Department of Geology G.G.M Science College Jammu

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Unit-3

3.2. Aeolian Process: Erosional and Deposional Features Produced By Wind

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Aeolian Process

Moving air is called wind and when it blows it effects the surrounding rocks. It produces the varieties of land forms by erosional and depositional process this also called as Aeolian processes. The Aeolian process is pertaining to wind activity which has the ability to shape the surface of the earth. Wind is one of the greatest agents of land erosionand transportation. The action of wind is important in arid and semi arid regions

Winds may erode, transport, and deposit materials and are effective agents in regions with sparse vegetation, a lack of soil moisture and a large supply of unconsolidated sediments. Although water is a much more powerful eroding force than wind, aeolian processes are important in arid environments such as deserts. The grains of aeolian sands are generally well-rounded due to prolonged transportation by wind, some time they are well polished.

Aeolian processes involve erosion, transportation, and deposition of sediment by the wind. The erosion by the wind is caused by the processes;

1. Corrasion/ Abrasion: Corrasion is a term for the process of mechanical erosion of the rocks by the forceful action of the wind which carries small size particles. Such action of the wind causes the grooving, scarring, polishing and grinding of rocks. The intensity of corrasion depends on the size and density of carrying materials, and surface rocks. If rocks are soft corrasion is more.

2. Attrition: It is the process where pieces of rock are transported through wind/ water and wear down the bed rock and surroundings as a result of friction. Gravel or other small stones are often carried through a current and then come into contact with the sides and bottom surfaces. As rocks are transported the regular impacts between the grains themselves and between the grains and the bed cause them to be broken up into smaller fragments

3. Corrosion: Corrosion is a process of chemical erosion**.** Rocks or stones can be eroded as water gets into cracks and holes and dissolves the rock through

Erosional Features Produce By Wind

1. Mushroom rock/ Pedestal rock: A mushroom rock also called pedestal rock is a typical mushroom-shaped landform that is formed by the action of wind erosion**(Fig.3.2a).** At an average height of two to three feet from the base, the material-carrying capacity of the wind is at its maximum, so abrasion is also maximized. In some cases, harder rocks are arranged horizontally over a softer rock, resulting in such erosion.

Mushroom type rocks(Fig.3.2a)

Yardang feayure (Fig.3.2b)

2. Yardangs: Yardangs are wind abraded ridges oriented with the prevailing winds and separated by abraded slide that conduct wind blowing sand **(Fig.3.2b).** Yardangs are large hill sized features formed by the wind. Yardangs are composed of cohesive silts and clays, sand or limestone. They develop in regions with strong uni-directional winds.

Yardangs become elongated features typically three or more times longer than wide. Facing the wind is a steep, blunt face that gradually gets lower and narrower toward the lee end. Yardangs are formed by wind erosion, typically of an originally flat surface formed from areas of harder and softer material. The soft material is eroded and removed by the wind, and the harder material remains. Yardangs are formed in environments where water is scarce and the prevailing winds are strong, uni-directional, and carry an abrasive sediment load. The wind cuts down low-lying areas into parallel ridges which gradually erode into separate hills that take on the unique shape of a yardang.

3. Ventifacts: These are desert rocks which have been cut, and sometimes polished by the abrasion action of wind. The rocks have been abraded, pitted. etched, grooved or polished by wind carrying sands. A Multi polished facets rock is formed by the wind erosion (**Fig.3.2c).** These features are produced in arid environment where there is no vegetation over.

