

Study Notes

Landforms Created by River and Glacier System



Geography Notes on Landforms Created by River & Glacier System

What are Landforms?

A landform is a feature of the Earth's surface that is part of the landscape. Each landform is distinct in terms of physical shape, size, and materials, and it is the result of specific geomorphic processes and agent(s). Because most geomorphic processes and agents are slow, the results take a long time to manifest. Every landform has a beginning, and once created, landforms can alter shape, size, and character throughout time due to the ongoing activities of geomorphic processes and agents.

Types of Landforms

Forces both inside and outside the globe can change the form of the planet's surface. Geomorphic forces were discussed in prior Geography notes. Endogenic and exogenic factors can both build landforms. A landform is a natural feature on the solid surface of the Earth. Examples include **mountains, plateaus, and plains**.

Mountains: Mountains cover over 27% of the world's land surface. Up to 80% of the world's fresh surface water originates in the mountains. According to the Food and Agriculture Organisation of the United Nations (FAO), around 12% of the world's population lives in mountains, while more than 50% is directly or indirectly dependent on mountain resources.

Plateaus: A plateau is an elevated terrain with relatively level land on top. It has a vast top surface and a steep slope on its sides. They are also known as the high plains or the tablelands. Plateaus cover around 18% of the earth's land surface.

Plains: Plains are the most common landforms on the planet's surface. A Plain is a low-lying, relatively flat land surface with a gradual slope and little local relief. Plains cover around 55% of the earth's land surface. The majority of the plain was formed by the deposition of sediments carried down by rivers. Aside from rivers, certain plains have been generated by wind, sliding glaciers, and tectonic activity.

Landforms by Water

Water is regarded as the most important geomorphic factor in causing the degradation of the ground surface in humid locations with heavy rainfall. The majority of running water erosional landforms are connected with energetic and young rivers flowing over steep grades.

Potholes:

- These are the deep natural underground cave formed by the erosion of rock, especially by the action of water.
- These currents erode the river's bed and create small depressions in it.
- These are drilled into the **bed of a river** and are cylindrical in nature.
- The diameter and depth vary from a few centimetres to meters.



- These are formed due to the **whirling impact** of the water current in the upper course of the river.
- In India, the potholes can be observed in the river bed of the Kukadi, Krishna and Godavari rivers in Maharashtra.

V-Shaped valley:

- In mountain ranges, you will find these types of valleys
- V-shaped valleys have steep valley walls with narrow valley floors
- V-Shaped valleys are deep river valleys with steep sides that look like the letter V, a diagram shown below will give you a better understanding
- These are generally formed by the result of erosion and withering by fast-flowing rivers and are generally formed in the **upper course** of the river.
- A deep and narrow valley with steep sides is called a **Gorge**.
- Many gorges are found in river Ulhas in Thane district in Maharashtra and the gorge of the river Narmada at Bhedaghat near Jabalpur in Madhya Pradesh are well known.

Canyon:

A canyon has steep step-like side slopes and can be as deep as a gorge. A canyon is wider at the top than it is at the bottom. In actuality, a canyon is a type of gorge. Canyons are frequently formed in horizontally bedded material.

Waterfalls (Geological):

- Waterfalls are formed due to the erosion of both hard rock and soft rock.
- As the river flows over the resistant rock, it falls onto the less resistant rock, eroding it and creating a greater height difference between the two rock types, producing the **waterfall**.
- Over thousands of years, the repeated collapse of the caprock and retreat of the waterfall produces a gorge of recession.
- Waterfalls exist because of the difference in rock types. When a river flows, it passes through many different rock types and when a river passes from a resistant rock bed to a softer one, it erodes the softer one very quickly and at the junction between the rock types, it steepens its gradient.
- The highest waterfall in the world is Angel Falls in Venezuela (~800 m).
- The largest waterfall is the Chutes de Khone (Khone Falls) on the Mekong River in Laos.
- The Niagara Falls on the river Niagara and Jog Falls in Karnataka on the **Sharavathi River** are famous waterfalls.

