A River's Course

The course a river takes is split into three stages, the upper, middle and lower stage. In the upper stage, the river is close to its source and high above its base level (the lowest point the river can erode to[1]). In the lower stage the river is far away from its source, close to the mouth and not far above its base level. In the middle stage, it's somewhere in between.

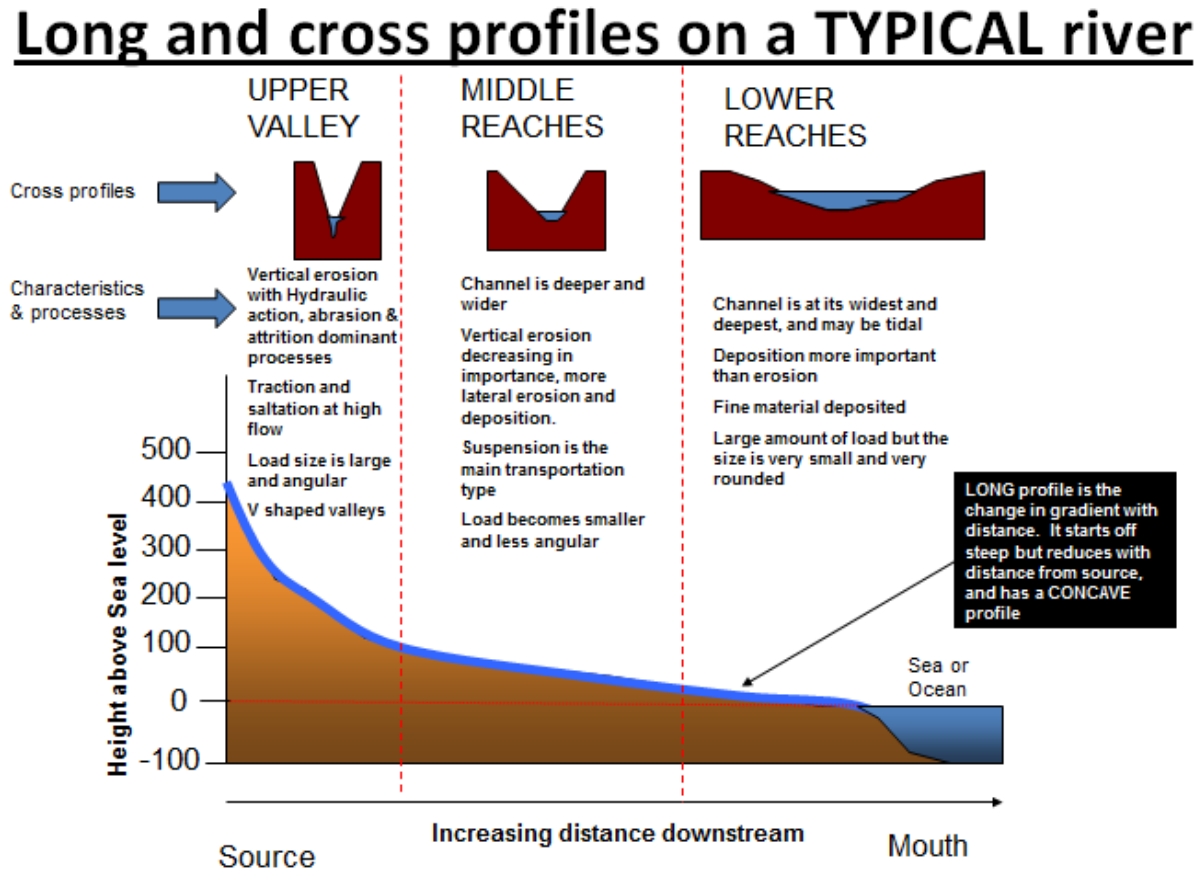
The total energy that a river possesses varies from one stage to another because of changes in the river's height, gradient and speed. In the upper course, the gradient of the river is steep and the river is high above sea level giving it a large amount of gravitational potential energy that can be converted to kinetic energy later on. In the middle course, the river's gravitational potential energy gets converted to kinetic energy and the gradient begins to level out resulting in the river's velocity increasing. By the time the river reaches its lower stage, it has next to no gravitational potential energy but lots of kinetic energy resulting in a high velocity.

