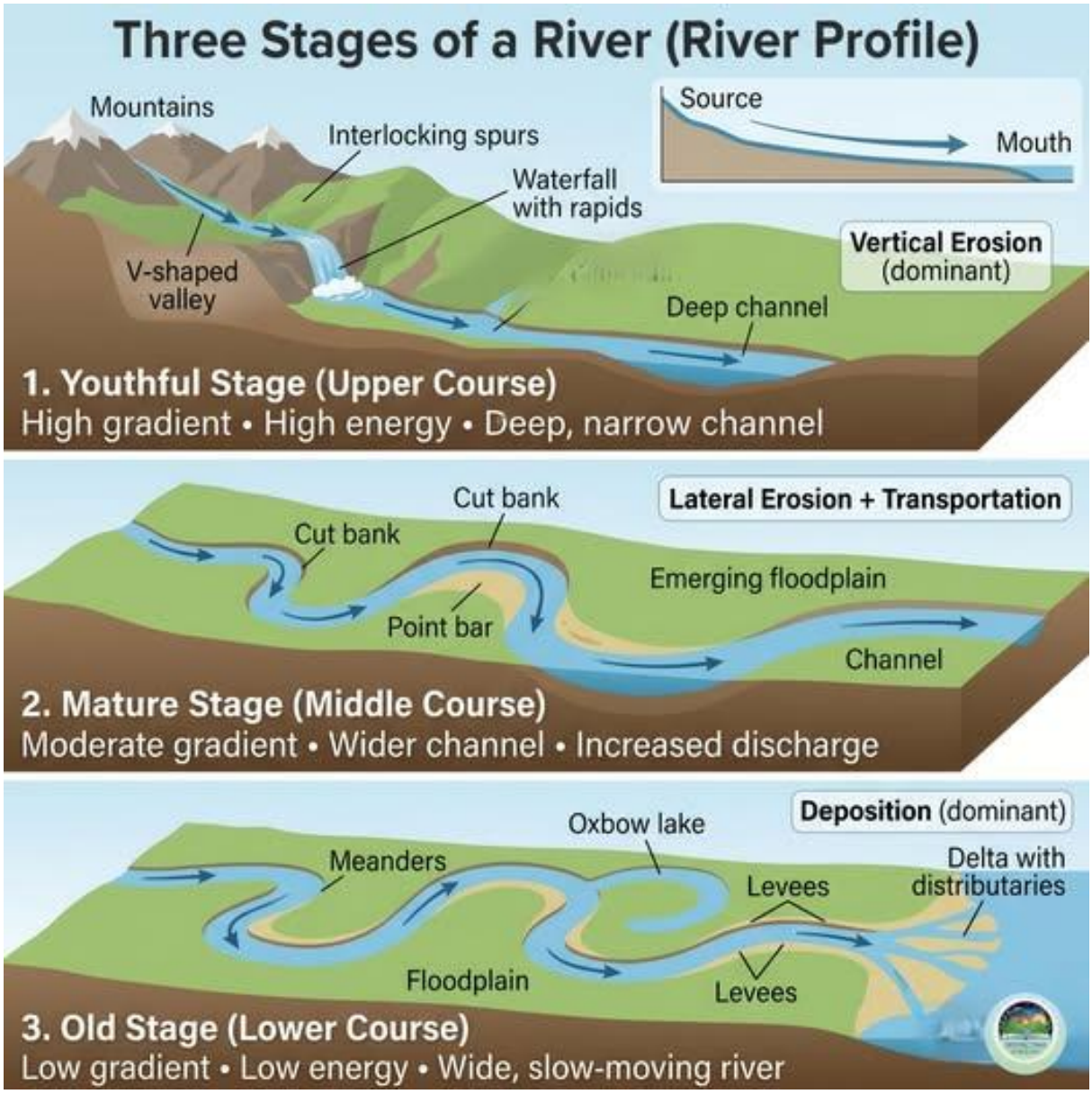
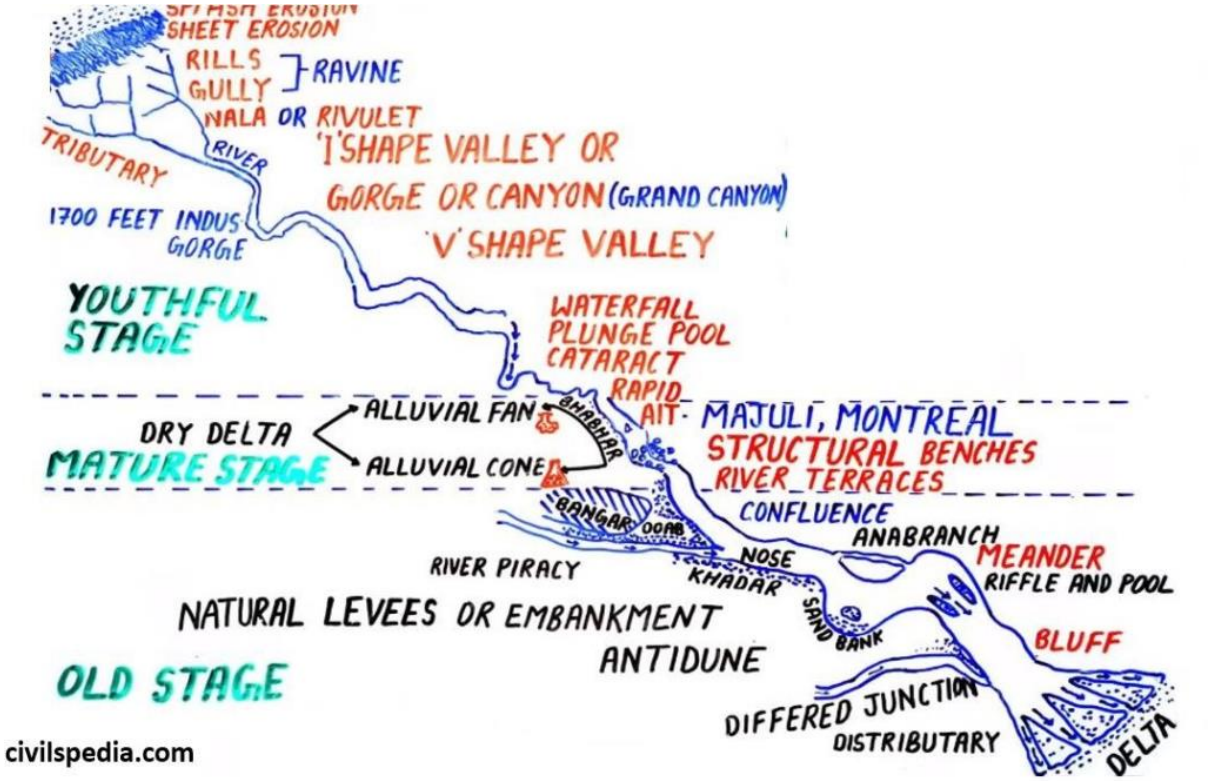

