Geomorphic processes: Landforms and Landscapes
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Lecture -36
Aeolian Processes and Landforms (Part II)

So welcome back. So, in the previous lecture we were talking about the transportation part that the deposition part and the landscape and we ended with the note that we can have free dunes or anchor dunes let's see that.

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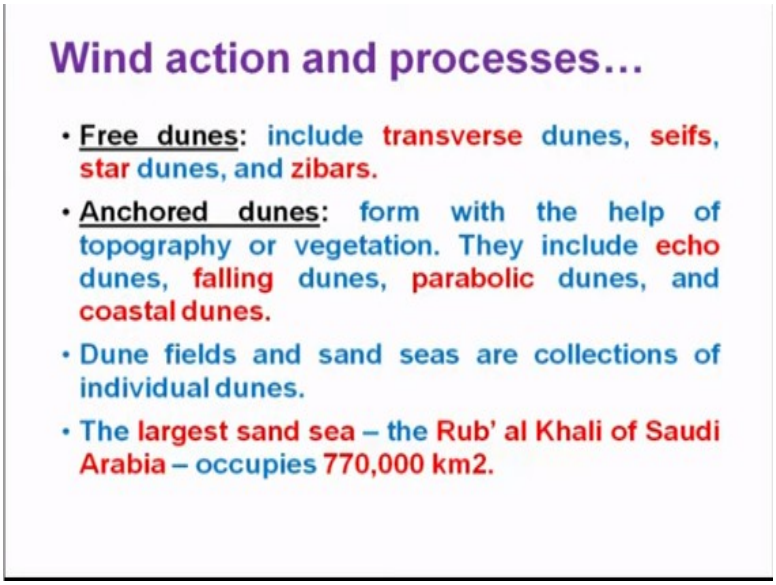

So, free dunes mainly include the transverse dunes, seifs, star dunes these are their shapes these are the shapes of the dunes are zibars. And then and we have anchored dunes formed with the help of some obstacle either the obstacle is because of the topography or vegetation. So, this type of dunes that is anchored dunes they include echo dunes, falling dunes, parabolic dunes and coastal dunes.

Dune fields and sand seas are collective or we can say the collection of individual dunes. So they collectively formed a major dune field smaller dunes or you can say the it can form a larger landscape. And the largest sand seas if we take in terms of the example of main in the main deserts in terms of the area so this is this one is the largest one sand seas Rub' al Khali of Saudi Arabia which occupies 770000 square kilometers.

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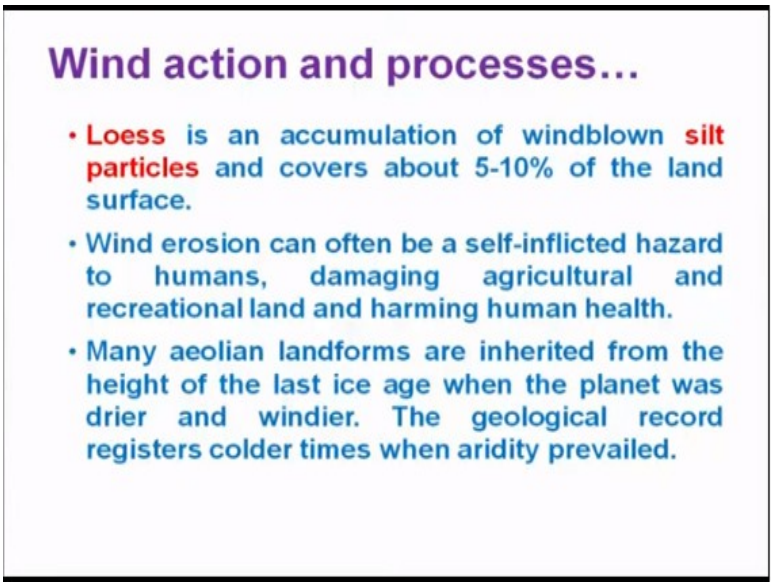

There is another term which is associated with the desert which is commonly used in most of the literature is Loess. So, Loess is again based on the material that is the size so Loess is an accumulation of windblown silt particles and it covers about 5 to 10 % of land surface. So, relatively good area amount of area or the region is been covered by Loess. Further wind erosion can often be self-inflicted hazard to humans in terms of damaging agriculture and recreational land and harmful human to human health.

