Fluvial Landforms

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Subject- Geology

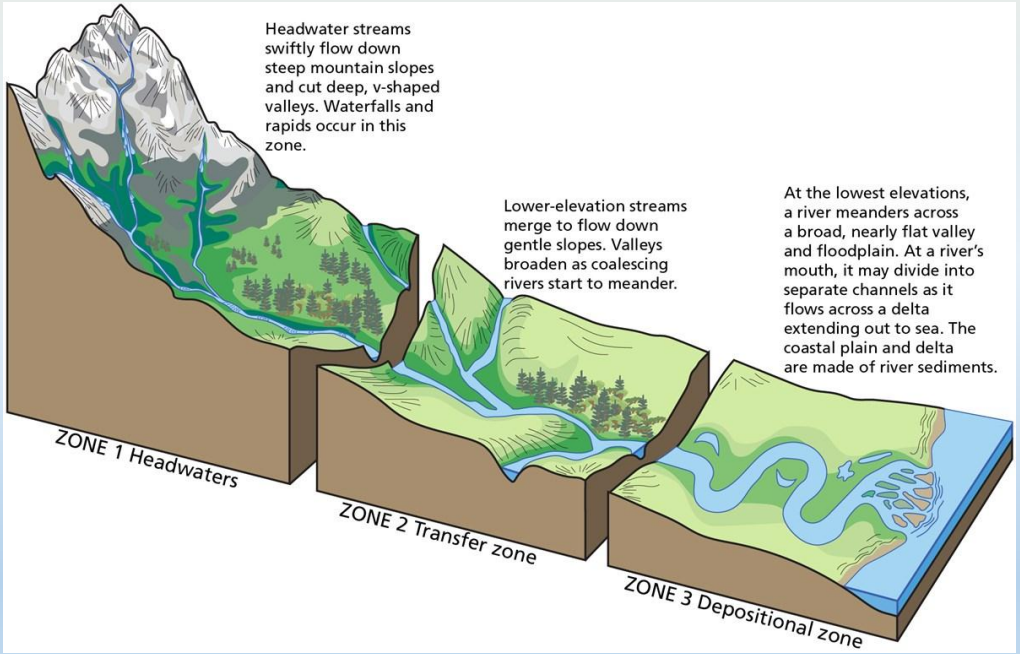
Course- M.Sc. Geology

Semester- II

Paper Code- MGELCC-5

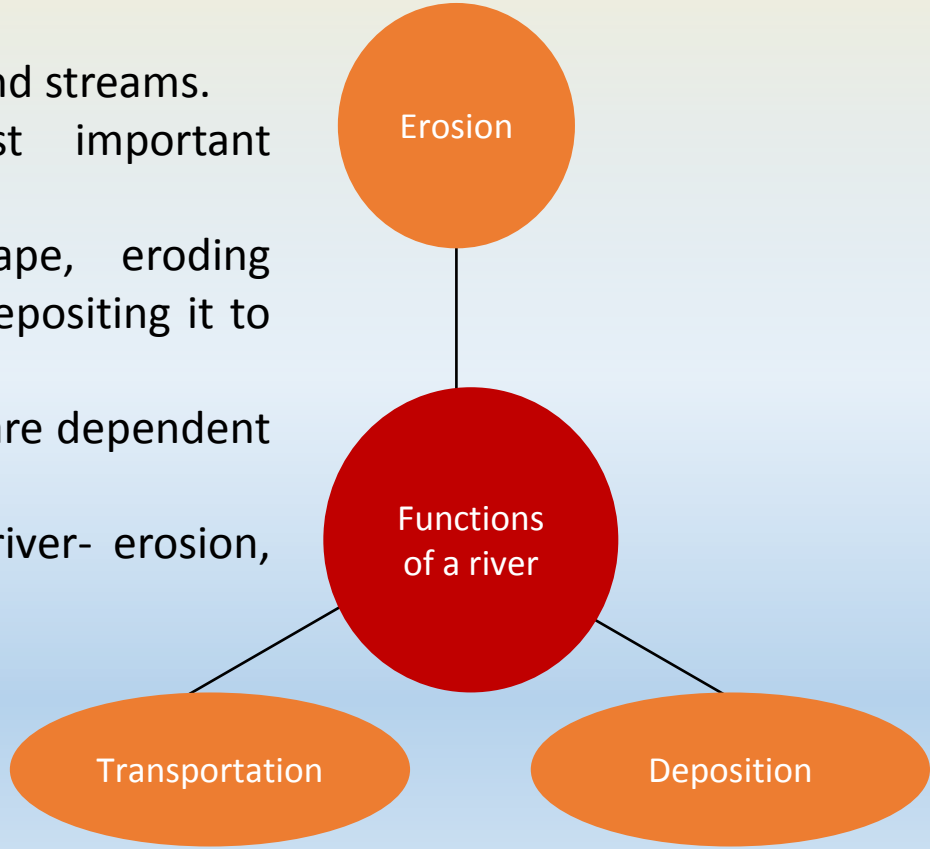
Paper Name- Geomorphology, Remote Sensing and GIS

Contents



Introduction

- Fluvial systems are dominated by rivers and streams.
- Stream erosion may be the most important geomporphic agent.
- Fluvial processes sculpt the landscape, eroding landforms, transporting sediment, and depositing it to create new landforms.
- Human civilization and ecosystems alike are dependent on fluvial systems.
- There are mainly three functions of a river- erosion, transportation and deposition.



