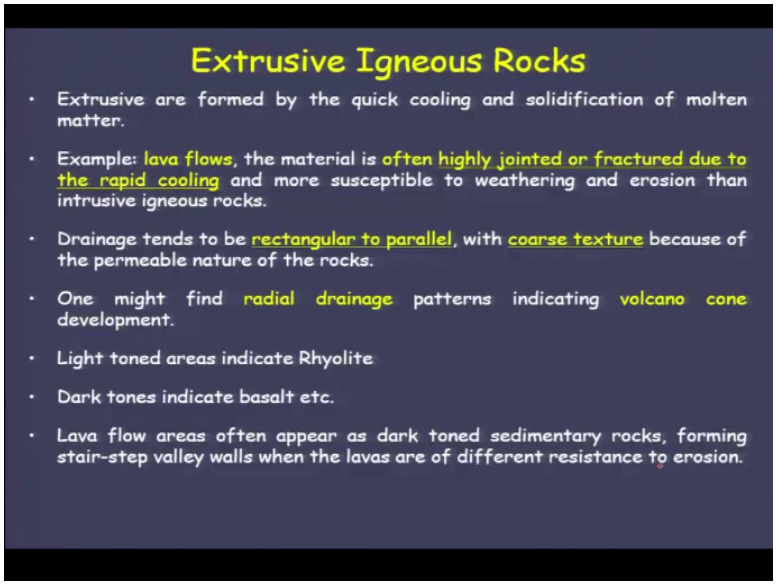

So now in terms of the extrusive rocks, they are formed by the quick cooling and solidification of molten matter okay. For example, lava flows, the material is often highly jointed or fractured due to rapid cooling okay and more susceptible to weathering and erosion than compared to the intrusive rocks okay. Drainage tends to be rectangular to parallel with coarser texture because of the permeable nature of the rocks okay.

One might find radial drainage pattern indicative of volcanic cone development okay. Light toned areas indicate Rhyolite. Darker tone indicates basalt and lava flow areas often appears as dark tone sedimentary rock okay similar to the sedimentary rocks where you are having a lava flows okay, forming stair-step valley walls okay when the lava are of different resistance to erosion okay.

Igneous rocks okay which are formed by quick cooling and with the material the molten matter is coming on the surface okay. Now for example the lava flow which usually you will find is a fine grain but they are highly jointed and fractured due to rapid cooling and the drainages which you will see mainly and depending again on the different type of rocks because you cannot say that the extrusive igneous rocks are all of same kind okay.

It will have different types and all that okay depending on the even the grain size will vary. Now basically what you will be able to come across that the landforms which you are having the radial drainages okay, you will see where you are having the volcanic cones okay and the dark lighter tones you will see if you are having Rhyolite with the darker tones in terms of the basalt and in some cases you will also see that basaltic terrain will show the closely spaced drainage okay fine.

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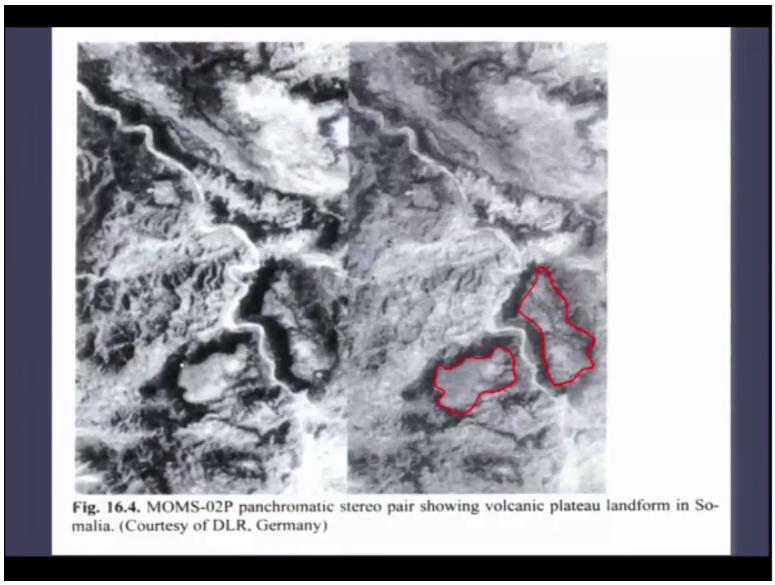

Now this is a typical of volcanic plateaus which you will come across in an igneous terrain what you have is very flat turtle like feature here okay and typical of here too okay. So this will clearly talk about the volcanic terrain mainly.

