

Photogeology in Terrain Evaluation (Part -2)
Prof. Javed N. Malik
Department of Earth Sciences
Indian Institute of Technology – Kanpur

Lecture – 19
Identification of Geological Structures and Geomorphic Landforms on Aerial/ Satellite Photos

Welcome back and in the last lecture you looked over some models in which you have seen some geomorphic landforms and geological structures as well as some kinds of different topographic like karst topography and some volcanic models as well as some models related to thrust and faulting and how fault and grievances are formed and how they look alike on the surface and how to map some region with the help of identifying some geological structures.

Like folds, faults and joints in dam bodies etc., so you also learn about the strike and deep and taking measurements of the strike and deep on a fault, fault plane, fault zone or on the limbs of a fold so that we can use this information to map an area to know the slope the kind of topography and relief ground relief of a particular region. So, these are information we can use to model some area in terms of having x y z coordinate or in terms of the elevation.

Elevation is the parameter which gives us the relief on the topography. In this lecture we are going to start with some geomorphic landforms.

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Geomorphic Landforms on Aerial/Satellite Photos

Over the black and white photographs okay so first we will go through the black and white photographs aerial satellite and then we will move to some color photos how they look alike on the surface so as in this case you are able to see these fluvial landform and fluvial topography and where you can easily identify some most prominent features.

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Fluvial landforms

- The gently sloping surfaces at 'A', 'B', and 'C'.
- Note that no single, large stream crosses any of the surfaces.
- Instead, hundreds of small gullies can be seen on the air photos.



Like here is a ridge which is moving like this and there are some hills and there is dissection of the ridges and hills this dissection maybe due to some fluvial source like some surface run off or due to precipitations and due to which there are a number of gullies are formed okay like this. We can map all these features with the help of this photograph as well as we are also looking over some flat topped and small features which are also known as bota.

And this ridge which is continuous on this photograph from this point to this point it is all it is having a slip slope on its both side but this region a and b this represents gently a slope okay so this area is gentler and this is slip and that is why because there is a surface run off and it may be form a source fluvial source like a river and here we are looking at major channel and at this place also we are having a major channel.

This may provide some surface run off to this region as well as the station also so that is why the number of gullies note that they are no single largest seen process in any of the surfaces and instead of that 100 of small gullies can be seen in the photo.

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Fluvial landforms

- The gently sloping surfaces at 'C' and 'D'
- Note that no single, large stream crosses any of the surfaces.
- Instead, hundreds of small gullies can be seen on the air photos.



The next photo is the other side of this region where you again note down the c and d part of this area c and d these are representing the gentler flow gently sloping surfaces gently sloping surfaces and other part is that there are some hilly terrain and some partly area of the remaining hilly terrain and a ridge might have eroded by fluvial sources like surface runoff from a river or anything.

So, these parts are the left over parts of the previous rocky terrain at this area and here we can note down that a single large channel kind of feature is very prominent here okay here also we can notice some changes in the slope downward okay and where we get such kind of topographic

relief and we can also find some radial drainage patterns and how they look alike you will see on the other photographs.

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- The zigzag ridges and valleys on this map indicate folded sedimentary rocks.
- The geologic structures of this area can be determined using V-shaped notches, asymmetry of ridges, and gently tapering or blunt nose at the apex of plunging folds.
- Beds that dip in only one direction make either homoclinal ridges or homoclinal valleys.
- Beds that dip in more than one direction make anticlinal ridges/valleys or synclinal ridges/valleys.



In this photo, you can quantify the areas which are having a very flat top terrain like these and this part b okay and other thing that is important it shows the asymmetry of the ridges as well as V shaped notches and there are gently tapering nose at the apex of plunging fold so where are the plunging fold I already explained you with the help of models and how different folds have look like on the photographs.

Like if you are having a plunging fold this will be your core area of the fold for okay the core area and its surface will be tapering its end okay so what is the meaning of that, it has this is the inch part of this area and the point of maximum curvature so this line is actually having a slope and this is not the straight as it should be in case of normal fold. The normal fold will look like this and it will go parallelily with reference to it limbs and its center.

So, this height varies very smaller scale whereas in this case as you know that this is the action plane of this fold and this is the axis and it is the hinge part so this fold is plunging over here suppose if there is only a cross-section left over on some ground so in that case you will only find these kind of features not the complete fold because the only cross section of this fold is left out why because all these things has been eroded.

