AS Geography 1.2 Fluvial Environments *Student Notes*

The channel processes of erosion, transportation and deposition and the resulting landforms such as valleys, waterfalls, rapids, meanders, braids, levees, ox-bow lakes, deltas and floodplains.

You need to know the specific mechanisms by which rivers erode (including abrasion, attrition, corrosion and cavitation) and transport (including suspension, solution, saltation and traction). You need to know where, when and why deposition occurs and the sequential nature of this process. The resulting landforms should be exemplified with located examples from arrange of rivers. Annotated diagrams and sketch maps should be used here.

A river that is draining towards the outlet of a river basin has kinetic energy that is used to do work.

River energy is used to:

1. Overcome friction (in other words to move!)
2. Transport any available load
3. Create new load through processes of erosion.

As river energy levels drop, load will be deposited.

The main processes of river erosion are:

- **Abrasion**. This occurs when rock particles already being moved by the river strike or are dragged along the rock bed. The impact removes small particles. Small particles tend to smooth and polish the surface of the rock bed. Abrasion is thought to be the most effective method of erosion and is probably responsible for most of the down-cutting in a river channel. A stream with little load will not experience much abrasion. Most abrasion takes place during short violent periods of flow, such as in a flood. Potholes in a streambed are produced by the grinding action (abrasion) of a small number of hard pebbles.

- **Attrition.** This is the reduction in the size of particles in transport as they strike one another or the bed and banks of the channel. The consequence is that as particles are moved downstream, there is a steady reduction in size. In addition, the angular edges of the particles become more rounded, since they are more exposed. Attrition therefore contributes to the decreasing size and increasing roundness of particles with distance downstream although other factors are also important, particularly the sorting processes that take place as finer particles are more easily and more regularly transported downstream in periods of modest discharge. Large and angular particles are less likely to be moved, except in infrequent periods of high discharge. Angularity also depends on the origin of the particles and their lithology.

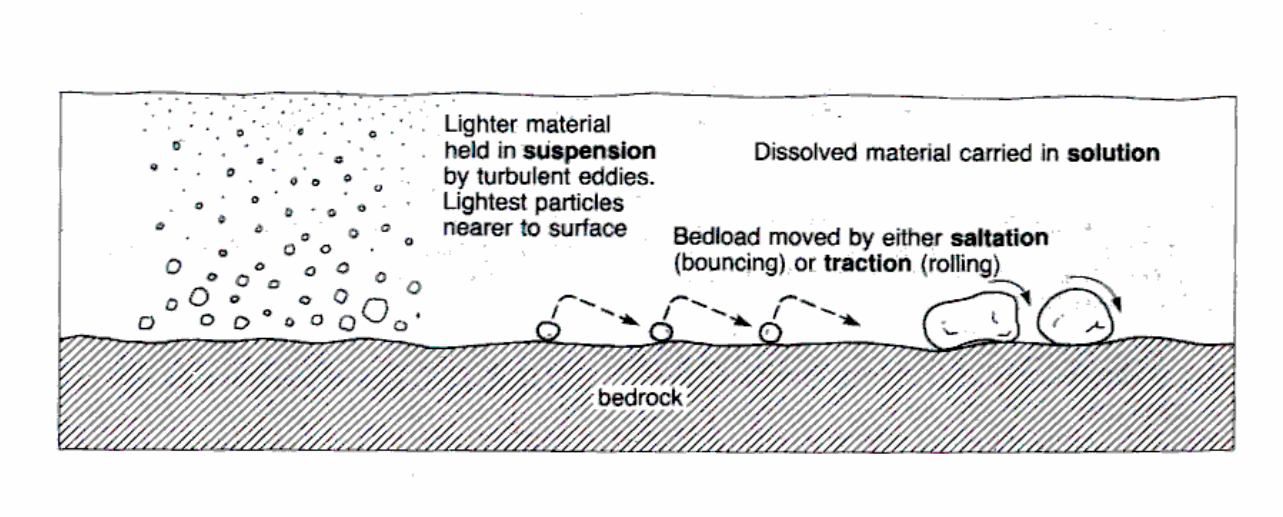
- **Corrosion (or solution).** This is most important on carbonate rocks such as limestone and chalk where carbonic acid (rainwater) dissolves the rock, which is carried away in solution.

- **Cavitation (or hydraulic action).** This process moves material into the river channel through the impact of moving water, and its frictional drag, on the bed and banks f the river. Usually, only unconsolidated material, such as sand and fine gravel can be removed. The implosion of air bubbles in areas of great turbulence, such as in waterfalls, can cause shockwaves that can add to the erosion process.

Load

The processes of erosion create the rivers **load**, which is transported downstream using a range of processes; the effectiveness of these processes depends on the size and shape of the particles of load, the energy available in the river and the mineral constituents of the eroded rock.