Three Stages of a River (River Profile)
Mountains
Interlocking spurs
Waterfall with rapids
V-shaped valley
Source
Mouth
Vertical Erosion (dominant)
Deep channel
1. Youthful Stage (Upper Course)
High gradient • High energy • Deep, narrow channel
Cut bank
Cut bank
Lateral Erosion + Transportation
Emerging floodplain
Point bar
Channel
2. Mature Stage (Middle Course)
Moderate gradient • Wider channel • Increased discharge
Oxbow lake
Deposition (dominant)
Meanders
Delta with distributaries
Levees
Floodplain
Levees
3. Old Stage (Lower Course)
Low gradient • Low energy • Wide, slow-moving river

Course of a River



Upper or Mountain Course /Youthful Stage

In this stage

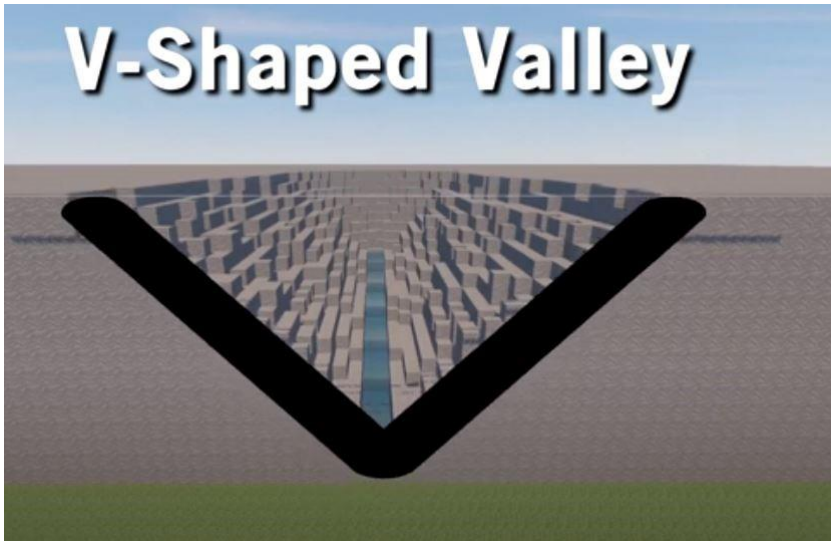
- Predominant Work = Erosion
- Predominant action = vertical corrasion.

