Fluvial Erosional Landforms

In geography, fluvial processes are associated with movement and energy associated with rivers and streams, and landforms created by them. Landforms are small to medium tracts or parcels of the earth’s surface.

There are two types of landforms created by the fluvial process

1. Fluvial Erosional Landforms
2. Fluvial Depositional Landforms

The removal and transport of sediment due to fluvial processes result in erosional landforms. In this article, we will discuss erosional landforms of Fluvial Process.

Fluvial Erosional Landforms

Unlike other geomorphic agents like wind and ice etc., which are confined to certain areas, the effect of running water is felt all over the globe wherever water is present. Thus running water forms the most potent geomorphic agent for denuding the Earth’s surface through erosion.

Different aspects of Fluvial Erodeive Action

In rivers, erosion and transportation go on simultaneously. There are different ways in which fluvial erosion takes place, such as:-

**Corrasion or abrasion** – Corrasion is a process of mechanical erosion of the earth’s surface caused by mechanical grinding of the river’s traction load (coarser material) against the bed and banks of the river. There are two distinct ways in which Corrasion can take place:

1. Lateral Corrasion – Lateral Corrasion takes place sideways and widens the V-shaped valley
2. Vertical Corrasion – it is the downward action. It deepens the river channel

**Hydraulic action** – It is a mechanical process, in which the moving water current flows against the banks and bed of a river, thereby removing rock particles. Some of the water splashes against the river banks and surges into cracks and crevices. This helps to disintegrate the rocks. The river water picks up the loose fragments from its banks and bed and transports them away.

**Attrition** – this is a form of fluvial erosion in which the bed load is eroded by itself due to wear and tear of the transported material when they roll and collide into one another. The coarser boulders are broken down into smaller stones and pebbles.

**Corrosion or solution** – this is the chemical or solvent action of water on soluble or partly-soluble rocks with which the river comes into contact. For example, calcium carbonate in limestone is easily dissolved and removed in solution.

While the first three processes of fluvial erosion come under mechanical erosion, the last or the fourth process i.e. corrosion comes under chemical erosion by fluvial action.
**Forms of Erosion**

River erosion takes place in three ways:

1. **Headward erosion** – it is a process by which a river increases its upstream length. This is achieved by a river cutting back at its source

2. **Lateral erosion** – it is a process through which river channel is extended in its width due to sideways erosion at the outside banks of the rivers

3. **Vertical erosion** – Vertical erosion takes place at the base of the river. The channel of the river gets deepened through vertical erosion
The fluvial cycle of erosion

Three distinct stages of youth, maturity and old age can be identified during the lifetime of a stream. At different stages of the erosional cycle, the valley acquires different profiles. The characteristics related to each stage of landscape development in running water regimes are summarised as below:

**Youth**

- Streams are few during this stage with poor integration and flow over original slopes
- The valley developed is thus deep, narrow and distinctly V-shaped with no floodplains or with very narrow floodplains.
- Downcutting predominates over lateral corrosion
- Streams divides are broad and flat with marshes, swamp and lakes.
- Some of the outstanding features which are developed in this stage are gorges, canyons waterfalls, rapids and river capture etc.

**Mature**

- During this stage, streams are plenty with good integration.
- Lateral corrosion tends to replace vertical corrosion

- The valleys are still V-shaped but wide and deep due to an active erosion of the banks;

- Trunk streams are broad enough to have wider floodplains within which streams may flow in meanders confined within the valley.

- Swamps and marshes of youth stage, as well as flat and broad inter-stream areas, disappear. The stream divides turn sharp.

- Waterfalls and rapids disappear.

- Meander and slip off slopes are the characteristic features of this stage

**Old**

- The river moving downstream across a broad level plain is heavy with sediments.

- Vertical corrosion almost ceases in this stage though lateral corrosion still goes on to erode its banks further

- Smaller tributaries during old age are few with gentle gradients.

- Streams meander freely over vast floodplains. Divides are broad and flat with lakes, swamps and marshes.

- Depositional features predominate in this stage

- Most of the landscape is at or slightly above sea level

- Characteristic features of this stage are floodplains, oxbow lakes, natural levees and Delta etc.

**Fluvial Erosional Landforms**

Most of the erosional landforms associated with running water are made by youthful rivers vigorously flowing over steep gradients. With time, stream channels over steep gradients turn gentler due to continued erosion, and as a consequence, lose their velocity, facilitating active deposition. There are two
components of running water. One is the sheet that refers to overland flow on the land surface. Another is streams and rivers that refer to linear flow as in valleys.

