Unit-3

Lesson - 9

Denudation

Landforms on the earth surface changes constantly. The endogenetic forces forms the asymmetrical landforms (mountains, plateaus, plains etc.) and the Exogenetic forces work constantly on these landforms to erode them to flat surfaces. The process through which the lowest rocks on the earth's surface are exposed is called denudation. There are different processes involved in denudation which are as follows-

1. Weathering-

It is a static process in which the rocks broken down through disintegration and decomposition.

2. Erosion-

It is dynamic process , in which the rocks are moved through the processes of attrition, abrasion and are shifted or transported to other places.

3. Mass movement-

The movement of the eroded material under the impact of gravity along the slope is called mass movement.

Weathering

The breakdown of rocks because of mechanical and chemical activities through the processes of disintegration and decomposition is called weathering.

The factors affecting weathering -

1. Structure and composition of the rocks

The Rocks which are porus and are composed of soluble minerals are affected more by chemical weathering. The rocks with vertical layers undergo mechanical weathering and the rocks with horizontal layers undergo chemical weathering.

2. Slope of the land

Weathering is comparatively lesser in the areas of gentler or negligible slope than in the areas of steeper slopes.

3. Difference in climate

Tropical and humid areas undergo more of chemical weathering whereas tropical and dry areas undergo more of mechanical weathering.

4. Effect of vegetation

Vegetation marginally act as a factor that causes weathering as well as it marginally also inhibits weathering. The areas which are not covered with vegetation undergoes more of weathering.

Types of weathering

On the basis of the factors that contribute in the disintegration and decomposition the rocks are classified under the following different categories-

1. Physical weathering

The process of the disintegration of rocks due to solar radiation, water and frost is called physical weathering.

A) Block disintegration

In the desert areas, when the rocks undergoes disintegrated into large pieces due to high daily range of temperature it is called block disintegration. (Fig No 9.1)

B) Exfoliation

When the outer layers of the rocks are peeled

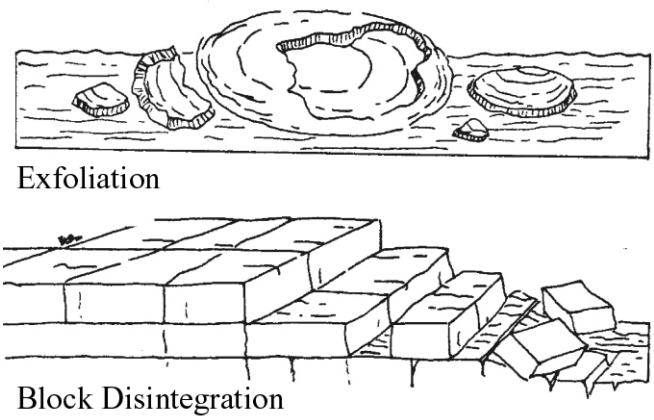

Fig 9.1 : Physical weathering

off because of constant heating and cooling, it is called exfoliation.

C) Frost weathering

The repetitive freezing and melting of the water in the cracks of the rocks exerts tremendous pressure and physically breaks the rocks, this type of weathering is called Frost weathering.

D) Pressure release

Whenever the excess pressure is released by the upper layers of the rocks, the lower rocks cracks due to this release of pressure.

2. Chemical weathering

The disintegration, solution decomposition and formation of new compounds due to the action of chemical processes of water and gases on the rocks is called chemical weathering.

A) Oxidation

The atmospheric oxygen dissolves in water and convert the minerals present in the rocks into oxides, this process is called oxidation. Oxidation increases the rate of weathering. The minerals that contain iron are more affected.

B) Carbonation

The atmospheric carbon dioxide mixes with the oxygen in water and forms carbonic acid. This carbonic acid is a strong solvent for limestone rocks.

C) Desilication

The removal of silica from the rocks is called Desilication process. In humid areas , due to the work of water, silica is separated from igneous rocks and the rocks further undergoes weathering.

D) Hydration

When the minerals of the rocks absorbs water it is called hydration. Rocks like Bauxite, Feldspar etc aborbs water, as a result it becomes heavier and later the rocks are further broken down.

E) Solution

When the rainwater dissolves many acids and carbonic elements it becomes a chemical mixture. This process is called hydrolysis.

3. Biological Weathering

Many Plants and animals contribute in biological weathering on the earth surface.

A) Weathering caused by vegetation

The roots of many trees enters the rocks and loosen the rocks particles, further causing the breakdown of rocks.

B) Weathering by animals

The rodents like rats or other creatures like Termites, Earthworms disintegrates the rocks.