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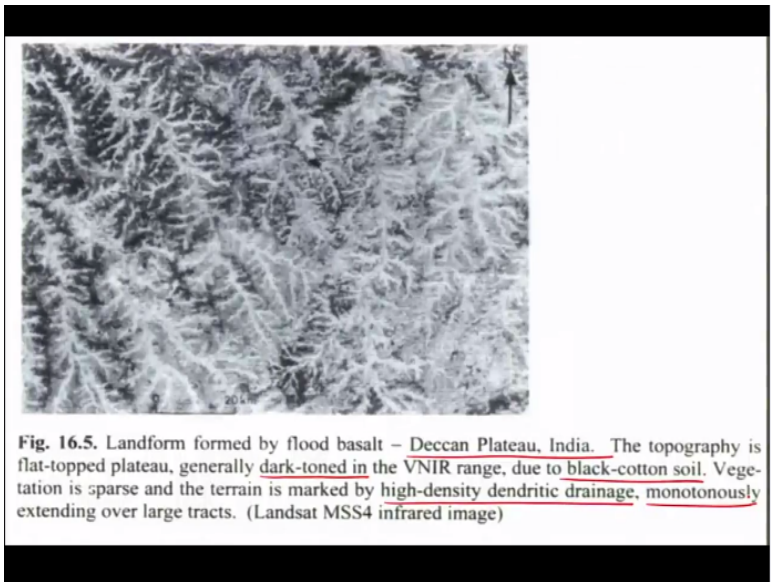

Fig. 16.5. Landform formed by flood basalt – Deccan Plateau, India. The topography is flat-topped plateau, generally dark-toned in the VNIR range, due to black-cotton soil. Vegetation is sparse and the terrain is marked by high-density dendritic drainage, monotonously extending over large tracts. (Landsat MSS4 infrared image)

And this one is a photograph from Deccan Plateau, India okay where you have the darker tone okay due to the black-cotton soil okay and the vegetation is sparse and the terrain is marked by high-density dendritic drainage okay and this because one thing which you will see in typical of dendritic drainages if you are having a monotonous terrain okay.

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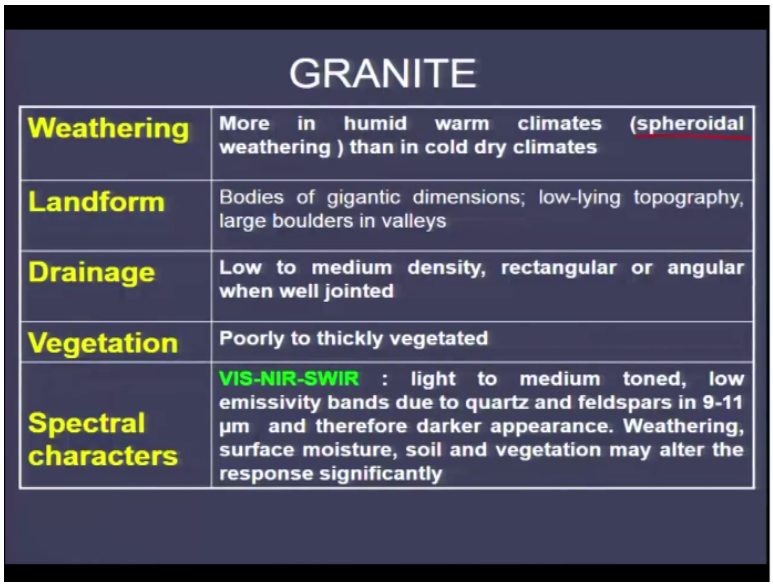

And coming to the further important parameters for the granite, weathering more in humid warm climates and mainly what you will see a sort of spheroidal weathering okay as compared to that of in the cold dry climates bodies of gigantic dimensions okay. So if you go in South India, you will be able to come across the huge boulders okay or the gigantic boulders of the granitic bodies okay.