**River Valleys**

- The extended depression on the ground through which a stream flows throughout its course is called a river valley.
- At different stages of the erosional cycle, the valley acquires different profiles
- Valleys start as small and narrow rills
- The rills will gradually develop into long and wide gullies
- The gullies will further deepen, widen and lengthen to give rise to valleys.
- Depending upon dimensions, shape, types and structure of rocks in which they are formed, many types of valleys like the V-shaped valley, gorge, canyon, etc. can be recognised.

![V-shaped river valley](image)
1) V-shaped Valley

- The river is very swift as it descends the steep slope, and the predominant action of the river is vertical corrosion.
- The valley developed is thus deep, narrow and distinctly V-shaped.

**How V-shaped Valleys are formed?**

[Diagram showing the formation of a V-shaped valley]

- The river uses its load to cut down into the bedrock causing vertical erosion.
- Loosened material is washed into the river increasing the load and therefore the ability to erode.
- With time the river directs its energy into eroding the valley laterally. The whole process then repeats itself.

Formation of the V-shaped valley

2) Gorge

- A gorge is a deep and narrow valley with very steep to straight sides.
- A gorge is almost equal in width at its top as well as its bottom.
- Gorges are formed in hard rocks.
- Example – Indus Gorge in Kashmir.
3) Canyon

- A canyon is a variant of the gorge.
- Unlike Gorge, a canyon is wider at its top than at its bottom.
- A canyon is characterised by steep step-like side slopes.
- Canyons commonly form in horizontal bedded sedimentary rocks.
- Example – Grand Canyon carved by Colorado River, USA.
Grand Canyon, Colorado River, USA

**Waterfalls and Rapids**

- When rivers plunge down in a sudden fall of some height, they are called waterfalls.
- Their great force usually wears out a plunge pool beneath.
- Waterfalls are formed because of several factors like the relative resistance of rocks lying across the river, the relative difference in topographic reliefs e.g. in Plateau etc.
- A rapid is similarly formed due to an abrupt change in gradient of a river due to variation in resistance of hard and soft rocks traversed by a river.
- Waterfalls are also transitory like any other landform and will recede gradually and bring the floor of the valley above waterfalls to the level below.
Potholes and Plunge Pools

- Potholes are more or less circular depressions formed over the rocky beds of hill-streams, because of stream erosion aided by the abrasion of rock fragments.

- Once a small and shallow depression forms, pebbles and boulders get collected in those depressions and get rotated by flowing water and consequently the depressions grow in dimensions.

- Eventually, such depressions are joined leading to deepening of the stream valley.

- At the foot of waterfalls also, large potholes, quite deep and wide, form because of the sheer impact of water and rotation of boulders. These deep and large holes at the base of waterfalls are referred to as plunge pools.

- These pools also help in the deepening of valleys
Incised or Entrenched Meanders

- Incised or entrenched meanders are found cut in hard rocks. They are very deep and wide.

- In streams that flow rapidly over steep gradients, normally erosion is concentrated on the bottom of the stream channel.

- Entrenched meander normally occurs where there is a rapid cutting of the river bed such that the river does not get to erode the lateral sides.

- Meander loops are developed over original gentle surfaces in the initial stages of development of streams and the same loops get entrenched into the rocks normally due to erosion or gradual uplift of the land over which they started.
- They are widened and deepened over a long period of time and can be found as deep gorges and canyons in the areas where hard rocks are found.

- They give an indication of the status of original land surfaces over which streams have developed.

- Incised meanders are said to be an impact of river rejuvenation.

**River Terraces**

- River terraces refer to surfaces relating to old valley floor or floodplain levels.

- They may be bedrock surfaces without any alluvial cover or alluvial terraces consisting of stream deposits.

- River terraces are basically products of erosion as they result due to vertical erosion by the stream into its own depositional floodplain.

- There can be a number of such terraces. They are found at different heights indicating former river bed levels.

- The river terraces may occur at the same elevation on either side of the rivers in which case they are called paired terraces

![Paired and unpaired river terraces](image)
Peneplain

- A peneplain (an almost plain) is a low-relief plain which is formed as a result of stream erosion
- The peneplain is meant to imply the representation of a near-final (or penultimate) stage of fluvial erosion during times of extended tectonic stability.