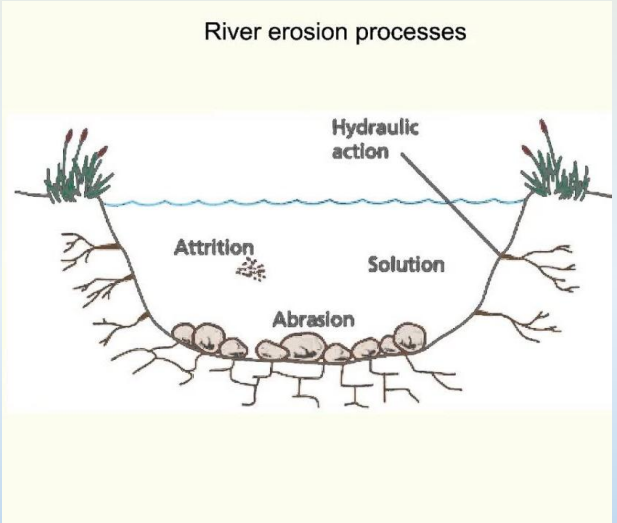
Seral no.	River	Place of origin
1	Ganga	Gangotri (Uttarakhand)
2	Yamuna	Yamunotri (Uttarakhand)
3	Indus	Mansarovar (Tibet)
4	Narmada	Maikal Hills, Amarkantak (MP)
5	Tapi/Tapti	Satpura Range, Betul (MP)
6	Mahanadi	Nagri Town (Chhattisgarh
7	Brahmaputra	Chemayungdung (Tibet)
8	Sutlej	Mt Kailash (Tibet)
9	Krishna	Mahabaleshwar (Maharashtra)
10	Godavari	Nasik (Maharashtra)
11	Cauvery	Brahmagiri Hills, Coorg (Karnataka)

Fig. Distribution of rivers in India.

Erosional action of a river

A river may erode in 4 ways

- **Abrasion/corrosion**- Load carried by a river will grind against its bed and sides. This process slowly wears the bed and sides away.
- **Attrition**- When thrown against the sides and bed of rivers, the load gets broken into smaller pieces.
- **Hydraulic action**- The work of turbulence in the water. Running water causes friction in the joints of rocks in a stream channel Joints may be enlarged and loosened fragments of rocks get swept away.
- **Solution/Corrosion**- Certain minerals in rocks like limestone can be dissolved in water. Rocks are then eroded.

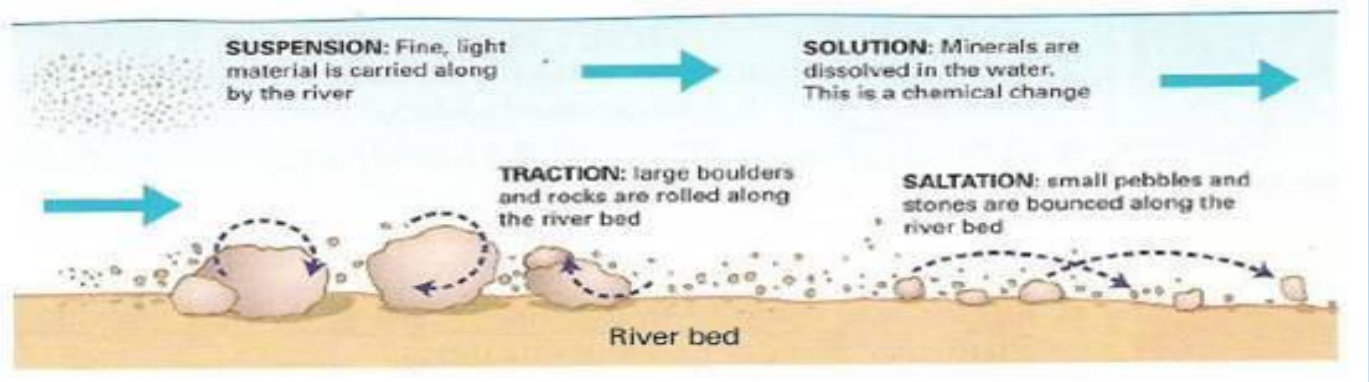


Transportation by a river

A river may transport in 5 ways

- **Traction**: The process of large pieces of load rolling along a river bed.
- **Saltation**: The process of load bouncing a long a river bed.
- **Suspension**: The process of smaller pieces of load being carried in a rivers flow.
- **Solution**: The processed of dissolved pieces of material being transported in a solution.
- **Flotation**: When material is transported on the surface of the river.