Landforms formed in this stage

1. Valleys

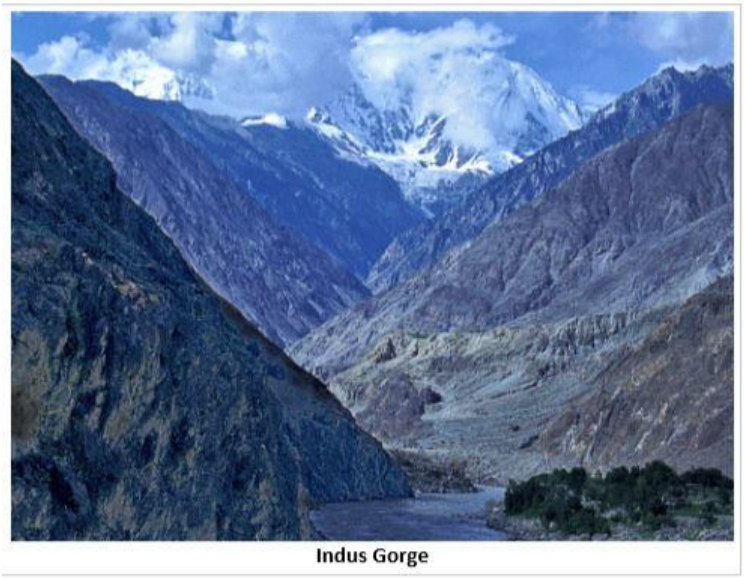
1.1 V-Shaped Valley

- In upper course, **vertical corrasion** is at work . **Downward cutting takes place so rapidly that lateral corrasion can't keep pace**. After some time, the loosened material slowly creeps downward and takes shape of V.
- The valley thus developed is deep , narrow & distinctively V-Shaped.



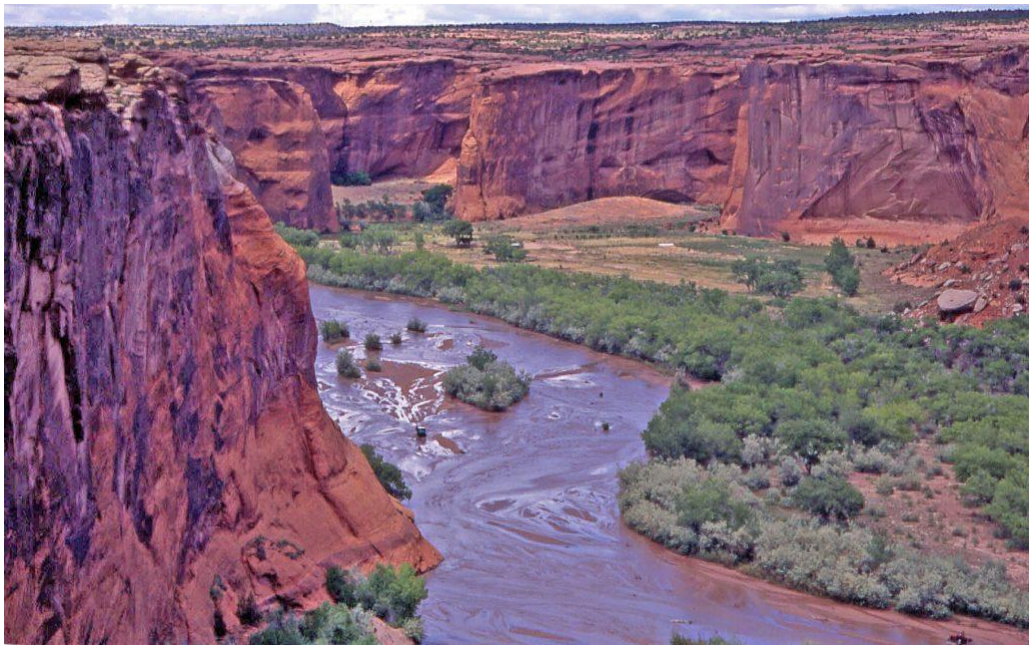
1.2 Gorges / I-shaped Valley

- In some cases, rocks are very resistant and hence afterward loosening don't take place (because of resistant rock). The valley formed is so narrow & sides are so steep that gorges are formed .
- Eg : Indus Gorge in Kashmir .


Indus Gorge

1. 3 Canyons

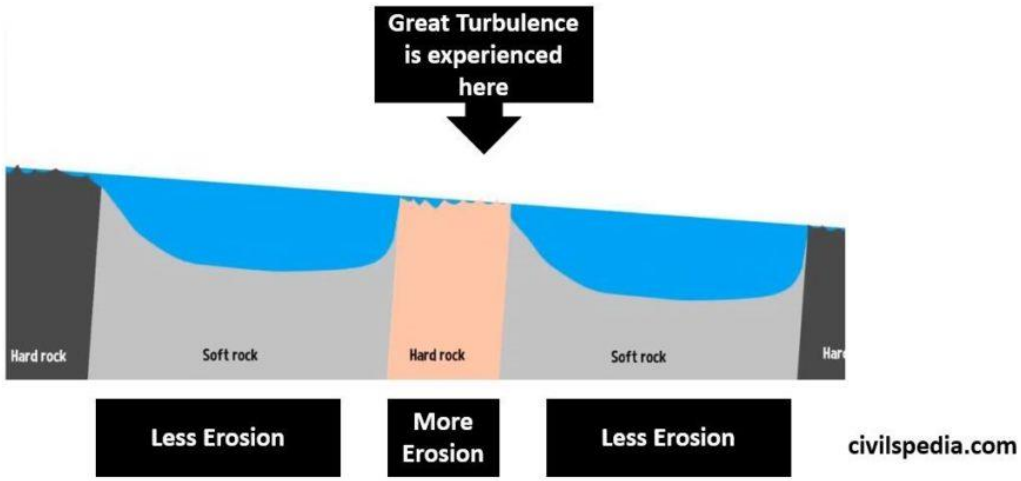
- Canyons are extended form of gorges.
- In arid regions, where there is little to widen the valley sides and river cuts deep into the valley floors , precipitous valleys called Canyons are formed.
- Eg Grand Canyon of Colorado river in Arizona state of USA .