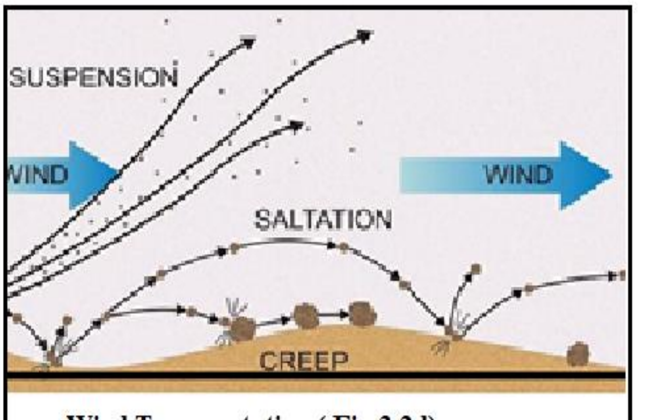
Ventifact (Fig.3.2c)

Transportation In Aeolian Process

The sediments of the different size which are produced by the various process of wind erosion are transported by the different mechanism. These are discussed as;

a. Suspension: Small particles, like silt and clay with size less than 0.2mm are held in the atmosphere in suspension. Upward currents of air support the weight of suspended particles and hold them indefinitely in the surrounding air.

b. Saltation: Saltation is downwind movement of particles in a series of jumps or skips. Saltation normally lifts sand-size particles no more than one centimeter above the ground and proceed at one-half to one-third the speed of the wind. A saltating grain may hit other grains that jump up to continue the saltation. The grain may also hit larger grains that are too heavy to hop, but that slowly creep forward as they are pushed by saltating grains. Surface creep accounts for as much as 25 percent of grain movement in a desert. medium size particles through series of bounces/ skipping. Mechanism of wind transportation is shown in **Fig.3.2d.**

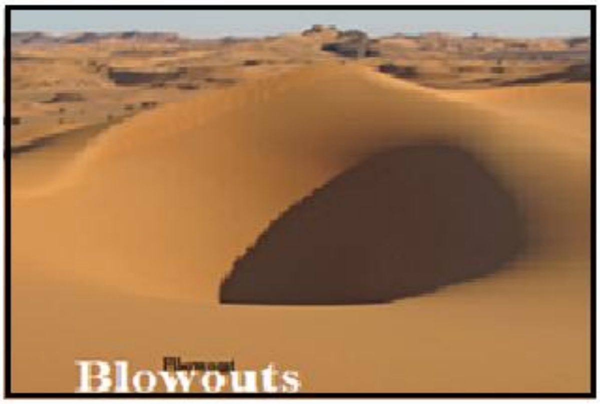


Wind Transportation (Fig.3.2d)

c. Surface Creep (Traction): It is a movement of coarse sand and pebbles which are too heavy to be lifted into air are moved by sliding and rolling impacting one another. Such movement of grains accounts 26% of the grain movement in a desert.

1. Deflation Zones: Most aeolian deflation zones are composed of desert pavement, a sheet-like surface of rock fragments that remains after wind and water have removed the fine particles. Almost half of Earth's desert surfaces are stony deflation zones. The rock mantle in desert pavements protects the underlying material from deflation.

2. Blowouts: These are sandy depressions in a sand dune by the removal of sediments by wind. Such wind features are commonly found in coastal settings and arid margins. The blowouts tend to form when wind erodes into patches of bare sand on the dunes which are not covered by vegetation **(Fig.3.2e).** Most of the time, exposures become re-vegetative before they could become blowouts and expand.



Blowout (Fig.3.2e)

3. Desert Pavement: A desert pavement, are also called reg (in the western Sahara), serir (eastern Sahara), gibber (in Australia), or saï (central Asia). This is a desert surface covered with closely packed, interlocking angular or rounded rock fragments of pebble and cobble size**(Fig.3.2f).**

They are formed through the gradual removal of sand, dust and other fine-grained material by the wind and intermittent rain, leaving the larger fragments behind. The larger fragments left are shaken into place through the forces of

Desert pavement (Fig.3.2f)

Hamada (Fig. 3.2g)

rain, running water, wind, gravity, creep, thermal expansion and contraction etc. The removal of small particles by wind does not continue indefinitely. The pavement forms acts as a barrier to resist further erosion. The small particles collect underneath the pavement surface, forming a vesicular A soil horizon.

