STANDARD HIGH SCHOOL ZZANA

S.6 GEOGRAPHY 1 WORK

CORAL LANDFORMS IN EAST AFRICA

Account for the formation of coral landforms in East Africa

Approach

- Define clearly coral landforms
- Describe the process of formation
- Identify the types
- Explain conditions which favor their formation in East Africa
- Explain the theories put forward to explain the formation of coral landforms

Answer guide

Coral landforms/ reefs are offshore limestone rock platforms formed by continuous deposition and accumulation of shells or skeletons of small marine organisms known as coral polyps.

Polyps are minute living organisms rich in calcium carbonate and when they die; their skeletons get deposited and accumulate on the continental shelf where they are compacted and cemented together to form coral reefs.

The processes of coral formation therefore involve;

▪The death of coral polyps and deposition of skeletons rich in calcium carbonate on the continental shelf

▪Over time, the coral deposits increase in weight, become compressed and compacted and cemented together

▪In this way, large banks of consolidated rocks are gradually built up, called coral reefs

▪The process of cementation and consolidation of coral reefs is facilitated by other organisms such as algae (calcareous algae) and echinoderms.

▪The nature of the coral landforms formed depends on the position and shape of the landmass on which they have accumulated. Thus there are three types of coral reefs namely; fringing, barrier and atoll

Types of coral reefs

Fringing reef - a narrow coral platform of about one kilometer wide joined to the coast or separated from it by a shallow lagoon which may disappear at low water level.

▪A fringing reef is formed very close to the coast with its leeward edge sloping steeply into the sea floor.

▪Fringing reefs can be seen at the East African coast near Kilifi, Tiwi and Mombassa in Kenya and Oyster Bay at Dar es Salaam in Tanzania.

Diagram

Barrier reef - a wide coral plat form formed much farther or several kilometers from the coast and separated from it by a much deeper and relatively wider lagoon.

▪Barrier reefs can be cited at Mayotte Island between Mozambique and Madagascar.

Diagram

An atoll is a circular shaped coral reef surrounding a wide and fairly deep flat-floored lagoon and generally broken in places by narrow channels.

Atolls are formed very far from the coast for example Aldabra atoll reef lies 700 km off the coast of East Africa, Chumbe Island found on Zanzibar

Diagram

Conditions that favor development of coral reefs

The growth and development of coral landforms along the East African coast is facilitated by;

▪Warm temperatures of tropical climate between 20^0c-30^0c ideal for growth of coral polyps. This applies to areas 30^0 N and south of the equator for example Indian Ocean coast

▪ Availability of salty, well oxygenated seawater with a salinity level of 27-40 parts per 1000 parts of ocean water provides adequate calcium carbonate taken up from sea water by coral polyps used to build and harden their shells /skeletons.

▪Existence of clear, silt free and calm water away from river mouth allows coral growth.

▪Existence of shallow continental shelf with depth less than 60 meters allows penetration of sun light to the sea bottom. This enables planktons on which polyps feed to carry out photosynthesis.

▪Presence of plentiful supplies of planktons on which polyps feed and survive

▪Presence of solid rock bed along the coast upon which coral reefs grow. A continuous continental shelf along the coast is ideal for the growth of coral reefs.

▪Occurrence of sea-level changes/ isostatic adjustments. That is, increase in the sea level encourages coral deposition while a fall in the sea level exposes the coral reefs.

▪Presence of calm/ stable water hence no strong waves such as typhoons to destabilize normal growth and accumulation of coral reefs.

▪Presence of coral polyps in abundance which when die; deposit skeletons of calcium carbonate which accumulate to form coral landforms.

▪The warm Mozambique Ocean current that washes the East African coast helps to maintain the temperatures of the Indian Ocean and thus enables the polyps to survive.

Theories of coral reef formation

The formation of barrier reefs and atolls has created a lot of controversy as they have been found at far greater depths, in some areas exceeding 1000 meters; a level where polyps cannot survive. As a result, relevant theories have been put forward to explain this anomaly. That is subsidence theory, deglaciation theory and antecedent theory.

