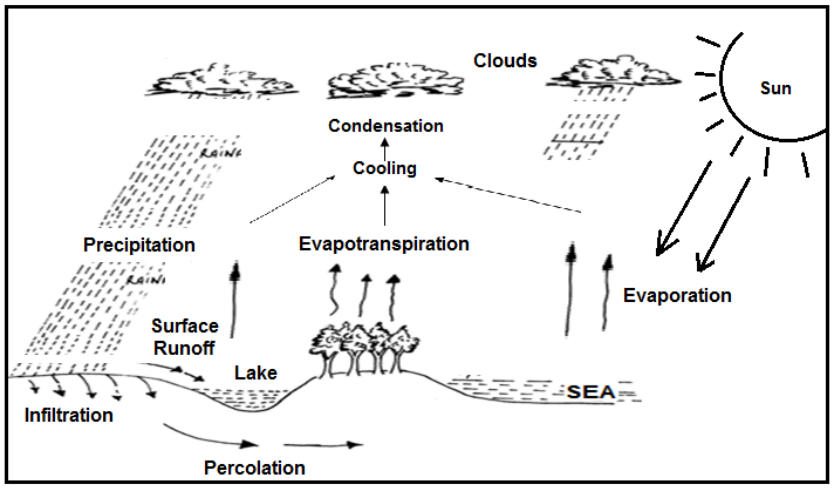
HYDROLOGICAL CYCLE & THE ACTION OF RIVERS

- Hydrological cycle is the endless/continuous circulation/interchange of water between the sea, atmosphere and land
- It involves the following processes
  - ***(a) Evaporation***: - This is the physical process through which moisture is directly lost from various water surfaces and the soil. The loss is due to sun's heat and the effect of air movement. It involves changing of water from oceans, seas, lakes and rivers into water vapour by the sun's heat then it rises into the atmosphere. It depends on
    - Availability of moisture on the land surface
    - Increase in temperature
    - Wind
    - Sunshine duration
    - Characteristics of water
  - ***(b) Cooling***: - as the water vapour rises into the atmosphere, it expands and cools due to reduced atmospheric pressure in the upper layers of the atmosphere
  - ***(c) Condensation***: - this is the cooling of water vapour below the dew point. It turns the water vapour into tiny water droplets that join together in large quantities to form clouds
  - ***(d) Precipitation***: - occurs when clouds become too heavy and drop the moisture they are holding. The dropped moisture then return to the soil inform of rain, snow or hail
  - ***(e) Surface runoff***: - when precipitation reaches the ground in form of rain, some water flows on the surface into valleys, ponds, lakes, swamps and even to the sea
  - ***(f) Infiltration***: - this is the water that seeps through cracks, crevices/fissures, joints and pores found within the rock and soil over which the surface runoff flows
  - ***(g) Percolation***: - is the process by which infiltrated water moves downwards and sideways by force of gravity through the pores and cracks



Significance of hydrological cycle

(a) It provides water that supports life for other human activities e.g. domestic and industrial uses
(b) It maintains the atmospheric energy stored in the atmosphere for the development of storms
(c) Moisture in the atmosphere is important in absorbing the terrestrial radiation thus keeping the lower atmosphere warm
(d) Leads to the formation of clouds and rainfall that assist in agriculture and vegetational growth
(e) Leads to distribution of water on the earth's surface

Action of Rivers

Definition of terms associated with rivers

- ***River***: - is a large natural stream of water flowing in a valley from an upland area towards the lowland
- ***Source***: - is the origin of the river. It can be a forested area, a mountain or a spring
- ***Mouth***: - is the terminal/end point of a river/the point where a river drains its water e.g. lake, sea or ocean
- ***Catchment area***: - This refers to the source of most rivers e.g. forested, mountainous area where a river draws its waters
- ***Tributaries***: - small streams/rivers that flow into larger/bigger rivers; feeding the main river with water
- ***River system***: - combination of a river together with its tributaries
- ***Watershed/divide***: - the boundary of a drainage basin marked by a ridge of higher land. It separates one drainage basin from other adjacent ones.
- ***Drainage basin***: - area of land drained/served by a river and its tributaries.
- ***River discharge***: - amount of water passing down a stream expressed in m^3/second
- ***River regime***: - is the seasonal fluctuation or variation in the volume of river water or discharge
- ***Interfluves***: - high areas in between tributaries

