

Chapter 6

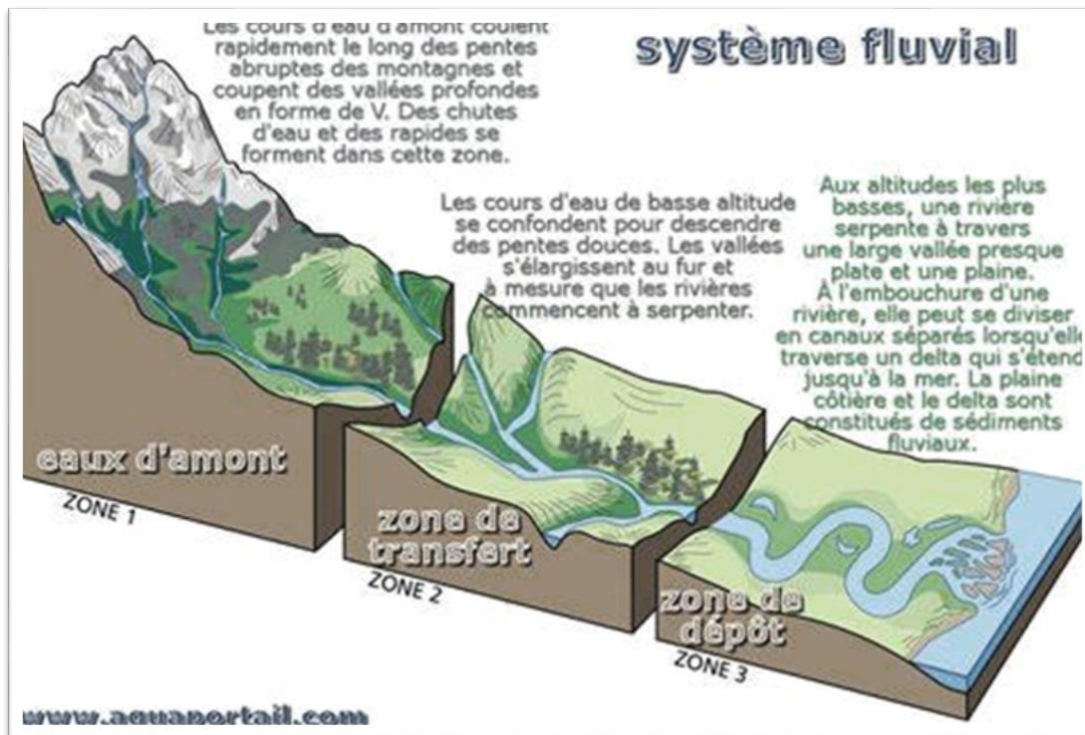
1/ River systems and forms

A river system is related to watercourses, especially rivers, but also to tributaries and confluences such as rivers. An entire river system characterizes a watershed. They are dominated by rivers and streams. Fluvial processes sculpt the landscape, eroding landforms, transporting sediment and depositing it to create new landforms.

The fluvial environment is closely linked to the activity of the river and also to the alluvial plain. Lake sediments form in lakes and glacial sediments form in mountains or ice-covered slopes.

A river system consists of three parts:

1. (headwaters) Headwaters flow rapidly along steep mountain slopes and cut deep V-shaped valleys. Rapid waterfalls exist in this area.
2. (transfer zone) Low-lying streams merge to descend gentle slopes. The valleys widen as the rivers begin to meander down.
3. (deposition zone) At the lowest elevations, a river meanders through a wide, almost flat valley forming a floodplain. At the mouth of a river, it can split into separate channels when it crosses a delta (in the case of the coastal river) that extends to the sea. The coastal plain and delta are made up of river sediments.