Low-lying topography is also you will be able to see okay fine and then the drainage density mainly will be low to medium okay when mostly you will see because of its typical fracture pattern and all that you will come across a rectangular to angular drainage. Vegetation does not support much so you will have mostly the barren terrain okay. In terms of the spectral characteristics, light to medium toned, low emissivity band due to quartz okay and feldspar.

So this is again the reflectivity will depend upon the mineral composition of a particular rock okay.

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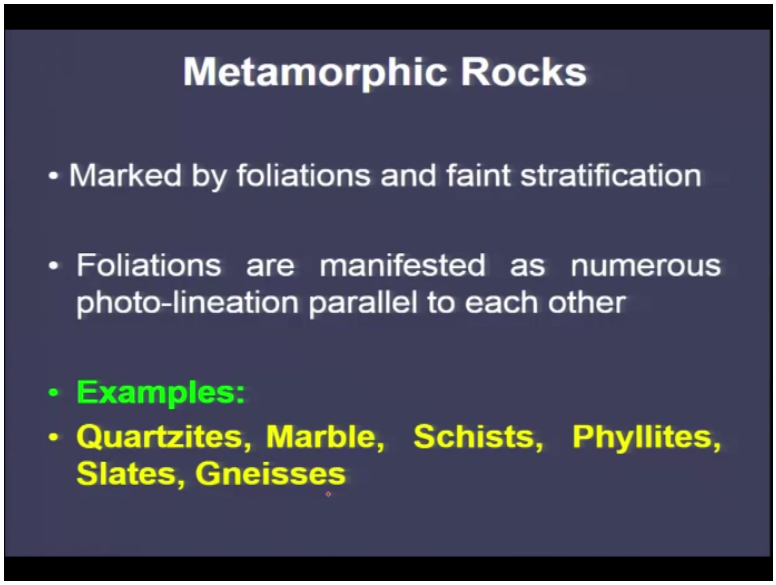

Now coming to the metamorphic rocks mainly okay. They are marked by foliations and very faint stratifications okay. Foliations are manifested as numerous photo-lineation okay parallel to one another. I will show in the next photograph or the slide where we will be able to easily make out a typical linear features okay what we are talking about the photo-lineations okay. The examples of the metamorphic rocks are quartzites, you have marble, schists, phyllites, slates, gneisses okay.

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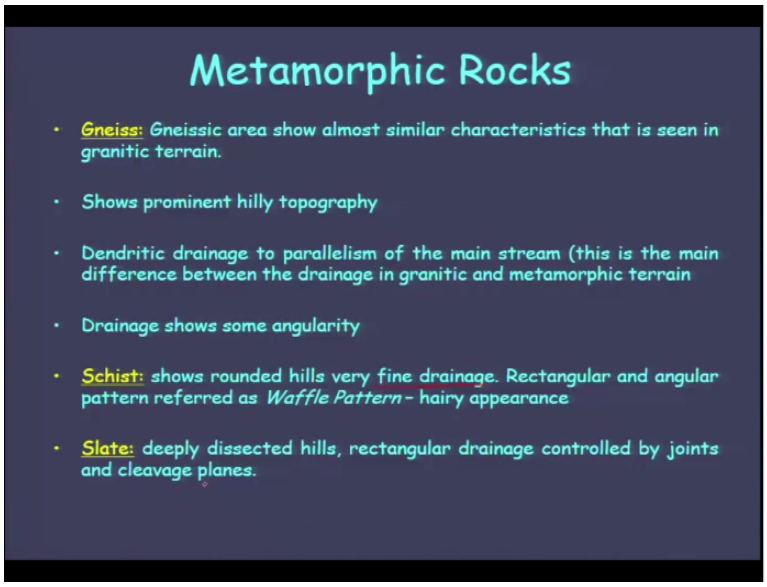