The main processes of river transportation are:



- **Suspension.** Some particles, such as silt and clay, are small enough to be held in the turbulence within the water and form ***suspended load***. In more turbulent water, larger particles may be transported in suspension.

- **Solution.** The dissolving of rocks adds to the river's load and is known as the dissolved load. This is most important on carbonate rocks such as limestone and chalk where carbonic acid (rainwater) dissolves the rock; however, almost all rocks are soluble to some extent. In tropical rivers, even silicates like quartz can be dissolved and the ***dissolved load*** is particularly important in tropical rivers.

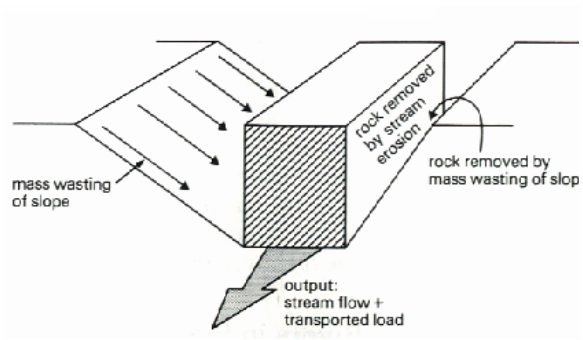
- **Saltation.** Larger particles, such as sand and gravel, are bounced along the riverbed under the hydraulic force of the moving water.

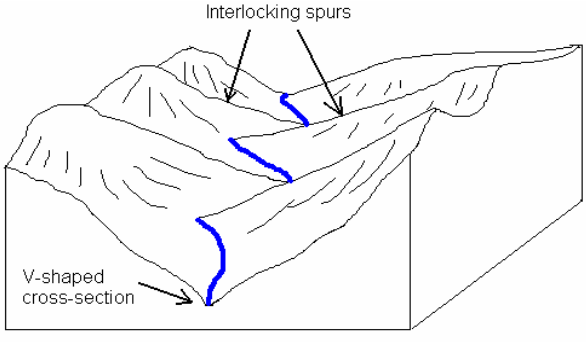
- **Traction.** Large particles are rolled along the streambed by hydraulic forces. Together with the load moved by saltation, this is known as the ***bedload.***

Landforms that result from erosion include:

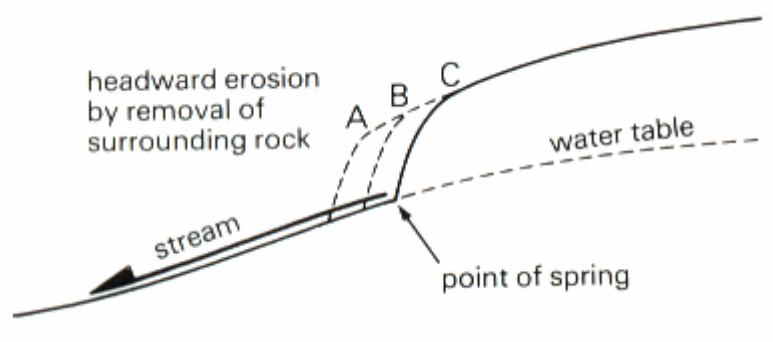
- **Pothole.** The holes are approximately cylindrical and are formed in a rock streambed by the grinding and scouring effects of pebbles that are created in an eddy, often in a stretch of rapids. Potholes can vary in size from a few centimetres to several metres in diameter. Good examples can be found at the Strid near Bolton Abbey on the River Wharf in Yorkshire and in the Afon Glaslyn in Snowdonia.

- **V-shaped valleys and interlocking spurs.** In periods of high discharge, upland streams, with their relatively coarse bedload, can experience rapid down-cutting or vertical erosion. The downward erosion is accompanied by weathering and downslope movements of soil and rock fragments (mass wasting) from the valley sides leading to a V-shaped valley cross-section. The river acts as a conveyer belt, removing the rock debris as its load. Rivers in upland area have to find their way around protrusions, so the downward erosion leads to the formation of interlocking spurs.





- **Stream Sapped Hollows/Alcoves**



These are small-scale erosional features formed by spring sapping. The erosion of weathered material at a point where a spring issues from the ground can lead to a small-scale headward extension of the stream channel. Small examples can be found at the headwaters of Farley Water, a tributary to the River Lyn on Exmoor.