Action of Rivers

- This involves erosion, transportation and deposition

<u>River Erosion</u>

- Involves the wearing away of the earth's surface through the action of naturally flowing water/rivers
- Occurs through the processes of hydraulic action, attrition, corrosion and solution
  - ***(i) Hydraulic action***
    - The force of the moving water and the eddying effect sweep away loose materials in the river channel or water is forced into cracks on the river banks
    - When water is hurled against the riverbanks; air in the cracks is compressed, creating pressure, which widens the cracks.
    - As water retreats; pressure in the cracks is suddenly released. The compression and widening of cracks repeatedly shatter the rocks, which are then carried away by the retreating water

(ii) Attrition

- Boulders being transported downstream are in constant collision with each other thereby reducing them into smaller particles forming smooth, rounded pebbles

(iii) Corrosion/Abrasion

- The river uses its load (gravel, boulders) as erosive tool i.e. the load is used as a tool for scouring. The load is hurled by the river water against the banks and dragged along the bed thereby chipping off the rocks on the bank and bed
- As the river load is hauled by the river against the river bank/bed, it scours/sculptures/abrades the sides and bed of the river channel

(iv) Solution

- Running river may dissolve minerals found in the rocks in which they flow. The material is carried down the river channel in solution

Factors that influence the rate of river erosion

- *Volume of the stream/river* i.e. the larger the volume the greater the force of moving water and hence the greater the erosion.
- *Nature and amount of load*: - large and hard objects e.g. boulders and rock pebbles cause more erosion compared to smaller and finer objects
- *River gradient and velocity*: - steep slopes experience higher velocity of river water due to greater influence of gravitational force. The rivers flow very fast and exhibit higher rates of erosion
- *Nature of the river bedrock*: - river beds with less resistant rocks are easily eroded especially if the rocks are well jointed or soluble in water.

Types of River Erosion

1. Headward Erosion

- Involves the river extending its length by cutting back upstream above its original source
- It may be caused by spring sapping (shifting of the position of a spring uphill thus shifting the source point of the river), rain wash, gulleying and soil creep
- It increases the length of the river

2. Vertical Erosion

- Occurs on the river bed through abrasion and solution processes
- It leads to the deepening of the river channel

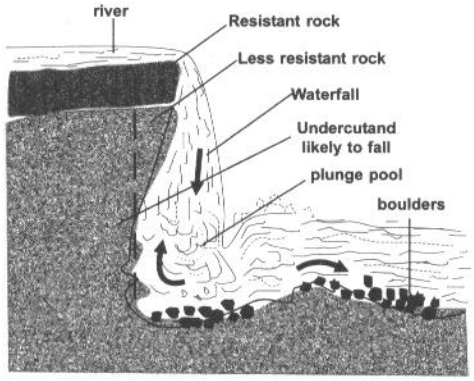
3. Lateral Erosion

- Occurs on the sides/banks of the river
- Leads to widening of the river channel

Resultant features of river erosion

1. *Stream cut/V shaped valleys*
   - As river water moves down slope over the earth's surface it cuts a depression/channel that starts as a gulley. With time the gulley widens through lateral erosion and deepens through vertical erosion forming a V shaped valley
   - Common in the upper courses of the rivers near the source

2. *Gorges*
   - A gorge is a deep, narrow and steep sided river valley. It forms in the following ways: -
     - Where a river flows across a plateau composed of horizontal and alternate layers of hard and soft rocks. Examples include Chebloch gorge on R. Kerio
     - Where a river flows along a line of weakness, e.g. fault line/line of less resistant rocks. Examples are gorges found on the floor of Rift Valley e.g. gorges along Rivers Malewa and Shiroro gorge on River Kaduna – Nigeria
     - Where a river maintains its course across a landscape which is being slowly uplifted (antecedent gorge)
     - Where a waterfall retreats upstream, leaving a deep valley on the downstream side due to vigorous erosive activity of the river water e.g. Batoka Gorge below Victoria falls on River Zambezi, gorges below Tissisat falls on Blue Nile (Ethiopia)
3. *Waterfalls*
   - A waterfall is a steep fall of river water where a river bed has sudden vertical/near vertical drop



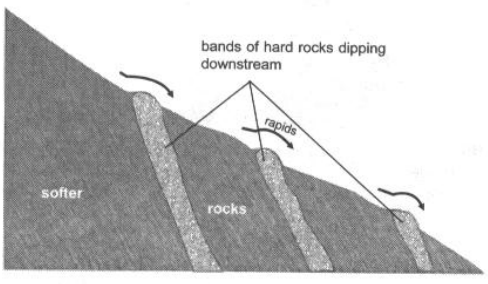
A new vertical face will shortly be produced as the overhang collapses and the fall retreats