Load: Material that is transported by a river. If the material is being transported along the bed, it is known as **bedload**, load transported in a rivers flow is often called **suspended load**.



Essential conditions for erosion, transportation and deposition

The Hjulstroöm Curve shows the linkage between sediment size and the velocity needed to erode, transport or deposit. The upper line shows the erosional velocity or **critical erosion velocity** needed to initiate sediment erosion.
The lower line shows the fall or settling velocity. In between the two there is the transportation of sediments.
A big gap between the critical erosion and deposition line implies that sediments will be transported further, the opposite happens for a small gap where a relative drop in velocity (critical fall velocity) causes sediments to be deposited.
The Hjulstroöm curve neglects other underlying factors such as vegetation and gradient that determine particle movement. Steeper gradients facilitate the movement.

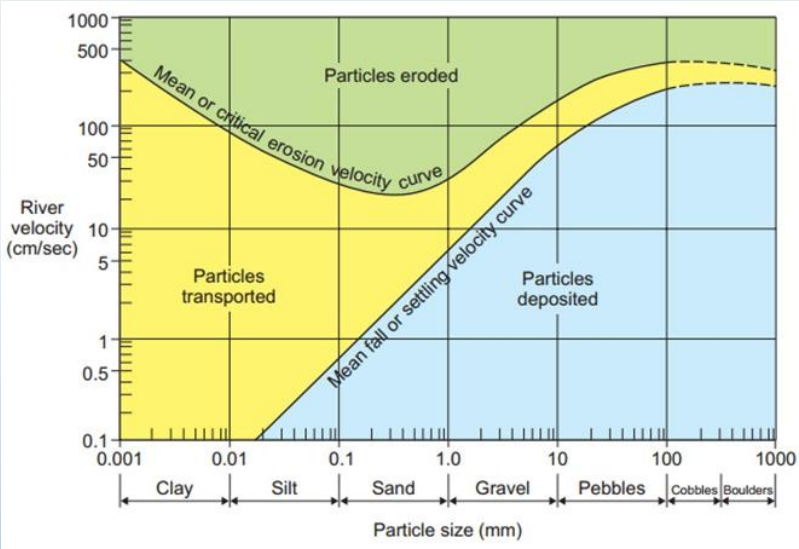
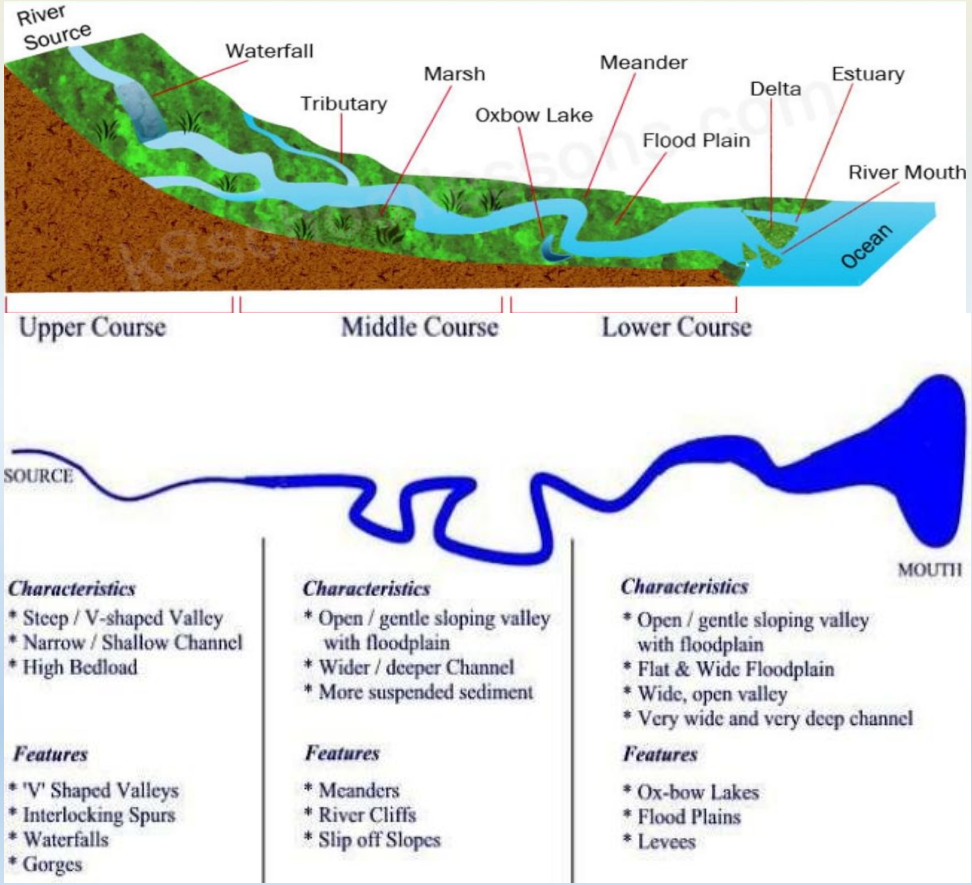