C) Weathering by humans

Human activities like agriculture, mining and construction also causes weathering.

Erosion

Erosion is derived from the Latin word 'Erodere' meaning wearing or tearing . Erosion is a continuous process in which, the rocks are worn off, eroded and transported by the work of agents of erosion like glaciers, underground water, waves, winds and rivers. The rivers, glaciers , wind , waves erodes the rocks in following ways:-

1. Abrasion

When the agents of denudation (Rivers, Glaciers, Wind, Waves) carries the rock boulders, pebbles cobbles, along with them , the valley floors are eroded. This process is called Abrasion.

2. Attrition

Attrition is the process of collision of the boulders, cobbles and pebbles against each other resulting in their fragmentation in the course of action of Wind, River and Waves.

3. Hydraulic Action

The erosion of the rocks due to excess of water pressure exerted by the river is called hydraulic action.

4. Corrosion or Solution

Due to the chemical action of the water, rocks get dissolved in water, this process called

solution or corrosion.

5. Deflation

The process of the lifting and blowing away of sand particles from the rocks by the action of wind is termed as deflation.

6. Cavitation

The waves generated in the river whirls, often drill deep holes in the floor of the river valleys . Riverine caves and pools are examples of this type of erosional work.

7. Plucking

The process in which the debris along the course of glacier is extracted from the valley floor and is transported along with the glacier is called plucking.

The eroded material is transported in 3 ways-

1) Solution

The materials are dissolved and transported along the water.

2) Suspension

The eroded material remains floating in the water and is transported along with the course of water.

3) Traction

The gravels, pebbles, cobbles and boulders travel along with the water by leaping and jumping along the valley floors, this is called traction.

Deposition

As the speed and slope gradient reduces, the capacity to carry the debris by the agents of denudation also reduces. The deposition of the eroded material results in formation of sedimentary rocks.

Mass translocation

The transportation of rock material in huge quantities under the impact of gravitational force along the slope gradient is called mass translocation. Rock wastes get accumulated along the bottom , after being slided from the slopes. this accumulated rock waste is called Talus. When the rock waste is accumulated in form of a cone it is called Talus cone. Mass translocation is classified under three different categories on the basis of speed and quantity of loosened rock material.

1) Slow speed mass translocation

Due to the lesser moisture content disintegrated rock waste slides slowly.

The process of slow drifting is more frequent in subpolar areas. This slow drift also includes processes like Solifluction, Rock creep, Talus creep, Soil creep.

2) High speed mass translocation

Due to abundance of water the drift of rock waste is at very high speed. High speed drift includes Earthflow, Mudflow and Sheet Wash. The sliding mudflow can easily be visible on the slopes of the valleys.

3) Very high speed mass translocation

In this type of drift availability of moisture is not important. Huge boulders suddenly fall down under the impact of gravity. It includes landslides, rockslide, rockfall, debris slide, debris fall and slump processes.

Cycle of Erosion

American geologist William Morris Davis proposed the theory of cycle of erosion in 1899. He described

"The cycle of erosion is a period of time during which an uplifted landmark undergoes its transformation by the process of land sculpture ending into a low featureless plain"

David further described that
"Landscape is a function of structure process and stage"

(i) Structure - On any part of the earth's surface, the structure of the rocks are first to be formed, formation of other landforms occurs later.

(ii) Process- The Process refers to the formation or lowering or erosion of landforms through agents of denudation (like river, winds, waves, glaciers,

underground water etc.) One of these processes somehow plays an important part in the transformation of landforms.

(iii) Stage- Similar to the life span of human beings, the cycle of erosion involves three stages like stage of youth, stage of maturity and stage of old age. The duration of these three stages depends on the mobility of the processes and the composition of rocks.(Fig. No. 9.2)

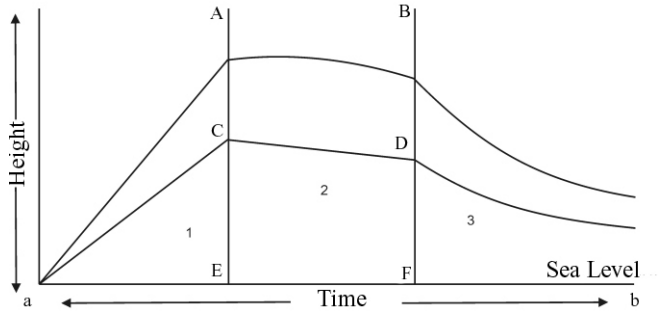

Fig. 9.2 : Cycle of Erosion of Davis

1. Youthful stage

During this stage the rivers deepens the valleys with vertical erosion

2. Mature stage

In this stage the rivers broadens the valleys through lateral erosion.

