DESERTIFICATION IN THE WORLD

This refers to the development of desert like conditions in an area and more so in a region adjacent to a desert. It may be expressed as the advancement or extension of the desert. This situation is acute in Somalia, Ethiopia, Djibouti and Kenya, where the combination of weak governments and a lack of annual rains linked to climate change are driving desertification levels.

Case Study

East Africa

In East Africa desert like conditions have been experienced or developed in parts of Northern Kenya, Central and Northern Tanzania, N.Eastern Uganda and the Ankole-Masaka corridor and parts of Western Uganda adjacent to Lake Albert, Lake George, Albert Nile and within the East African rift valley.

Indicators of desertification

- Decreasing rainfall amounts.
- Rainfall becomes more unreliable i.e. more recurring cycles of drought start being experienced.
- Increasing temperatures i.e. temperatures tend to rise.
- Reducing relative humidity i.e. the amount of water vapour in the atmosphere reduces.
- Increasing diurnal range of temperature.
- Reducing thickness of cloud cover i.e. the skies tend to become clearer and clearer with each passing year.
- There is loss of water retention capacity of the vegetation and soils i.e. there are increasing evapo-transpiration rates.
- Reduced bio-diversity i.e. there is degradation of the biological productivity of the land i.e. reduced plant and animal species.

- Increasing wind and run off erosion hence consequently resulting into reduced soil fertility.

Causes of desertification

Desertification is basically caused by environmentally unfriendly human activities. However to a small extent it may be brought about by naturally existing conditions in the atmosphere that may lead to cycles of drought. Such atmospheric systems that result into cyclic changes or occurrence in the atmosphere have compounded the problem of desertification.

Human activities that have contributed to desertification in East Africa in general include the following:

- Deforestation.
- Overgrazing.
- Overstocking.
- Bush burning.
- Reclamation of wetlands.
- Borehole drilling.
- Industrial activity.
- Mining/Quarrying.
- Poor methods of cultivation.
- Political conflicts/wars.

Problems of desertification

Desertification is associated with a number of negative effects and therefore it is undesirable. This is because of the following:

1. It may lead to crop failure or low crop yields hence leading to famine and human suffering. In sub – Saharan Africa it has been a major cause of famine. This is because of the prolonged dry seasons and recurring droughts which lead to crop failure and consequently food shortages resulting into human suffering and death due to hunger, starvation and disease.

2. The resultant decreasing rains may prompt irrigation. Consequently this may lead to salination of the soils, which is also a form of soil degradation.

3. The high or increasing temperatures are not conducive for human settlement as well as human activities such as cultivation.

4. The degradation or deterioration of the natural vegetation may cause a decrease in forestry products and a reduction in the ability of the natural vegetation to protect the environment.

5. It encourages soil erosion and creates conducive conditions not only for run off water erosion but also wind erosion.

6. It may lead to the encroachment of sand dunes due to wind erosion and such sand dunes are normally unsuitable for human activities such as cultivation.

7. It may result into the disappearance of some drainage features such as small streams and wetlands due to excessive evaporation and yet these drainage features play important roles i.e. both protective and productive roles.

8. Leads to the destruction of the natural habitat for wildlife and hence reduced biodiversity. This is because desertification leads to a change in the physical environment such as reduced vegetation cover, increased temperatures and reduced wetlands. It also destroys the natural habitat for a variety of wildlife.

Measures to combat desertification In East Africa

1. Legislation against environmental degradation. Laws have been passed against the destruction of the environment such as wetland reclamation. Most of such vulnerable areas have been gazetted as nature reserves or conservation sites.

2. Afforestation: this has involved the campaign to plant trees in order to arrest the effects of desertification. Tree planting campaigns have been conducted by the government, NGO’s, environmental/wildlife clubs as well as individuals.

3. Reafforestation: i.e. re-planting of trees where trees have been cut or where deforestation has taken place e.g. Mabira forest, Kibaale forest etc.

4. Introduction and practice of improved methods of cultivation i.e. methods that do not harm the environment. This has been mainly through protecting agricultural land by adopting practices that conserve soils e.g. mulching, crop rotation, gully prevention measures, application of manure and fertilizers etc.

5. Rotational grazing: This has been facilitated by paddocking. Efforts have also been made to ensure that the carrying capacity of land is maintained in order to avoid overstocking. Rotational grazing also helps to check overgrazing.

6. Re-settlement of people adjacent to forest reserves as well as eviction of forests encroachers. Re-settlement of the people is to prevent encroachment upon the forests especially when population is increasing and when land shortage problems are cropping up e.g. encroachers in Kibaale forest reserve were evicted and resettled.

7. Sensitization of the public about the role of forests or natural vegetation. This has been through the education of the masses on the dangers of deforestation and also how to utilize the environment sustainably. This has created awareness about environmental issues such as desertification-associated problems. This sensitization has been through a variety of mass media e.g. the press, electronic media, seminars/workshops, schools, Local council meetings, public rallies etc.

8. Introduction and encouragement of the use of fuel saving stoves or those that use saw dust such that less biomass is used as fuel. This reduces on the tendency of the destruction of forests for fuel.

9. Rural electrification and provision of other sources of energy such as solar energy, bio-gas etc as an alternative to wood fuel.

10. Creation or establishment of environmental organizations to champion or spearhead the fight against desertification through environmental protection and restoration of degraded lands. Some of these organizations are governmental or

non-governmental. They may also be international, inter-state, national or local. Some are also voluntary organizations. Examples of these bodies include; NEMA in Uganda (a parastatal body charged with protecting the environment.) Uganda Wildlife Authority (UWA). In addition, there are wildlife clubs, tree planting clubs and anti-pollution clubs. International organizations include; the Kagera Basin Organisation, Inter Governmental Authority on Drought and Development (IGADD), interstate ones like the East African Wildlife Society and others like Karamoja Development Agency

(KDA) to combat desertification and aridity and ensure development of the area.

11. Encouragement and use of indigenous methods of protecting the environment and more so natural vegetation and drainage features i.e. through traditional customs and taboos.

12. Population control measures through population re-distribution and family planning as well as encouraging late marriages, discouraging polygamy etc to avoid over population, which would lead to land shortage and deforestation.

Question:

Account for desertification in either Sahel region or East Africa.

Approach:

Introduction:

- Define desertification
- Case study
- Areas experiencing desertification

Body:

Physical and human factors

Conclusion:

THE CLIMATE OF EAST AFRICA

East Africa lies within the tropical latitudes but due to a combination of factors the region experiences a variety of climatic types. The different parts experience different types of climate which include:

1. **Equatorial climate**

This type of climate is experienced in the region between 5°N and 5°S of the equator. For instance in places such as the Congo basin. In East Africa the equatorial climate is experienced around the L.Victoria basin and typical equatorial climate is experiences within the L.Victoria and specifically the Islands within L.Victoria. Typical equatorial climate is characterised by;

a) Heavy rainfall of about 2000mm evenly distributed throughout the year.
b) Temperatures are high with an average of 27°C
c) High humidity of about 80% or more. This is because of evaporation and heavy rainfall is received.
d) Double maxima of rain i.e. there are two rainfall peaks received. The rainfall regime is characterized by a bimodal pattern. There is hardly any dry spell (dry season).
e) The type of rainfall received is mainly convectional rainfall commonly accompanied by lightning and thunderstorms.
f) There is thick or dense cloud cover because of the humid conditions that result into rising air whose moisture condenses at higher levels to form clouds.
g) It is characterised by low atmospheric pressure and this is mainly because of the high temperatures experienced.

In East Africa due to factors such as altitude, the equatorial climate has tended to be modified. The equatorial climate experienced in much of East Africa is not typical that of the rest in other tropical regions. That is why most of the areas fringing Lake Victoria are said to experience a modified equatorial type of climate rather than a typical equatorial type of climate. This is because the characteristics do not reflect typical equatorial type of climate e.g. heavy rainfall of about 1500mm is experienced. Temperatures average 23°C.

In addition, humidity is less than 80% and there is some distinct or short dry spell experienced especially in January and June.

2. Moist Tropical Climate/Modified Equatorial climate

This is experienced in much of Central and Western Uganda and parts of Northern Uganda. This type of climate may not differ much from the equatorial type of climate however rainfall received is less and seasons tend to be distinct. It is characterized by the following;

a) High rainfall fairly distributed throughout the year. Annual rainfall ranges from 1000-1500mm.
b) Moderate temperatures of between 25°C and 27°C.
c) There are seasons of rainfall and aridity experienced i.e. there are dry and wet seasons. However in some parts, the rainfall seasons tend to merge to form one long rainfall season and one long dry season. This is common with regions further from the equator. Therefore some areas experience double maxima of rain while others experience a single maximum of rain.
d) Rainfall varies with the position of the area e.g. in the Northern hemisphere, most tropical regions receive rainfall in the second half of the year while in the Southern it is received in the first half of the year. This is because of the influence of the ITCZ.
e) Relative humidity is moderate i.e. from 50 – 60%.
f) The temperature range is moderate i.e about 5 -10°C.

DRY TROPICAL CLIMATE

This type of climate is experienced in several parts of East Africa mainly adjacent to the semi arid region e.g. the Western parts of Karamoja, the Southern Nyika plateau, parts of Western Tanzania etc.
This type of climate is characterised by the following;

(i) Rainfall received ranges between 760mm – 1000mm.
(ii) Rainfall is seasonal though the dry seasons tend to be long.
(iii) There are high temperatures experienced, average temperatures tend to be above 30°C
(iv) The temperatures ranges are high approximately 10 -15°C.
(v) There is limited cloud cover.
(vi) There is low atmospheric humidity i.e. less than 40%.

SEMI ARID AND ARID CLIMATE /SEMI DESERT & DESERT CLIMATE

This type of climate is experienced in Northern Kenya e.g. the Chalbi desert, North Eastern Uganda i.e. Karamoja, semi desert in Southern Kenya i.e. Nyiri desert, North Eastern parts of Tanzania e.g. Masai steppe semi desert. In central Tanzania, in the Eastern parts of Ankole i.e. the Ankole – Masaka corridor.
In addition Semi desert climate is also experienced in the Western Rift valley region around Lake George and Lake Edward. Semi arid conditions are also experienced in the rift valley as well. This type of climate is characterised by the following:

(i) Low rainfall of less than 760mm. Other areas experience even much less e.g. in the Chalbi desert annual rainfall is 250mm.