Subsidence theory by Charles Darwin 1842

Charles Darwin explained that the process of coral formation was gradual and occurred due to subsidence of a volcanic island.

Darwin's theory explains that volcanic eruption formed a volcanic island on the ocean floor.

Coral polyps established and colonized the edge of the volcano hence formed a fringing reef.

The volcanic island slowly subsided due to isostatic re-adjustments that followed eruption. Such subsidence increased the depth of water beyond the level at which coral polyps could survive.

Consequently, some polyps died while others survived on the flanks/ sides and started to grow to keep pace with the changes in the water depth.

The polyps that survived grew vigorously upwards and outwards and in the process transformed into barrier reefs and eventually into atolls when the volcano completely submerged.

N.B. the diagrams should show the upward ad outward growth.

Deglaciation theory by Daly

Daly based his theory on the sea level changes during and after the ice age, not subsidence of the volcanic island.

According to Daly, before the ice age or glaciation, fringing corals colonized the edge of a Marine Island due to warm water and other conditions that favor coral growth and development.

During the ice age/glaciation, a lot of water was locked up in ice-sheets and caused a fall in the sea level. The cold conditions killed some coral polyps while maximum erosion removed the top of the island and the reef to form a wave cut platform.

After the ice age, the return of warm conditions resulted into deglaciation, a rise in the sea level and growth of corals.

As sea level increased, the polyps that survived on the flanks of the wave cut platform grew vigorously upwards and outwards to keep pace with the changes in the water depth and be maintained at the surface water.

Through this process, coral reefs that colonized the flanks gradually transformed into barrier reefs and finally into atolls when the island/ wave cut platform submerged completely.

Diagram

Antecedent theory by sir john Murray

According to Murray, there existed stable submarine plat forms on which pelagic deposits including corals accumulated at a depth below 60 meters. Barrier reefs and atolls began to form on these platforms as fringing reefs.

As reefs grew upwards and outwards, they were pounded by waves such that masses of coral fragments accumulated on the seaward side; cemented and consolidated into hard reefs .The polyps inside the reef however died due to lack of food and their skeletons dissolved in water to form a lagoon inside the reef.

This changed the barrier reef in to atoll.

Diagram

Economic importance of coral reefs

Positive

▪Coral reefs are tourist attractions because of their beautiful shapes and color which make them unique hence a source of foreign exchange for Kenya and Tanzania. For example fringing reefs at Bamburi, Shungyu in Dar es Salaam.

▪Coral reefs contain limestone which is extracted for production of cement used in construction works for example Bamburi cement.

▪Coral reefs are source of education material and research. For example in the field of oceanography, geomorphology and search for oil prospects.

▪Coral reefs weather down into fertile soils which support crop cultivation for example coconuts, mangoes, citrus fruits and cashew nuts and cloves in Pemba, Mombasa and Zanzibar.

▪Coral reefs contain limestone used in manufacturing fertilizers rich in calcium carbonates hence boosts crop cultivation.

▪Fringing reefs have favored the development of ports by protecting the harbor from destructive waves which would otherwise have destroyed the coast through flooding. For example port Mombasa and Dar es Salaam.

▪Fringing reefs also protect beach swimmers from dangerous marine organisms such as crocodiles and hippos because they find it difficult to cross the reefs to the beach. This promotes tourism.

▪Coral reefs are potential areas for mining oil because they contain a lot of fats which sip down and accumulate into rock strata to form oil wells.

▪Fishing is carried out in the coral lagoons. For example fish, crabs and lobsters

▪Lagoons are also used for recreation purposes such as swimming and sun bathing especially tourists.

Negative effects

▪Coral reefs weather down into poor sandy soils which discourage growing of other crops apart from coconut and cloves.

▪Fringing and barrier reefs are obstacles to marine transport and fishing because they form hard projecting rocks which wreck ships, fishing boats and nets.

▪Coral lagoons are colonized by mangrove vegetation during the low tides leading to spread of disease vectors such as mosquitoes which cause malaria.