- They may be formed in the following ways

Formation	Examples
▪ When a layer of more resistant rock lies across a river bed horizontally, vertically or inclined, the less resistant rock on the downstream is eroded faster than the more resistant rock upstream leading to a steeper gradient that develops into a waterfall	▪ Gura/Tana/Grand/Adamson – all on river Tana ▪ 14 falls – R. Athi ▪ Thomsons – Ewaso Ngiro
▪ Where a river descends/flows over a fault scarp; the river enters the rift valley through a fault scarp	▪ Turkwell – R. Turkwell ▪ Torok – R. Torok ▪ Webuye – R. Nzoia ▪ Kabalega – R. Nile ▪ Kalambo – R. Kalambo
▪ Where a river descends a sharp edge of a plateau	▪ Chandler's – R. Ewaso Ngiro ▪ Lugard's – R. Galana ▪ Pangani – R. Pangani
▪ Formed as a result of river rejuvenation (i.e. at knick point)	▪ Winjo ▪ Gogo – all in R. Kuja
▪ Where a river descends a hanging valley into a glacial trough	▪ Vivienne – R. Nithi
▪ Where a river descends a cliff coast into the ocean; some rivers may not be able to erode through the rocks forming a cliff because they may be very resistant, the river then drops into the ocean forming a waterfall	▪ Lobe fall – R. Sanaga – Cameroon
▪ Where a dyke blocks a river/a river descends a lava barrier or from a landslide; this leads to accumulation of water on the upstream side to form a lake/dam, a waterfall may form at the point of overflow	▪ Chania ▪ Thika – all on R. Tana ▪ Tissisat – R. Nile

4. <u>Rapids</u>

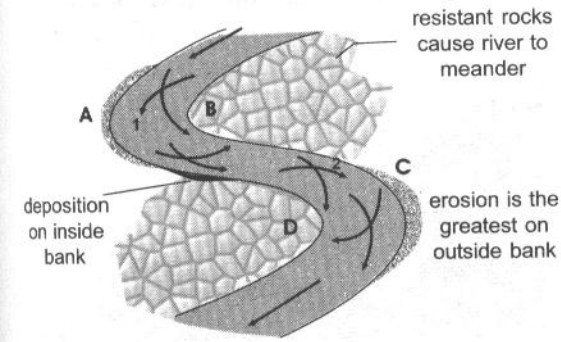
- This is a section of the river with accelerated current; where the stream descends at high speed without a break in the slope of the river bed sufficient enough to form a waterfall
- occurs where a layer of resistant rock lies across the river bed and dips downstream
- example Kora rapids on R. Tana



Rapids/cataracts

5. *Interlocking spurs*

- These are projections of land in the upper course of a river that overlaps with each other.
- They form when a river comes across an obstacle/ resistant rock, hence will tend to curve round these rocks, following areas of least resistance, making the river to have a winding course
- With time the bends are extended and become more pronounced.



B and D are interlocking spurs (alternate spurs)

6. *Potholes*

- When water in a river is flowing rapidly over shallow depressions on the river bed, it develops strong currents called whirlpools that flow in circular manner.
- This also keeps the river load in circular manner too causing the rock fragments to erode the river bed leading to formation of circular depressions called potholes

River Transportation

- Eroded material in a river are transported through solution, suspension, traction and saltation

(a) ***Solution***: - this involves transportation of materials that are dissolved in water

(b) ***Suspension***: - this is the transportation of light and insoluble materials in the form of a mixture. The lighter material float on the water surface or are partially submerged in the river water flowing downstream

(c) ***Traction***: - larger particles (boulders) are pushed and rolled along the streambed by the force of water i.e. hydraulic action and action of gravitational force

(d) ***Saltation/hydraulic lift***: - medium sized load are moved in a series of short jumps/hops along the riverbed. The force of water lifts the particles but they land again by the force of gravity.

Factors that influence river transport

- Nature/amount of the load: - small and lighter particles can be transported over longer distances/larger and heavier particles e.g. boulders are transported over shorter distances
- Gradient and velocity of the river: - if a river flows over steep land, it flows faster/at a higher velocity and this enables it to transport more material/load
- Amount of river discharge/volume of river: - a river with a larger amount/volume of river water transports a greater quantity of load
- Presence/absence of obstacles along the river channel e.g. rock outcrops, swamps etc that check the river velocity thus reducing its ability to transport