2. Falls

2.1 Rapids

- These can form in any part of river course but are **more numerous in mountain course**.
- They are **formed when there are different layers of hard rock and soft rocks** . Due to unequal resistance of hard & soft rocks , there is unequal erosion of both set of rocks . The hard rocks will make river to jump and fall down

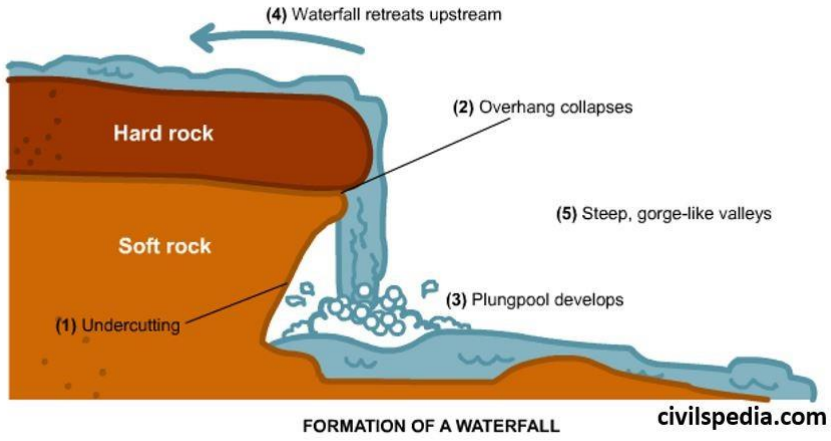


2.2 Cataract

- Falls similar to rapids but of **greater dimensions** are referred to as Cataracts.
- There are 5 along the Nile that interrupt the smooth navigation.

2.3 Waterfalls

- When rivers plunge down in a sudden fall of some height , they are known as waterfalls. Their force usually **wears out a plunge pool beneath .**
- They can be formed in various ways
    - When a bar of resistant rock lies transversely across a river valley . Eg Niagara Falls in US
    - At **fault line** across river. Eg Victoria falls on River Zambezi
    - When **river plunges down the edge of a plateau** like River Congo .



FORMATION OF A WATERFALL

3. Entrenched /Incised Meanders

- These are formed when **downcutting process is slow & river cause lateral erosion** leading to asymmetric valley formation .
- Note : These are different from meanders which occur due to both erosion and deposition. In this, only erosion takes place.

Middle or Valley Course /Mature Stage

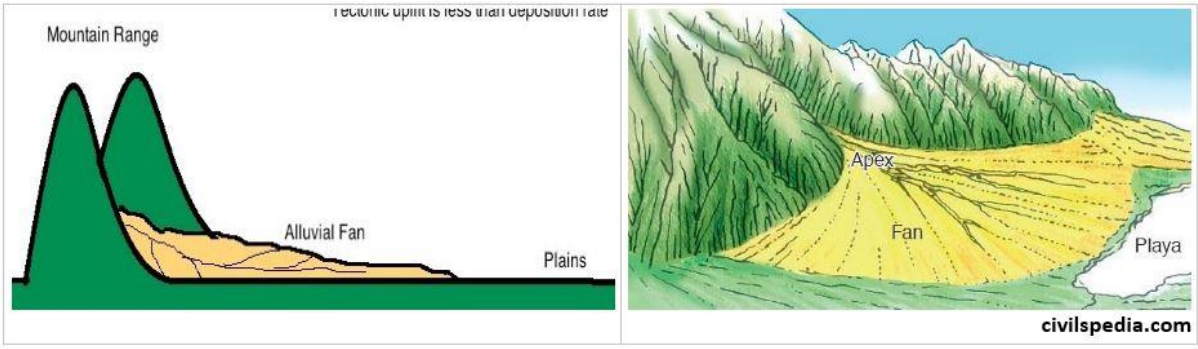
In Middle Course,

- **In Middle Course, Erosion , Transportation and deposition is done by the river .**
- **But amount of erosion is very lower than Youthful stage and in that too, Lateral Corrasion** tends to replace vertical corrasion.
- The volume of the water increases with the confluence of many tributaries & this **increases the river's load**.
- **Predominant work** of the river = **predominantly transportation with some deposition (main deposition happen in Oldage Stage).**

Landforms formed in Middle Stage

1 . Alluvial Fans

- Alluvial fans are formed when streams flowing from higher levels break into foot slope plains of low gradient. Normally very coarse load is carried by streams flowing over mountain slopes. This load becomes too heavy for the streams to be carried over gentler gradients and gets dumped and spread as a broad low to high cone shaped deposit called alluvial fan.
- **Examples :** Alluvial fans are found in Kosi river when it enters Bihar just after exiting Himalayas