Many Aeolian landforms are inherited from the height of last ice age when the planet was drier and windier. The geological record registers colder times with aridity that prevailed in the past. So, basically the most important point in this three bullet is one is the lowest is the final deposit another point is that the wind action is definitely when it is there is an you can say wind storm in desert it will be harmful to the human health.

And the Aeolian activity is not only experienced in the recent times but in past also that is we can we talk about the geological time scale in geological time scale and the planet has experienced on the entire spells and the wind action and the landscape desertic landscape in the past.

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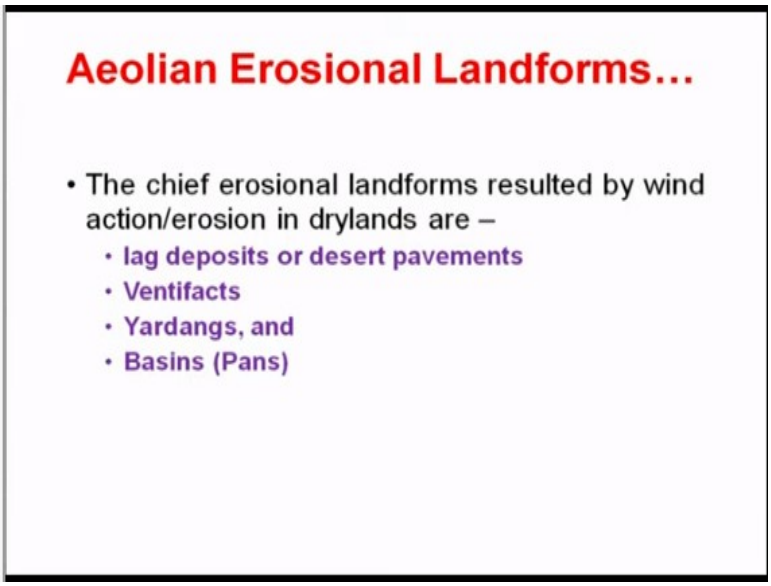

So, the Aeolian landforms very much similar to what we discussed. In this also we will try to do the same as the Aeolian landforms whereas we talked about the glacial landforms, erosional landforms and the partial landforms. So, we are having the erosion landforms so the chief erosional landforms resulted by wind action in dry lands are lag deposits or desert pavements. Now, this features or the lag deposits are seen or observed in the areas where earlier fluvial action use to take place or the deposition.

Now the lag deposits will be mostly comprised of the graveling material. So wind action what it did was because it was with areas started experiencing time spells so it got exposed. So the wind is capable of eroding the sand so metrics which was available within that gravels was removed and only the material which was left out where the wind was unable to carry is the pebbles big pebbles and that will result into the formation of the lag deposits. Then the ventifacts, yardangs will see few of them basins or pans.

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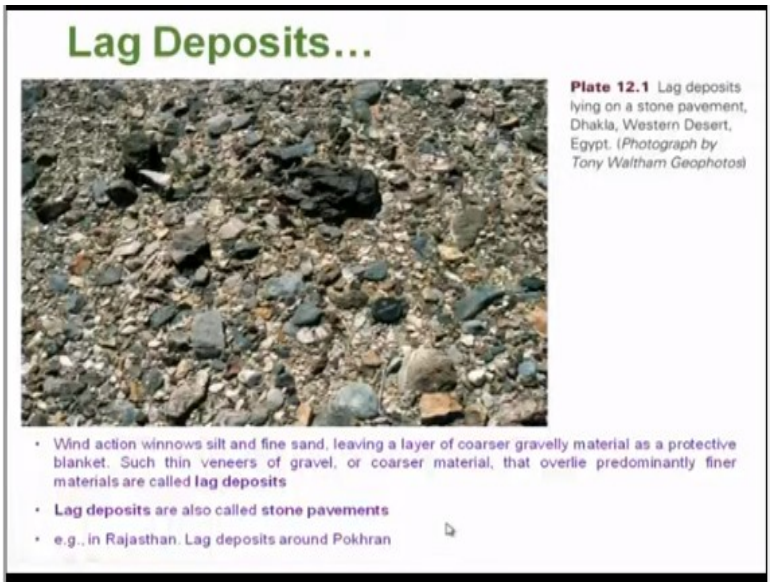