The Long Profile

The long profile shows how a river's gradient changes as it flows from its source to its mouth. The long profile shows how, in the upper stage of a river's course, the river's gradient is steep but it gradually flattens out as the river erodes towards its base level. One thing to note is the presence of knick points in the long profile. These are points where the gradient of the river changes suddenly and can be caused by landforms like waterfalls or lakes, where the lithology of the river changes and differential erosion takes place. Knickpoints can also be the result of rejuvenation, where the base level of the river falls giving it some extra gravitational potential energy to erode vertically.

Throughout the long profile of a river, deposition and erosion are balanced meaning that, given enough time, the river's long profile would become a smooth, concave, *graded profile* and all the knick points would be eliminated as they are either eroded or filled in by deposition. It would take a *long* time for a river's long profile to become a graded profile though so the idea of a graded profile is, essentially, theoretical as it doesn't really occur in nature. It's not too hard to imagine what a graded profile would look like but here's a sketch of one anyway:

If you needed to describe the graded profile you could describe it as a smooth, concave profile in dynamic equilibrium.



Changing River Processes

If there's one key thing to take away from everything that's been discussed so far it's that the energy of a river changes as it flows through its course. As we've already discussed when we talked about river processes, rivers do stuff because they have energy and what they do depends on how much of a certain type of energy they have. Logically, this means that the processes that a river carries out changes throughout its course as it moves from one stage to another.

Processes in the Upper Course

In the upper course, the river has a lot of gravitational potential energy so it has a lot of energy to erode vertically. The bed of the river is eroded greatly while the banks aren't

eroded as much. The river mainly transports large pieces of angular rock and does so by traction because it doesn't have enough kinetic energy to move the load in any other way. This increases erosion of the bed by corrasion as a result of the load being dragged along the bed of the river. Vertical erosion is further increased by the rough nature of the channel in the upper course which increases the water's turbulence and its ability to erode. Erosion and transportation only takes place in large quantities in the upper course when the river's discharge is high after periods of heavy precipitation. When the river's discharge falls the river stops transporting the large boulders its transporting and deposits them.

Processes in the Middle Course

In the middle course, the river has less gravitational potential energy and more kinetic energy so erosion shifts from vertical to lateral erosion. Corrasion is still the main erosive process as large particles are transported by saltation. The average load size has decreased in the middle course, so more load is being transported in suspension. In the middle course, the river can flood and in doing so, it deposits gravel and sand sized particles onto its flood plain.

Processes in the Lower Course

In the lower course, the river has next to no gravitational potential energy so erosion is almost exclusively lateral. There isn't much erosion though because the channel is smoother resulting in less turbulent flow. The main place where erosion takes place is where the river meanders. The average particle size is very small now, another reason for the reduction in erosion. The river's load is mainly composed of silts and clays and it is transported in suspension or even solution. Like in the middle course, when the river floods it deposits its load but deposition now also takes place at the mouth of the river where the river meets the sea or a stationary body of water.

River Cross Profiles

A river cross profile is a cross-section of a river's channel **and** valley at certain points in the river's course. The cross profile of a river changes as it moves from the upper to lower course as a result of changes in the river's energy and the processes that the river carries out.

In the upper course, the valley and channel are narrow and deep as a result of the large amount of vertical erosion and little lateral erosion. The sides of a river's valley in the upper

course are very steep earning these valleys the nickname *"V-Shaped Valley"* since they look like a letter V. The river's valley can be anything from a few meters to a few hundred metres in width depending on the lithology but the channel rarely more than 5m or 6m wide.

In the middle course, the valley has increased in width due to the increase in lateral erosion but its depth hasn't changed significantly because vertical erosion has slowed down. Similarly, the channel's width has increased but it's still roughly the same depth. The land to either side of the channel in the valley is now the river's floodplain and the valley's sides are much gentler.

In the lower course the valley is now very wide (often several kilometres) and the floodplain has increased greatly in size. The channel is a little wider but not much deeper.