4. Hamada: Hamada is a type of desert landscape consisting of high, largely barren, hard rocky plateaus. Hamadas are produced by the wind removing the fine products of weathering by deflation. The finer-grained products are taken away in suspension, while the sand is removed through saltation and surface creep, leaving behind a landscape of gravel, boulders and bare rock.

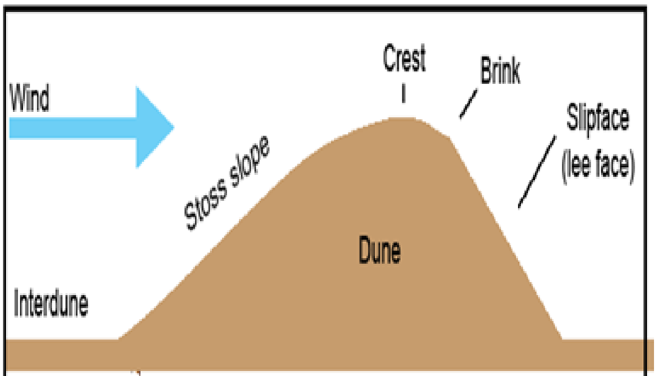
5. Erg: An erg (also sand sea or dune sea, or sand sheet) is a large, flat region of desert covered with sand with little or no vegetation cover. The term takes its name from the Arabic word ʿ*arq* meaning "dune field". Erg is also called as a desert area that contains more than 125 km^2 of aeolian or wind-blown sand. Smaller areas are known as "dune fields". The largest hot desert in the world, the Sahara, covers 9 million square kilometres containing several ergs, such as the Chech Erg and the Issaouane Erg in Algeria. Ergs are concentrated in two broad belts between 20° to 40°N and 20° to 40°S latitudes.

Erg (Fig.3.2h)

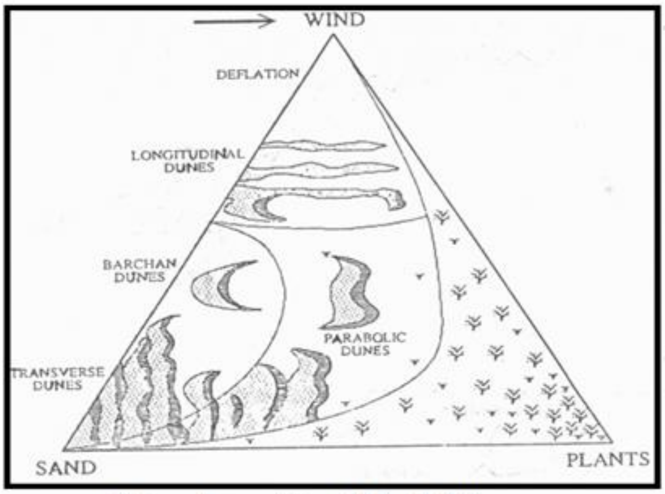
6. Lag deposit: Lag deposits are coarse grained wind residual deposits left behind after finer particles have been transported away, due to the inability of the transporting medium to move the coarser particles.

7. Dunes: Dunes are large masses of sand, and are common in desert environments. An area with number of dunes is called a dune system. Dune is also defined as a hill of loose sand built by aeolian processes.

Dunes occur in some deserts, inland and along some coasts. In most cases, the dunes are important in protecting the land against storm waves from the sea. The largest complexes of dunes are found in dry regions and associated with ancient lake or sea beds.