River Deposition

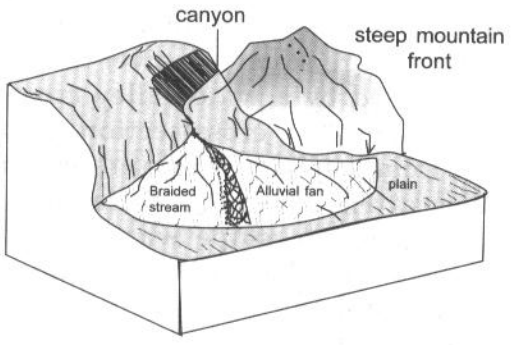
- This occurs when the competence and capacity of a river to transport its load is reduced/decreases
- It is caused when a river's energy to transport is reduced. This can be due to the following factors:
  (a) Emptying into a calm water body e.g. a swamp/lake
  (b) Reduction of river velocity due to reduction in the river's gradient
  (c) Freezing of river water especially in very cold areas e.g. high latitude/altitude areas
  (d) Fluctuation of river volume due to underground seepage/flooding
  (e) Obstacles within the river channel reducing the river competence
  (f) Wider and larger load causes more friction with the river channel leading to reduction in stream velocity thus deposition
  (g) Widening of the stream bed due to lateral erosion

Resultant features of river deposition

- These include alluvial fans, meanders, ox bow lakes, braided river channels/river braids, natural levees, flood plains and deltas

1. *<u>Alluvial fans</u>*

- This is a fan shaped deposit of fairly coarse material laid down by a stream with a large load as it emerges from a steep narrow valley onto a wide gentle plain.
- Deposition takes place when a fast flowing river in a constricted valley/channel losses its velocity on entering a plain.

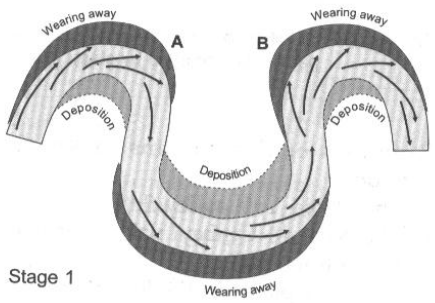


Alluvial fans develop in desert areas as streams leave steep slopes and flow into adjacent plains

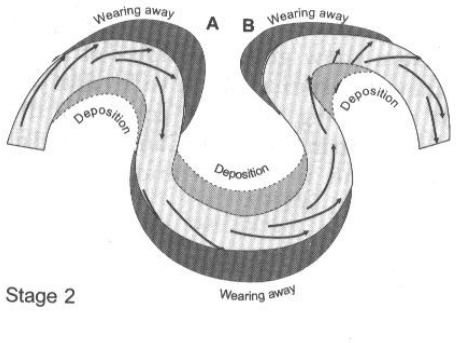
- Examples include *Ombei Fan* – Kano plains (Kenya)

2. *Meanders*

- These are loop-like bends in the river course that develop from the sluggishness of a river due to a decrease in gradient.
- The river therefore flows slowly and tends to flow round an obstacle instead of cutting through it



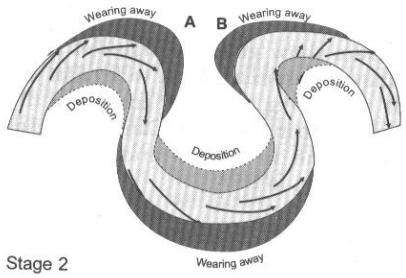
- Once a bend develops around the obstacle, the water current pushes hard on the outer banks causing maximum lateral erosion
- The river water comes to a temporary stand still on the inner bank causing the river to deposit alluvium while at the same time eroding the outer bank



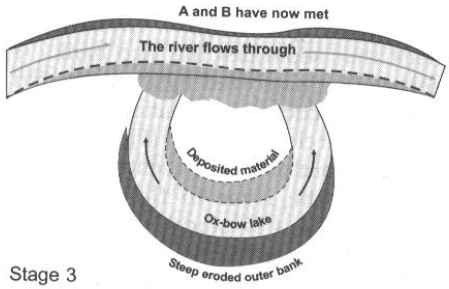
- The meander grows bigger and more pronounced due to alternate deposition and erosion on the inner and outer banks respectively
- Meanders are common on the lower courses/stages of rivers Yala, Miriu, Nzoia, Nyando, Tana and Sabaki – all in Kenya

3. *<u>Ox bow lakes</u>*

- This is a horse shoe/crescent shaped lake formed on the flood plain of a river
- Active lateral erosion takes on the outside of the bends narrowing the meander neck. The meander neck is eventually cut through



- The cut ends of the meander are sealed by deposition and the meander now becomes an ox-bow lake