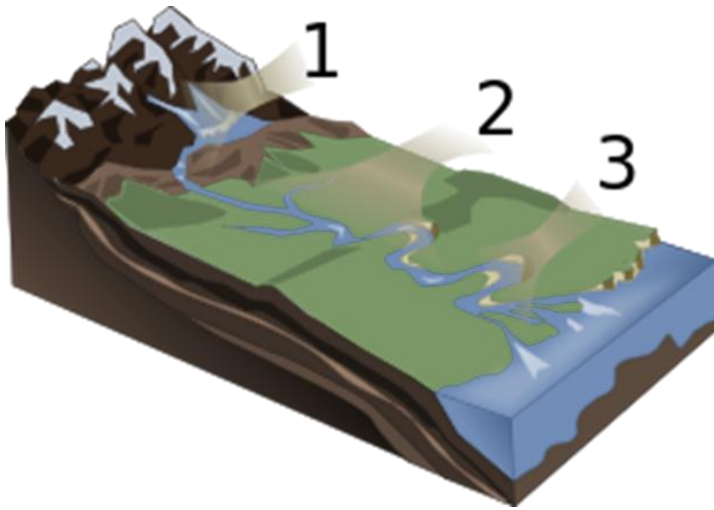


2/ Longitudinal profile

Schumm presents a longitudinal division of watercourses at the scale of the catchment basin, schematically broken down into three zones (major geomorphological units) characterized by the dominant sedimentary process:

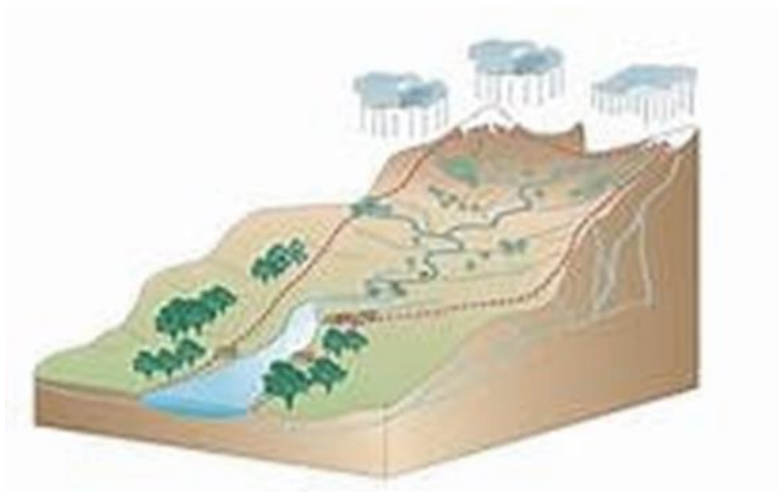
- A production zone, also known as an erosion zone or a replenishment basin, (1) is made up of the heads of the catchment area (point or diffuse water sources and the transition channels to steeply sloping Tier 1 watercourses). It corresponds to the headwaters of small rivers in the watershed, whose turbulent and oxygenated waters form a brisk current that supplies the river system with water and sediment. The Tier 1 stream begins when flows are concentrated enough to produce erosion and create a bed with distinct edges.
- A sediment transfer zone, which decreases downstream. The connections between the channel and the surrounding slopes, and therefore the production of sediments, are less strong than in the production area. It corresponds to the average course of the rivers.
- An accumulation zone made up of manure cones, alluvial plains⁴, and mouths (deltas, estuaries). This area of low slope corresponds to the lower reaches of the rivers.

The watershed is the topographic area drained by this stream and its tributaries upstream; all flows originating within this surface must pass through the straight section in question to follow their downstream path.



3/ The watershed

Is the topographic area drained by this stream and its tributaries upstream; All flows originating within this surface must pass through the straight section in question to follow their downstream path. This is an area in which all water flows converge at the same point. Thus, any drop of water that falls in this territory delimited by natural boundaries is directed towards the watercourse or its tributaries, then downstream and its outlet.