▪Fringing reefs limit the size of docking area at Mombasa and Dar es Salaam Ports which results into congestion of ships and limited space for ocean wagons.

SEA LEVEL CHANGES OR EUSTATISM

(a) Explain the causes of sea-level change in the coastal areas.

(b)Examine the landforms resulting from sea level changes.

Approach

- Define sea level change and state the types of sea level changes
- In part (b) Identify and describe the formation of both submerged and emerged coastal landforms in highland and low land areas
- Draw diagrams and give examples where applicable from East Africa and outside East Africa.

Answer guide

Sea level changes refer to the rise and fall of the sea level in relation to the land along the coastal areas. **Alternatively, sea level changes can be defined as** the vertical movement of land relative to the sea along the coastal regions.

When sea level changes occur worldwide is called **eustatic or major change** and when it occurs on minor or local scale is called **isostatic change**.

TYPES OF SEA LEVEL CHANGES

Sea level changes are either positive or negative. Positive eustatism/ change occurs when the sea level rises in relation to the land and produces submerged coasts and their related landforms.

Negative eustatism/ change occurs when the sea level falls in relation to the land and produces emerged coasts and their related landforms.

CAUSES OF SEA LEVEL CHANGES

1.Sea level changes are caused by climate, glaciation and deglaciation, Change in ocean temperatures, Occurrence of earth movements, deposition of sediments and global warming.

2.Climatic changes. Pluviation period characterized by heavy rain fall such as El-Nino and monsoon lead to the rise in sea level while desiccation/ prolonged drought period leads to a fall in sea level.

3.Glaciation and deglaciation. Glaciation during the last ice age caused a fall in sea level because huge quantities of water froze into ice on high mountains and ice-sheets in Polar Regions. Deglaciation during the inter-glacial period characterized by warmer conditions, melted thick ice sheets from continental landmasses, forming rivers; which drained huge volumes of water into the sea; leading to a rise in the sea level.

4.Change in ocean temperatures. When world temperatures increase for example due to volcanicity on the ocean floor, water in oceans expands and the volume of water increases causing a rise in sea level. On the other hand when temperature falls for example during winter, water in oceans contracts and the volume falls; leading to a fall in sea level relative to the land.

5.Influence of global warming**.** The steady rise in the average temperature over the surface of the earth is affecting climate by melting ice on continental landmasses, bringing erratic rains and flooding hence the rise in sea level.

6.On the other hand, global warming is accelerating evaporation and aridity leading to the fall in sea level.

7.Occurrence of earth movements/ tectonic movements at the coast. Earth movements are forces that originate from the interior of the earth due to plate tectonism for example faulting, warping and volcanism.

8.Earth movements are responsible for sea level changes in the following ways;

▪Warping movements-up- warping / up lifting of coastal areas and down warping of ocean basins leads to a fall in sea-level while up-warping of ocean basins and down-warping of coastal areas leads to a rise in sea level.

▪Occurrence of Volcanicity on ocean floor. Volcanoes formed where tectonic plates meet at convergent boundary/ subduction zones, displace water in oceans up-wards causing a rise in sea level.

▪Plate tectonism. The divergence of oceanic plates at mid-ocean ridges leads to expansion/ widening of ocean floor and a fall in sea level.

Other hand, convergence of tectonic plates leads to contraction/ narrowing of ocean floor and a rise in sea level.

▪Faulting in coastal areas leads to down thrust of some parts causing a fall in the sea level.

9.Isostatic readjustments. When huge quantities of materials are added on to continental landmasses for example ice sheets during the quaternary era, increase the weight of continents forcing them to sink down slowly, displacing water upwards hence a rise in sea level.

10▪Deglaciation of huge ice sheets and erosion on the continental landmasses reduces the weight of continents and cause isostatic uplift of landmass which ultimately leads to a fall in sea level.

11▪Deposition of sediments on the ocean floor such as alluvium by rivers**,** construction works in water, cultivation along the coast e.t.c reduces the size of the ocean basin, displaces water upwards leading to the rise in sea level.