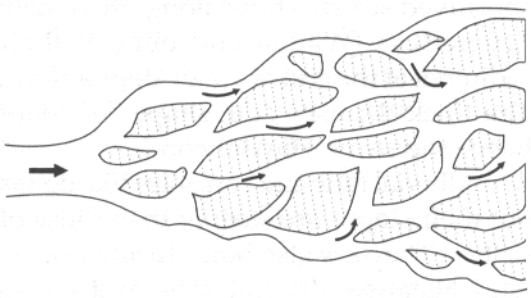


Formation of ox-bow lakes

- Examples includes lakes Kanyaboli (R. Yala) , Shalu, Bilisa, Gambi and Shakababo – all on R. Tana

4. *<u>Braided river channels/river braids</u>*

- This is an extremely wide, shallow channel in which the river divides and subdivides in a series of interconnecting minor channels separated by sand banks and islands of alluvium.



Braided stream. Bars split the main channel into many smaller channels, greatly widening the stream.

- River braids occur under the following conditions: -
  - Heavily loaded streams flowing between banks of easily eroded material
  - Areas of reduced gradient of the stream
  - Arid areas where evaporation is high
  - Dry season, when the river volume is reduced.
  - Presence of obstacles like rock outcrops, which may cause the river to be subdivided
- Examples are common in the lower courses of rivers Nzoia, Yala, Sondu and Nyando

5. *Natural levees*

- These are raised river banks between which a river flows during its old stage
- They start forming when a river floods, spilling over its banks and deposition occurs
- Coarse materials are deposited first followed by finer alluvium that are carried further into the flood plain
- These accumulation of coarse materials raise the river banks to form natural levees

Diagram

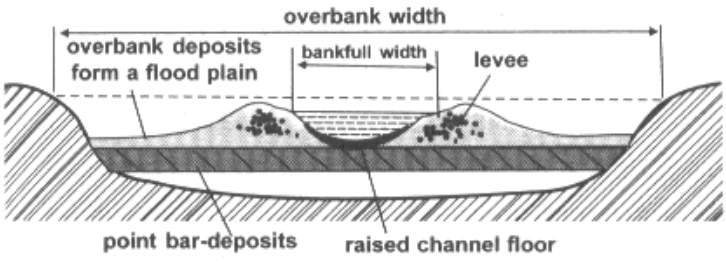
- Examples of rivers with natural levees include Hwang Ho (China), Yang Tse Kiang (China), Mississippi (North America), and Omo (Ethiopia)

6. *Deferred tributaries*

- This is a river that is forced to flow alongside the main river for long distance before being able to join the main river
- The tributary then starts flowing parallel to the main river across the flood plain until it finds a break in the bank further downstream where it can join the mainstream

7. *Flood plains*

- This is a wide flat plain of alluvium on the floor of a river valley over which the river may spread in time of flood
- It is produced through erosion and deposition by a meandering river. As the river meanders, it widens the river valley through lateral erosion; removing the interlocking spurs/reducing them into low bluffs/cliffs
- In the process, the meanders migrate downstream hence widening the river channel
- The initial deposits at the end of the slip off slope merge to form continuous alluvial deposit on both sides of the channel
- During floods, alluvium is deposited on the entire valley floor resulting into a flood plain
- Examples of rivers with flood plains include Nzoia, Yala, Tana, Sabaki and Nyando



The formation of the floodplain

8. *Deltas*

- This is a wide and low lying flat tract of alluvial deposits formed at the mouth of a river.
- It forms when a river deposits some of its load on entering into as sea; as a marine delta or on entering into a lake; as a lacustrine delta
- The velocity of the river is checked by the relatively stagnant sea or lake water as the river enters into a sea/lake from the flood plain
- The heavier load is deposited immediately at the mouth whereas lighter materials are carried further into the sea/lake
- As the deposited materials accumulate, this part of the sea/lake becomes shallower, the river builds levees on the sides of the channel making it narrower
- In some cases, the river may burst its banks and divide into smaller channels called distributaries that spread the river deposits and increasing the area covered by the delta

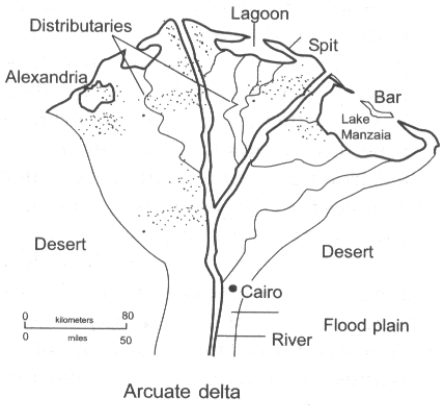
Conditions ideal for the formation of deltas

- River must have a large load of sediments to be deposited at the mouth.
- River should be slow flowing on entering the mouth/low velocity at the mouth to facilitate deposition
- Rivers load should be deposited faster than it can be removed by currents and tides.
- Absence of obstacles (lakes, swamps) in the river's course which would filter sediments.
- Calm sea/absence of strong waves
- Shallow continental shelf/shore.