Fig. The Hjulstroöm Curve

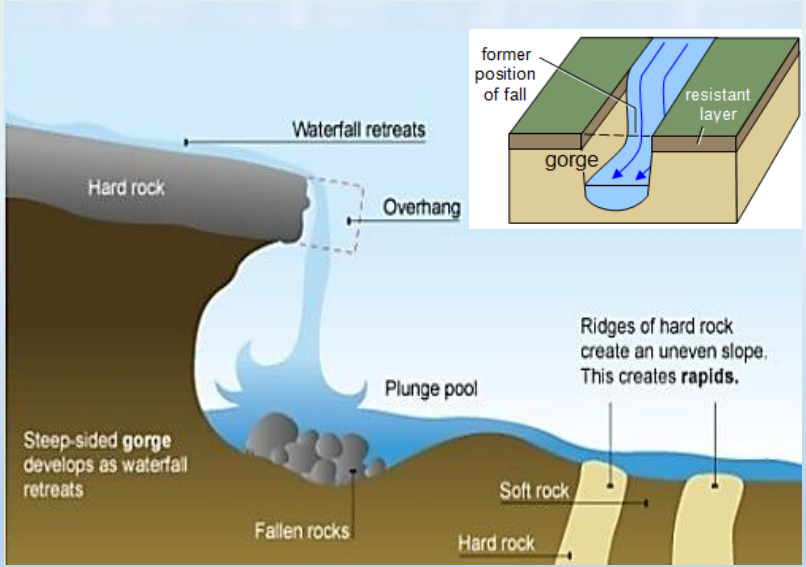
Classification of Fluvial landforms

River landforms can be categorized in two different ways. They can be classified either by the processes that made them (erosion and deposition) or where they are found (upper course, middle course or lower course).

Upper Course	Middle Course	Lower Course
• Waterfalls • Rapids • Gorges • V-shaped valleys • Interlocking spurs • Alluvial Fans	• Meanders • Oxbow lakes • Levees • Braided rivers	• Deltas • Floodplains



Landforms of Upper Course



Waterfalls and gorges:

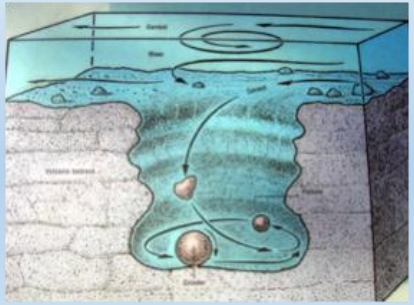
Waterfall: Waterfalls are where water descends vertically. Waterfalls are usually created by a change in rock type. As the river moves from hard rock to soft rock, erosion increases creating a waterfall.

As the water falls over the waterfall it erodes the river bed and the bottom of the waterfall. This makes a **plunge pool** and causes some undercutting. The undercutting creates an **overhang** which will eventually become too heavy to be supported and collapse into the plunge pool. The whole process then starts again, which means the **waterfall is constantly retreating upstream** towards the source. As the waterfall retreats it leaves behind a **gorge**.

Gorge: A gorge is a deep sided valley left behind when a waterfall retreats.

Landforms of Upper Course

Rapids: Rapids are sections of rough turbulent (white water) water. They are normally formed when river get layers of hard and soft rock. The layers of soft rock erode quicker than the layers of hard rock. This makes the bed of the river uneven creating rough turbulent water.



Potholes: Potholes are holes found in the river bed. Load carried by the river is washed around in a circular motion causing vertical erosion.

Landforms of Upper Course

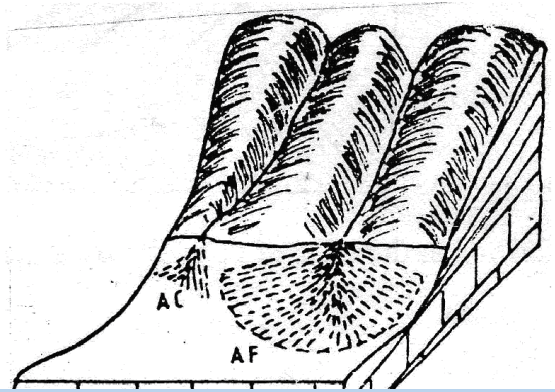
V-shaped valleys are found in a river's upper course where vertical erosion is dominant. The river will erode (cut) downwards while the sides are weathered (attacked by the weather e.g. rain, wind and the sun). The weathered material will then fall into the river and be transported away leaving a v-shaped valley.

Interlocking spurs are the areas of the valley (hills) that stick out into the river forcing it to meander around them.