So metamorphic rocks now if you take gneissic rocks, the gneissic are shows almost similar characteristics and that is seen in a granitic terrain okay but of course you will come across or you can make out easily that there is a granitic terrain and there is a basaltic but yes of course you may come across the granitic gneiss okay which will be seen in form of boulders also okay, show prominent hill topography, dendritic drainage to parallel of the main stream okay.

And this is the main difference between the drainage in granite and metamorphic terrain okay, so in granitic train you will not be able to see a very good drainage pattern but here you will see drainage dendritic or parallelism will be seen of the mainstream okay. Drainage shows some angularity. Now in terms of the schist, which shows rounded hills, very fine drainage okay.

Rectangular to angular pattern referred as Waffle Pattern like hairy appearance okay. Slate, deeply dissected hills you will see and a rectangular drainage controlled by joints and cleavage planes okay.

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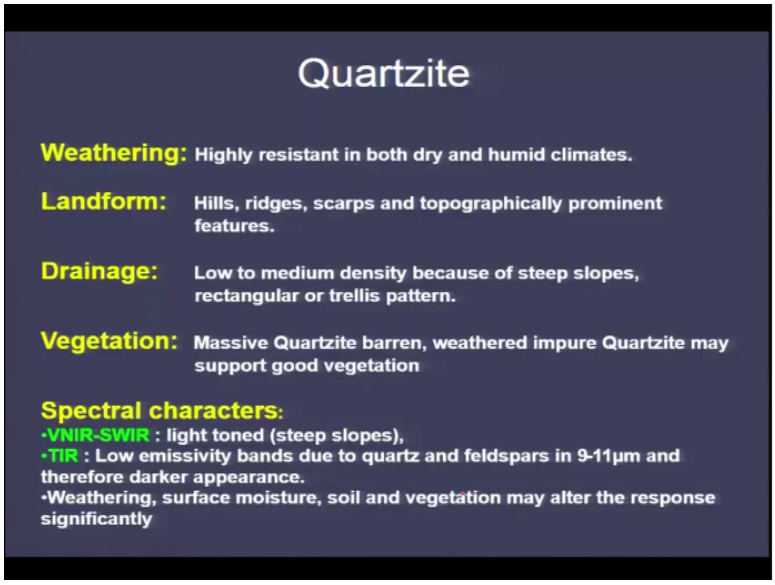

Now in terms of the quartzite which is the most resistive rock okay in both dry and humid climates. Landforms, if you see you will come across hills, ridges, scarps and very prominent topographic features okay. Low to medium density drainage you will come across because of steep slopes okay and of course because of its high resistance to erosion okay. Vegetation, massive quartzites are mostly barren okay, weathered impure quartzites may support to some extent good vegetation okay.

Coming to the spectral characteristics, mostly it has been seen it is light toned okay and if you look at we have low emissivity bands due to quads and feldspar. Therefore, it gives a darker appearance okay and furthermore here about the weathering part okay.

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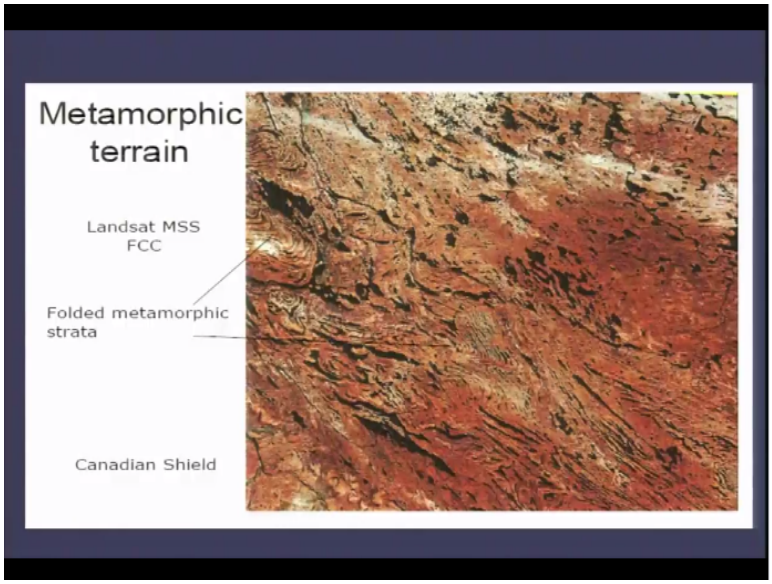