Meanders and Ox-bow lakes:

Meanders are bent in a river that forms as a river's sinuosity increases.

- A **meander** forms when moving water in a stream erodes the outer banks and widens its valley, and the inner part of the river has less energy and deposits silt.



- **Meanders** form a snake-like pattern as the river flows across a fairly flat valley floor.
- The **sinuosity** of a river is a measurement of how much a river varies from a straight line.
- Meanders are formed due to **lateral erosion** and as the erosion increases over a period of time, the meanders in the river again start flowing in a straight line.
- Meander formation is a self-intensifying process where a greater curvature results in more erosion of the bank which in turn results in greater curvature.
- **Oxbow** lakes are an evolution of meanders that undergo extensive deposition and erosion
- When the meanders cut from the main course and water accumulates in this pool then it resembles the shape of the oxbow.

Fan-shaped plains:

- These are formed in the region where the **Tributaries Rivers** join the main river.
- These are formed due to the deposition of material carried by the Tributaries Rivers.
- These flows come from a single point source at the apex of the fan, and over time move to occupy many positions on the fan surface.
- This deposition resembles the shape of a Fan like plains

Flood Plains:

- These are formed due to the **overflows** of the river and **floods** in the nearby areas.
- It is an area of low-lying ground adjacent to a river, formed mainly of river sediments and subject to flooding.
- Floodplains are made by downstream travelling meanders.
- **Silt** carried by the water gets deposited in flooded areas and forms flat plains on both sides of the river.
- The **Gangetic Plain** is a floodplain.

Levees:

- It is an embankment built to prevent the overflow of a river by a ridge of sediment deposited naturally alongside a river by overflowing water.
- When a river floods, it deposits its load over the flood plain due to a dramatic drop in the river's velocity as friction increases greatly.
- Repeated floods cause the **mounds** to build up and form levees.

Delta:

- Delta is a term coined by **Herodotus** (The Father of History) after the Greek letter Delta because of the deltoid shaped at the mouth of the Nile river.
- A **River delta** is a landform that forms from the deposition of sediment carried by a **river** as the flow leaves its mouth and enters slower-moving or standing water.



- This occurs when a **river** enters an ocean, sea, estuary, lake, reservoir, or (more rarely) another **river** that cannot transport away the supplied sediment.
- Over a period of time, this deposition builds the characteristic geographic pattern of a river delta.
- **The Sunderbans** delta of the Ganga River is the largest in the world.

What is Glacier?

- A **glacier** is a persistent body of dense ice that is constantly moving under its own weight; it forms where the accumulation of snow exceeds its ablation over many years.
- On an average day, a glacier moves **1 to 15** meters a day.
- There are two types of glaciers, **Continental** Glaciers and **Alpine or Mountain** glacier

Glacial Landforms

Glacial landforms are those created by glaciers. The majority of modern glacial landforms are the product of massive ice sheets migrating throughout the Quaternary glaciations. Glacial landforms can still be found in areas without active glaciers or glaciation processes. A straight row of stakes laid across a glacier would gradually bend as they descend the valley, implying that the glacier moves quicker in the centre than at the outside.

Glaciers form where there is more snowfall than melts each year. When snow falls, it instantly starts to compress or thicken and become more firmly packed. Firnification is the process by which snow condenses into glacial firn (thick, granular ice). When the ice thickens to around 50 metres (160 feet), the firn grains join together to produce a massive mass of solid ice. The glacier begins to calve as a result of its weight. A glacier's many components move at varying rates. The flowing ice of the glacier advances faster than the glacier's base.

Types of Glacial Landforms

There are majorly two types of Glacial Landforms **Depositional and Erosional**.

Glacial Deposition

Glaciers have substantially impacted landscapes in mid and high-latitude alpine regions. The primary glacial depositional landforms are as follows:

- **The Drumlins:** These flat, oval-shaped topographies mimic ridges and are composed primarily of glacial till with minor amounts of gravel and sand. It forms as a result of glacier fissures that enable rock debris to slide beneath heavily weighted ice. Drumlins' long axes run parallel to the direction of ice movement. Drumlins depict the movement of glaciers. The Stoss end, the steeper of the two ends, is used to face the ice flow.