Landforms of Upper Course

Alluvial fan: slope is below 10˚

Alluvial cone: slope is from 10 ˚ - 50˚



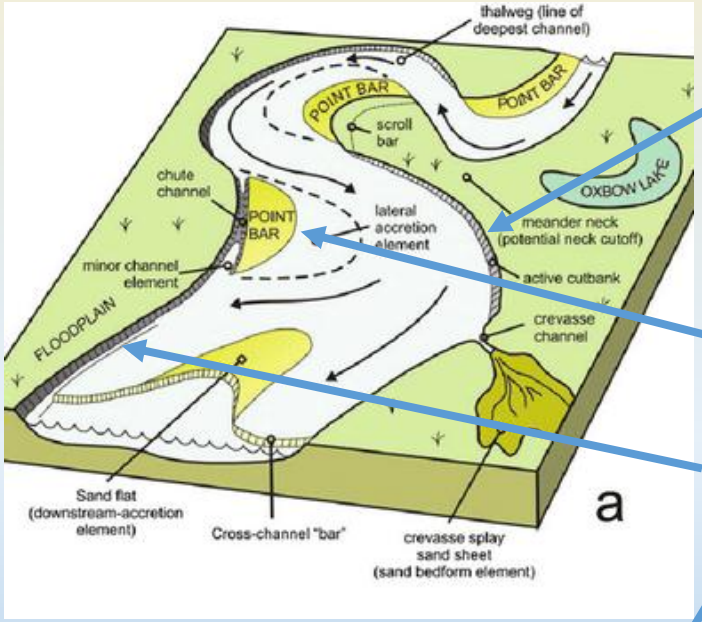
Alluvial Fans and Cones:

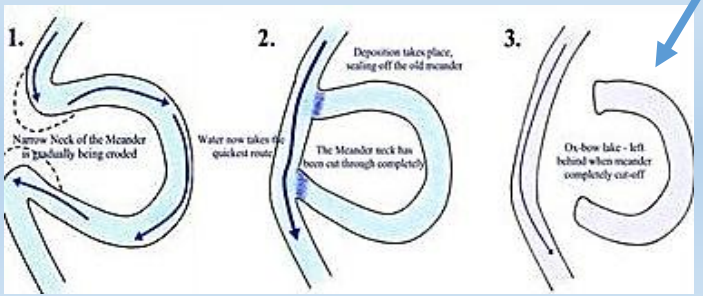
Alluvial fans and cones form due to accumulation of materials. These are always formed at the base of foothills where there is abrupt drop (decrease) in the channel gradient. The transporting capacity of the streams decreases enormously at the foothill zones while they leave the mountains and enter the plain topography because of substantial decrease in their velocity consequent upon decrease in channel gradient.

Consequently, load consisting of finer to coarser and big-sized materials coming from upstream is deposited at the point of break in slope or foothill zone and thus alluvial fans are formed. There is sorting of materials in the alluvial fans. The size of sediments decreases outward from the apex (which is towards the hills) of the fans towards their outer margins (distal side).

When the slope is alluvial fan is more and it seems like a cone then this is known as alluvial cone.

Landforms of Middle Course





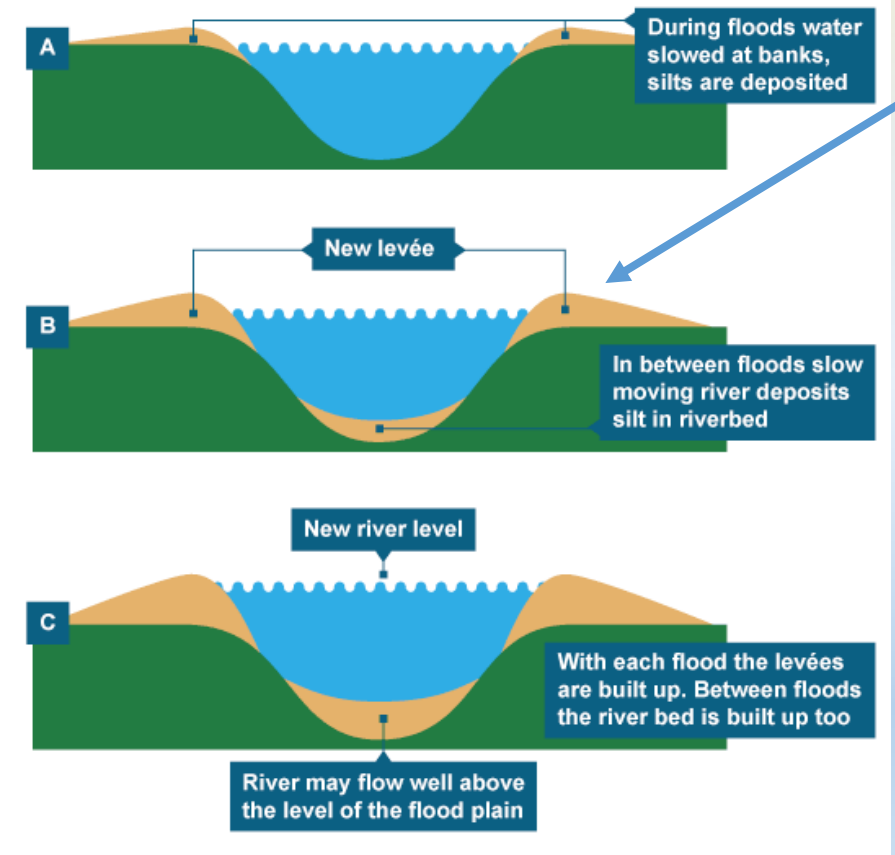
Meanders: A meander is simply a bend in the river. If a river is very bendy it is said to be sinuous. A meander starts to form when the thalweg moves to one side of the river channel. This causes greater erosion on one side of the channel and deposition on the other. Over time the erosion and deposition will cause the river to bend. Meanders are constantly moving and over long periods of time widen the floodplain.