So, if you look at the lag deposit this is what I was talking about. So, lag deposits are basically it is we can say the the material which is left out and the metrics is been removed or blown away by the wind action. So, wind action winnows silt and fine sand leaving a layer of coarse gravelly material as a protective blanket. Such thin veneers of gravel or coarse material that overlies predominantly finer material are called lag deposits.

So, in between whatever the sand or this we can say the fine sand or silt which was available is been removed or eroded. So, lag deposits are also called stone pavements. Example in Rajasthan the Pokhran area if you visit then you will be able to see beautiful lag deposits with rounded gravels.

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Coming to another one the ventifacts, basically this is because of the abrasion. So the erosion or removal of particles of rocks or sand from softer rocks by wind action. So, abrasion of pebbles, cobbles or boulders by wind action will result into the erosive surfaces.

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Then comes the Zeugen singular is Zeuge also called perched or mushroom rocks and related to they are related to yardangs. So, either they are termed as Yardangs as well as Zeugen. They are produced by wind eating away softer so what has happened is the softer material or the strata are been eroded leaving behind the top which are comparatively harder. So, the softer strata closed

to the ground are eroded leaving the hard rock strata in the upper part which keep tries to a shape of mushroom which are termed as Yardangs and Zeugen.

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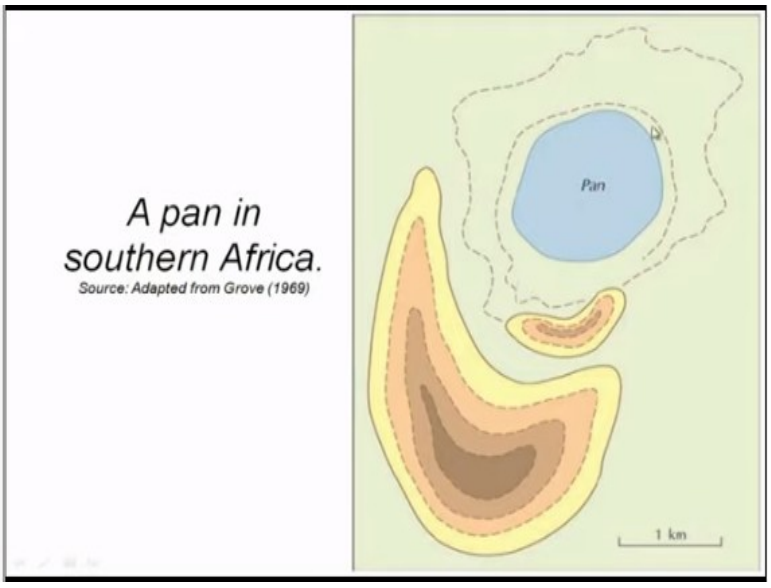

And then we have pans basically these are all the like a small basin which are comprised of mainly the saline water or salted water.

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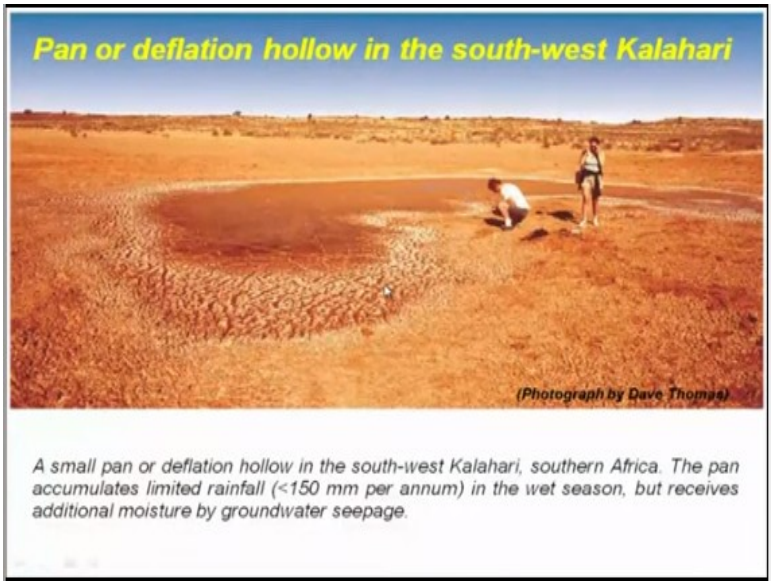