(ii) There is very low humidity of about 20% or less.
(iii) There's limited cloud cover i.e. they are generally clear skies partly due to the limited atmospheric moisture required for cloud formation.
(iv) Temperatures tend to be high, average temperatures range from 35°C – 38°C.
(v) There is a high diurnal range of temperature approximately 20°C.
(vi) Unreliable rainfall i.e. periods of extended drought may be experienced and rainfall periods may not be predicted.

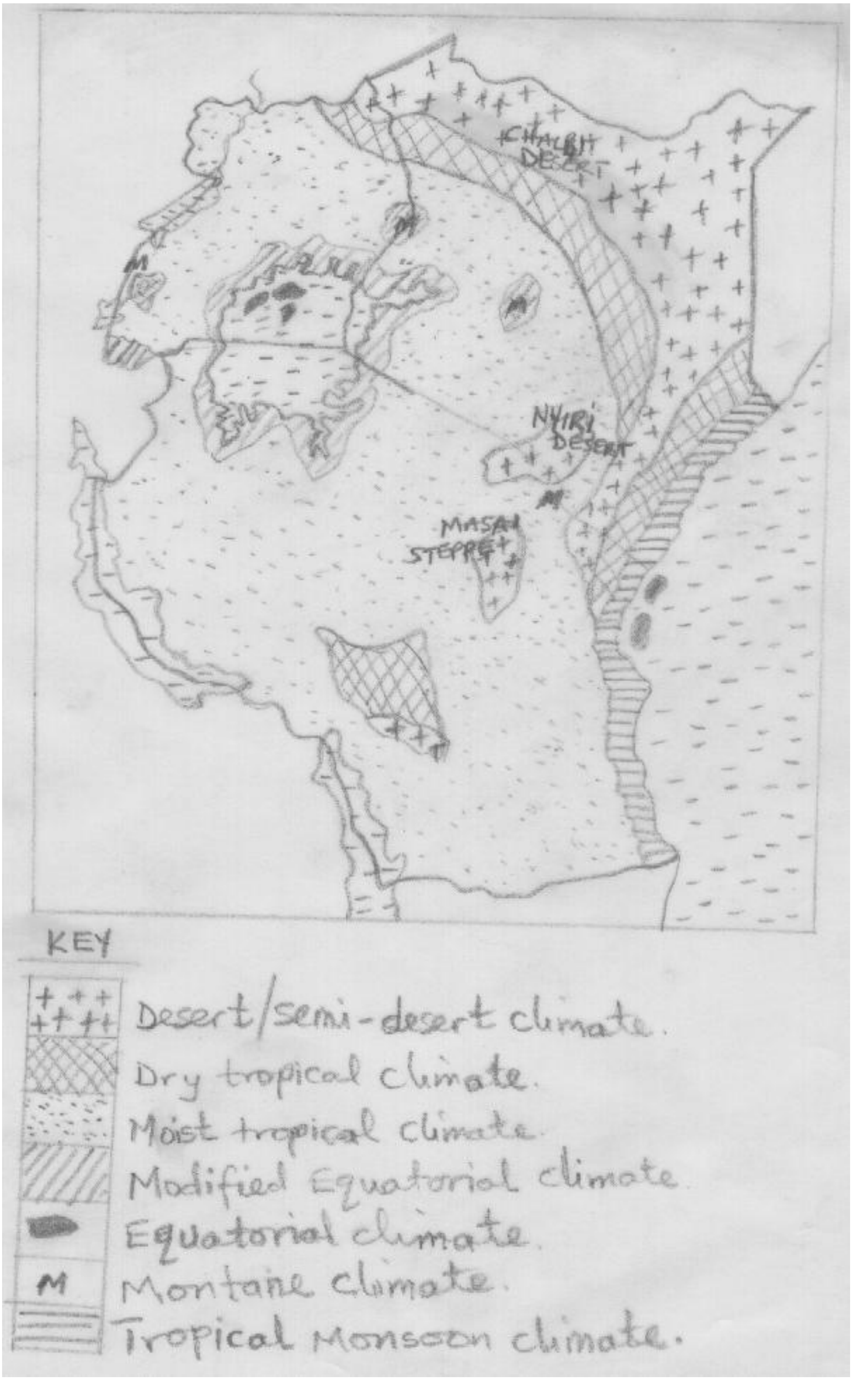
MONTANE CLIMATE/ ALPINE CLIMATE

This climate may also be referred to as Alpine climate and is experienced on the mountain peaks of E.Africa e.g. high levels of Mt. Rwenzori, Mt.Kenya,Mt.Elgon,Mt.Meru,Mt.Kilimanjaro,Mt.Muhavura,Mt.Mgahinga,Mt. Sabinyo etc.
The distinguishing factor is that there are low temperatures experienced. Snowfall may also be experienced in altitudes of more than 4800m. The type of rainfall received is relief and is heavier on the windward sides of the mountains while the leeward side experience lower rainfall because of the shadow effect. Atmospheric pressure in the montane climate conditions tends to be low as a result of rarified air.
In addition, the gravitational effect at higher altitudes is lower resulting into the low pressure.

TROPICAL MONSOON CLIMATE

This is experienced in the coastal region of E.Africa. The climate is basically influenced by the seasonal winds known as the monsoon winds. These seasonal winds affect the coastal areas of E.Africa i.e. the N.E & S.E monsoons tend to bring in heavy rainfall.
The rainfall is high and ranges between 1000mm and 1800mm.
Since the coastal regions are at a lower altitude, high temperatures are experienced.
Areas that experience tropical monsoon climate include areas along the coastal belt e.g. around Malindi, Mombasa, Tanga, Dar es Salaam, Kilwa etc.

MAP OF EAST AFRICA SHOWING THE CLIMATIC REGIONS



ARIDITY IN EAST AFRICA

Aridity is a climatic phenomenon characterised by high temperatures and insufficient rainfall or very low rainfall. In the USA areas of less than 250mm of rainfall are regarded as arid areas. However in some parts of the world, the aridity may be measured differently e.g. in East Africa areas of less than 500mm may be regarded as arid. Areas of aridity are generally referred to as deserts or semi deserts and are characterised by dryness.
In East Africa areas that experience aridity include Northern Kenya, parts of Eastern Kenya, North Eastern Uganda, the Ankole - Masaka corridor parts of North Eastern Tanzania, Central Tanzania, parts of southern Kenya and parts of the western and the Eastern rift valley e.g. along Lake Albert, Lake Edward and Lake George.
Desert areas are those that may receive less than 250mm of rainfall and these may include areas in Northern Kenya e.g. around Ladwor in North Eastern Kenya and the Chalbi desert.
In addition to this there is also the Nyiri desert in Southern Kenya and the Masai steppe in North Eastern Tanzania.
On the other hand semi desert areas experience relatively higher rainfall though less than 500mm.

CHARACTERISTICS OF ARID AREAS

1. Low and seasonal rainfall is experienced. Drought is a common phenomenon in such areas.
2. High temperatures are experienced i.e. temperatures of 30°C and above.
3. High diurnal range of temperature normally more than 15°C i.e. during the day it is very hot and during the night is cold.
4. There is generally low humidity. Relative humidity tends to be less than 20%.
5. There is a limited cloud cover. Much of the year is characterised by clear skies.
6. There are high transpiration rates and evaporation rates.
7. There is unreliable or unpredictable rainfall.
8. There is occurrence of strong winds and occasionally dust storms are experienced.
9. There is limited plant cover, this is because of the low rainfall such that the vegetation tends to be adapted to low rainfall conditions e.g. there are generally drought resistant species such as steppe savannah grasslands, thicket, thorn bush, cactus, scrub, as well as patches of bare land.

CAUSES OF ARIDITY

Arid conditions in East Africa have been brought about by a number of factors.
The basic causes of aridity have been physical while human factors have increased or contributed to further aridity in East Africa.

Physical causes of aridity

1. **Prevalence of dry/desiccated winds**.
Some areas in East Africa have been influenced by dry winds for instance the N.E trade winds which emanate from the Arabian Desert. Those winds pick some moisture as they blow Southwards towards Africa however these winds tend to loose their moisture in the Ethiopian highlands. Since they are dry they do not bring in rain.They even absorb the little moisture that exists in the regions in which they blow and even warm up such areas. This explains the dry conditions experienced in Northern Kenya.

2. **Limited water masses:** Several areas in East Africa that experience aridity such as Northern Kenya and Central Tanzania lack large water bodies that could otherwise contribute to atmospheric moisture through evaporation. This therefore results into limited atmospheric moisture in such areas and therefore dry conditions result.

3. **Highland relief causing the rain shadow effect** on the leeward side of the highland. Relief has contributed to aridity in East Africa because of the rain shadow effect produced on the leeward side of mountains.
The prevailing winds that continue onto the leeward side from the Windward side are desiccated or dry and do not bring in rainfall but instead may even absorb the little moisture that may exist in the leeward areas. Arid areas in East Africa that are due to the rain shadow effect include Northern Kenya, the Masai steppe on the leeward side of the Pare and Usambara mountains ranges in N.East Tanzania. The western rift valley zone area on the leeward side of the Rwenzori mountains.
In addition, the absence of highlands or mountains to trap high level winds bearing moisture may also contribute to aridity, this is because winds gather momentum and blow away to other areas.

4. **Continentality:** This refers to the remoteness from the sea. Areas far from the Indian Ocean and whose climate is continental or affected by land conditions have tended to suffer from aridity. Coastal areas are influenced by maritime conditions such as land and sea breezes that lead to high rainfall. However, continental areas such as central and N.Eastern Tanzania tend to be dry because of the long distance from the sea.

5. **Coastal configuration:** this refers to the shape or alignment of the E. African coast. The coast is aligned in a N.E or S.W direction. Due to this alignment winds from the N.E such as the N.E trades tend to blow parallel to the coast especially along the Kenyan coast in a south westerly direction and hardly blow inland. Therefore these moisture-laden winds which may not blow inland deprive much of northern, central and southern parts of Kenya of rainfall. This therefore partly explains the prevalence of arid conditions in these parts of Kenya.