Slip-off slope (point bar): This is formed on the side of the river with greatest deposition (the inside of the meander). It is simply deposited material that forms a small beach like area and gently sloping bank.

River cliff: This happens on the side of the river channel with greatest erosion (the outside of the meander). It creates a steep sided bank which often leads to undercutting of the bank.

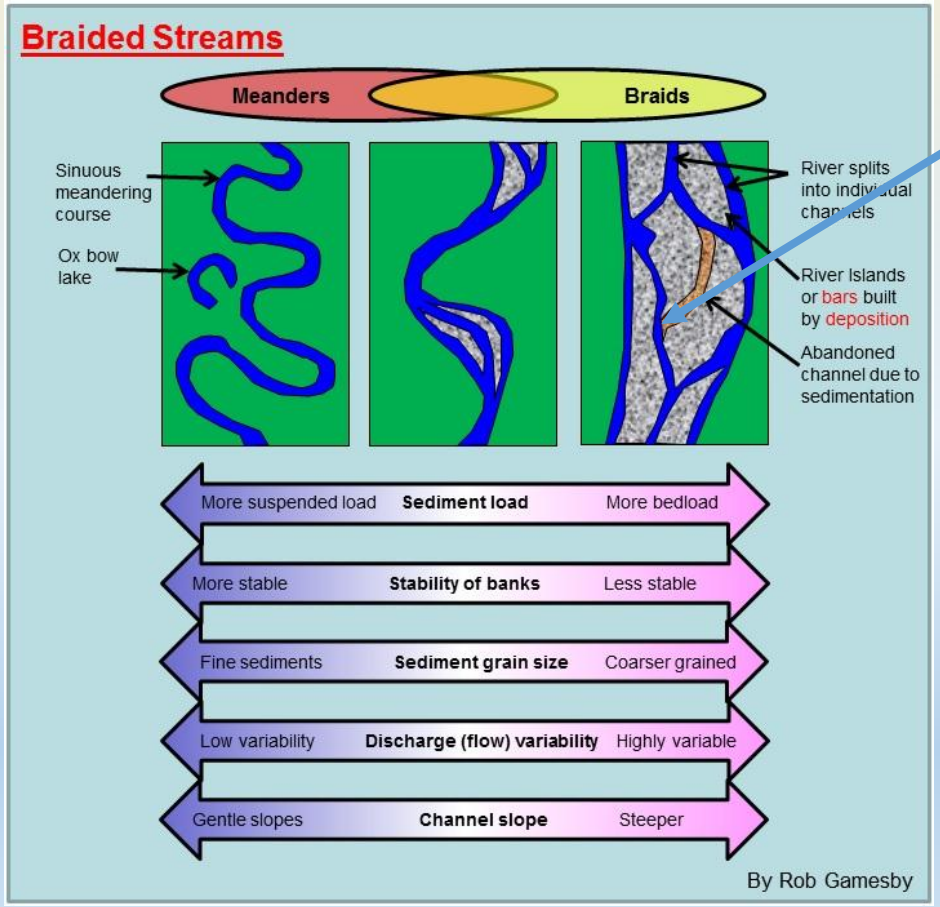
Oxbow lakes: Oxbow lakes are created when two meanders connect (join). The river will often finally connect the two meanders during a flood event when the river is more powerful. The thalweg then shifts to the center of the river (and does not travel around the old meander) causing deposition on the outside of the river channel cutting off the old meander and creating an oxbow lake.

Landforms of Middle Course



Levee: A levee is a natural or artificial wall. They prevent rivers from flooding cities in a storm surge. But if a levee breaks, the consequences can be disastrous. The natural movement of a body of water pushes sediment to the side, creating a natural levee. The banks of a river are often slightly elevated from the river bed. The banks form levees made of sediment, silt, and other materials pushed aside by the flowing water. Levees are usually parallel to the way the river flows, so levees can help direct the flow of the river.