So, only what you are looking from the surface when we see as in case of the models when we look a fold in from the front side we can show we can look on its cross-section and we can have the information of its bending planes and the thickness of the limbs etc and their orientation but when we look at this fold from the surface then it is not possible to look on this section in that case we will look only this part.

So, when the top part which is exposed end of the line surface when this part is eroded so in that case only some limbs are left over like this so this is the top section of the limbs so here in this case you are getting these plunging folds okay another thing where the beds that dip in only one direction make either homoclinal ridge or homoclinal valleys okay so in this case you can look that there is a linear ridge like feature.

And streams are coming and these are the tributaries actually which are joining in the main channel okay so most probably you will find the generatic drainage pattern in such regions so if you talk about homoclinal region and homoclinal fold so this in this case this fold is homoclinal fold because the both lames of this fold are dipping at the same angle so both the lames are dipping at the same angle.

This angle maybe from the actual plane also and you can take the difference of the actual plane area so these many things you can identify on a particular image the next thing is the beds that deep in more direction make and decline ridges valleys are synclinal valleys they are combination of two folds in a series so one of that must be anticline another should be synclinal.

And so in this case when you get the higher part of the beds on the core section of a fold so it means this fold must be anticline fold in case when there is no section or there is a depression kind of thing developed in between the lames of a fold or centre of a fold in that case it may be a synclinal fold okay whenever you find the two fold in a series so in that case one is syncline and anticline here you get this thing and plunging syncline and plunging anticline.

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Vertical aerial photograph showing faults affecting the terrain configuration along the eastern side of the Barisan Mountains in North Sumatra, Indonesia.

Scale 1:40,000



And this photograph you will be able to map some faults which has affected the terrain and the configuration along the eastern side of this terrain is shown in this vertical aerial photograph where most of the things you can identify very easily like this cutting of the order section of the geomorphic landforms so these features obviously represents the faults suppose here is the stream flowing like this and then it is getting diverted along this fault.

And then coming like this so this stream got diverted due to this faulting pattern as in case of Taksal fault where streams got deflected due to strike slip faulting so what kind of fault that was and it was lateral, right lateral strike slip fault and what happens there and suppose this is the fault line streams are coming like this and when they cross this fault line or the fault zone so then they get diverted in the terms of their flowing path.

Okay because this sense of motion on this fault is like this, this block is moving in this direction and this block this direction so this is very easy to identify a sense of motion on the strike slip fault and how to identify it suppose this is a Strike-slip fault okay this is the right block and this is the left block and if the right block is coming towards me then it will be right lateral strikes slip fault and if the left block coming towards me it will be left lateral strikes slip fault.

Right lateral strikes slip fault as termed as dextral fault also and left lateral strikes slip fault is also termed as sinistral fault and remember that here also there is strikes slip fault and the streams are

deflected when they cross this fault you will find some streams which cross this fault but do not much deflection it means that they originated after the last event of this fault okay obviously this fault move during an earth quake.

Or even on this fault and blocks move when there is an event of the fault. So, whenever there is an event they will be some strike slip motion. Suppose in one event it moved away around 1 metre in 2 events suppose 2 metres so it will show we can also detect the number of events on a fault by quantifying the deflection pattern of different strings like this stream is showing the maximum deflection of around 3 metre.

This is showing the deflection of 2 metre and it is showing the deflection of 1 metre so it means that it is the oldest stream which generated along this terrain and flowed through this fault. This is the younger and this is the younger than and suppose this is stream number 1 and this is stream number 2 and this is stream number 3 and this is stream number 4 because this shows the maximum deflection.

It will be your oldest stream is developed on this terrain crosses the fault okay that is why it shows the maximum deflection and it shows the deflection of two meters which is somewhat lesser than the 3 metre so that is why this is the younger stream number 1 interesting then steam number one and then similarly stream number 3 is younger than stream number 2 while stream number 4 is the youngest stream.

Because it does not show any deflection on it for so this is all about Taksal fault which was the sinistral fault this fault is also seems to be like a strike slip fault because it shows some deflection and streams. Here is another fault the linear feature okay there is some other kind of feature which is matching with the pattern of a meandering river okay so meandering channel flow like this.

