2.3 How do fluvial processes shape the land?
Part 2

Managing river and coastal environments: A continuing challenge

At which section does each of these photos taken?
What are the different sections along a river course?

- **Upper course**: Relatively straight, with bends around obstacles.
- **Middle course**: Winding.
- **Lower course**: Big bends occur.
Part 2
Managing river and coastal environments: A continuing challenge

What are the different sections along a river course?

Different section of the river has different amount of energy.

- Gradient of the upper course: steep
- Gradient of the middle course: less steep
- Gradient of the lower course: gentle

The long profile of a river
At the upper course …
How much energy is there at the upper course?

The amount of energy is little because:

- The catchment areas of the tributaries at the upper course is (large / small). The amount of the channel water is (large / small).
- Large boulders in the channel (increase / decrease) the channel roughness.
- (Much / Less) of the energy are used for overcoming friction.
At the upper course …
What is the work involved here?

- **Vertical** erosion is the dominant work at the upper course.
- Headward erosion also occurs when water starts to gather.
- Because of the little river energy, the rate of erosion is **slow**.
- **Small** load can be transported.
- Deposition is **rare**.

What is the shape of the river valley?

Narrow and deep V-shaped
At the upper course …
What are the landforms produced here?

Landforms at the upper course

- Interlocking spurs
- Gorges
- Potholes
- Rapids
- Waterfalls
At the middle course …

How much energy is there at the middle course?

- The energy of the middle course is (smaller / greater) than the upper course.
- More tributaries are joining the river. The amount of river water (increases / decreases).
- The river energy (increases / decreases).
- The channel becomes smoother. The water flows faster.
At the middle course ...  
What is the work involved here?

- The river flow is faster and with more energy.
- The main work involved is (erosion / deposition).
- Lateral erosion occurs at the (outer / inner) bank.
- Deposition occurs at the (outer / inner) bank.
- There is extra energy for transportation.

More open and asymmetrical V-shaped...
At the middle course …
What are the landforms produced here?

Landforms at the middle course

- Slip off slopes and river cliffs
- Meanders
- Bluffs
At the lower course …
How much energy is there at the lower course?

- The gradient is gentle here.
- A (smaller/larger) number of tributaries joined. This provides (more/less) water to the channel.
- The river bed is (smooth/rugged), so the friction here is greatly (reduced/risen).

What is the shape of the river valley?
Wide V-shaped
At the lower course …

How much energy is there at the lower course?

- It has the **largest discharge** among the three courses.
- Therefore, the flows are at a (**high**) speed.
- The lower course has the **highest energy**.

The lower course of River Mekong, Laos
(Credit: Tsui Chung Pong David)
At the lower course …
How much energy is there at the lower course?

The river energy drops when:
- the channel flow is blocked by seawater at the mouth of the river;
- the amount of river water reduces during the dry seasons;
- flooding occurs and the flood water overflows from the channel.

Mouth of the river

The mouth of a river in Tung Chung Bay
At the lower course …

What is the work involved here?

**Deposition** - whenever and wherever speed of flow is lowered

**Erosion** - at the outer banks of the river

**Transportation** - bringing the load towards the mouth of the river
At the lower course …
What are the landforms produced here?

- Flood plains
- Deferred tributaries
- Oxbow lakes
- Deltas
- Levees
- Braided streams
Case study: How does the Chang Jiang change along different courses?

Tuotuo He

Yichang

Hukou

Upper course
Middle course
Lower course

Land height (m)
- 2,000
- 500
- 0
- Watershed
Case study: How does the Chang Jiang change along different courses?

General information about the Chang Jiang basin

- The longest river in China and the third longest in the world;
- Large average annual discharge;
- The load is not heavy as compared with the Huang He;
- About 70-80% of the river water comes from rainfall.
What are the characteristics of the upper course of the Chang Jiang?

The river source: The Tuotuo He
- The discharge is small.
- The gradient is gentle.

At the Jinsha Jiang
- South-flowing.
- The channel winds through interlocking spurs.
- The gradient is steep.
- Strong vertical erosion produces the Hutiaoxia.
What are the characteristics of the upper course of the Chang Jiang?