Water reservoirs act as decanters. Near-zero flow velocities allow solid materials to settle and gradually fill in the dam. The water released downstream is cleared of any solid load. Dams also reduce the width of the minor riverbed by limiting the size of floods

4/ A dam:

Is a hydraulic structure built across a watercourse and intended to regulate its flow and/or store water¹, in particular for flood control, irrigation, industry, hydroelectricity, fish farming and drinking water retention.

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River Dam: It makes it possible to regulate the flow of water, for the benefit of river traffic, irrigation, and the relative prevention of natural disasters (floods, floods), through the creation of artificial lakes or reservoirs.

A natural dam : Is an obstacle of non-human origin and variable size that impedes the bed of a watercourse to the extent that it forms a body of water upstream of the dam. It is the main process of formation of natural lakes along with endorheism or subsidence. Its more or less sudden rupture can cause flooding downstream.



The natural dam and the resulting body of water can take on various shapes and sizes, from a few tens of centimetres to several hundred metres in height for dams and from a few metres to kilometres in length for reservoirs. The narrower and steeper the valley, the smaller the volume of the dam.

5/ A stream

Is a small, shallow stream with a moderate flow (up to 2 m³/s), fed by natural water sources or draining a watershed, often a tributary of a pond, lake or river. It can dry up in the event of drought because its source is alterable by climatic conditions.

A stream is a natural flow that normally flows continuously, but unlike a river, its flow is low and can even disappear during the dry season, summer or winter, depending on the rainy season. In the case of a very rare and sporadic flow, it is preferable to use the name stream, torrent or gully. By bypassing obstacles (rocks, roots) or by the interplay of erosion and sedimentation, natural streams form meanders that slow down the flow of water and allow it to better infiltrate into the water table. Between one and five metres wide, higher than the stream but less than the river.



6/ A stream in braids

Is a watercourse with many unstable channels, forming divisions or connections between these arms, called anastomoses. These different arms form a complex network that quickly changes places, taking on a shape reminiscent of a braid, hence the name. The braided pattern is characteristic of a multi-channel bed that reflects adjustment to abundant coarse loading and contrasting flows.

The bed is composed of several unstable channels separated by lively or weakly vegetated banks, all forming part of the minor bed. Between the different arms are temporary islands of varying sizes made up of sediments torn from the mountains and deposited when the slope becomes lower, either in a piedmont plain (bars).



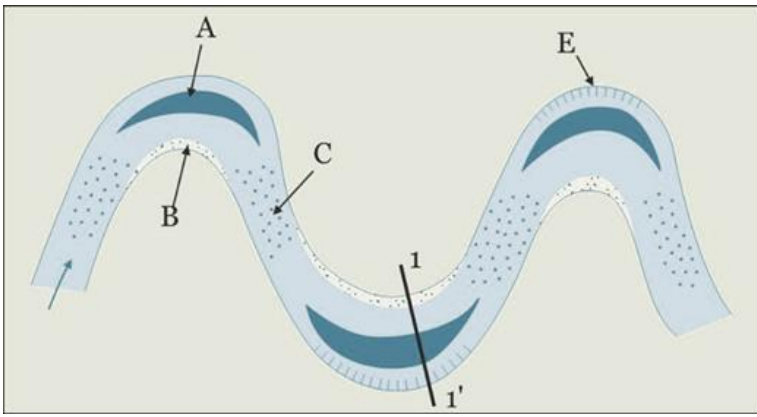
7/ Braided River

The sills impede solid transport and in particular bedloading. If the solid transport is sufficient, the upstream riverbed will rise to the level of the threshold ridge minus a few centimetres because of the suction created by the falling water. Downstream, as with dams, there is erosion. The sills at an angle to the axis of the river make it possible to lower the flood water level on their crest, and therefore to increase the draught. As a result, they have less impact on sediment transport than sills perpendicular to the river axis.