Now typical of metamorphic terrain you will see in very linear features here and since they are highly deformed you can come across the folded metamorphic stratas okay and there is a typical landscape which one can see here okay, so you can see these bands here. These are not of the sedimentary terrain but this is of typical of metamorphic region okay. Straight lineations you can make out and pick up here.

So what we will do is we will pick up all three environments okay like igneous, metamorphic and sedimentary and will try to give you in lapse okay, so that you can identify that.

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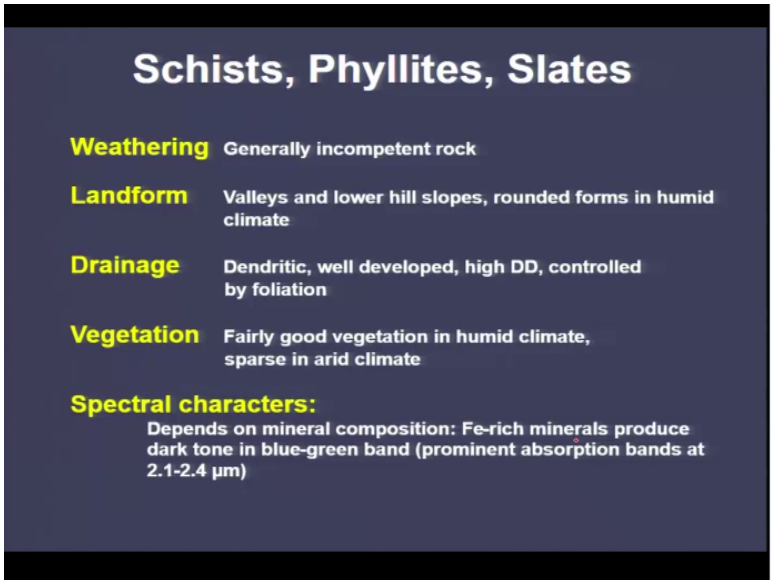

Now coming to schists, phyllites and slates. They are generally incompetent rocks okay. Landforms, valleys and lower hill slopes, rounded forms and humid climate. Drainage again you will have dendritic, well-developed. Drainage density will be comparatively higher controlled by foliations okay. Vegetation fairly good in humid climate, sparse in arid. Spectral characteristics again depends on the mineral composition okay.

Iron-rich minerals produce darker tone and blue-green bands okay, so in blue-green bands you will see a darker tone if you are having the iron-rich minerals.

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Similarly, in terms of the gneissic okay, as we were talking in one of the slide that this shows a very typical pattern like granite okay. So they are quite good like resistive rocks okay. Then, schists and phyllites but lesser than quartzites okay. Landforms which you will come across will be low-lying undulating terrain, rounded smooth surfaces of the landforms, density will be comparatively higher, sub-parallel drainages are often seen.

And also rectangular pattern okay, good vegetation cover, again this spectral characteristic, highly variable spectral banding of dark and light tones may be prominent okay. So in terms of the schist because it will have the darker minerals as well as lighter minerals okay. So you will be able to make out that variability in the spectral characteristics okay.