Drainage Patterns

- The drainage pattern of a stream refers to the typical shape of a river course as it completes its erosional cycle
- They are governed by the topography of the land, resistance and strength of base rocks and the gradient of the land
- There are various types of drainage patterns which are described briefly as below:-
Various types of drainage patterns

**Dendritic drainage pattern**

- It is the most common form of drainage system.
- The drainage pattern resembling the branches of a tree is known as “dendritic” In a dendritic system, there are many contributing streams, which are then joined together into the tributaries of the main river.
- The examples of Dendritic Pattern include the rivers of northern plain such Indus.

**Trellis drainage pattern**

- In the trellis drainage pattern, the primary tributaries of rivers flow parallel to each other and they are joined by secondary tributaries at the right angle.
- The geometry of a trellis drainage system is similar to that of a common garden trellis used to grow vines.
- Trellis drainage is characteristic of folded mountains,
- Examples of trellis pattern include the drainage system of the Appalachian Mountains in North America and Seine and its tributaries in Paris basin (France) etc.
Parallel drainage pattern

- A parallel drainage system is a pattern of rivers caused by steep slopes with some relief.
- The parallel drainage pattern is observed in a uniformly sloping region where the tributaries seem to be running parallel to each other.
- A parallel pattern sometimes indicates the presence of a major fault that cuts across an area of steeply folded bedrock.
- Examples of this system include the rivers of Lesser Himalaya

Rectangular drainage pattern

- Rectangular drainage develops on rocks that are of approximately uniform resistance to erosion, but which have two directions of joining at approximately right angles.
- In the rectangular drainage pattern, the mainstream curve at right angles and the tributaries join the mainstream at right angles.
- Example – Colorado river the USA

Angular drainage pattern

- Angular drainage pattern is commonly observed in foothill regions.
- Angular drainage patterns form where bedrock joints and faults intersect at more acute angles than rectangular drainage patterns. Angles are both more and less than 90 degrees
- the mainstream is joined by the tributaries at acute angles.

Radial drainage pattern

- When the rivers originate from a hill and flow in all directions, the drainage pattern is known as ‘radial’.
Volcanoes usually display excellent radial drainage. Other geological features on which radial drainage commonly develops are domes and laccoliths.

The rivers originating from the Amarkantak range present a good example of it.

**Centripetal drainage pattern**

When the rivers discharge their waters from all directions in a lake or depression, the pattern is known as ‘centripetal’.

Examples – streams of Ladakh, Tibet and Loktak Lake in Manipur (India)

**Annular drainage pattern**

In an annular drainage pattern streams follow a roughly circular or concentric path along a belt of weak rock, resembling in plan a ring-like pattern.

Example of such system include Black Hill streams of South Dakota, USA
Study from India's Best IAS Teachers LIVE Online

NeoStencil is India's number 1 platform for LIVE online learning. We help you connect with India's best teachers from the comfort of your home.

Some of our popular UPSC Civil Services Exam courses:

**UPSC General Studies Foundation Courses offered at NeoStencil**

1. Lukmaan IAS
2. Pavan Kumar IAS
3. Destination IAS
4. Toppers 25

**UPSC Mains Optional Subjects courses**

- **Pub Ad**: S. Ansari, Pavan Kumar, Atul Lohiya (Hindi Medium)
- **Philosophy**: Mitrapal
- **Geography**: Prof. Majid Husain, Alok Ranjan (English and Hindi Medium), Md. Rizwan
- **Sociology**: Praveen Kishore, Vikash Ranjan, Venkata Mohan, Mujtaba Husain
- **Anthro**: Venkata Mohan
- **History**: Alok Jha
- **PSIR**: Kailash Mishra (English and Hindi Medium), RS, Sharma
- **Law**: Dinesh Verma (Scope IAS)

**General Studies Mains Test Series**: Pavan Kumar IAS, Lukmaan IAS, AAI IAS

**Pub Ad Test Series**: Pavan Kumar

**Sociology Test Series**: Praveen Kishore, Venkata Mohan, Lukmaan IAS

**Geography Test Series**: Prof. Majid Husain, Alok Ranjan (English and Hindi), Lukmaan IAS

**Anthro Test Series**: Venkata Mohan

**Essay Test Series**: Lukmaan IAS, Venkata Mohan

**Current Affairs Online Courses for IAS Exam Preparation**

1. Lukmaan IAS
2. Venkata Mohan
3. Mk Yadav
4. Alok Jha

We also Provide Online courses for IES | GATE | SSC | State PCS Exams. For more details visit our All Courses Page – here