6. **Corriolis force effect:** this is a drag force as a result of the earth's rotation and has effect in that any object moving in the northern hemisphere from the southern hemisphere is deflected to the right. This force accounts for the prevalence of arid conditions in the Ankole - Masaka corridor and other parts to the N.West of Lake Victoria. This is because when the S.E trade winds blowing through Tanzania cross the Equator, they are deflected eastwards i.e. to the right leaving the North Western parts of Lake Victoria without moist winds. This explains the semi-desert/arid conditions experienced in the Ankole-Masaka corridor and the neighbouring areas.

7. **Perturbation:** This is a situation where low pressure conditions due to high temperatures are created on the Indian Ocean and as a result air from the land or air that would have blown on shore is instead redirected into this low pressure belt. Air will therefore blow from the land to the Indian ocean thereby becoming offshore winds and as a result rain is formed in the Indian ocean while parts of the East African mainland and including Northern Kenya are left dry.
   Perturbation that may occur during certain seasons contributes to aridity and especially extended drought in East Africa.

Human causes of aridity

These include mans' environmentally unfriendly activities such as the following:

1. **Deforestation:** The removal of vegetation by man is a cause of aridity. This has been due to mans' activities in the clearance of forests and other forms of natural vegetation. The main activities involved include cultivation, lumbering, industrialisation etc which have led to the destruction of natural forests that contribute to atmospheric moisture. Destruction of this source of atmospheric moisture results into aridity. Deforestation also contributes to soil erosion, which in turn leads to poor plant growth consequently leading to poor rates of transpiration thereby compounding the problem of aridity.

2. **Overstocking:** The rearing of a big number of animals i.e. more than what the pastureland can accommodate can lead to aridity. In case the carrying capacity of the land is exceeded, the pastures are depleted very fast and the large number of animals trample the ground to create bare patches of land and loosening the soils thereby promoting erosion. This results into poor vegetation growth and low levels of transpiration and consequently leading to aridity.

3. **Overgrazing:** This may be as a result of continuous grazing by herbivorous animals without leaving the land to rest. Overgrazing depletes the vegetation cover and may lead to low rainfall because of limited transpiration.

4. **Bush burning:** This may also be responsible for aridity because it leads to the degeneration of the grass and other plants and reduces transpiration. Traditional farmers normally burn grass with the aim of ensuring growth of fresh pastures for the animals but this may have adverse effects on the climate.

5. **Reclamation of wetlands:** Wetlands like swamps, swamp forests, grass swamps, marshlands, dambos etc are major sources of atmospheric moisture through evapotranspiration and their reclamation greatly reduces the process. In addition, the water table is lowered. In the final analysis, humidity and rainfall are reduced and this leads to aridity. Reclamation in East Africa has been due to the search for land, for cultivation, settlement as well as industrialisation.

6. **Borehole drilling:** The sinking of boreholes to provide underground water resources for humans and animals may lead to the lowering of the water table. As the water table falls, plant roots may fail to access the soil moisture and as a result the plants wither. This therefore reduces the capacity of the natural vegetation to recharge the atmosphere with water vapour through evapotranspiration and this may increase on the problems of aridity.

7. **Industrialisation**: Industrial development has also been a cause of aridity or desertification in East Africa. Industrial plants or factories emit exhaust fumes or clouds of smoke containing pollutants such as carbon dioxide, carbon monoxide, sulphurdioxide etc which tend to be green house gases. Such gases are good absorbers of solar radiation thereby contributing to increase in temperatures.
   In addition, gases such as carbon dioxide and sulphurdioxide may dissolve in water leading to acid rains. Acid rains lead to forest damage in that the plants loose their leaves, their growth stagnants and may finally die. This in turn will also reduce on the ability of the natural vegetation to

recharge the atmosphere with moisture through transpiration and hence aridity.

8. **Mining:** The extraction of minerals and more so through open cast method leads to the destruction of surface vegetation meaning that the ability of the vegetation to contribute to the atmospheric moisture is greatly reduced and thereby compounding the problem of aridity.

9. **Poor methods of cultivation:** Primitive or non-scientific methods of cultivation that expose soils to erosion have also contributed to aridity. With erosion the ability of the soil to support plant growth is reduced meaning that there would be poor vegetation and consequently low levels of evapotranspiration. Such methods include shifting cultivation, cultivating up and down slope and other forms of subsistence cultivation. In addition, the use of machinery such as tractor ploughs that carry out deep cultivation tend to loosen soil particles making them prone to erosion.

10. **Political conflicts/Wars:** These may lead to destruction of vegetation through burning, cutting down of trees, demolition of vegetation by armoured vehicles as well as emission of dangerous chemicals and gases through explosives and bombs. Such explosives tend to harm the natural vegetation. Consequently, transpiration is reduced and rainfall also reduces.

All these human environmentally unfriendly activities may result in reduced atmospheric moisture and an increase in temperature. It is important to note that human causes of aridity increase desert conditions. They are also, the causes of desertification. Otherwise the naturally existing desert areas of East Africa are basically as a result of physical factors.

DESERTIFICATION

This refers to the development of desert like conditions in an area and more so in a region adjacent to a desert. It may be expressed as the advancement or extension of the desert. Desertification has been commonly experienced in the Sahel region of Africa. In East Africa desert like conditions have been experienced or developed in parts of Northern Kenya, Central and Northern Tanzania, N.Eastern Uganda and the Ankole-Masaka corridor and parts of Western Uganda adjacent to Lake Albert, Lake George, Albert Nile and within the East African rift valley.

Indicators of desertification

1. Decreasing rainfall amounts.
2. Rainfall becomes more unreliable i.e. more recurring cycles of drought start being experienced.
3. Increasing temperatures i.e. temperatures tend to rise.
4. Reducing relative humidity i.e. the amount of water vapour in the atmosphere reduces.
5. Increasing diurnal range of temperature.
6. Reducing thickness of cloud cover i.e. the skies tend to become clearer and clearer with each passing year.
7. There is loss of water retention capacity of the vegetation and soils i.e. there are increasing evapotranspiration rates.
8. Reduced bio-diversity i.e. there is degradation of the biological productivity of the land i.e. reduced plant and animal species.
9. Increasing wind and run off erosion hence consequently resulting into reduced soil fertility.

Causes of desertification

Desertification is basically caused by environmentally unfriendly human activities. However to a small extent it may be brought about by naturally existing conditions in the atmosphere that may lead to cycles of drought. Such atmospheric systems that result into cyclic changes or occurances in the atmosphere have compounded the problem of desertification.

Human activities that have contributed to desertification in East Africa in general include the following:

1. Deforestation.
2. Overgrazing.
3. Overstocking.
4. Bush burning.
5. Reclamation of wetlands.
6. Borehole drilling.
7. Industrial activity.

8. Mining/Quarrying.
9. Poor methods of cultivation.
10. Political conflicts/wars.

Problems of desertification

Desertification is associated with a number of negative effects and therefore it is undesirable. This is because of the following:

1. It may lead to crop failure or low crop yields hence leading to famine and human suffering. In sub – Saharan Africa it has been a major cause of famine. This is because of the prolonged dry seasons and recurring droughts which lead to crop failure and consequently food shortages resulting into human suffering and death due to hunger, starvation and disease.
2. The resultant decreasing rains may prompt irrigation. Consequently this may lead to salination of the soils, which is also a form of soil degradation.
3. The high or increasing temperatures are unconducive for human settlement as well as human activities such as cultivation.
4. The degradation or deterioration of the natural vegetation may cause a decrease in forestry products and a reduction in the ability of the natural vegetation to protect the environment.
5. It encourages soil erosion and creates conducive conditions not only for run off water erosion but also wind erosion.
6. It may lead to the encroachment of sand dunes due to wind erosion and such sand dunes are normally unsuitable for human activities such as cultivation.
7. It may result into the disappearance of some drainage features such as small streams and wetlands due to excessive evaporation and yet these drainage features play important roles i.e. both protective and productive roles.
8. Leads to the destruction of the natural habitat for wildlife and hence reduced biodiversity. This is because desertification leads to a change in the physical environment such as reduced vegetation cover, increased temperatures and reduced wetlands. It also destroys the natural habitat for a variety of wildlife.

Measures to combat desertification

In East Africa and other parts of Africa, the number of steps has been taken to combat desertification or reverse the trend of desertification. These include;

1. **Legislation against environmental degradation**. Laws have been passed against the destruction of the environment such as wetland reclamation. Most of such vulnerable areas have been gazetted as nature reserves or conservation sites.

2. **Afforestation:** this has involved the campaign to plant trees in order to arrest the effects of desertification. Tree planting campaigns have been conducted by the government, NGO's, environmental/wildlife clubs as well as individuals.
3. **Reafforestation**: i.e. re-planting of trees where trees have been cut or where deforestation has taken place e.g. Mabira forest, Kibaale forest etc.
4. **Introduction and practice of improved methods of cultivation** i.e. methods that do not harm the environment. This has been mainly through protecting agricultural land by adopting practices that conserve soils e.g. mulching, crop rotation, gully prevention measures, application of manure and fertilizers etc.
5. **Rotational grazing:** This has been facilitated by paddocking. Efforts have also been made to ensure that the carrying capacity of land is maintained in order to avoid overstocking. Rotational grazing also helps to check overgrazing.
6. **Re-settlement of people** adjacent to forest reserves as well as eviction of forests encroachers. Re-settlement of the people is to prevent encroachment upon the forests especially when population is increasing and when land shortage problems are cropping up e.g. encroachers in Kibaale forest reserve were evicted and resettled.
7. **Sensitization of the public** about the role of forests or natural vegetation. This has been through the education of the masses on the dangers of deforestation and also how to utilize the enviroment sustainably. This has created awareness about environmental issues such as desertification-associated problems. This sensitization has been through a variety of mass media e.g. the press, electronic media, seminars/workshops, schools, Local council meetings, public rallies etc.
8. **Introduction and encouragement of the use of fuel saving stoves** or those that use saw dust such that less biomass is used as fuel. This reduces on the tendency of the destruction of forests for fuel.
9. **Rural electrification** and provision of other sources of energy such as solar energy, biogas etc as an alternative to wood fuel.
10. **Creation or establishment of environmental organizations** to champion or spearhead the fight against desertification through environmental protection and restoration of degraded lands. Some of these organizations are governmental or non-governmental. They may also be international, inter-state, national or local. Some are also voluntary organizations. Examples of these bodies include; NEMA in Uganda (a parastatal body charged with protecting the environment.) Uganda Wildlife Authority (UWA). In addition, there are wildlife clubs, tree planting clubs and anti-pollution clubs. International organizations include; the Kagera Basin Organisation, Inter Governmental Authority on Drought and Development (IGADD), interstate ones like the East African Wildlife Society and others like Karamoja Development Agency

(KDA) to combat desertification and aridity and ensure development of the area.