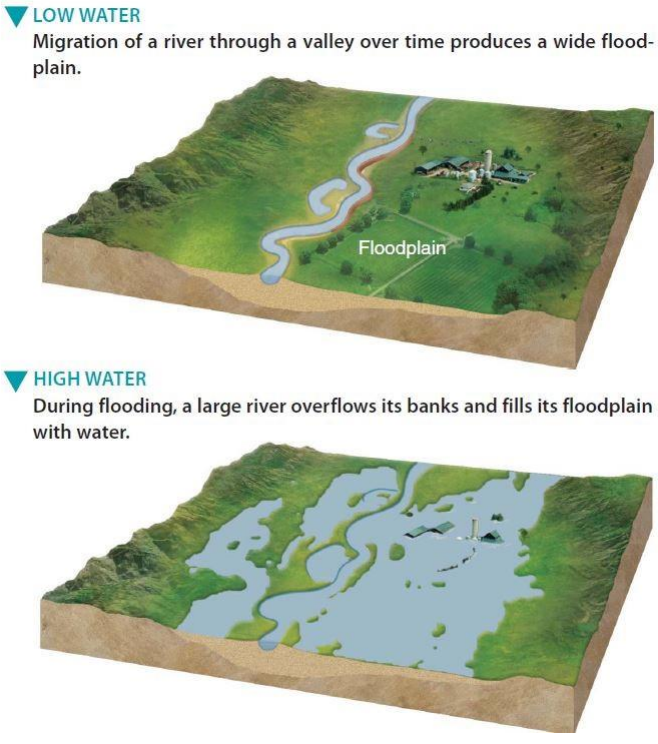


2. Alluvial Cone

- As the velocity of river decreases, its transportation capacity also decreases. Due to this decline deposition starts in Foot Hills. This deposition forms Alluvial Cones.
- It is same as alluvial fan but slope is more (between 10 to 50 degree)

3. Flood Plains

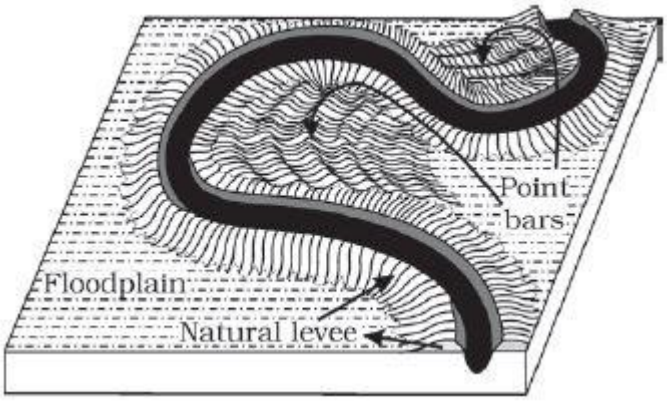
- Rivers in their course carry large quantities of sediments . During annual or sporadic floods, these materials are spread over the low lying adjacent areas.
- A layer of sediment is thus deposited during each flood , gradually building up a fertile flood plain.



4. Levees

- With the continuous deposition of soil on the banks by the river, the level of banks rises and they look like natural dams known as levees .

- During flooding as the water spills over the bank, the velocity of the water comes down and large sized and high specific gravity materials get dumped in the immediate vicinity of the bank as ridges. They are high nearer the banks and slope gently away from the river



<u>Lower or Plain Course /Old Age stage</u>

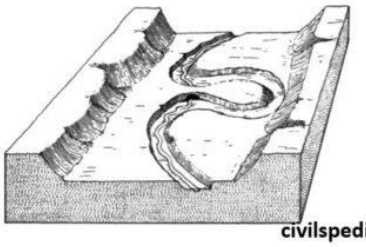
In Lower/Oldage Course,

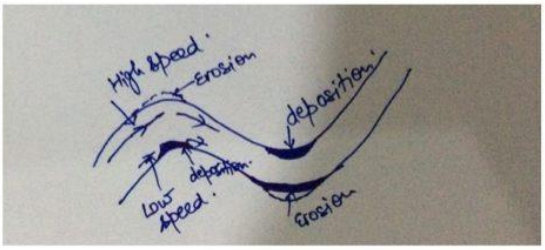
- River moving downstream across a broad and level plain is **heavy with debris brought down from the upper course** . Hence, work of the river is mainly deposition, building up its bed & forming extensive flood plains.
- Vertical corrasion has almost ceased though some lateral corrasion still goes on to erode its bank (like in Meanders).

Landforms formed in Later Stage

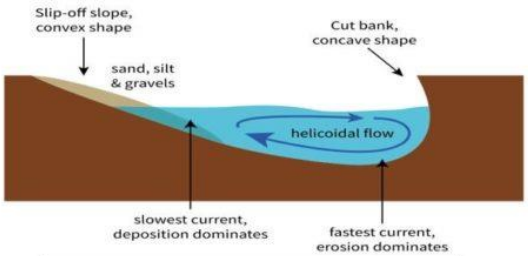
1 . Meanders

- A meander is a winding curve or bend in a river.
- Meanders are the result of both erosional and depositional processes.(explained in diagram below)
- The **irregularities of the ground** , force the river to swing in loops. Once the channel begins to flow in sinusoidal path , the **amplitude & concavity of loop increases rapidly due to dense erosion occurring at the outside and deposition occurring inside .**
- **Note : Meanders can be found in Middle as well as Later Stage**