This is an example of pan and can be seen closer to the dunes. So, pan or deflation hallows in the south-west Kalahari so it says that the small pan deflation hallows in south Kalahari. The pan accumulates limited rainfall less than 150 millimeter per annum in the wet region but receives additional moisture by ground water seepage because we are talking about that this type of

features will be seen in desert with the rainfall is less but it receives the additional moisture from the ground water seepage.

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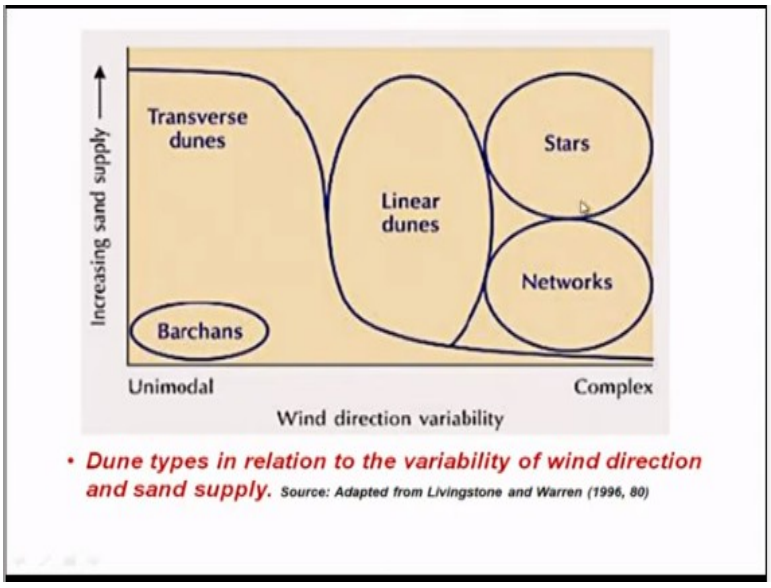

Now, considering the increasing sand supply and wind direction variability different type of dunes will be resulted. So, dune types in relation to variability of wind direction and sand supply. So, wind direction variability and this the material available that is the sand will result into the formation of different type of dunes which could be unimodal or could get into the formation of complex dunes like star dunes.

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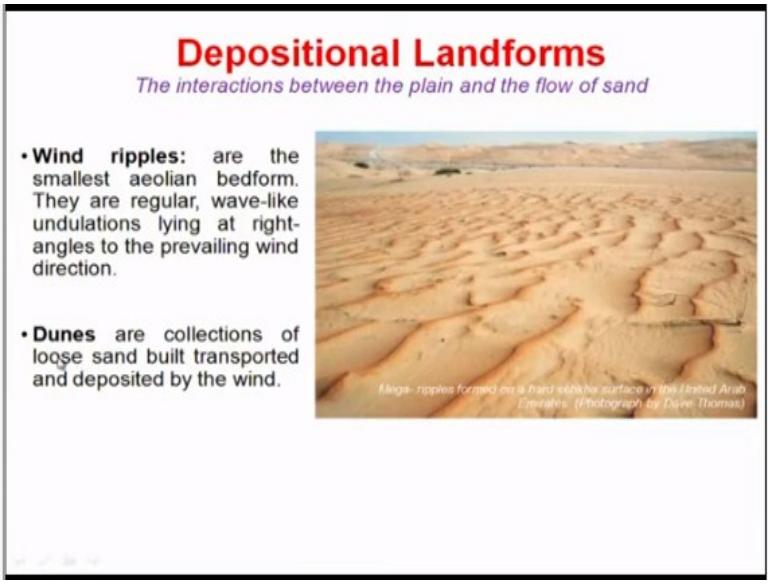

So, we will look at the depositional landforms now so erosions we have completed now looking at the depositional landforms what we see the wind ripples very small features. But this photograph is of the mega ripple you can have the small ripples also. So the wind ripples are the smallest Aeolian land bed forms they are regular, wavelike undulations lying at right angle to the prevailing wind direction.