8/ A meander:

Is a very pronounced sinuosity³ in the course of a river or stream, which occurs naturally when the current is sufficient to erode the banks in the presence of more resistant materials, ice jams or beaver dams. The single-channel bed is characterized by a sinuosity index greater than 1.5. Solid transport is carried out almost exclusively by suspension and not by bedloading

The onset of natural sinuosities is accentuated by the centrifugal force that exerts pressure on the outer part of the curve. Its curvature is mainly due to a slight slope. Meanders are a major phenomenon in river dynamics.



a stream representing its meanders: (A) concavity wet, (B) convexity bank developed along the convex bank, (C) riffle located at the inflection points of curvature, 1-1' cross profile, (E) concave bank.

There are two approaches to explaining the formation of meanders: turbulence and compression. The natural meanders of rivers evolve in space and time under the effect of erosion and sedimentation due to the current, in the face of hard substrates free meanders or alluvial plains: they unfold in the main bed of the river; These are highly mobile meanders that can leave areas very wet



River with free meanders



Steep-sided meanders.

9/ The floodplain

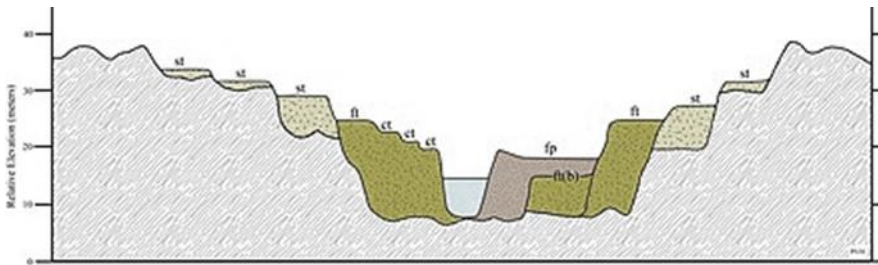
Is flat or gently undulating land adjacent to a river, stream or lake that experiences occasional or periodic flooding. The floodplain consists of lowlands characterized by alternating high and low water levels along a stream, river or any watercourse or body of water that may overflow, a plain that may be subject to flooding. A distinction can be made between: natural floodplains, known as alluvial plains of the major bed; and man-made floodplains due to human intervention.

10/ An alluvial terrace:

Or fluvial terrace, is a flat area located on the slopes of a river valley and made up of alluvium (sediments) deposited by the river at a certain period. Accumulated upstream of natural weirs or dams (natural ice jams), these alluvial deposits were deposited on the edges of the bed following a receding flood or the disappearance of a natural dam.

The succession of several episodes of sedimentation and erosion frequently leads to the layering of several terraces.

The rate of the sediment deposition and erosion cycle may have varied depending on the base level, the hydrodynamic regime of the river, the sediment load or tectonic movements.



11/ WATERFALL.

Waterfall; water falling from rock to rock. There are natural waterfalls and man-made waterfalls. An artificial waterfall is a construction made of recesses or steps over which a waterfall is led, by means of several pipes, which as it falls and divides.

Ice climbing is a sport derived from climbing and mountaineering that involves climbing frozen waterfalls using ice axes and crampons. An icefall refers to an extensive collection of seracs on the surface of a glacier.



12/ Deltas and alluvial fans

Are important geological features that result from the process of sediment deposition from rivers and other water bodies. Deltas develop when rivers bring more sediment to the marine environment than marine erosion can mobilize. Delta is a triangular alluvial accumulation zone created by a river as it enters a low-tide sea or lake



A delta is divided into 3 parts: * The delta plain is the extension of the alluvial plain. It is crossed by a network of branching channels, the distributaries. Between the channels are marshy and vegetated areas in humid climates. Deltaic plain Sediments are alluvial plain facies affected by the influence of tides. Sandbars and cobbles are deposited in the channels.

* The delta front is the extension of the deltaic plain under the sea. * The prodelta is the outermost and deepest part of the delta; it rests on the marine sediments of the coastal shelf.