11. **Encouragement and use of indigenous methods** of protecting the environment and more so natural vegetation and drainage features i.e. through traditional customs and taboos.
12. **Population control measures** through population re-distribution and family planning as well as encouraging late marriages, discouraging polygamy etc to avoid over population, which would lead to land shortage and deforestation.

EFFECTS OF CLIMATE ON HUMAN ACTIVITIES

Climate has influenced land use and human activities in several parts of East Africa. The different climatic conditions such as equatorial climate, modified equatorial climate, tropical, montane, semi desert and desert climates have had profound effect on human activities, or land use in areas where they are experienced. This is because the rainfall and temperatures may vary and create conditions for different land use or human activities. The effects can be seen in the following ways;

1. In the equatorial or moist tropical type of climate, a variety of human land use activities have cropped up e.g. forestry, cultivation of annual and perennial crops, dairy farming such as in the Kenya highlands, areas around Lake Victoria etc.
2. In areas of tropical climate, there is cultivation of mainly annual crops as well as the rearing of livestock, wildlife conservation and tourism have been important.
3. Temperate climatic conditions as experienced in the highland areas such as the Kenya and Kigezi highlands, Rwenzori Mt. Ranges have cool conditions that have favoured dairy farming and growth of vegetables or temperate crops such as wheat, Irish potatoes etc.These highland areas have also favoured the growth of pyrethrum e.g. in Kabale and Bundibugyo.
4. Montane climatic conditions as experienced in the mountainous areas such as the Rwenzori, Elgon, Kenya, Kilimanjaro, Meru etc have encouraged forestry especially montane forests which may be temperate e.g. the Coniferous forests or they may be Bamboo forests. Other economic activities in montane climatic regions include; Lumbering, Wildlife conservation and tourism such as mountaineering or sight seeing.
5. In the semi-desert climatic regions there has been the growth of drought - resistant crops e.g. Sorghum, Millet, Maize and Sisal have been encouraged. Nomadic pastoralism has also been practised in Semi-arid areas such as Karamoja, the Masailand, Turkana land and the Boran region of Northern Kenya.

   Furthermore, tourism and wildlife conservation have developed in these areas. Many of the semi-desert regions have been gazetted as wildlife conservation sites such as National parks and Game reserves thereby promoting tourism e.g. Tsavo National Park, Queen Elizabeth National Park, Serengeti National Park, Kidepo Valley National Park, and Lake Mburo National Park etc.

Geomorphology

Geomorphology as already notes is the study that deals with the genesis originally forms and process which operate evolution of land ate over time to produce these land forms

The process broadly divided into two ie;

Internal/ tectonic/ endogenic process

This is further divided into two

- Volcanic earth movements
- Faulting
- Warping
- Earth quakes

External/ denudation/ Exogenic

These are processes which operate from out of the surface and they are responsible for modifying or changing the forms that are produced by internal processes.

Examples of external processes include;

- Weathering
- Mass wasting
- Glaciation
- River action
- Wave action

Faulting

Faulting refers to the fracturing of blocks of rocks to produce lines of weakness along which displacement takes place. The lines of weaknesses are referred to as faults. Faulting by radioactivity and geochemical reactions resulting from great heat and pressure within the interior of the earth.

Areas affected by faulting in east Africa are northern Kenya, central Kenya, northern central and southern Tanzania and then much of the western Uganda.

Faulting has produced a number of land forms mainly include;

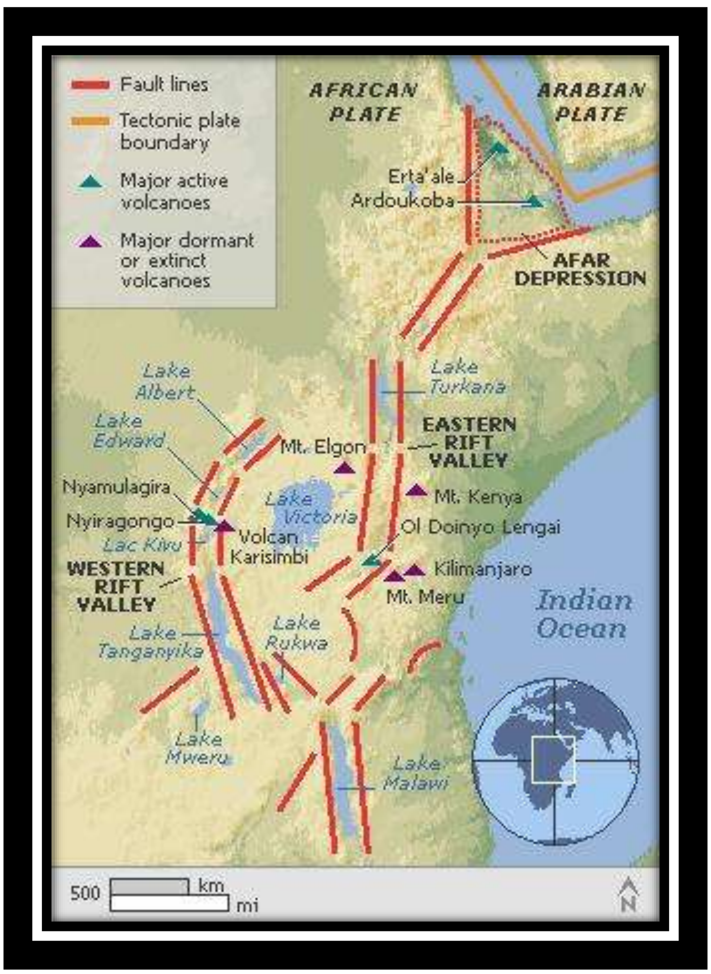
- Rift valley
- Blocks Mountains
- Escarpments
- Gardens
- Tilt blocks
- Fault guided river valleys
- Reversed drainage systems.

Rift valley

A rift valley is an elongated depression bordered by two or more in facing fault scarps.

The rift valley is the most outstanding land form produced by faulting. The great East African valley extends from Turkana in northern Kenya moved through central Kenya to northern and southern Kenya around Lake Malawi. The western arm extends to cover Lake Tanganyika, Lake Albert up to west Nile.

The East African rift valley has several rift valley lakes namely Lake Turkana, Lake Naivasha, Lake albert, Lake George, Lake Tanganyika etc. . The rift valley also has variations in altitude or height above sea level for example mountain Rwenzori is as high as 5100m above sea level which is contrast to Lake Tanganyika which is as deep as 650m.The aberdere ranges in Kenya also raise over 4000m above the ground



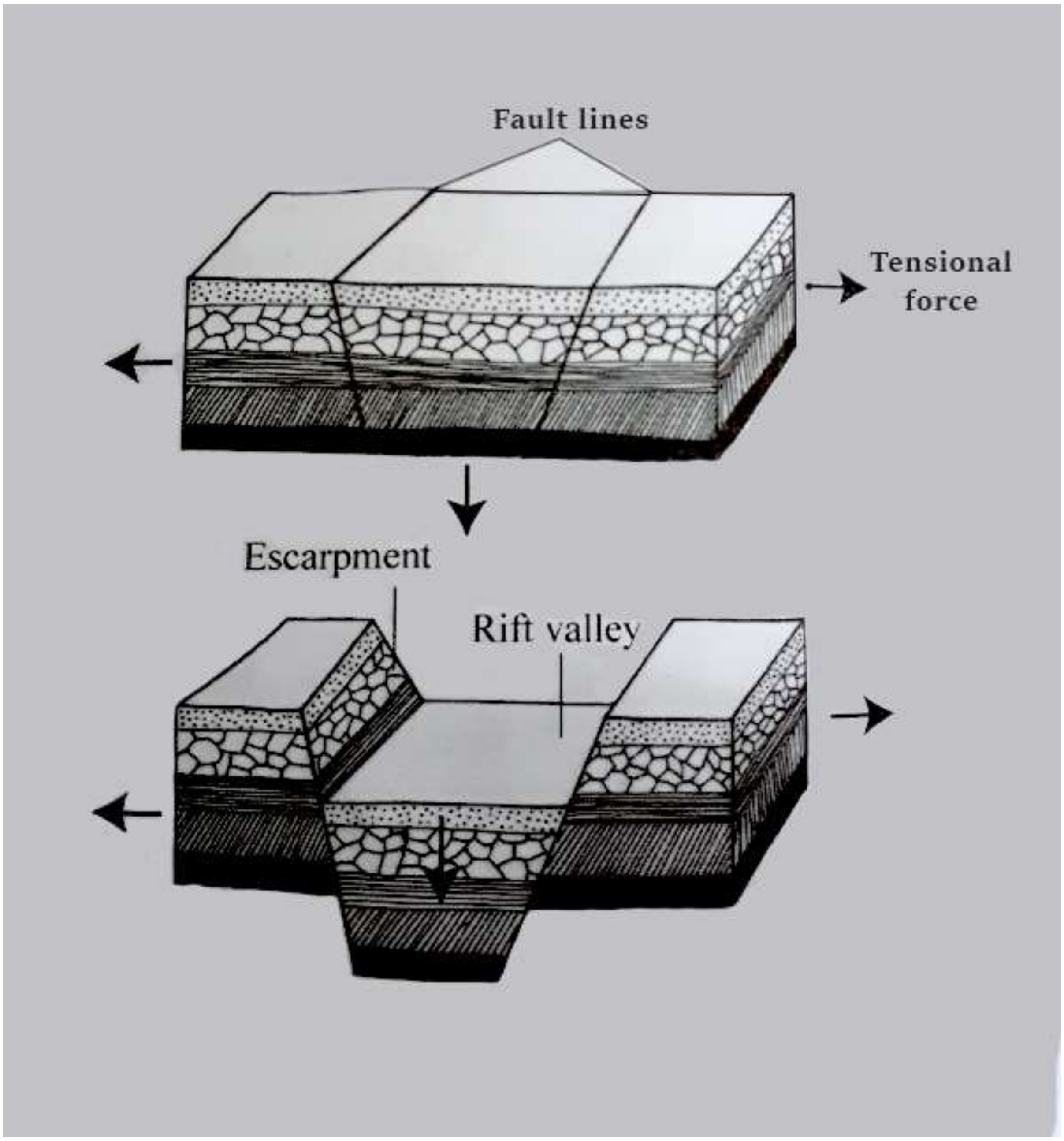
Formation of the East African rift valley.