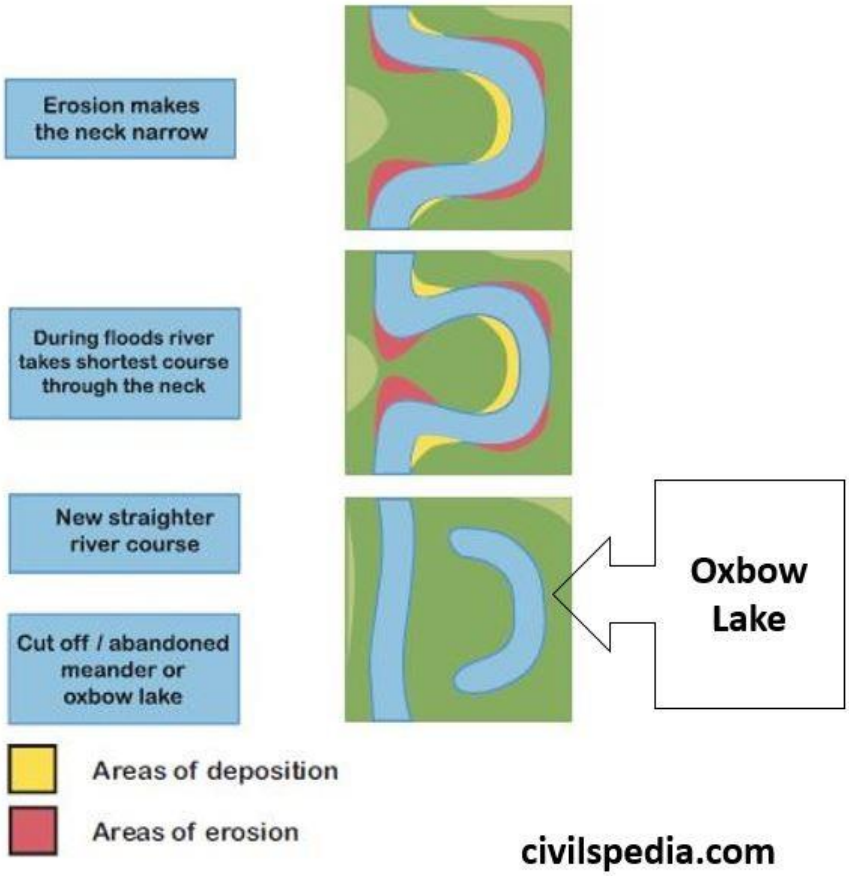
View from above



Side view

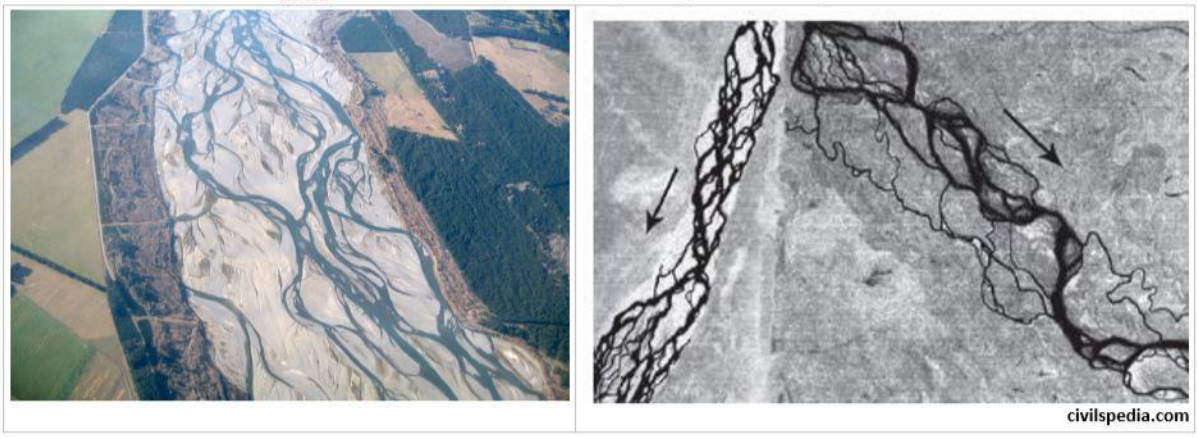
2. Ox-bow Lakes

- An oxbow lake is U-shaped body of water that forms **when a wide meander from the main stream of river is cut off creating free standing body of water.**
- It has different nomenclature at different places – **Billabong in Australia, Rasacas in Texas etc**
- Both **meanders and ox bow lakes are formed both in middle and lower course.** Ox Bow is more commonly found in lower course .