This shows the direction of the wind is in this direction so it lies almost right angle to the prevailing wind direction. Dunes are collection of Loess or loose sand built transported and deposited by the wind. In the backdrop what you see here is the sand dunes. So, you have ripples which is the smallest Aeolian landform and the dunes which is one of the largest Aeolian landforms.

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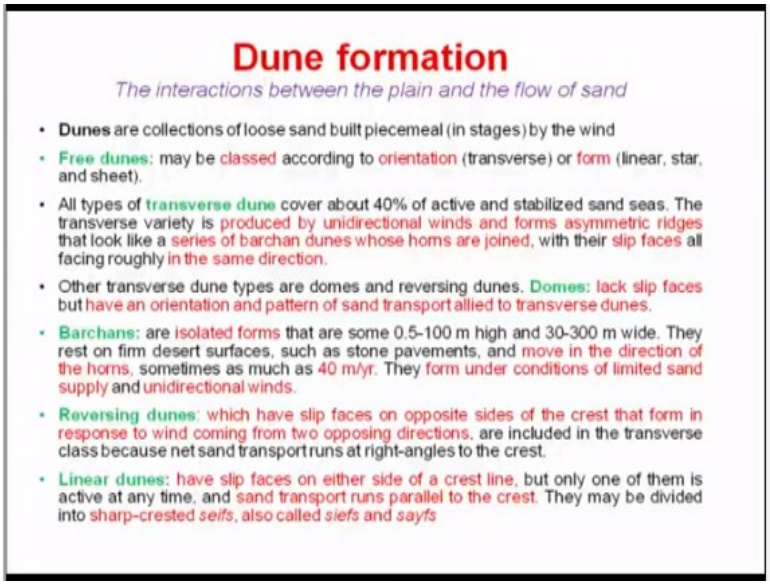

Now, the process of dune formation if we look at then the wind action and the material available mainly you will see in the dunes is the sand may be it will vary from course to find but mainly the wind action will play an important role. So, as we saw in one of the slide that the wind action the variation in the wind directivity also will play an important role in the formation of different dunes.

So, there are several type of dunes few of them we will try to look at over here. So, mainly the dunes or collection of loose sand in stages by the wind free dunes may be classed according to

orientation, form. So, they can be either transverse dunes in terms of the form we can say either they are linear dunes, star dunes or sheet dunes. Now, all types of transverse dunes mainly if we take covers about 40 percent of active and stabilized sand seas.

The transverse variety is produced by unidirectional wind and forms asymmetrical ridges that looks like series of barchan dunes whose horns are joined. So, if you take the barchan dunes we will see in the next slide so if you are so if you join the horns of the barchan dunes that will show very similar pattern of the your transverse dunes. Now this transverse dunes with their slip faces all facing roughly in the same direction of the wind.

Other transverse dunes type are domes and reversing dunes and usually the domes will lack slip faces but have an orientation and pattern of sand transported allied to transverse dunes. Similarly, barchans are isolated forms where the horns are not connected they are isolated there are some like 0.5 to 100 meter high and about like 30 to 300 meters wide. So, there the in terms of the landforms they are gigantic.

They rest on firm desert surfaces such as stony pavements and move in the direction of horns. So, this part you will have to remember the direction of horns the wind direction is or the diff or the horns will be in same direction of the wind direction. So, the in the in case of barchans but in case of the parabolic dunes which are going to talk about it is different. So, with the help of the sketches or the the pictures which we are going to show you it will become more clear.