The origin of the great East African rift valley is still mythical. However a number of theories have been put forward to try and explain the possible origin of the great east African rift valley. These include;

- Tensional theory by Gregory
- Compressional theory by E.J Wayland
- Relative uplift/ subsidence by Dixey and Troupe

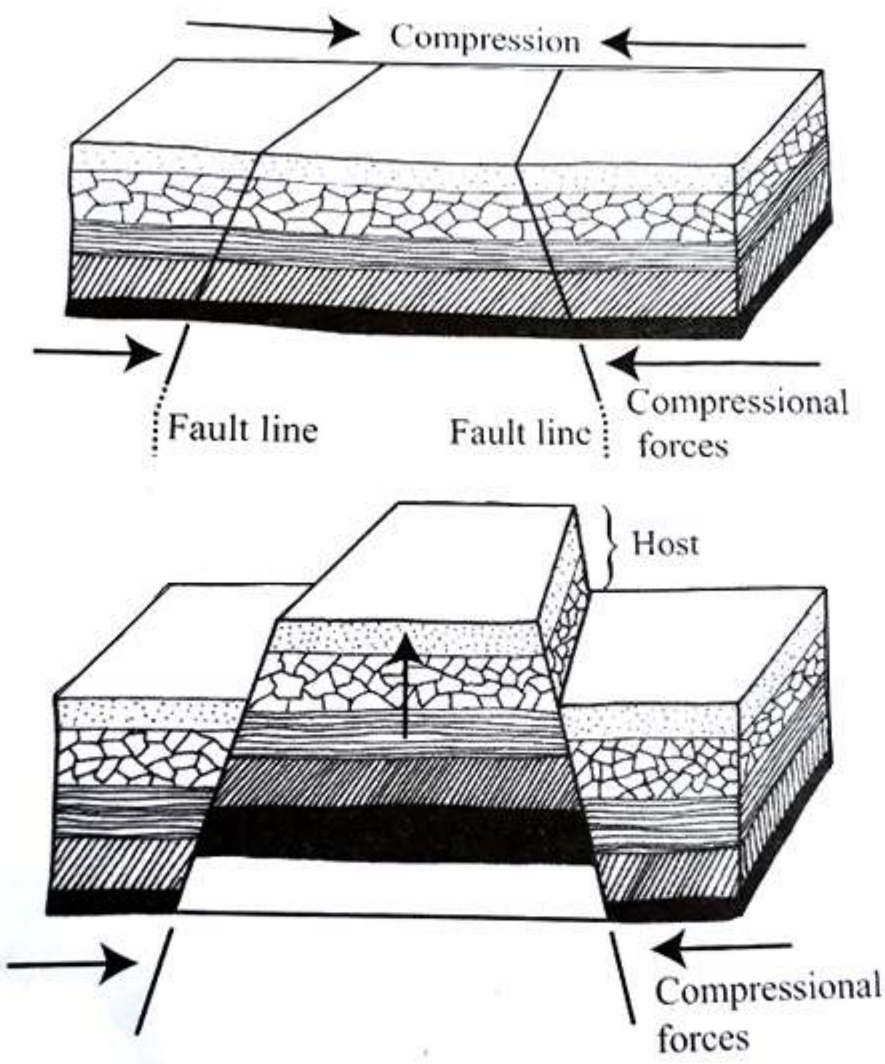
Tensional Theory

the tensional theory was advanced by Gregory and it maintains that the East African land mass was subjected to tension pulling the land mass to opposite sides and over time, land mass developed strains which resulted into lines of weakness referred to as normal faults. as these forces pulled further, the middle block subsided and sunk under its own weight leaving the side blocks at a higher level thus forming a rift valley with gently sloping sides for example the Gregory rift in Kenya.



Compressional theory by Wayland

The compressional theory is based on the assumption that the East African land mass was subjected to forces of compression, pushing the land mass from either side towards the central point. With time the lad mas developed strain that later resulted into lines of weakness called reverse faults. This divided the land mass into blocks and eventually the side blocks were forced to upthrust and override the central block thus forming the rift valley with steep sides e.g. the Albert rift in western Uganda.

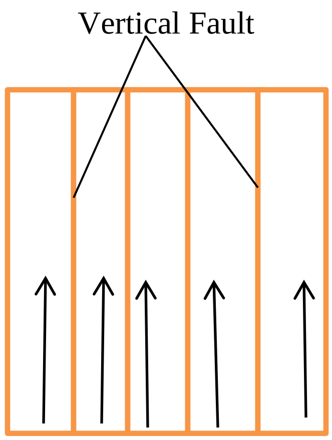


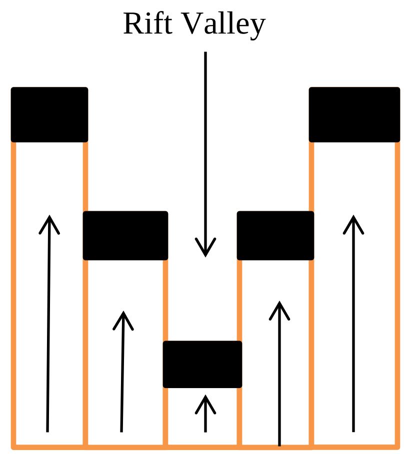
Relative uplift/relative subsidence by Dixey and Troup

According to this theory the East Africa land mass was subjected to forces which acted upon it over time it developed several vertical faults and the land mass was affected in two ways.

Relative uplift or differential uplift

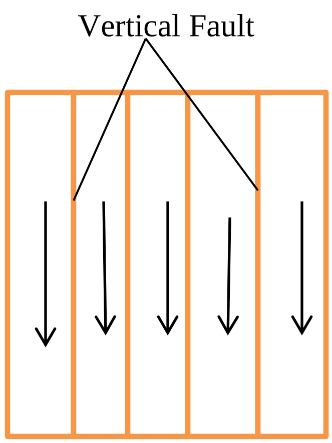
forces were generated which acted on the East Africa land mass and it developed several vertical faults that divided the land mass into blocks which started moving gradually upwards but the side blocks were uplifted at a much faster rate while the middle block was uplifted at a slower pace and lagged behind thus leading to formation to formation of a rift valley which is steep faulted. For example the Kedong part of the East African rift valley in Kenya.

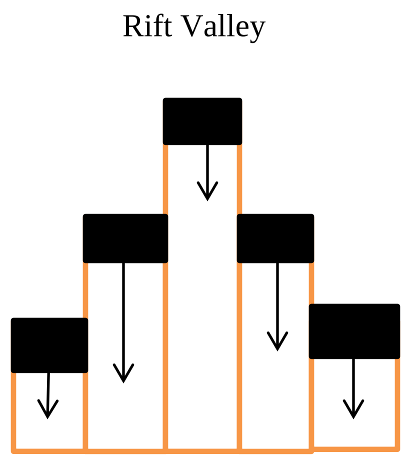




Relative sinking/subsidence

Alternatively the East African land mass was subjected to forces which acted upon it. it developed strain which developed into several into several vertical faults thereby dividing the land mass into blocks. the different blocks then started gradually subsiding and sinking but at a different rates in that the middle blocks sunk at a much faster rate compared to the side blocks thereby forming the rift valley that is steep folded e.g. Kedong part of the rift valley.





Question:

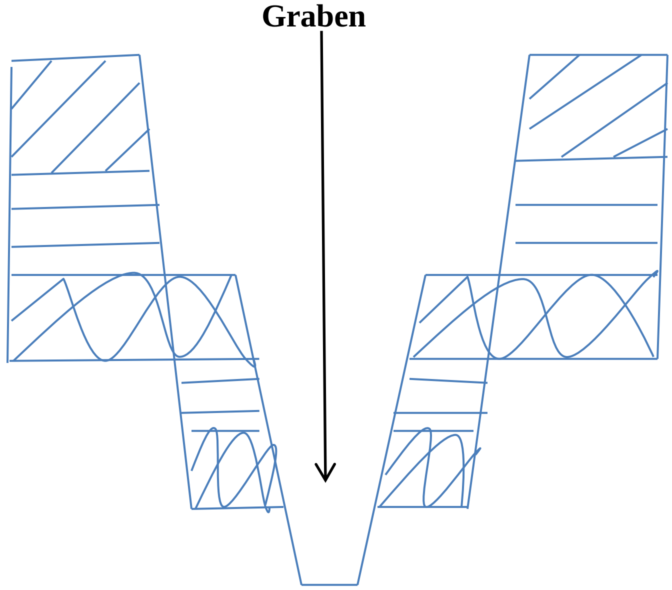
The compression and tension theories are the most relevant theories in the formation of the Great Rift Valley. Discuss

Features resulting from faulting

Graben

A Graben is an elongated depression which develops in the already formed rift valley. When tension forces act on the land mass pulling it to either side, over time it develops lines of weakness referred to as normal fault. It is along these that the middle block subsides and sinks under its own weight thus forming a rift valley. however, when secondary faulting takes place in this already formed rift valley tension forces further pull apart resulting due to further subsidence thus formation of the Graben and when its occupied by water it forms Graben lakes. In East Africa examples like Turkana, Tanganyika, Malawi and Albert are all occupied by Graben.