In between here you will be able to look over some kind of fan like features which maybe an alluvial fan at the basic level of the interpretation you can at least just that because this features are nearby a river very close to this river they might be related to alluvial terrain or alluvial plain

or alluvial fan and this whole plain is called the alluvial plain okay this fan like features also alluvial fan.

Here very clearly dissected hills are shown which can be mapped very easily on this photograph okay this maybe because of your channel which is flowing from here to here okay so whenever there is a supply of huge of water quantity so there will be lots of frozen on the terrain and which depends on the slope of the topography and suppose topography slope in this direction so they will be more erosion on this side.

However, you will not see any more erosion on this side very less erosion this is highly eroded terrain okay. This is very close to coastal region also and that may be a reason that some amount of water is drained from the sea part and these may be forming the tidal history of the channels which are having the maximum input of water during the high dives also.

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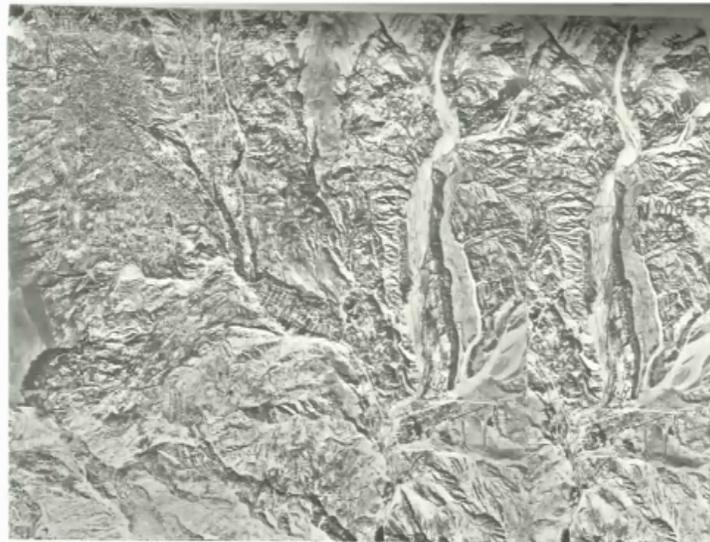


Fig. 7.19 Extended stereopair showing pitting and collapse of escarpments in Lima, Peru, at a scale of 1:50,000.

So, this is the extended stereopair and it is mainly showing the gulling and collapse of the escarpment and gullies you know very well so these very dense features which converts the land into a bad land topography are mainly the gullies and gullies erosion occurs when they are number of major channels flowing across the topography and due to which they cause the erosion island cross-cutting are being the structural features.

And they may also do some undercutting due to in season during some events when there is uplift of this region so that this river will maintain the base level because suppose a river is flowing like this. This is the cross-channel of a river this is the highest water level here and this is the topographic slope okay suppose there is uplift what will happen topography has its own level.

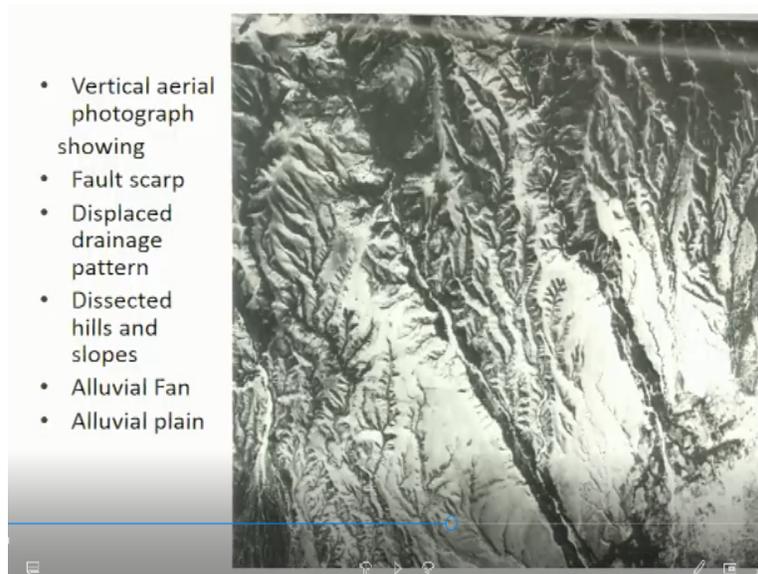
But the river is flowing from some up land area and going towards the low land region and suppose in this case this is the highly elevated region play 2 kinds of thing or escarpment and this is some plainer land forms like alluvial or flood plain extensive flood plain formed by the rivers so what will happen because a river is flowing from higher ground to lower ground and this axis represents the distance.