So, but this part you can remember that barchans are isolated even the parabolic dunes are also isolated forms and they can be they can vary from 30 meters to 300 meters wide, 0.5 to 100 meters high. So, and the move in the direction of the horns sometime as much as 40 meters per year. So, this is important in terms of the hazard so if you have the migratory dune field then it is difficult to occupy that area for any reason.

So they form under conditions of limited sand supply and unidirectional wind. Reversing dune: which have slip face on opposite side of the crest that forms in response to wind coming from two opposing directions. So, barchan is unidirectional wind that it will form in the unidirection

whereas the reversing dune will have or will form which will have the slip face on opposite side of the crest.

That forms in response of the winds coming from two different directions and they include they are included in transverse dunes class because net sand transport runs at right angle to crest. Then comes the linear dunes it also has a slip face on either side of the crest line but only one of them is active at any time and sand transport runs parallel to the crest. They may be divided into sharp-crest seif also called seifs or safys.

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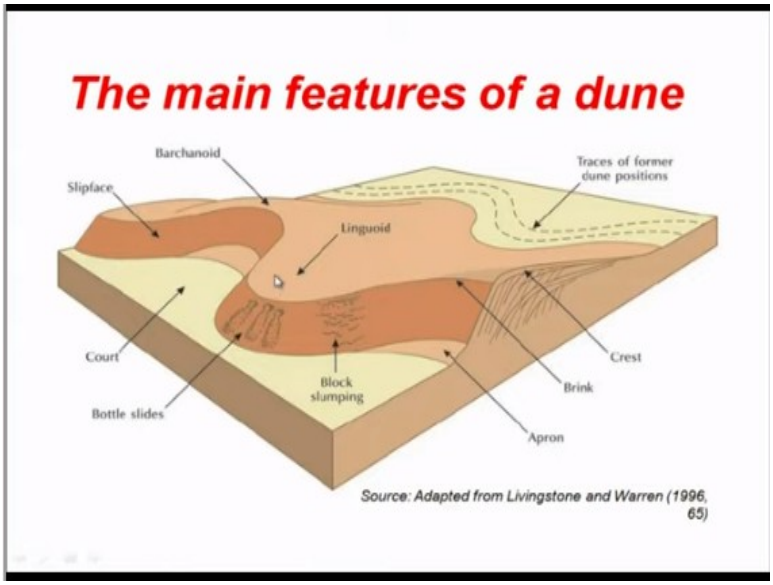

So, main features of a dune is the crest and the movement of the crest as well as the slip face and the back side what you see here is the previous traces of the dunes which used to be here and they have migrated in the direction of this is the wind direction.

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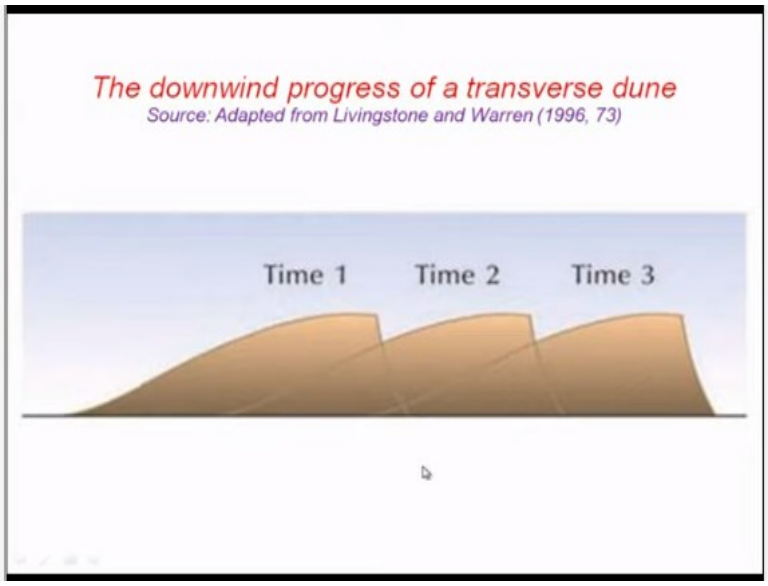

Now, depending on the wind direction and the material which is available few dunes which are free dunes will have tendency to flow to move from one place to another place as shown here and the downwind progress of a transverse dunes. So, the first time time 1, time 2 and time 3 the migration of the dunes will take place.