LAND FORMS PRODUCED BY SEA LEVEL CHANGES

(b)When the sea level rise in a highland coast, the coast is submerged and the following landforms are created;

Rias. A ria is a funnel shaped drowned river valley at the sea. Before submergence, the river flows into the ocean through a valley. When the sea level rise, the river valley is flooded or submerged at the sea to form a ria.

Rias are wider and deeper seawards and narrower and shallower landwards which gives them a funnel shape.

Rias are formed on coastlands where hills and river valleys meet the sea approximately at right angles for example Kilindini harbor on which Mombasa port is established, Mtwara, Tanga, Dar es Salaam, Lamu e.t.c along the East African coast. Rias also found on southern shores of Lake Victoria.

Diagram

Dalmatian coast/ longitudinal coastline. This is a coast with a chain of off islands running parallel to it. A Dalmatian coast is Formed in areas where elongated hills / ridges and valleys lie parallel to the coast before submergence.

When the sea level rises, valleys are flooded or submerged to form sounds while the un submerged hilltops form a chain of islands running parallel to the coast line. The

submerged valleys/ sounds separate islands from the main land to form a dalmatian coast. For example, Smith sound on the southern shores of Lake Victoria at Mwanza, Bamburi hills south of Bukoba on Lake Victoria, Dalmatian coast of Pemba and Zanzibar islands of Tanzania e.t.c.

Diagram

Fiords are drowned u-shaped glacial troughs with steep walls seawards in highland coasts. Fiords are Formed when sea level rises and floods glacial troughs/ valleys formed initially by glaciers over deepening the valleys below sea level. Fiords have steep sides and deeper seawards. For example the coast of Norway, British Columbia, southern Chile e.t.c

diagram

Peninsulas. A peninsular is an elongated piece of land projecting seawards. They are formed in areas where highlands lie at right angles to the coast. When the sea level rises, valleys are flooded / submerged leaving elongated pieces of land projecting seawards. For example Entebbe peninsular and Mweya peninsular.

diagram

Submerged lowland coasts. When a lowland coast is submerged the following landforms are produced:

Estuaries- are submerged river valleys in lowland coasts with a v-shaped cross profile pointing landwards. They are Formed when sea level rise along a lowland coast causing the sea to penetrate inland to a considerable distance along river valleys. They are wider and deeper landwards. For example river Rufiji in Tanzania, river kibanga at Mombasa, estuaries of Thames e.t.c

Creeks -are narrow inlets at the coast formed by submergence/ drowning of small streams in lowland coast due to rise in sea level. For example Chake- chake, Mtwapa, Makupa e.t.c along Mombasa on Kenyan coast.

Mud flats, **lagoons and marshes**. Mud flats are plat forms made of deposits of fine silt and alluvium deposited by rivers or waves. Continuous deposition of these sediments builds sand spits and bars. When the sea level rise, seawater is enclosed behind spits and bars to form a lagoon usually colonized by marshes and mangrove swamps. These features are Found at Mombasa, Dar es Salaam e.t.c.

Landforms created by the fall in the sea-level/ Emerged landforms

When the sea level falls the formally submerged landforms are exposed to form emerged landforms in **highland and lowland coasts:**

Emerged landforms in **highland coasts**

Raised cliffs. A raised cliff is a steep rock face along the sea coast that is no longer in contact with the sea. Before submergence, waves attacked coastal rock and through processes of abrasion, hydraulic action and solution, a notch formed, enlarged and deepened. With time, land above the notch lost support and collapsed to form a cliff.

When sea level falls, new cliffs are created and the old cliffs that are no longer in contact with the sea are left behind high above the present water level hence the name-raised. Raised cliffs are Found at Mombasa.

diagram

Raised terraces are former wave cut plat forms which are no longer in contact with the sea created by materials eroded from the cliff. When sea level falls, new wave cut plat forms are created and the old terraces which are no longer in contact with the sea and left high above the current sea level hence the name raised terraces.**diagram**

Raised beaches. These are beaches which are no longer in contact with the sea left high above the current sea level.

Before submergence, sand and shingle materials are deposited by constructive waves to form a gently sloping platform called beach at the coast.