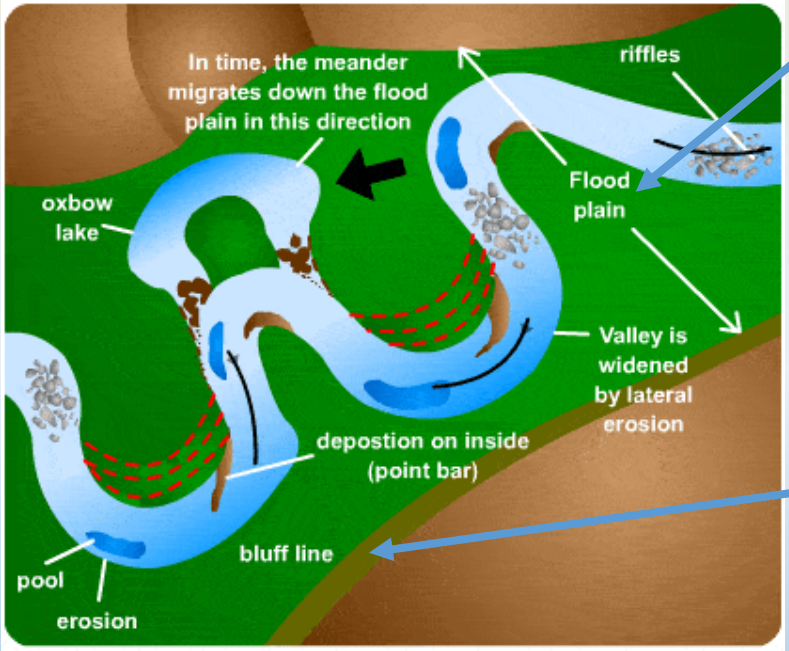
Landforms of Middle Course



Braided Rivers:

Some rivers have lots of small channels that continually split and join. These are called braided rivers. Braided rivers are usually wide but shallow. They form on fairly steep slopes and where the river bank is easily eroded. Braided rivers have a lot of rock, gravel and sand that is carried along the river bottom. When the amount of water flowing through individual channels deceases the river dumps this material creating **islands** and **bars**.

Landforms of Lower Course



Floodplain: Floodplains are simply the areas of land that rivers flood onto when they exceed bankfull discharge. The constant movement of meanders creates floodplains. Because horizontal erosion is more dominant in a rivers lower course, floodplains tend to be a lot wider in a river's lower course. However, they also make great farmland because of alluvial deposits.

Alluvium: Mineral rich load that is deposited on floodplains in times of flood. Alluvium is essential to keep farmland fertile.

Bankfull discharge: This is when the river channel is full and can not hold any more water. If the river exceeds bankfull discharge then it floods.

Bluff Line: The outer limits of the floodplain. The bluff line is found just before the gradient of the valley sides start to increase.

Strand line: This is the line of material left behind after a river has flooded. The strand line is found on the outer limit of the flood somewhere on the floodplain. A strand line normally consists of pieces of wood and litter.

Landforms of Lower Course

Delta is a “depositional feature of a river formed at the mouth of the river. These are wetlands that form as rivers empty their water and sediment into another body of water, such as an ocean, lake, or another river.

On the basis of the shape, following are various types of Deltas:

Arcuate Delta: It is fan-shaped Delta. A bowed or curved Delta with the convex margin facing the body of water. Relatively coarse sediments are formed in this type of Delta. The river activity is balanced with the wind. Example, the River Nile Delta in Egypt and the Ganges Delta in India.

Bird’s foot Delta: Named because it forms like a bird foot’s claw. This shape is created when the waves are weak and the river flow is stronger. They are formed due to deposition of finer materials by river water. Deposited alluvial material divides the river into smaller distributaries. Thus, this Delta rarely occurs along ocean coasts because the waves are often stronger than the river current. Such Delta is also called finger Delta. Example, Mississippi river Delta, the USA.

Cuspate Deltas: It is formed where sediments are deposited onto a straight shoreline with strong waves. The waves push the sediments to spread outwardly creating the tooth-like shape. Example, Tiber River of Italy.