Graben

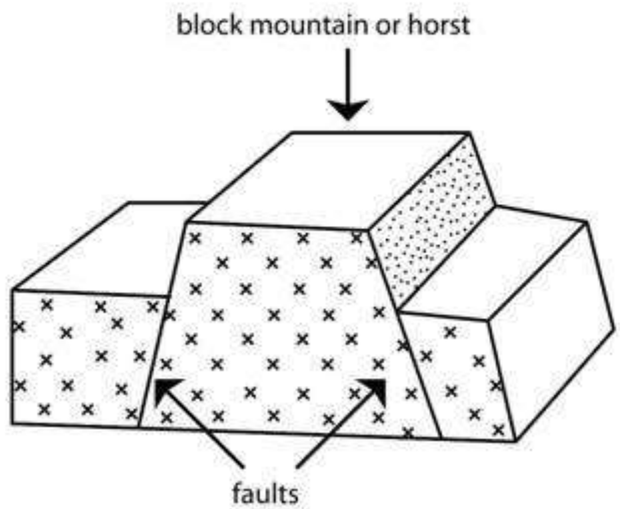


Block Mountain

A block mountain (horst) is a raised piece of land or high land ordered by fault scarps on either sides or it stands for about the surrounding areas. The formation of a block mountain can be explained with the tensional theory, compressional theory and relative up lift/ subsidence.

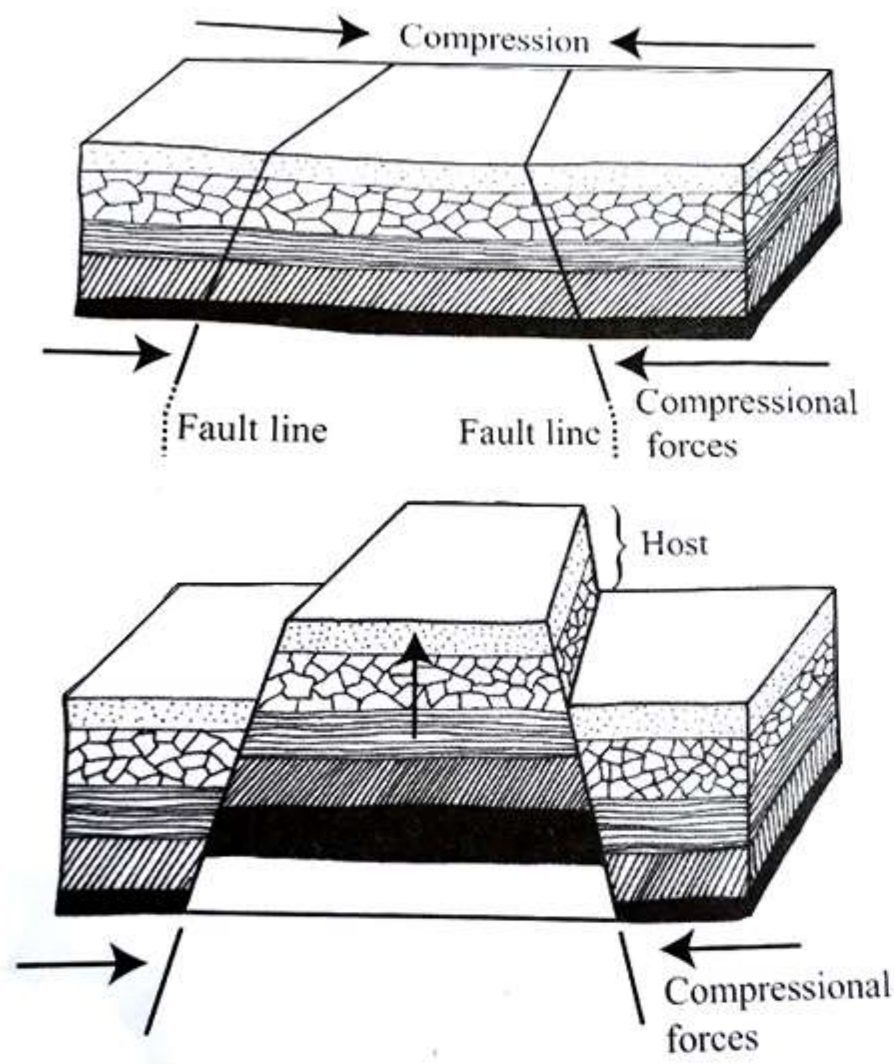
Tensional theory

According to the tensional theory land mass is subjected to forces of tension resulting from radioactivity and geochemical reaction with in the interior of the earth. the tension forces pull the land mass apart and it develops normal faults which divide the land into 3 blocks and as forces pull further, the blocks begin to subside and slide down wards while the middle block remain stable at higher level thus forming a block mountain



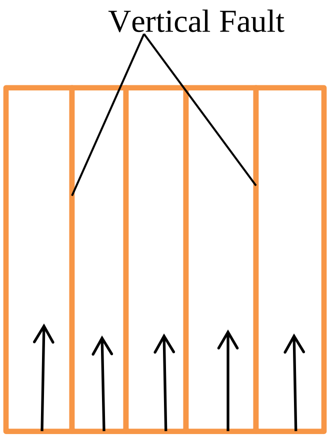
Compressional theory

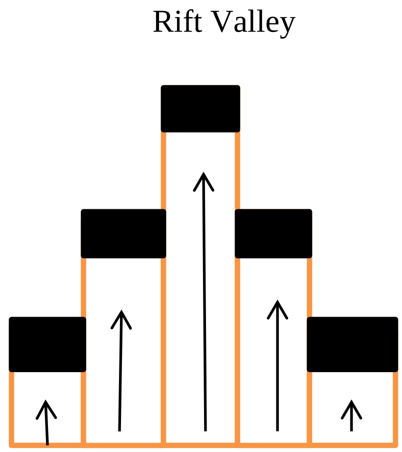
According to compressional theory the land mass is subjected to forces of compression that puss towards the central point from the sides. Over time, it developed reverse faults and it's along this that the middle block was formed upthrust and over side. The side blocks which were stable thus forming a block mountain.



Relative uplift

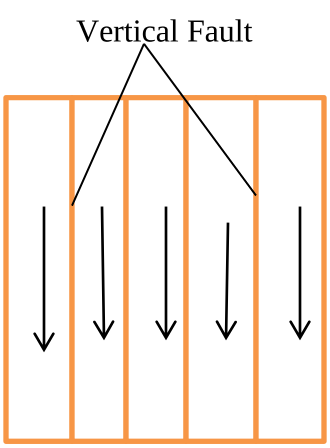
The theory is based on the assumption that the land mass was subjected to forces resulting from radioactivity and geochemical reactions. Which acted on the land mass over time and it developed vertical faults which divided into blocks. The different blocks were then gradually up lifted but at different rates. The forces on the side blocks were moving on at a slower pace while those on the middle block were moving on a higher speed thus rising of the middle block above the side blocks to form a block mountain.

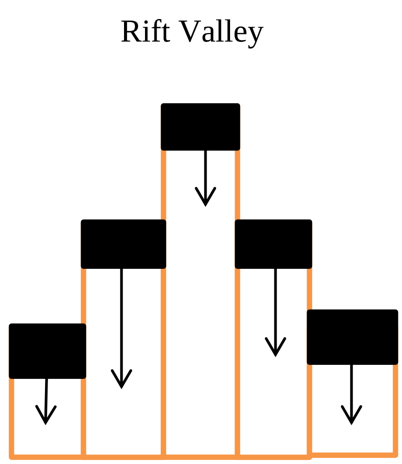




Relative /differential sinking/ subsidence

According to this, the east African land mass was subjected to forces resulting from radioactivity and geochemical reactions. As forces acted on the land it developed several vertical faults which divided the land into different blocks which later started sinking/ subsiding or moving downward but at different rates. The side blocks were sinking at a faster rate compared to the middle block which was sinking at a low pace and therefore lagged behind thus leading to the formation of a block mountain.





Examples of block mountains in east Africa include, Uruguru, mountain Rwenzori, w Uganda ,Usambara , Mahenge and pare in Tanzania.

Escarpments

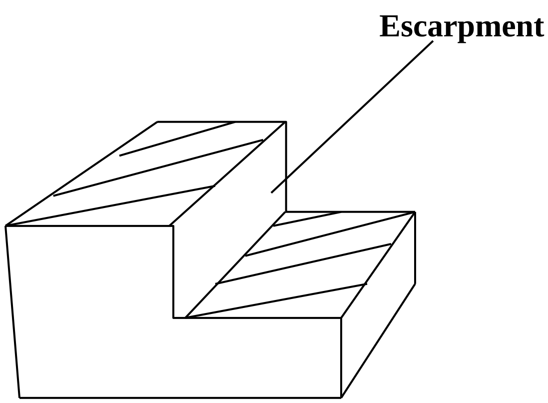
An escarpment a vertical steep sided land scape.

It's formed as a result of geo chemical reactions with in the interior of the earth. The results from great heat and pressure which melts the rocks. Forces are then generated which acted on the land it develops faults and it's divided into blocks. As forces continue to act, the land blocks are then displaces having one at a higher level and there other at a low level forming an escarpment.

examples of escarpments in east Africa include Butiaba, Kichwamba in western Uganda

Elegoge, Nandi , Mau in Kenya

Manyara and Chungwa in Tanzania



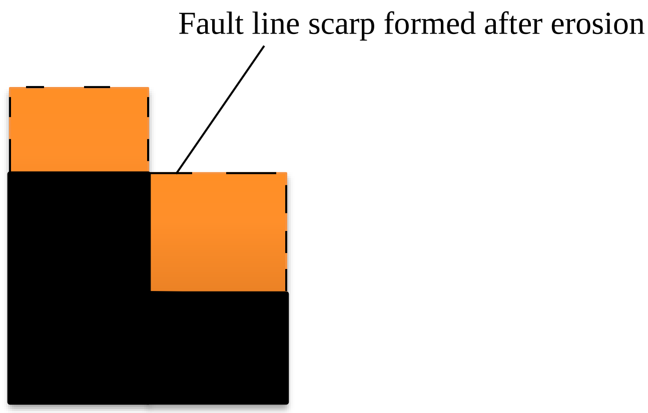
Fault line scarp

A fault line scarp is formed when on existing escarpments is subjected to denudated forces which act on it, remove some particles thus modifying it into a fault line scarp

e.g.