- **Esker:** The esker is one of the most stunning landforms formed by fluvio-glacial deposits. They are frequently built of gravel and washed sand. The eskers vary in size and shape. When glaciers melt, water seeps down their edges or flows on top of the ice. These waters pool beneath the glacier and flow through a passage beneath the ice-like streams. These streams are produced by ice and flow above the ground. When the ice melts, very coarse objects like stones and blocks, along with a few small particles of rock debris, settle down in the valley of ice beneath the glacier and become visible as the curving ridge known as Esker.
- **Glacial Till:** Glacial till is the unsorted coarse and fine debris released by meltwater glaciers. There is some rock debris swept down and deposited that is small enough to be carried by melt-water streams. Outwash deposits are glacial fluvial deposits. The outwash sediments are varied and layered.

Glacial Erosion

Major Glacial Erosion Landforms are provided below:

1. Cirque
2. Glacial Valleys/Troughs
3. Aretes and Horns

Cirque:

- It is a half-open steep-sided hollow at the head of a valley or on a mountainside, formed by glacial erosion.
- Cirques are created by glaciers, grinding an existing valley into a rounded shape with steep sides.
- The back wall of the cirque is like a **high cliff** and the floor is concave and huge in size. The total shape resembles an **armchair**.
- When a glacier melts completely, water accumulates in the cirque and forms a lake which is known as a **tarn**.

U-shaped Valley:

- **U-shaped valleys**, or glacial troughs, are formed by the process of glaciation. They are characteristic of mountain glaciation in particular. They have a characteristic **U shape**, with steep, straight sides and a flat bottom
- As the erosion of the sides is greater than that of the floor, a valley is formed with vertical sides and a wide floor. This valley is called a U-Shaped valley.
- These valleys can be several thousand feet deep and tens of miles long.
- As a glacier moves downhill through a valley, usually with a stream running through it, the shape of the valley is transformed. As the ice melts and retreats, the valley is left with very steep sides and a wide, flat floor. This parabolic shape is caused by glacial erosion striving to decrease friction as much as possible



Hanging Valley:

- It is a valley which is cut across by a deeper valley or a cliff.
- Hanging valleys are often associated with valley glaciers, joining the main valley along its sides.
- Hanging Valley Landforms Have 2 Main Characteristics - a valley that leads to another valley below and A cliff or steep wall below the meeting point
- They are the product of different rates of erosion between the main valley and the valleys that enter it along its sides.
- The tributaries are left high above the main valley, hanging on the edges, their rivers and streams entering the main valley by either a series of small waterfalls or a single impressive fall

Aretes and Horns:

Aretes, which are glacial landforms, are usually seen between two perpendicular circles. These U-shaped valleys were scoured by glaciers, leaving knife-edged slopes behind. The glaciers erode the bedrock beneath these valleys even more, resulting in aretes at the upper reaches of the parallel valleys. Between aretes between two cirques, there is typically a low area called as a col. A number of cirques are typically clustered radially on the sides of larger mountain ranges, such as the Alps. When glaciers wear down the higher regions of these mountain ranges, they form sharp peaks. These pointed peaks, nicknamed as horns, are surrounded by vertical headwall cliffs divided by aretes.

Fjord:

- Geologically, a **fjord** is a long, narrow inlet with steep sides or cliffs, created by glacial erosion
- Fjords are common in Norway, Greenland and New Zealand

Moraine:

- The material transported and deposited by a **glacier** is known as moraine.
- A mass of rocks and sediment carried down and deposited by a glacier, typically as ridges at its edges or extremity
- Zigzag hills, with many steep slopes, made up of long stretches of sand and gravel are called **eskers**.
- The oval-shaped hills of lesser height are called **drumlins**.
- There are 4 types of moraines – Lateral, Medial, Terminal and Ground



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