Types of Deltas

(a) Arcuate delta

- This consists of coarse sediments of sand and gravel
- Forms where the offshore currents are very strong

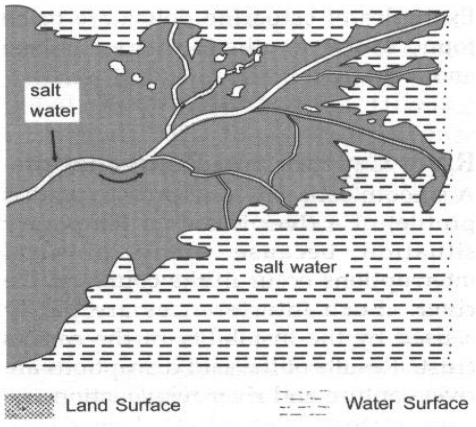


Arcuate delta

- Examples are deltas on rivers Yala, Tana, Sondu and Rufiji. Others include Nile Delta (Egypt), Niger Delta (Nigeria)

(b) Bird's Foot Delta

- Forms on rivers, which carry large quantities of fine alluvium into waters where there is low wave energy
- The river flows into the sea/lake through distributaries that form the shape of a bird's foot
- It forms at the river mouths with few tides, currents and waves to disturb the silt

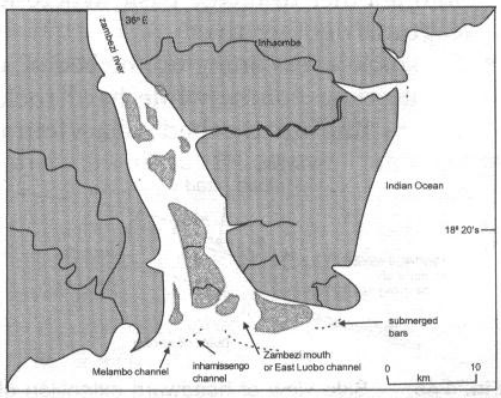


Bird's foot delta

- Examples include deltas of rivers with the mouths at Lake Victoria e.g. Nyando, Miriu, Kuja, and Nzoia. Others are deltas found on the mouths of rivers Malewa, Gilgil, Omo and Turkwell

(c) Estuarine Delta

- An estuary is a submerged river mouth at the coast
- An estuarine delta forms in the estuary as the river deposits its load forming sandbanks and islands until the whole estuary is filled up with the sediments and the river cuts across it in a single channel that may be bordered by levees.



Estuarine delta at the mouth of the Zambezi

- Examples are deltas on River Zambezi (Mozambique), Volta (Ghana), Betsiboka (Madagascar)

(d) Inland Deltas

- Forms along the course of a river before it reaches the mouth; lake/sea
- Develop when the velocity of the river is reduced on entering a relatively flat land, especially a swampy one.
- During floods, the river builds up levees, which cause distributaries to develop.
- Alluvial deposits are spread over vast area when the river floods.
- Examples include Niger Delta (Mali), Okavango Delta (Botswana)

Development of a river profile

- River profile is the longitudinal section of a river from the source to the mouth
- It focuses on the appearance of the rivers course laying emphasis on gradient and characteristic features on the long profile
- The river profile is divided into: -
  (a) Youth/youthful/torrential stage/upper course
  (b) Mature/middle/valley stage/course
  (c) Old/plain/lower stage/course

(a) Youthful Stage

- The river flows very fast/at high velocity
- The most dominant river action here is erosion with vertical erosion being more dominant compared to headward erosion
- Characteristic features here include gorges, waterfalls, rapids, interlocking spurs, potholes and V shaped valleys

(b) Mature stage

- The river channel is wider because it is joined by many tributaries from upstream
- Lateral erosion is more dominant than vertical erosion
- The river slopes become gentle
- Deposition takes place along some sections
- Characteristic features include U shaped river valleys, meanders, river bluffs, slip off slopes