When sea level falls, the beach loses contact with the sea and left behind high above the current sea level as a dry land hence the term-raised beach. For example Dar es salaam, Mombasa, Tanga e.t.c

diagram

Raised caves, geos and blowholes. Continuous wave erosion against jointed coastal rock through abrasion, hydraulic action and solution create large holes in the cliff face called caves. When the roof of the cave collapses, it forms a narrow inlet called a geo and a blowhole when waves erode the roof of a cave to the surface.

When sea level falls, all these features reappear behind high above the current water level.

The fall in the sea level in lowland coast creates coastal plains and Fiards.

coastal plains formed when the continental shelf is exposed after a fall in the sea level. The coast line of Coastal plains have no bays and head lands.

diagram

Fiards- are drowned u-shaped glacial troughs/ valleys formed along lowland coasts. They have a broader u-shaped profile than the fiord. For example the coast of south East Sweden, coast of Nova Scotia and Maine.

diagram

(a)**Account for the development of sea level changes in the coastal areas of East Africa.**

(b)Explain the effect of sea level changes on landform development in the coastal areas of East Africa.

Approach

- Define sea level changes and types of sea level changes
- Explain the causes of sea level changes with examples
- In part (b) Describe the formation of both submerged and emerged coastal landforms in highland and low land areas
- Draw diagrams and give examples from East Africa.

WAVE ACTION

EFFECTS OF WAVES ON LAND FORM DEVELOPMENT IN EAST AFRICA

Waves are Oscillations or ripples on water caused by wind, earth quakes such as Tsunami, heavy marine vessels such as ships, whale e.t.c

Waves are effective agents of erosion hence create both erosional and depositional land forms.

WAVE EROSIONAL FEATURES

QN Discuss the processes responsible for the formation of erosional features on the coast of East Africa.

Approach

- **define waves**
- Identify and explain the processes of wave erosion
- Identify wave erosional features and explain their formation in relation to the processes identified above

- ❖ Draw diagrams and give relevant examples.

Answer guide

Waves are Oscillations or ripples on water caused by wind, earth quakes such as Tsunami, heavy marine vessels such as ships, whale e.t.c

Waves are effective agents of erosion. Waves erode through four major processes to create erosional landforms. That is hydraulic action, solution, attrition and abrasion.

Solution / corrosion -takes place on coasts dominated by limestone rocks which contain calcium carbonate which dissolves in water and carried away in solution.

Hydraulic action- takes place when breaking waves exert enormous pressure against jointed rock. As Waves hit the joints air is compressed.

As waves retreat, air expands rapidly. Eventually, repeated compression and expansion of air in rock joints break /shatter coastal rocks and enlarge joints deeper.

Abrasion/corrosion- takes place when waves use materials being carried such as pebbles, boulders and sand to scratch against and wear down coastal rocks.

Attrition-takes place when pebbles and rock fragments being carried by waves keep knocking against each other and eventually wear down by friction to smaller pieces.

Through these processes, wave create cliffs, wave cut plat forms, bays and headlands, caves, arches, stacks, stumps, blow hole and geos common along the shores of lake Victoria and the coast of East Africa

Wave erosional landforms are found between high and low tide level.

Cliffs. A cliff is a steep rock face along the sea coast or lake shore above high tide level. A cliff may be high or low in height.

Cliffs form when wave cut a notch in the coastal rock at high tide level through abrasion. Gradually, the notch is enlarged by hydraulic action and solution deeper inland. Eventually the land above the notch loses support and collapses into water and a steep rock face is left behind. Cliffs are found at Lutembe beach and Botanical gardens in Entebbe along the shore of Lake Victoria, Fort Jesus at Mombasa, Watamu at Kenyan coast and Dar es Salaam and Kilwa.**diagram**

Wave cut plat form- is a surface of debris sloping seawards below the cliff formed between high and low tide level.

It forms when materials eroded from the cliff by abrasion and hydraulic action are deposited below the base of the cliff by breaking waves and accumulate seawards to form a bench like platform called a wave cut platform.