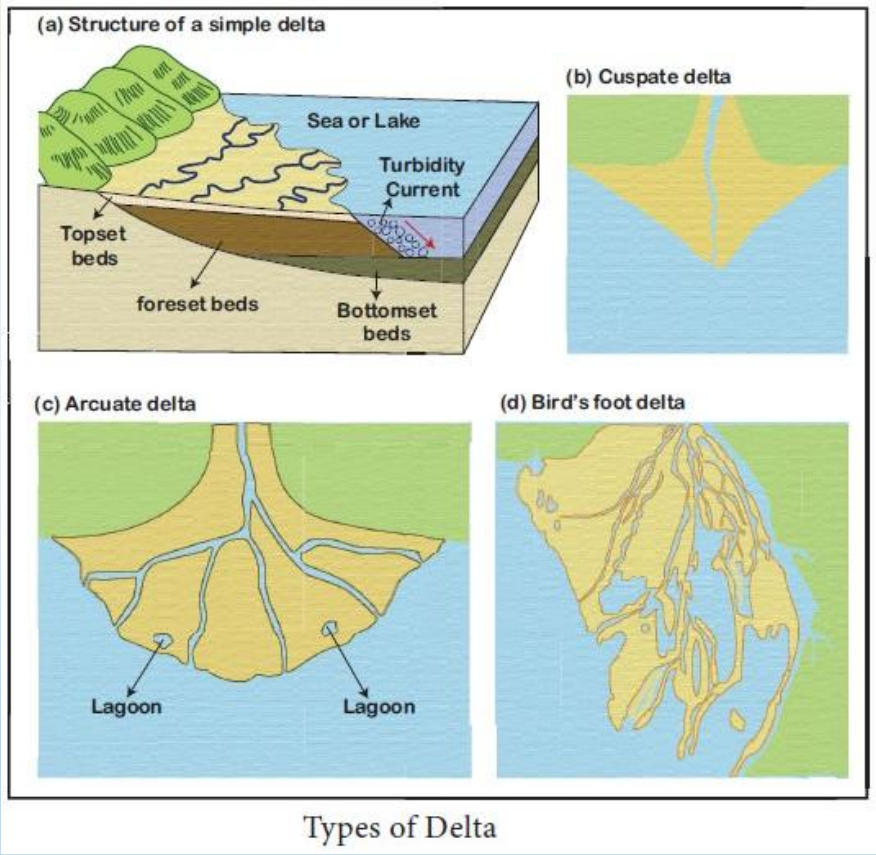
Estuarine Delta: It is formed at the mouth of submerged rivers depositing down the sides of the estuary. Example, the Seine River of France, the Deltas of Narmada and Tapi (formerly Tapti) rivers of India.

Lacustrine Delta: It is formed when a river flows into a lake. Example, Lough Leanne river Delta, Ireland.

Truncated Delta: Sea waves and ocean currents modify and even destroy Deltas deposited by the river through their erosional work. Thus, eroded and dissected Deltas are called truncated Deltas.

Abandoned Delta: When the river shifts its mouth, the Delta already made is left abandoned. Such a Delta is called an abandoned Delta. Example, Yellow river Delta, China and the Western part of Ganga Delta made by Hoogly river, India.

Landforms of Lower Course



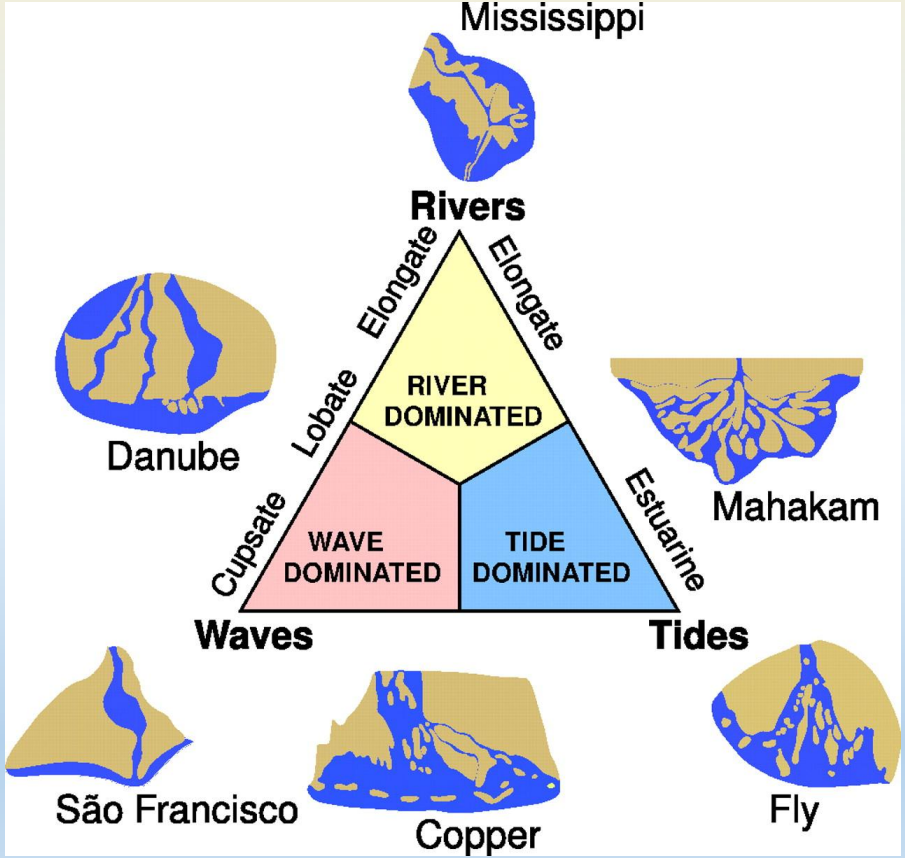


Fig. Structure of a simple delta and different types of deltas.

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