Mutito

Kiloswa Msolwa



Fault guided river valley

A fault guided river valley is formed when a flowing river comes across an area which has a crack or faults and it begins to curve its valley by removing / detaching the shattered rocks as it flows

e.g. river Aswa in Acholi land in northern Uganda

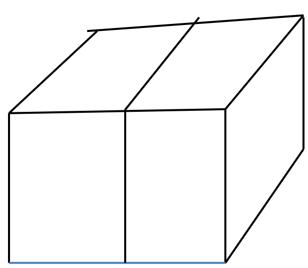
Kerio and Ewaso-Ngiro in Kenya

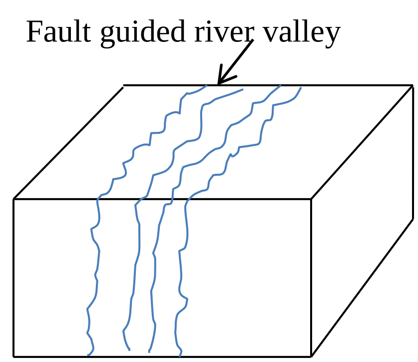
River Mizimu in Tanzania

Wassa and Ntusi in western Uganda

Crack

Fault

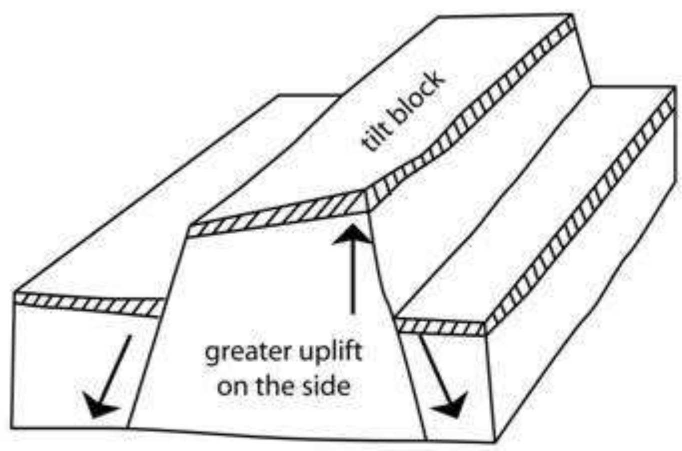




Tilt blocks

A tilt block is an inclined weak like land form which is formed as a result of radioactivity and geochemical reactions with in the interior of the earth. This result into great heat and pressure that set off convective currents that generate sources that act on the land and generated several vertical but inclined faults. This divided the land into separate blocks which were then displaced and tilted upwards to form tilt blocks and where there are many tilt blocks, they form tilt block scenery. When tilt blocks are occupied by water they form tilt block lakes.

e.g. lake olbalassat in Kenya.



Faulting in some areas resulted into radioactivity e.g. western Uganda and this resulted into reversal of rivers thus affecting the drainage of the area. Rivers like Katonga, Kagera and Kafu were originally flowing west wards into the Atlantic Ocean but because of their gradual uplifting in western Uganda, they have reversed their direction of flow and are now flowing into Lake Victoria and Kyoga basin.

Similarly, rivers like Nzoia, Mala and Nyando which were flowing east wards into the Indian Ocean because of their gradual uplifting may have also reversed their direction and they are flowing into the Kyoga and Victoria basin.

Questions

Examine the effect of faulting and land form formation in ea.

Assess the effect of faulting on land form formation.

To what extent is faulting responsible for formation of relief features or land forms in east Africa

Distinguish between compressional and tensional forces

Explain the land forms resulting from compression and tensional forces

Coastal geomorphology

A coast is a zone where the land and sea over lap and interact. A coast can either be gentle or steep, sandy or rocky. In east Africa, coasts are along the lakes and along the Indian Ocean.

Waves

These are defined as Undulations on the surface of the water caused by winds blowing across it. When the wind blows over the water, there is friction between the water and the wind. Energy is transferred from the wind to the water and forms the wave which normally moves along in the direction of the wind.

Waves can also be generated by tectonics movements such earth quakes that move under the sea, large whales, submarines, volcanic eruptions etc. Waves are the chief agents of marine erosion, transportation and deposition along the coast.

Each wave has a swash and back wash effect.

Illustration

The forward movement of a wave is known as the swash and it is usually more powerful when the wave breaks and retreats and then the back wash is formed.

Waves can be constructive or destructive. Waves which are constructive lead to deposition and its associated Landforms. Waves can also be destructive leading to erosion and its associated landforms or features.

Landforms resulting from wave erosion or formed by wave erosion.

Waves are very effective agents of erosion and wave erosion occurs through the following processes;

Hydraulic action, Abrasion, Attrition, Solution

- **Hydraulic action.** When a wave hits for cliff at the coast with great force, it compresses the air in the joints and cracks in the Cliff. When the wave retreats, this pressure is released explosively. When this pressure release action is repeated, the rock is stressed, cracks are then enlarged and pieces begin to fall off the cliff.
- **Abrasion**. It occurs when the rock particles that have been broken off by hydraulic action are thrown by the waves at the cliff. They erode it at the base leading to undercutting of the cliff.
- **Attrition.**

It occurs when the rock fragments and pebbles are knocked against each other in the water and become smaller and more easily removed.

- **Solution.**

it occurs in soluble rocks such as limestone is dissolved and washed away. However, no visible rock fragments are left. All these processes together produce landforms which include cliffs, caves, good etc. as explained below.

1. **A Cliff**

It's a steep slope or rock face along the sea or coast. It might be 400m in height or quite below. Cliffs may either be vertical or slanting. The formation of cliffs depends on the nature of rocks, their stratification and jointedness, their resistance to erosion and their homogeneity or heterogeneity. Cliffs are formed by waves that attack a gently sloping land towards the sea or lake resulting into the formation of notches.

These notches or cuts are created by waves through the processes of wave erosion like hydraulic action or abrasion. These notches are very common on rocks which have well developed gorges. continuous wave erosion, weathering and mass wasting results into the collapse and retreat of gently sloping rock leaving behind a steep rock surface along the sea or lake. Best examples of cliffs in east Africa include fort Jesus near Mombasa, port Garaza near Tiwa and at kasenyi on the shores of Lake Victoria.

Illustration

2. **Wave cut platforms.**

This refers to a gently sloping bend like rock sloping seaward below the Cliff. They form between low and high water tides. It's formed as a result of water attack on the cliff. These waves force the cliff to collapse and slowly retreat. This results unit the creation of wave cut benches through the grinding action of materials swept back and forth by the breaking waves. These benches are finally enlarged into wave cut platforms e.g. at Tiwi beech in Kenya and the oceanic hotel at Mombasa was built on wave cut platforms.

Illustration

3. **Bays and headlands.**

Bays and Headlands are indented coasts where water either projects into the adjacent land or land projects towards the sea. They are formed where there are alternating hard and soft rocks which lie at right angles to the coast.

Bays are wide indentions where the sea or lake projects towards the land. They are as a result of differential erosion of the soft rocks where the eroded soft rocks are forced to curve in into which the sea or lake water flows or follows. Best examples can be found at Sango bay, Murchison bay, the Napoleon Gluff, Barckley Gluff and Speke gluff on Lake Victoria and Watamu and Malindi bays in Kenya.

Headlands on the other hand are projection of land and resistant rocks protruding towards the sea. When the soft rocks are eroded to form bays and resistant rocks remain and stand out as headlands.

Illustration

4. **Caves**

Caves are holes or tunnels that are dug into the cliff. They develop from waves that enlarge an initial line of weakness in the rock especially along joints, faults and bedding plains. The breaking waves through the processes of abrasion and hydraulic action compress the air the crevices, joints and holes within the cliff face. When the water retreats, the air expands rapidly. This expansion and compression loosens the rocks and enlarges the cracks which later results into the formation of cylindrical tunnels called caves.

In some cases, the force of waves spurting into the air may weaken the roof of the cave so much that the roof collapses. The resulting landform is a vertical shaft or tunnel connecting the cave to the cliff top. This landform is called a blow hole or gloup.

When the entire roof of the cave collapses due to wave erosion along the major joints or faults, the resultant landform is called a geo.

5. **Arch, stack and stump.**

An arch is a bridge like feature found above the cave. It's formed when a cave is curved into the side of the headlands or where the caves develop on either side if a headland and they alternately join.

With continued wave erosion on the headland, the arch may collapse leaving behind an isolated rock mass separated from the main land called a stack. Best examples can be found at the rock pillar Stack near Entebbe airport at Kasenyi fish landing site. An arch is found at Vasco da Gama pillar in Malindi.

Illustration

Continued wave erosion of the stack may lower it below water level or maybe submerged at high tide to form a stump.

Landforms formed from wave deposition

For wave deposition to take place, the materials have to be moved along the shores by longshore drift i.e. a mechanism in which waves transport eroded materials before they are deposited to form various landforms.

The major wave deposition features include beaches, spits, bars, mudflats etc.

1. **Beach**

A beach is an accumulation of materials deposited by waves mostly consisting of sand, shingle or both along the coast. They are gently sloping coastlines of sane and shingle which are transported and deposited along the coast by longshore drift. It's formed when constructive waves remove materials from the bottom of the sea and deposit them at the shores where they accumulate. Beaches maybe submerged at high tide or may be exposed at low tide e.g. Nyaki beach in Kenya near Mombasa. Others include Nabugabo, Butembe, Gaba, Lido etc. along the shores of Lake Victoria.

Illustration

Types of beaches

1.1. **Barrier beach**

These are long Sandy ridges of islands lying parallel to the coast and separated by a lagoon. They are formed on gently sloping coastlines by longshore drift and waves breaking off shore materials are deposited under water as off shore sand bars and appear above high tides. Wave action gradually moves the deposits on the main land as barrier beaches. They are referred to as barrier islands when they are not joining the Coast.