Wave cut platforms are exposed during low tide and submerged during high tides. They are found below fort Jesus at Mombasa and Gereza at Kilwa.**diagram**

Headland is an elongated piece of land projecting into the sea. It is produced by differential wave erosion at the coast were hard and soft rocks alternate. Through wave abrasion and solution, soft rocks are eroded away to form bays while the hard rocks resist erosion and remain standing as head lands. For example Kibanga headland on Entebbe peninsular on Lake Victoria shores and Watamu headland on Kenyan coast.**diagram**

Bays. A bay is extension of the sea or lake into coastland or an inlet of water projecting into the adjacent coastland. Formed when weak rocks are eroded away through wave abrasion and solution. For example Kavirondo Gulf in Kenya on Lake Victoria, Sango, Murchison and Napoleon bay on Lake Victoria in Uganda.**diagram**

Caves. A cave is a huge hole in cliff face with a wide entrance and narrow end. Caves develop from waves enlarging joints, fault lines, cracks and other lines of weakness in coastal rock by abrasion and hydraulic action. For example limestone caves near Mombasa, Kiwi and Kilifi beaches in Kenya, Botanical and Lutembe beaches in Uganda.**diagram**

Sea arches. A sea arch is a tunnel through a headland. Formed either when two caves from the opposite side of a headland join together due to prolonged wave abrasion, hydraulic action and solution from both sides and when waves erode the cave further and breaks through the headland through abrasion, hydraulic action and solution.**diagram**

Stacks. A stack is an isolated pillar of rock rising from the sea cut from the headland. A stack is Formed when the roof of sea arch collapses into water due to prolonged wave erosion. For example stacks in Lake Victoria at Entebbe. Huge stacks form islands for example islands of Mafia, Zanzibar and Pemba. **diagram**

Stumps are ruminants of eroded stacks. They are Formed due to prolonged wave abrasion and hydraulic action until stacks are reduced to the size of being submerged during high tides. For example Ssese stumps in Lake Victoria and Watamu on the Kenyan coast.**diagram**

Blow holes. A blow hole is a cylindrical hole / opening drilled from the roof of a cave to surface or top of a cliff. Formed by wave abrasion, hydraulic action and solution usually by water splashing on the cave roof. They are Found at Malindi and Watamu, botanical gardens on Entebbe peninsular.**diagram**

Geos. A geo is a deep and narrow steep sided inlet found in the cliff. Forms when the roof of a cave collapses into water due to prolonged wave erosion through solution. Found at Malindi and Watamu on the Kenyan coast.**diagram**

LAND FORMS PRODUCED BY WAVE DEPOSITION

QN Account for the formation of wave depositional landforms in East Africa.

Approach

- Describe the process of wave deposition.
- Explain the landforms that are formed due to wave deposition
- Draw diagrams and give examples.

Answer guide

Deposition takes place when materials or debris are moved along the shores by waves and long shore drift, a mechanism by which waves transport eroded materials before they are deposited to form various landforms.

The major wave depositional landforms in East Africa include;

Beaches -such as barrier beach and Bay head beach,

Bars -such as bay bar, off shore bar, fore shore bar, barrier islands,

Spits -such as hooked spits, cuspate spit and winged spit

Tombolo and Mud flats.

Beaches- a beach refers to the accumulation of sand, mud, shingle, pebbles and other unconsolidated materials forming a gently sloping plat- form on a low-lying coast. Beaches are normally formed between the low tide level and high tide level on gentle sloping coastline.

▪beaches are formed are formed when Constructive waves remove materials from the bottom of the sea and deposit them at the shore where they accumulate.

▪The materials may be submerged or exposed by tides for example Nyeri beach in Kenya near Mombasa.

Types of beaches

Barrier beach- refers to a long shore ridge of sand deposits lying parallel to the coast and often separated from coast by a lagoon on gentle sloping coastline by long shore drift and waves breaking off shore (before reaching the coast).**Diagram**

▪Barrier beach usually develops from Materials deposited on the continental shelf as off shore sand bars. More deposition increases the height of the bar until it appears above the sea level.