And this axis represents the elevation so what will happen if there is some uplift in topography and uplift in this region so what will river do and we will maintain its base level because this region is got uplifted due to some earth quake so or movement of faultier and some block has moved up due to which this topography is showing some high relief so in that case the river will maintain its base level.

So, it will undercut our in sized and when we need this topography okay that is called the maintaining the base level of erosion in this case this is the base level of erosion for this river base level okay. When it will maintain some base level due to uplift so it will go down and undercut the bedrock okay so on this image we can easily map this region and we can classify the terrain on the basis of the fluvial channels and the extensive flood plains on both the sides.

Of course, there are some dissected hills or ridges in between these floodplain regions and due to which there are a number of gullies are formed okay and convert this land into a bad land topography.

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On this image, this image is very important and please try to understand what is shown on this image first try to identify the most prominent features always on this image they will go with this feature okay. So, I will say that this is the most prominent feature in my image and other thing I can also mark here that there is some ridges or kind of maybe kind of faulting. So, this this fault is very prominent.

And we do not have any confusion in interpreting it this lineament as a fault because right because this is cross-cutting the fluid terrain and this is flowing and and bisecting the drainage patterns and there is a sense of movement in between these two kind of drainage basins. So, there is one drainage base in and this is another drainage basin. And then you will find another drainage basin.

So, here you can easily identify that there are streams and these are showing the dendritic pattern okay I do not need to explain it because I have already explained in the last lectures okay. So, dendritic drainage patterns on this side also on this side also a very clear cut tree like wrenching and radiating features. Okay these are the drainage patterns and here a very prominent alluvial fan is shown.

Alluvial fan is when the river diverge is somewhere in a sea or some low land coming from an up hand region so then it will form a fluvial alluvial fan the base. So, this is the base of this region

so this is the upland plan and this is the towards this side there is a plainer area. So, this is the aluvial fan and so this fault is cross-cutting the topographic and bisecting this drainage pattern.

So, this is we can say that this must be this fault is showing a large slip which may be a deep slip or a strike slip but there is dissection of the topographic on both the sides so this why this fault shows the maximum slip.

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Fig. 15.7 Extended stereopair, scale 1:20,000 showing a badland area in the Dakotas, USA.

Okay so we have another image again the extended stereopair stereopair is what when we take images of a same area by moving through an aircraft or a satellite and the two images which will have the 60% overlap or so those images are called the stereopair. This was explained in the first part of this course 60% overlap is the standard overlap however there may be some other numbers.

Which may be preferred for different kind of purposes different kind of histories also. So, here on this image you will see again the and line topography and this from the Dakotas USA and how the bad line are formed this I explained in the last slide. So, this is also showing some rivers and (()) (31:12) and this land has converted into a bad land which should not be preferred for some construction purpose.

Or for putting some structures like tunnels or anything some railway lines okay some dams and

so these kind of sides should not be preferred the other sides similar to bad land topography class topography or the topography having the faltered and folded terrain are joined terrain okay. So, these all kinds of topography are not favorable for the construction purposes.

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Fig. 15.24 Extended stereopair, scale 1:50,000 showing erosion features in the Thaba Bossiu area, Lesotho, and specifically the whitish affected by scarp-collapse erosion. Compare with fig. 15.25.

This is again a genetic stereopair showing erosion and features in the Thaba Bossiu area of Lesotho and the whitish was affected by the scarp collapse erosion. Okay when you will become a photo interpreter or an experience photo geologist and then you can see these images in greater detail. Okay because you will have the idea of topography because when you have the field experience.

Or some experience of different kinds of land forms when you have been where you have been physically there to study different kind of land forms or if you have been interpreting these images for a longer time then it is it will be easier for you to identify all these structures and forms and settlements and you can use these kind of photographs and to map some area and do to make their use for the land use purpose.

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15.25 Ground view of an area affected by the scarp-collapse erosion phenomena pictured in the aerial view of fig. 15.24. Only rock is left, wetted by emerging groundwater.

This is showing the ground view of an area affected by the scarp collapse again okay so the erosion and its base and only the where the rock is left and that is very wetted by the emerging ground water. So, so but these kind of things you can only identify when you have the the inside view of an area otherwise it is difficult to do to interpret these kind of things. Okay because these things are related to some political information.