At the Sichuan Pendi

- More rainfall
- Many large tributaries join the main channel
- Discharge increases rapidly
- Great erosive power
- Forms Sanxia before the river reaches the middle course
What are the characteristics of the middle course of the Chang Jiang?

- A big drop in altitude and gradient.
- Meanders are formed.
- Numerous lakes are found, e.g. Dongting Hu.
What are the characteristics of the lower course of the Chang Jiang?

- The land is flat and low, e.g. the Chang Jiang Pingyuan.
- The tributaries are shorter, e.g. the Huangpu Jiang.
- Meanders, braided streams, leeves and deferred tributaries are found.
- Its speed of flow slows down as it enters the Dong Hai.
- Delta and lagoon are formed, e.g. Tai Hu.

(Credit: NASA)
The end
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What are the landforms produced at the upper course?

1. Interlocking spurs

- They are the spurs interlocking with each other.
- The river has too little energy to remove obstacles, so the river water flows around them.
- **Vertical** erosion deepens the channel and makes the obstacles more marked.
What are the landforms produced at the upper course?

2 Rapids

- The river water is unable to erode the layer of resistant rock.
- The river bed becomes (even/uneven).
- The turbulent currents are called rapids.

Please click above for footage.
What are the landforms produced at the upper course?

3 Gorges

- Vertical erosion is **faster** than lateral erosion.
- This creates a **deep** and **narrow** V-shaped valley, i.e. a gorge.
What are the landforms produced at the upper course?

4 Waterfalls

Please click above for footage
What are the landforms produced at the upper course?

4 Waterfalls

- Less resistant rock is eroded by river water at a (slower / faster) rate.
- The river falls vertically down forming a waterfall.
- The falling water produces strong hydraulic action, forming a circular hollow filled with water, i.e. a plunge pool.
When a river flows over an uneven surface, it causes turbulence in the water.

A pothole is formed when the water drills with the load it carries.

The load becomes smaller and rounder while swirling.
What are the landforms produced at the middle course?

1. Slip off slopes and river cliffs

What are the landforms produced?

- Inner bank: deposition
- Outer bank: lateral erosion

- Fastest part of the river flow
- Slip off slope
What are the landforms produced at the middle course?

2 Meanders

- The outer bank gets worn away through lateral erosion.
- The inner bank builds up through deposition.
- The river (bends/straightens).
- Each bend is called a meander.

![Diagram showing meanders with labels: More convex, More concave, Slip off slopes form, Faster stream of water thrown towards outer banks, Sediment.](image-url)
What are the landforms produced at the middle course?

3 Bluffs

- The meanders migrate downstream.
- They remove the interlocking spurs on their way through erosion.
- River cliffs at outer bank are pushed back and join into lines, forming bluffs.
What are the landforms produced at the lower course?

1. **Flood plains**

   - The load is carried to the valley floors by the flood water.
   - Repeated flooding and deposition build up a flat area.
   - The deposits on the flood plain are called alluvium. They are fertile and good for farming.
Part 2

Managing river and coastal environments: A continuing challenge

What are the landforms produced at the lower course?

2 Levees

- The flood water overflows from the channel.
- The (small / large) load is dropped at the river banks.
- The banks are (raised / collapsed).
- The levees are the ridge-like features at the river banks.
What are the landforms produced at the lower course?

3 Deferred tributaries

The tributaries finally break through the levees and join the main channel. These tributaries are called deferred tributaries.
What are the landforms produced at the lower course?

4 Oxbow lakes

- Oxbow lakes are the product of active lateral erosion and deposition in the river.
- When two outer banks of two bends meet, a new channel is formed.
- Sediment silts the original channel.
- An oxbow lake is formed.
What are the landforms produced at the lower course?

5  Braided streams

In wet seasons, the river is forced to split into several separated channels. These split channels are called braided streams.
What are the landforms produced at the lower course?

6  Deltas

A delta is a gently sloping platform of sediment gradually builds up and extends into the sea.

It is a fan-shaped mud flat formed at the mouth of the river.

The speed of flow (rises / drops).