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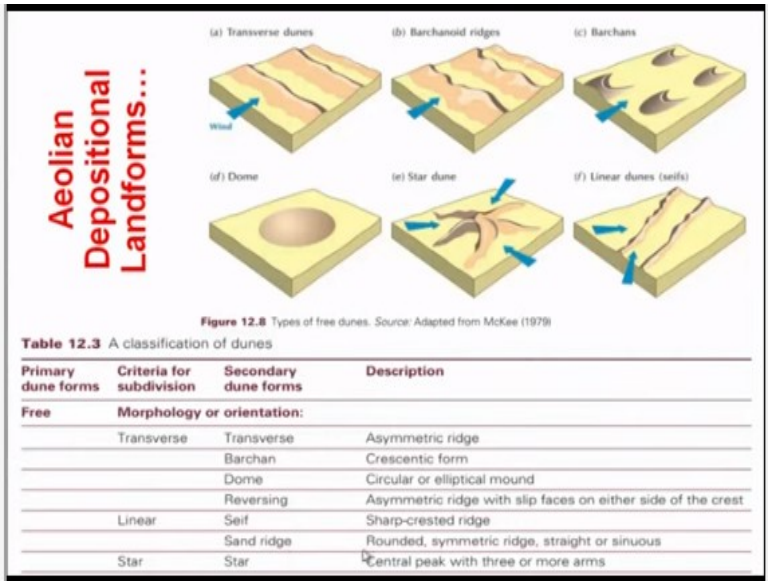

Figure 12.8 Types of free dunes. *Source:* Adapted from McKee (1979)

Table 12.3 A classification of dunes

Primary dune forms	Criteria for subdivision	Secondary dune forms	Description
Free	**Morphology or orientation:**		
	Transverse	Transverse	Asymmetric ridge
		Barchan	Crescentic form
		Dome	Circular or elliptical mound
		Reversing	Asymmetric ridge with slip faces on either side of the crest
	Linear	Seif	Sharp-crested ridge
		Sand ridge	Rounded, symmetric ridge, straight or sinuous
	Star	Star	Central peak with three or more arms

Now, Aeolian depositional landforms if we classify in terms of considering the different directions of the wind and with respect to the either the horns are connected or the ridges are aligned and they can be classified into three categories mainly based on the morphology. And further sub classification can be done based on the that is what we called the criteria for sub division which is based on the morphology and the orientation.

So, one is the transverse dunes which includes transverse, barchans, domes and reversing dunes which are been shown here transverse, barchans and then you are having the domes and the reversing dunes. And then further is the linear one which is the seifs dunes here sand ridges and star dunes here. So, if you look at the transverse dunes mainly what we look at this asymmetrical ridges and the barchans or the crescent shape sand dunes within horn are seen in the direction of the wind.

Then you are having domes is very simple electrical mound or circular mound, reversing are the asymmetrical ridges with the slip face on either side of the crest. Then we have the linear, sharp crested ridges so sharp crested ridges are this one here which are because of the wind from two different directions sand ridges then we have star dunes again from different directions which will result into the formation of the or the ridges which are connected in the center and will give rise to an star shape dunes.

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Then the example of the linear dunes because the crest here are the horns are connected very much. So, these are the typical of the linear dune field or we can say the transverse dune field.

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Then you are having the barchans so the crest or the horns if you see so are been isolated they are not connected much but some places they are connected giving rise to the transverse or the ridges. But this is are typical of barchans and the wind direction is from this place this is an free phase here these are the barchans. So, barchans are isolated forms ranging from as we have discussed 0.5 to 100 meter high, 300 to no 30 to 300 meter in width, the rest on the migration so this we have already discussed.

So, mainly they are formed in the area or under the condition of limited sand supply and in the areas where you have unidirectional wind flow.

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An example of the star dunes which are having the action of wind from different directions. So, with this we will stop here and we will try to continue in the next lecture with more slides on dunes as well as I would say that the we have one or two topics which were been left out will try to cover that in coming lectures. Thank you so much for your kind cooperation. Thank you.