▪High tides and wave action gradually move the deposition to the mainland to form barrier beaches for example at Mombasa.

▪When the deposit is not joined to the coast is called **a barrier island**.

Diagram

Bay head beach- refers to a crescent of sand and shingle lying between headlands.

▪Bay head beaches are formed when long shore drift and constructive waves deposit materials at the heads of bays between headlands. Bay head beaches do not extend to the headlands where wave erosion is dominant

Examples include Ggaba, Lutembe, and Lido beach in Entebbe on Lake Victoria.

Diagram

A spit -refers to a low, narrow ridge of sand or shingle joined/ attached to the mainland at one end with the other end extending in the sea.

▪a spit develops where the river deposit large quantities of materials into an estuary and then long shore drift moves the materials to form a linear shape with one end joined to the mainland with the other extending in the sea or lake

▪Spits exist at Kaiso and Tonya on Lake Albert, and Ras Luale north of Dar es Salaam.

▪A spit May link the two headlands to form **a bay bar**.

Diagram

Types of spits

Hooked spit /curve spit - this is a narrow embankment of sand or shingle attached to land one end with the other end extending to the sea being curved across a bay or an estuary by the longshore drift.

▪The hooked spit is formed when waves moving obliquely to the shore/ longshore drift tends to swing around the end of the spit extending to the sea and curves it toward the shore, or waves approaching the shore from several directions

For example Kaiso on the Eastern shore of Lake Albert and Ras Luale near Dar es Salaam.**diagram**

Cuspate spit- this is applied to two spits converging off shore or when longshore drift recurve the hooked spit until it becomes attached/ joined to the shore at both ends.

▪For example Tonya point on Lake Albert

Diagram

Winged headland spit- refers to spits attached at both sides of the headlands by longshore drift.

▪Formed by long shore drift for example Kaiso spit and Tonya spit on Lake Albert.

Diagram

Bars- a bar refers to a ridge of sand, mud, gravel and shingle deposited off shore and lies parallel to the coast.

▪Bars are formed on gently sloping coast and irregular shorelines.

▪The Formation of a bar is related to formation of barrier beach where waves moving or drifting materials to the shore break off shore and drop the materials being carried under the water.

▪Repeated deposition leads to accumulation and formation of an embankment of sand called a bar separated from the coast by a lagoon.

Types of bars

Bay bar –this is a ridge of sandy material joining the land at both ends in a bay.

▪Bay bar is Formed where a spit is built across a bay continues to grow lengthwise until it is attached to two headlands enclosing a lagoon and marshes.

▪For example Lake Nabugabo enclosed by Lwamunda swamp.

Diagram

Off shore sand bar- it applied to temporary submerged sandbar.

▪Formed on gently sloping coasts where waves break off shore and back wash deposit materials off shore.

▪Repeated deposition builds an embankment of sand off the coast called off shore sand bar found at Tanga along the coast of Tanzania and Lamu on the Kenyan coast.

▪The expanse of sea water enclosed between the off shore bar and the main land is called a sound.

Diagram

Fore shore sand bar- formed by constant accumulation of sand causing off shore sand bars to rise above water surface.

Barrier islands applied to bars which gradually move inland by wave attack and enclose an area of shallow water (sounds) and have no connection to the mainland.

Tombolo -refers to the shingle or sand bar joining an island to the mainland.

▪For example the Tombolo which used to connect Lambu islands to Masaka and Lambu to Bukakata.

Cuspate fore head - refers to triangular shaped deposit of sand and shingle projecting sea wards

▪It is formed by convergence/ coalescence to an apex of two separate curved spits broadly at right angles or by two sets of constructive waves.

Gradually may get enlarged by additional materials forming beach ridges

Mud flats -are plat forms made of deposits of fine silt and alluvium deposited by rivers or waves. Continuous deposition of these sediments builds sand spits and bars. When the sea level rise, seawater is enclosed behind spits and bars to form a lagoon, colonized later by marshes and swamps. Found at Mombasa, Dar es Salaam e.t.c.