As well as some geographical information and some kind of geological and formation of a particular region.

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- Violent accelerated linear erosion in the Chama Valley, Venezuelan Andes.
- Active retrogressive erosion on steep slopes with slumping in the heads of ravines.
- Scale 1:20,000

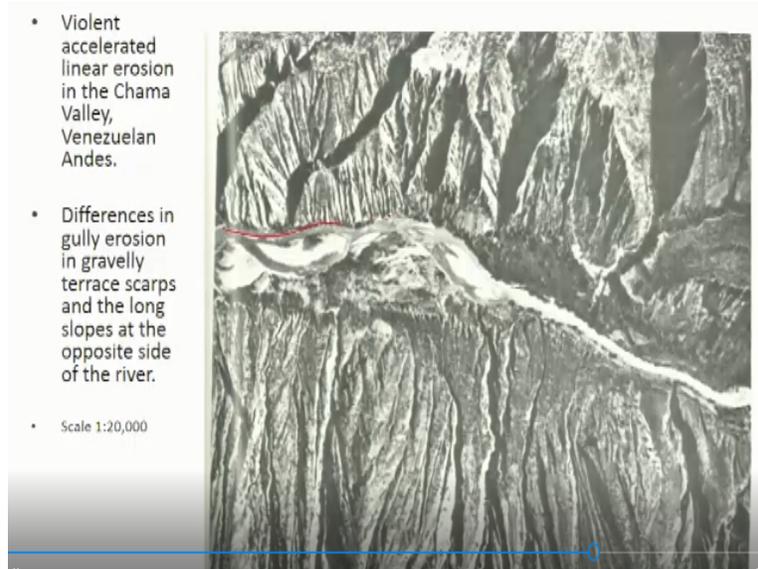


This is a really fascinating image that shows the accelerated linear erosion in the Chama valley

and another part is this is showing the retrogressive erosion on the steep slopes okay so this is a valley if you take the profile from here from point a to b you will find something like v shaped valley here also the cross-section c to d will give you a v shaped valley okay and this is showing the intensive user.

As well as you can see some kind of linear features okay which are basically the parallel drainage pattern coming and joining this main channel flowing through this valley the Chama valley okay. So, here you are able to look at at the parallel parallel drainage pattern.

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Again we will quickly move through these images which is again showing the Chama Valley and here you can map the stream okay which is showing some endure at his place and there are some and there are some sand bars inside this is basically a braided channel where you are having a braid bars inside this okay some kind of sand island. And on the both sides you are looking at the parallel drainage patterns.

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Topographic
Expression of
Folded Strata
Spence,
Wyoming

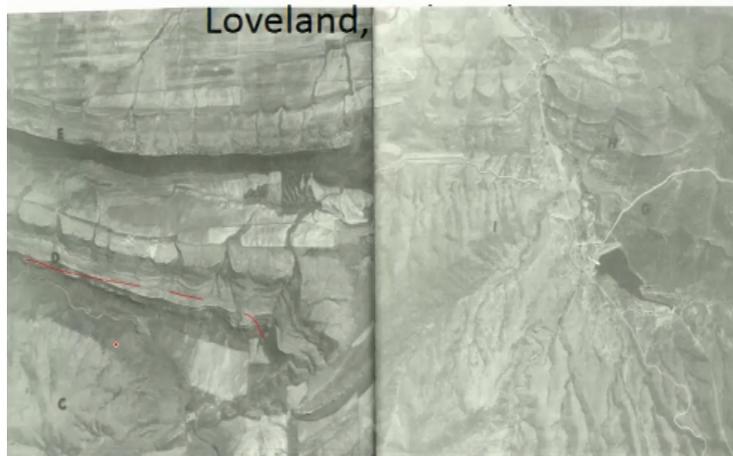


So, let us look have a let us look at some folded terrains on the black and white or greyscale aerial photographs here you can see that this topographic expression is showing the folded strata okay this is from the Spence this is showing the folded strata where you can find some statue like features these are actually representing the zig zag pattern of the terrain. Okay so when you see the control map of this region you will have a clear idea.

That yes there is some tectonic landform over here like here for discutting this terrain and dividing the region of an alluvial plane from the folded terrain. So, the left side of the of this fault you will find the alluvial plane and lots of streams very dense stream pattern and due to which there is gully erosion. Inside also you will be able to map a very good zigzag folded terrain okay.