- **Waterfalls and Gorges.** Rivers frequently flow across geological boundaries and at these points, the river picks out differences in the resistance to erosion. Where the river flows from hard to soft rock, the softer rock is more rapidly eroded and the gradient of the river is locally steepened to form a waterfall of section of rapids.
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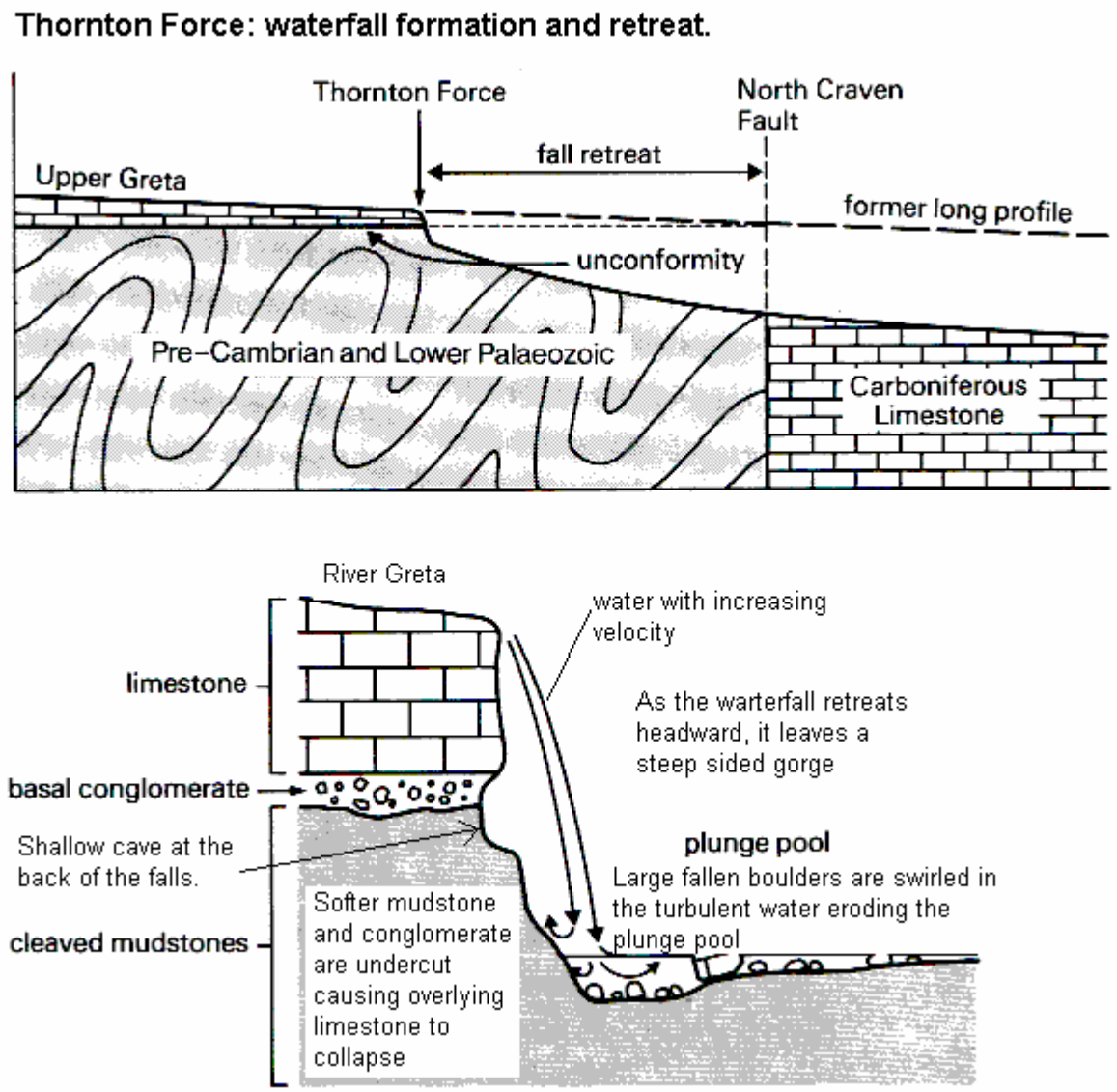

Thornton Force (height: about 10m), near Ingleton in West Yorkshire is a waterfall that began at the North Craven Fault, where older, softer rocks have been brought to the surface beneath younger, more resistant Carboniferous Limestone. Use the diagram to try to work out the sequence of events that has led to the current position of the waterfall and the formation of the deep valley or gorge between it and the North Craven Fault.

- **Rapids.** Rapids are formed in much the same way as waterfalls. Usually where the gradient of the bed increases without a sudden break in slope, or where the river flows over gently dipping bands of harder rock. Rapids and waterfalls increase the turbulence of the water and hence its erosive power, eventually lowering the gradient. Rapids can be found along many parts of the rivers East and West Lyn, particularly in the lower part of their valleys, which has been rejuvenated. The Strid on the River Wharf near Bolton Abbey in Yorkshire is also a location where rapids can be seen.