(c) Old stage

- Large river load
- Deposition is dominant
- River gradient is very gentle/almost level.
- River flows very slowly
- The river valley is shallow, broad and flat.
- Seasonal flooding
- The river is very sluggish, forming pronounced meanders
- Deposition along the banks forms levees
- Characteristic features include deltas, distributaries, natural levees, raised river beds, flood plains, alluvial fans, river braids, pronounced meanders, and ox bow lakes

Diagram

River Capture

- Aka river piracy
- This is the diversion of the headwaters of one river into the system of an adjacent but more powerful river due to erosion
- Initially these two rivers flow adjacent to each other and share a common watershed
- The pirate river has a more erosive power due to high water volume. If it is flowing over less resistant/softer rock, it erodes these softer rocks faster compared to the weaker river
- The valley of the pirate river becomes deeper and wider making it to flow at a lower level compared to the weaker river
- The pirate river also extends its valley backwards by headward erosion. Eventually it joins the weaker river and the weaker river's headwaters start flowing into the valley of the pirate river
- The remaining section of the river where the upper waters have been captured is called the *misfit/beheaded stream*
- The sharp bend at the point of capture is called an *elbow of capture*
- The dry river valley between the elbow of capture and the new course of the misfit stream forms a *wind gap*

Diagram

Conditions necessary for a river capture to occur

- The pirate river ought to be flowing at a lower level compared to the less powerful river
- The powerful and misfit rivers must be flowing in adjacent valley, sharing a watershed
- The pirate river should have a wider valley compared to misfit rivers
- The pirate river must have a more active headward erosion compared to the misfit stream

- Examples of river capture in Africa
  - R. Miriu captured to form R. Sondu
  - R. Mwine captured R Mizmui – Tanzania
  - R. Tano captured by Black Volta River – Ghana
  - R. Gongola captured by R. Benice – Chad
  - R. Eyong captured by R. Imo – Nigeria

River Rejuvenation

- This is the renewal or revival of a river's erosive activity/ability
- It can occur at any stage/course of the river

Causes of river rejuvenation

(a) Change in base level

- Base level is the lowest level to which a river can erode its bed and over which land can be eroded by running water
- This change can be caused by a fall/drop in sea level, regional or local uplift of land, unequal regional subsidence of the land and creates a sharp knick point along the river course.
- Rejuvenation caused by changes in the base level is referred to as *dynamic rejuvenation*

(b) Increase in a river's discharge

- This can be due to increase in precipitation and river capture leading to greater erosive power

- This is called *static rejuvenation*

(c) Change in rock resistance

- From resistant rock to less resistant rocks
- When the river passes over relatively softer rock, it starts to erode vigorously once again.

Features resulting from river rejuvenation

(a) Knick points

- This is a point with a sudden break of slope in the long profile of a river
- They occur following a fall in base level

Diagram

(b) River Terraces

- These are step-like benches cut out on old river valleys and abandoned by rejuvenated rivers as they renew their erosion to cut new channels
- Expose – can be paired and unpaired

Diagram

(c) Incised meanders

- These are meanders formed when a rejuvenated river cuts deeper into the original meander
- The river cuts deeply into its bed creating a new valley with the same meandering shape within the old valley
- Can be ingrown(asymmetrical) or intrenched (symmetrical)

Diagram

(d) Rejuvenation gorges

- Increased down cutting of the river channel as a result of river rejuvenation may create gorges along the river course
- This can be due to antecedence (a river maintaining its course while the surrounding area is being uplifted) or due to change in climate

Drainage patterns

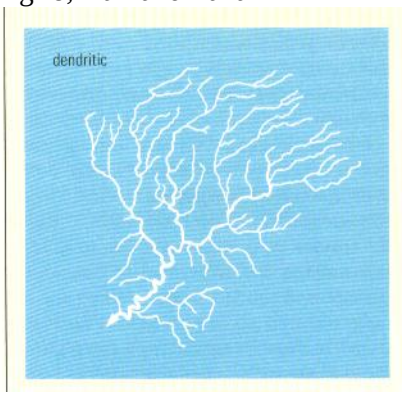
- This is the plan or layout made by a river and its tributaries on the landscape/earth's surface

<u>Factors influencing the development of a drainage pattern:</u>

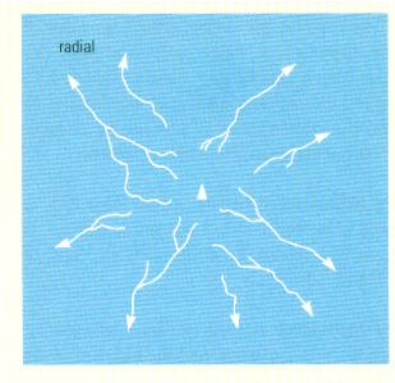
- Slope of the land guides the direction of a river flow
- Difference in rock resistance/hardness – determines how deep and wide a river channel will become.
- The rock structure along a river's profile.