3. Braided Streams

- A braided stream is one which does not flow in a single definite channel but rather a network of everchanging, branching and reuniting channels.
- Thread-like streams of water rejoin and subdivide repeatedly to give a typical braided pattern



4. Delta

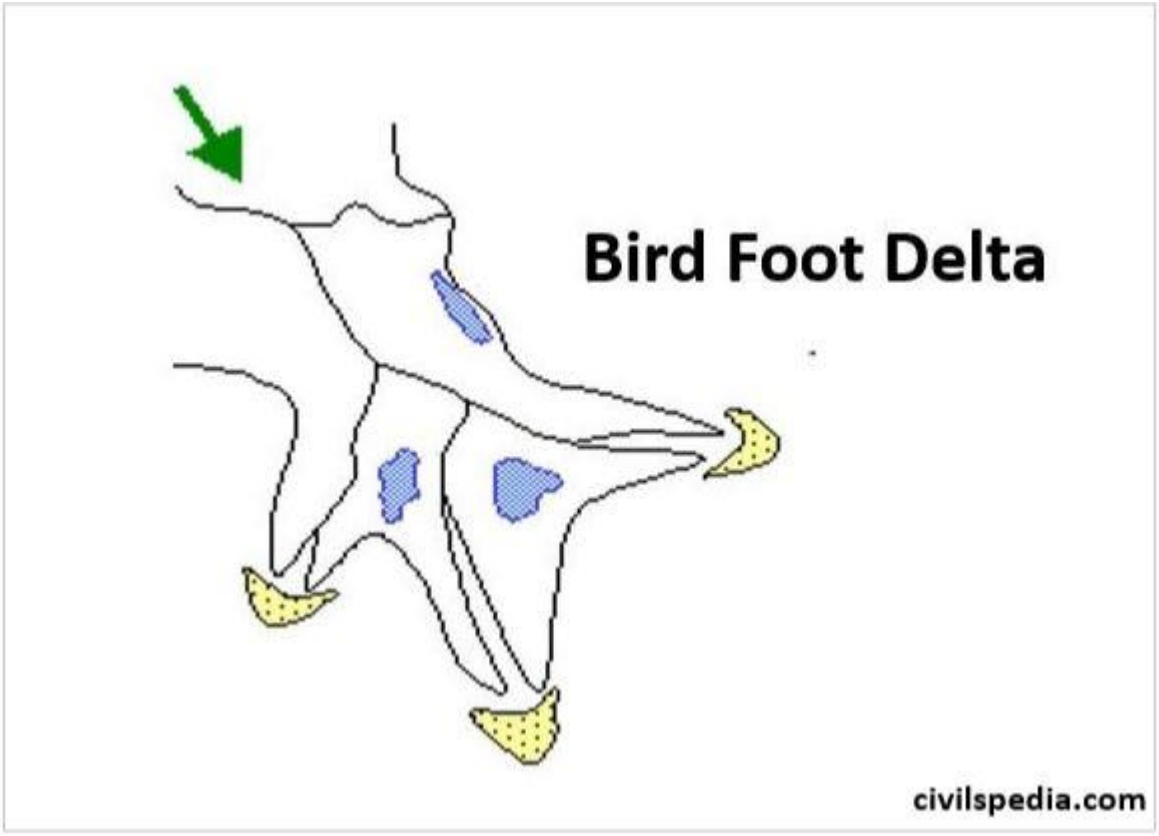
- When a river reaches the sea , the **fine material it has not yet dropped are deposited at its mouth** , forming a **fan shaped alluvial area known as Delta** .
- This alluvial tract is , infact , a **seaward extension of the flood plain.**
- Delta extend sideways and seaward at an amazing rate . The River Po extends its delta by over **40 feet a year**
- (GK) Ganges Brahmaputra delta is the largest delta in the world.

Deltas differ in their size , shape , growth & importance. A number of factors such as the rate of sedimentation , the depth of the river & sea bed and character of tides , currents & waves greatly influence formation of Delta.

<u>Different type of Deltas</u>

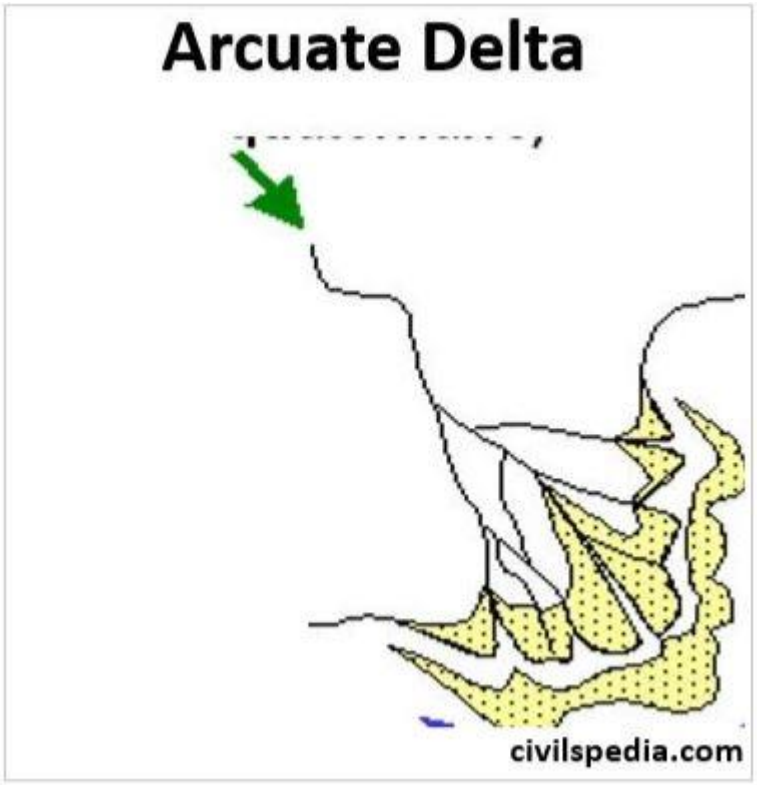
a. Bird's foot Delta

- Deposited alluvial material divides the river into smaller distributaries. Several distributaries look like the foot of a bird.
- Example : Mississippi is example.