3. Old age stage

In this stage the topographic regularities are reduced and the entire region is turned into a Peneplain.

Penck's cycle of erosion

A German geographer, Walter Penk, has proposed the cycle of erosion as sum total of interactions between the phases of development, rate of a upliftment and the degradation of landforms.(Fig No.9.3)

1. First Phase

According to Penck, upliftment and erosional processes occurs at the same time. There is more of upliftment in comparison to erosion.

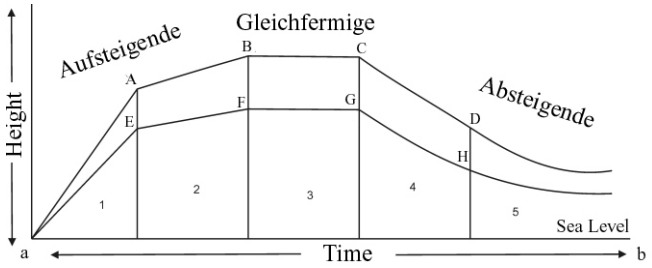

Fig. 9.3 : Cycle of Erosion of Penck

2. Second Phase

During this phase, the processes of upliftment and erosion occurs simultaneously, as a result the valleys get broader and more deeper.

3. Third Phase

In this phase, due to the competitive state between the processes of upliftment and erosion, the difference between the upper and the lower curves remains same, from the base level.

4. Fourth Phase

In this phase the rate of upliftment is reduced whereas erosion is progressive with the same rate as it was in the previous phase. This results into the deepening of the valleys and lowering of Doabs.

5. Fifth Phase

The rate of upliftment as well as erosion becomes slower and weaker. The difference of both the curves from base level is also reduced.

Difference between the view points of Davis and Penck

1. According to Davis the erosion starts after the upliftment of the landform but according to Penck the upliftment and erosion of landforms starts simultaneously.
2. Davis beleives that the upliftment takes place in very short period of time where as Penck believes that the upliftment takes longer period of time.
3. The cycle of erosion as proposed by David involves youth stage, mature stage and old stage whereas the Penck cycle of erosion describes Aufsteigende pertaining to increase in rate, Gleichfermige meaning

uniform rate, and Absteigende meaning reduced rate.

4. According to Davis, the cycle of erosion describes landform as the work of structure, process and time. Penck proposes formation of landforms as the result of rate of upliftment and degradation.
5. The cycle of erosion as proposed by Davis completes in three stages where as the cycle of erosion proposed by Penck undergoes through 5 phases.

Important points

1. Denudation is the sum total of activities of erosion , weathering and mass movement.
2. The disintegration and decomposition of rocks at their own place is called weathering.
3. The word erosion is derived from latin word Erodere meaning wearing or tearing.
4. The process of collision of boulders, pebbles, and rock particles against each other which are being transported by rivers or waves is called Attrition.
5. The process of removing or blowing of loose particles of sand or dust by the action of the wind is termed as deflation.
6. According to William Morris Davis landscape is a function of structure, process and stage.
7. According to Penck the process of upliftment and erosion start simultaneously.

Exercise

Multiple choice questions

1. The disintegration and decomposition of rocks is called
   A) Denudation
   B) Erosion
   C) Weathering
   D) Solution

2. What is Denudation?
   A) erosion and transportation
   B) erosion and deposition
   C) erosion weathering and mass transportation
   D) erosion and solution

3. The process of exfoliation is mostly found in these regions in which -
   A) Higher annual range of temperature
   B) Higher temperature
   C) Lower temperature
   D) Higher daily range of temperature

4. Which place undergoes accelerated rate of chemical weathering?
   A) Tropical and dry
   B) Polar regions
   C) Tropical and humid
   D) Cold and humid

5. The transportation of huge rock debris under the impact of gravitation, along the slope is called...
   A) erosion
   B) weathering
   C) mass translocation
   D) transportation

Very short type questions-

6. Which kind of weathering is oxidation?
7 What do you mean by erosion?
8. Attrition takes place in erosion or in weathering?
9. Which kind of weathering is block disintegration?
10. Which kind of weathering is carbonation?

Short type questions-

11. Describe briefly the meaning of denudation.
12. Write the types of weathering.
13. What is plucking?
14. What do you mean by solution?
15. Explain physical weathering.

Essay type questions

16. Clarify the meaning of weathering and describe its different types.
17. Explain denudation and describe its different types in detail.
18. Explain the concept of cycle of erosion.

Answer Key -

1.C. 2.C. 3.D. 4.C. 5.C