Dune Morphology (Fig.3.2i)



Dune formation (Fig.3.2j)

Dunes are made of sand sized particles, and may consist of quartz, calcium carbonate, gypsum etc. The upwind/upstream/upcurrent side of the dune is called the stoss side; the downflow side is called the lee side. Sand is pushed or bounces up the stoss side, and slides down the lee side. A side of a dune that the sand has slid down is called a slip face. Dune morphology is shown in **Fig.3.2i.**The dune formation depends on i) supply of sand, ii) steady wind direction, iii) presence of vegetation, rocks to trap the sand. The dune formation is shown in **Fig.3.2j.** These dunes are discussed as under;

i. Barchan or Crescentic dune

Barchan dunes are crescentshaped mounds which are generally wider than their length. The leeside slipfaces are on the concave sides of the dunes. These dunes form under winds that blow consistently from one direction (**Fig.3.2k).** They form separate crescents when the sand supply is comparatively small. When the sand supply is greater, they may merge into barchanoid ridges, and then transverse dunes. Barchans have a long and gentle 910 -15 degree windward slope and short steep leeward slope. These range in height from 1- to 15 mts. Their width may go upto 140 mts.

Barchan dune (Fig.3.2k)

ii. Transverse dunes

Transverse dunes (Fig.3.2L)

These are long asymmetrical dunes that are formed perpendicular to the wind direction. It has single long slip face (**Fig.3.2L).** They forms large field of dunes which resembles with sand ripples on large scale. They consist of ridge of sand with a seep face in the downward side and are formed in region where sand supply is abundant and wind direction is constant.

iii. Seif or longitudinal dunes

Seif dunes are linear dunes with two slip faces. The two slip faces make them sharp-crested **(Fig.3.2m)**. They are called *seif* dunes after the Arabic word for "sword". They may be more than 160 kilometres long.

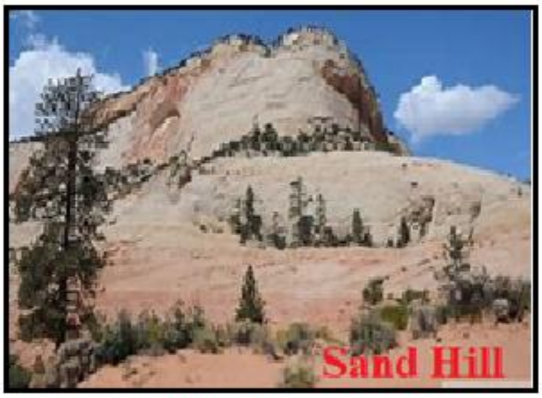
Longitudinal dune (Fig.3.2 m)

Seif dunes are associated with two directional winds. The long axes and ridges of these dunes extend along the resultant direction of sand movement.

These dunes are formed when a barchan dune moves into a bi-directional wind regime, and one arm or wing of the crescent elongates.

iv. Parabolic dune: Parabolic dunes can form when vegetation begins growing on the ends of a sand dune, holding them in place while the rest of the dune moves ahead**(Fig.3.2n).** Parabolic dunes can form where sand supply is moderate and wind is from a single direction. These dunes often occur in semiarid areas where the precipitation is retained in the lower parts of the dune and underlying soils.

Parabolic dune (Fig.3.2 n)



Sand Hill (Fig.3.2n)

8. Sandhill: Wind piles the fine grains of primarily quartz sand informs of hillocks called sand hills **(Fig. 3.2o)**. These are32 km long and 120 metres high, now held in place by grass. The region's climate ranges from semiarid (west) to sub-humid (east) and is continuously windy.

9. Loess

Loess is an aeolian sediment formed by the accumulation of windblown silt, mostly 20–50 micrometer in size, about twenty percent clay and equal parts sand and silt loosely cemented by calcium carbonate. It is usually homogeneous and highly porous and is traversed by vertical capillaries that permit the sediment to fracture and form vertical bluffs.

Loess is homogeneous, porous, friable, pale yellow or buff coloured, typically non-stratified. Loess grains are angular with little polished or rounded and composed of quartz, feldspar, mica and other minerals. Loess are described as a rich, dust-like soil.

Loess deposits become very thick, more than a hundred meters in areas of China and tens of meters in parts of the Midwestern United States. It generally occurs as a blanket deposit that covers areas of hundreds of square kilometers and tens of meters thick.

Loess often stands in either steep or vertical faces. Because the grains are angular, loess will often stand in banks for many years without slumping.

References:

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