- They include

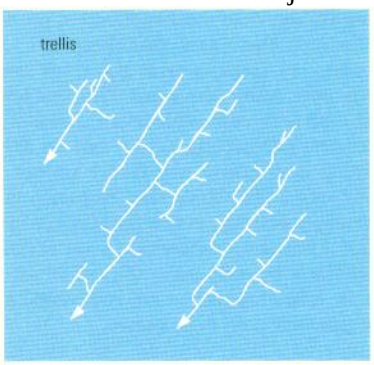
(a) ***Dendritic***: - the tributaries join the main river at acute angles. It develops on rocks with uniform resistance and structure. Examples of rivers with dendritic drainage patterns are Sondu, Nzoia, Yala, Ewaso Ngiro, Athi and Tana



(b) ***Radial***: - develops on a volcanic dome/a cone shaped upland. The river flows outwards/radiates from the peak/top of the volcano downslope around the dome/mountain that forms the source of the rivers. Examples include rivers Ewaso Ngiro and Tana on Mt. Kenya.



(c) ***Trellis/Rectilinear***: - tributaries join the main river at right angles as well as the minor tributaries to the major tributaries. It develops in areas of heterogeneous rocks that dip/slope in the same direction. It is mainly found in scarpland regions/regions of folded rock. Examples are rivers Lak Galole and Kakoni that join R. Tana at right angles



(d) ***Centripetal***: - this comprises of rivers flowing into a common inland basin or depression e.g. a lake, sea or swamp. It occurs in both homogeneous and heterogeneous rocks. The river is guided by the slope dipping towards the depression. Examples are rivers flowing into the rift valley lakes (***Diagram)***

(e) ***Parallel***: - the rivers run parallel to each other in areas with well jointed rocks. Examples include rivers Tana and Athi

(f) ***Fault guided***: - this develops in faulted areas. The rivers flow along the fault line because they are relatively weak hence easily eroded. The drainage pattern formed depends on the pattern of the fault line. Example include river Kerio and Ewaso Ngiro

Drainage System

- This refers to the flow of river water in valleys with respect to the nature of underlying rock

Types of drainage systems

(a) Accordant
(b) Discordant
(c) Back tilted

(a) **Accordant**: - the river flows according to the rock structure and slope by following weaker rocks
(b) **Discordant**: - the river flows against the slope, nature of rock and land forming process. It is further divided into antecedent and superimposed drainage systems
(i) Antecedent drainage system: - here, the river maintains its course and direction of flow while the surrounding rock is uplifted. The position of the river is maintained through continuous vertical erosion of the rising landscape. The uplift leads to rejuvenation and formation of an antecedent gorge. Examples of rivers with antecedent drainage system are Rivers Malewa and Gilgil, the Great Ruaha River and R. Niger
(ii) Superimposed drainage system: - develops where a river flows over the rocks it is down cutting. Once these rocks are removed through erosion, the river begins to flow over a new set of rocks of a different structure that are older. If the river maintains its original direction of flow without being influenced by the newly exposed rock structure, it is said to be superimposed on the new set of rocks. Examples include River Nile, R. Zambezi and R. Vaal (RSA)
(c) **Back tilted**: - occurs due to major river capture or large scale diversion of the river direction due to uplift or down warping

Diagram

Significance of Rivers and the resultant features

- Rivers provide water used for domestic, industrial and irrigation purposes e.g. rivers Yala, Nairobi, etc.
- Some rivers especially in their older stage form natural waterways that can be used for transport e.g. Yang Tse Kiang, Rhine and Mississippi.
- Drowned or submerged river mouths form rias/fiords that are deep and well sheltered thus facilitate the development of ports e.g. Rotterdam on Rhine Delta – Netherlands
- Some rivers are rich fishing around (St. Louis Mississippi)
- Gravel and sand harvested from river banks are used for building and construction purposes.
- Some river deposits contain alluvial soils with valuable mineral e.g. gold, diamond e.g. R. Orange diamond.
- Features formed by rivers (waterfalls, gorges, meanders) are tourist attraction hence earning foreign revenue
- Some rivers provide sites for development of HEP stations and projects e.g. Seven Forks (Tana), Owen Falls (Nile – Uganda)
- Rivers deposit fertile alluvial soils good for cultivation.