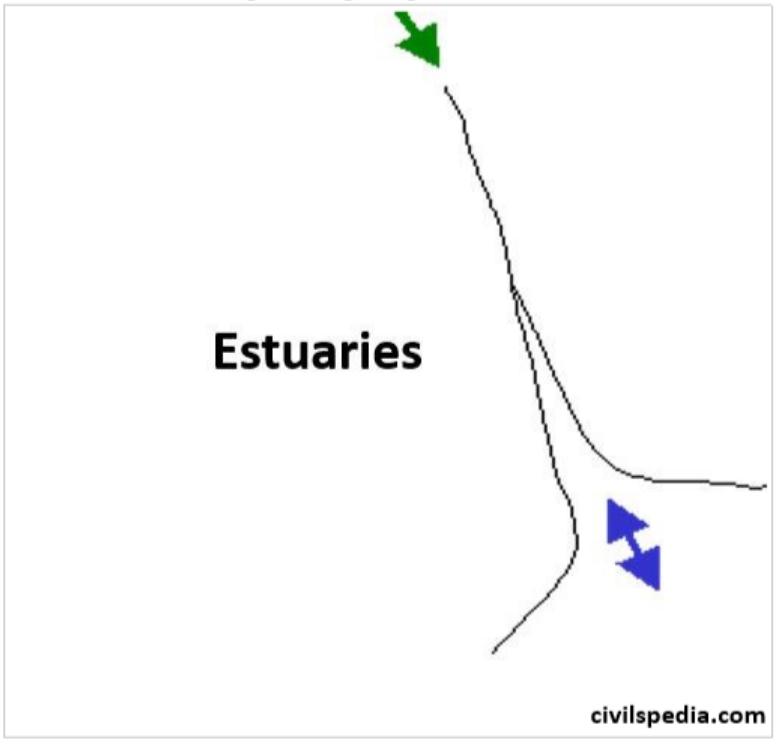
b. Arcuate shaped Delta

- Delta look fan shaped with **numerous distributaries**
- Examples are Amazon, **Ganga** & Mekong.



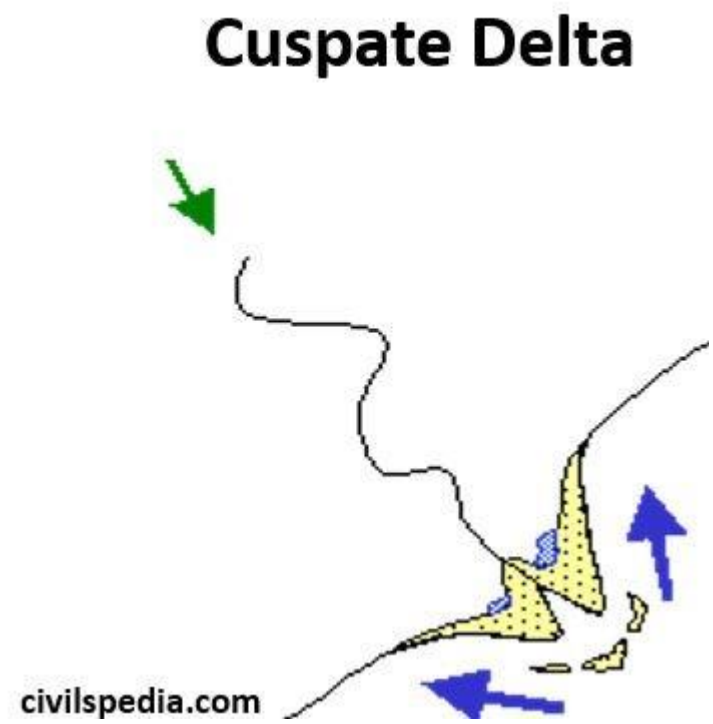
c. Estuarine Delta

- When river has their deltas submerged in coastal waters (mainly due to submerged coast like India's western coast) or don't have much deposition to form delta.
- Most of India's west flowing rivers originating in Western Ghats.



d. Cuspate Delta

- Have tooth like projection at their mouth.
- Example : Ebro of Spain.



<u>Conditions favourable for formation of deltas are</u>

- **Active vertical & lateral erosion** in upper course to provide sediments to be eventually deposited as Deltas.
- The sea adjoining the delta should be **shallow** or else the load will disappear in the deep waters.
- The coast should be sheltered, preferably **tideless**.
- There **should be no large lakes** in the river course to filter off the sediments.
- There should be no strong current running at right angle to the river mouth.