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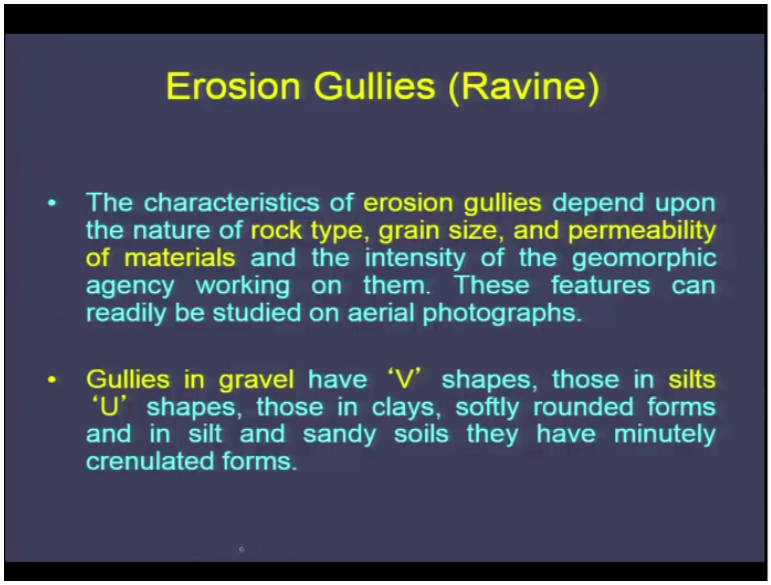

Now erosion or the ravines okay and particularly the characteristics of erosion gullies depends upon the nature of rock types, grain size and the permeability of the material okay and the intensity of the geomorphic agencies working on them okay. These features can readily be studied on the aerial photographs okay. Now gullies in gravel have V-shaped okay, those in silts will have U-shape okay or those in clay softly rounded forms and in silt and sandy soils they have minutely crenulated forms okay.

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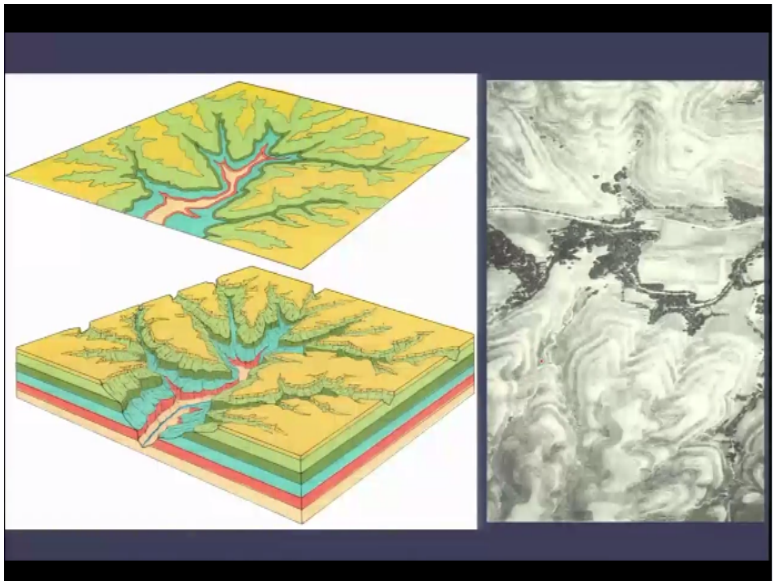

This is one of the good example okay of terrain basically where you can see the lighter and darker tones okay of different rock types here okay. So what you can make out here clearly again is that very drainage, widely spaced and a typical of could be a folded terrain here okay but this is the basic idea behind the identification of different sedimentary rocks or sedimentary terrain where you can see the tonal variations okay.

On the left what we have tried to explain is that okay. So this is the extracted information which shows the lean valley and the boundaries of the valley here okay which you can see that eroded rocks and then different type of rocks which are been exposed here are also been seen okay. So these exposed rocks within the valley will give you these tonal variations here what you can see it okay.

So there are some wide valleys here and then you have the tonal variations of that okay. So this you are able to see which usually is difficult to see in the landscape in the section okay but when it is exposed within the valley one can easily make out and this is what been picked up on the satellite photos okay. Thank you so much.