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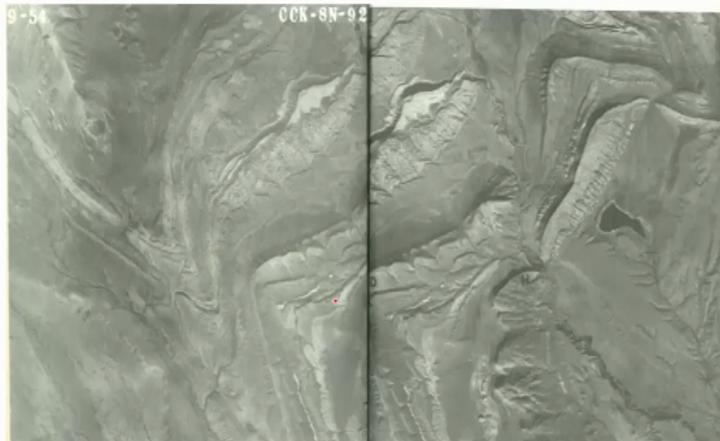
Topographic Expression of Folded Strata



Similarly, on the other photograph you will find the folded strata so how the surface expression of the folded strata is you can see here okay so from this from the space or from the sky you can only view the the outcrop pattern like if there is erosion of the surficial matter of a fold then you will find only the limbs connection on the surface okay which is the cross-section actually.

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Topographic Expression of Folded Strata Antelope Ridge, Wyoming

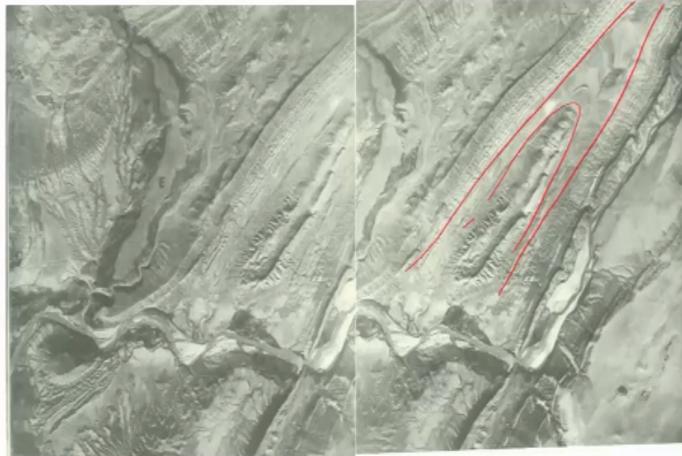


Another image that is also showing the folded strata it is a very beautiful image which classify the folding pattern as well as the changes and limbs and the course of the fold. So. this here this is the center of this fold okay and here this fold represents another center and here is an ear and other connection between the folds okay so you can easily identify all kinds of tectonic elements

on a photograph.

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Topographic Expression of Folded Strata Hurricane, Utah



Again a folded terrain a very clear cut relationship between the hinges and the limbs you can even quantify the thickness of the limbs on this photograph. This is a huge hold that is why it is showing the extensive limbs running across the topography. Okay so based on this you can also map the topographic slope where it should be the the the released data and going down word okay.

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Topographic Expression of Joints and Faults Ship Rock, New Mexico

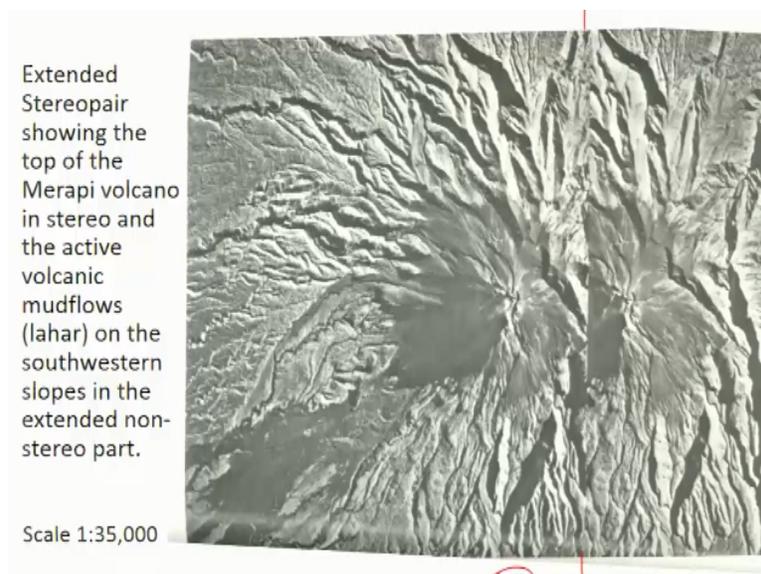


So, these expressions showing the faulted and jointed terrain okay where do not go on this line because these lines are showing the mosaic of this photograph. So, here you can see that a fault is

coming like this which is delimited here and up here okay and this feature is very prominent on this image. This is actually a kind of reverse part where this part has come up and this part is down.

This part is up okay there are joints in between this terrain okay number of joints and here are some fault so you can map all the tectonic features on this map this photo. Similarly, this photo shows some joints and folds and these streams how they are going and connecting and cross-cutting this faults this fold sorry this is the limb of the fold and these streams are flowing across topographic relief which has been build up by the folding.

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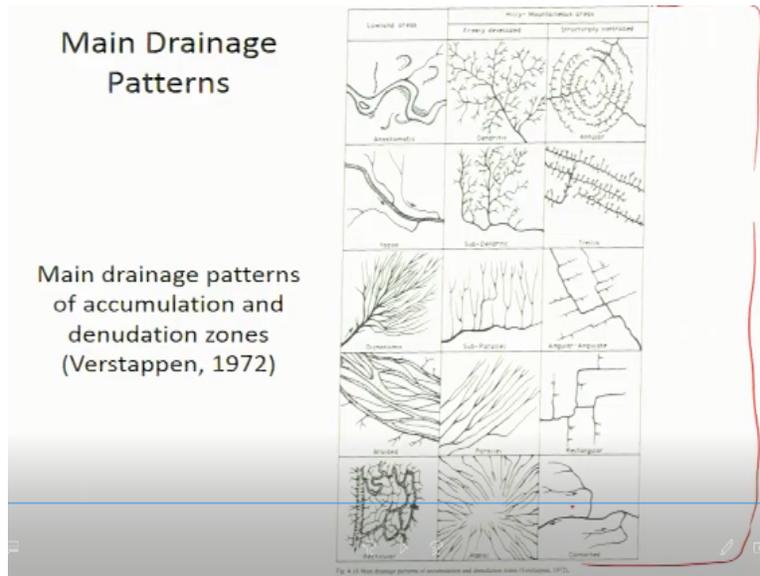
Okay this image shows a very typical expression of a volcanic cone where you can see actually this is a stereopair. So, up to there is photograph number 1 and this is photograph number 2 and this is the overlapping part. So, this part is also covered on this photograph and this is the overlapping part okay. So, when we look over this with the help of a stereo scope so then we can see this volcanic cone 3D which has been explained very well in the first part of this course.

And you can also see here the radial ridges of these strings radiating outward from the cone this is the crater of this volcano okay and vent is going through this inside the earth from where lava erupt and here you can also see some lava flows. So, this blackish part is basically showing the lava flows which is limited up to this extent. Okay so now you can see that from just looking

from the air on our region at region we can define the extent of lava flow.

And many things which are related to hazard mapping on zonation and to to present some some land for different kind of construction purposes or to decide how to use this land.

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In the last I would like to make sure that you just recall this information okay you might have learned it somewhere else or some other course also. But in the first part I remember and this information was shared with you so this image is showing different kinds of drainage patterns okay where this is the most common dendritic drainage data this is annular this is sub dendritic that is when there are joints or faulted terrain and some then getting the image.

The pattern will follow the mainstream will follow the the zone of default or the joint. So, in that case you will find a dendritic pattern but with some paralleled strings. This s Trellis this is angulate pattern which is parallel to sub parallel and this is acute parallel paralleled drainage pattern this is rectangular and these are also common to faulted and jointed topography and this Is radial pattern as I explained.

In case of a volcano or a volcanic cone or some dolomized structure you will find the streams radiating from the center. Okay so these are the main drainage main types of drainage patterns which you should remember and we will use it for our practical purposes and you have identified

it and we can also give you some image and the exam very you have to identify different types of drainage patterns.

Okay we will continue in the next lecture with some color photographs and with the help of google images I will explain all these features how they look like and real on the surface of the earth. Thank you so much.