Illustration

1.2. ***Beach cusps***

These are projections of Sand and shingle that are cone shaped with an apex facing sea wards formed by eddies or head currents of a powerful swash.

or these are series of small horn shaped projections separated by shallow indentations that face sea wards giving the beach a pointed appearance. Cusps are formed mostly where waves break parallel to the shore and most cusps develop on exposed beaches where large waves are frequent.

1.3. **Bay head beach.**

It is a crescent of sand and shingle lying between headlands. Examples include Lutembe beach, lido beach, and Bugonza on the shores of Lake Victoria.

1.4. **Spits**

A spit is along narrow accumulation of shingle and sand in a linear form with one end attached to the land and the other projecting into the sea or across the estuary. A spit may link two headlands to form a bay bar. Spits develop from the movement of materials by longshore drift.

When the long shore drift operates across a river mouth, a zone of slack water develops between the long shore drift and river and any material carried by longshore drift is deposited.

The deposited material forms a spit. The main condition for the formation of spits is the presence of an ample longshore drift materials together with an irregular coastline. Examples include Kaiso and Tonya spits along the shores of Lake Albert.

Illustration

2. Tombolo

This refers to a spit that grows out from the coast and links an island to the mainland. The ideal condition for the formation of a Tombolo is an ample supply of debris for wave deposition to form connecting ridges and a low tidal range such that the deposited materials are not carried away. Best examples are found at Lambu Island which is joined to the mainland at Masaka

Illustration

3. Sand bar

This refers to a ridge of sand, mud, gravel and shingle deposited off shore and parallel to the coast. It's formed on gently sloping coasts and shorelines with an irregular shape. Its formation is attributed to waves that move or drift the materials along the shore or as a result of backwash combining the materials directly behind the beach.

Similarly, long breaking waves cause the sand grains to move seaward resulting into accumulation of materials on the submerged line known as break point bar. The repeated process leads to the formation of a bar behind which develops a lagoon, mud floods and mashed.

4. Bay bars

Bay bars form where spits continue to grow in length and link the two headlands which later enclose a lagoon and mashed. Examples are on lake Nabugabo in Masaka which is enclosed by Rwamunda swamp and lake Nabugabo was cut from Lake Victoria as a bay bar.

Illustration

5. Coastal dunes

these develop on coasts where winds are predominantly onshore and are sufficiently strong enough to move a large supply of sand inland from a wide beach area. They are Common along arid and semi-arid coasts.

6. Mud flats

Mud flats form when tides and waves deposit fine materials such as silt along gently sloping and sheltered coasts. The deposition of large quantities of Alluvium results into the building of a plat form of mud mixed with water called a mud flat e.g. the mud flats along the east African coast which are occupied by mangrove swamps and forests.

SEA LEVEL CHANGES

sea level changes refer to relative movements in the level of water in the sea, Ocean, lakes relative to the adjacent land. When the sea level changes on a worldwide, it's known as eustatism or an eustatic change. water in the sea is never constant.

Sometimes the level or water in the sea or ocean can rise relative to the land and this is referred to as submergence or positive change.
At times, the level of water in the sea or ocean Lowers or reduces relative to the land and this is known as emergence or negative sea level changes.

Therefore, sea level changes or base level changes involve two processes i.e.

- ✓ submergence or positive base level changes
- ✓ Emergence or negative base level changes

Sometimes the change in sea level is Worldwide and uniform which indicates an actual movement of the sea itself. This is known as eustatic sea level changes.

EMERGENCE

Emergence refers to where the land has risen relative to the sea or where the sea level has fallen relative to the adjacent land. This results into exposure of features that are formally under water and can be seen.

Causes of emergence

- ✓ Rise in the level of the adjacent land due to isostatic uplift.
- ✓ Fall in the level of the sea level due to drought, glaciation, global warming, widening of the sea floor etc.

SUBMERGENCE

Submergence refers to a situation where coastlines fall relative to the adjacent land or where the sea has risen relative to the adjacent land or Coast.
This therefore leads to formally exposed land / features being covered by water (indulated)

CAUSES OF SUBMERGENCE

- ✓ fall in the level of the adjacent land due to relative sinking (Down warping)
- ✓ Rise in the level of the sea because of illuviation, deglaciation, narrowing of the ocean floor etc.

CAUSES OF SEA LEVEL CHANGES

1. **climactic factors**

Temperature changes can also lead to sea level changes. High temperatures result into prolonged droughts hence high rates or excessive evaporation leading to a fall in the sea level relative to the land adjacent.

Temperature changes leads to expansion and contraction of the sea water. A rise in temperatures of the water will cause its expansion which later brings about submergence while a fall in temperatures results into contraction of sea water which later brings about emergence.

Pluviation i.e. increased precipitation or rainfall leads to a rise in sea level relative to the adjacent land while desiccation i.e. decrease in rainfall totals leads to a fall in sea level relative to the land. E.g. in 1997 - 1998 Uganda experienced el-Mino rains which led to an increase in water in lakes causing submergence. In 2010, there was a prolonged drought period which resulted into emergence due to reduced water in lakes as a result of excessive evaporation.

2. **Glaciation and deglaciation**

Deglaciation involves the melting of Ice due to a rise in temperatures. The melt waters lead to the release of large quantities of water which flow into the Sea leading to a rise in the sea level.

On the other hand, during periods of major glaciation, there is a drop in global temperatures. Water is frozen off into large ice masses in the Polar regions and mountains which cause a universal fall in the sea level.

3. **Tectonic movements**

These are related to processes of warping, faulting, volcanicity and seismic activity. Up warping of coastal areas and down warping of ocean basins leads to a fall in the sea level resulting into emergence while down warping of coastal areas and down warping of the ocean basins results into the rise of the sea level (submergence).

Enlargement or expansion of the ocean basins due to plate divergence leads to a fall in sea level (emergence) e.g. the Atlantic Ocean is experiencing emergence of its coastlines since it's getting larger as plate movements cause north and South America to drift away from Europe and Africa respectively.

On the other hand, contraction it ocean basins due to plate convergence leads to a rise in sea level.

4. **Volcanism:**

volcanoes at constructive plate boundaries and subduction zones displace water causing rise of sea level relative to the land.

5. **Isostatic re-adjustments**

The word isostasy is a Greek word meaning equal standing. The structure of the earth is in such a way that lighter rocks (sial) are sitting on denser rocks (sima). Due to isostatic re-adjustments, large amounts of weight e.g. glaciers, buildings, deposited debris etc. may be loaded or unloaded onto a region which may cause the land to sink or to rise and consequently cause emergence or submergence.

The addition of materials on continental areas increases weight causing continents to sink slowly hence a rise in the sea level e.g. ice accumulation during the Ice Age. After the melting of the ice sheets, the isostatic uplift of land masses occurred leading to a fall in sea level.

6. **Sedimentation.**

Deposited sediments in the sea or ocean basins by in flowing rivers reduce the size and depth of the ocean basins leading to a rise in the sea level hence submergence.

7. **Human activities**

The pumping of water or oil for the ground can lead to the gradual sinking of the ground which results into emergence.

Man can also carryout dredging or desilting of coastlines which results into emergence. Sometimes sand mining at the coast can also bring about emergence. this is because the size of the lake basin is enlarged therefore bringing about lowering or drop or decrease in the water level.

Pouring of sewage and other sediments in the lake brings about submergence since the sediments try to fill the ocean basin and causes the rising of water.
in some countries, there is pouring of expired food, items like wheat, rice etc. in the ocean and this brings about submergence.

8. **Global warming**

The world's temperatures have been increasing over the years by at least 0.6 degrees Celsius or 1 degree

This increase in global temperatures has been due to man's misuse of the environment involving deforestation, burning of fossil fuels e.g. coal, oil and natural gas etc. which reduces gases that trap heat in the atmosphere e.g. carbon-dioxide and carbon-monoxide which makes the climate to become warmer. This has resulted into melting of snow and ice e.g. at the poles resulting into submergence.

In the tropics, global warming has led to the reduction of glaciers which are potential sources of water to rivers that flow into oceans. This has resulted into reduction in the volume of water flowing into the seas and oceans hence bringing about emergence.

FEATURES OR LANDFORMS RESULTING FROM SEA LEVEL CHANGES

LANDFORMS RESULTING FROM SUBMERGENCE (RISE IN SEA LEVEL)

when the water level in the sea or oceans rises, areas or features which were not formerly in water become submerged.

Submerged features fall into two categories i.e.

- ✓ Highland features
- ✓ Lowland features

Submerged highland features

1. **Rias**

It's defined as a long narrow water inlet at the coast. Before the sea level rises, a river flows into the ocean through a Valley. When sea level rises, the valley is flooded or submerged by the rising water levels to form a ria. It's formed with a shape of a funnel and decreases in width and depth inland. Examples can be found along the coast of east Africa at the mouth of the Mwachi river which forms the Kilindi harbor at Mombasa, the drowned river mouth of the Kombeni river which forms the Mombasa harbor.

Illustration

2. **Dalmation coastline / longitudinal coastline.**

These are submerged tops of hills or highlands. They are formed in areas where hills and valleys lie parallel to the coast before submergence.

When the sea level rises, the valleys become flooded with water and the hills remain as chains of islands within the ocean and run parallel to the coastline. The water within the drowned valleys that separates the chains of islands from the main land is known as a sound.

Examples include the Smith sound west of Mwanza on Lake Victoria, the Pemba and Zanzibar coasts etc.

Illustration

3. **Fiords**

These are submerged or drowned U-shaped glacial troughs or valleys formed along glaciated coasts. They have steep walls often rising straight from the sea. When the sea level rises, the coast is submerged and the lower parts of the U-shaped valleys or glacial troughs are and filled with water hence forming fiords. They are usually steep sided and very deep. There are no examples in east Africa but there are many at the coast of Norway, British Columbian coast, at the Coast of Chile etc.

llustration

SUBMERGED LOWLAND FEATURES

4. **Estuaries**

These are submerged or drowned river valleys with a V-shaped cross profile pointing landwards. It is formed when the sea level rises along a low lying Coast causing the sea to penetrate Inland along river valleys eg the rufigi and kibanga estuaries. They are similar to Rias only that Rias form in highland coasts while estuaries form in lowland coasts.

5. **Creeks**

These are narrow inlets formed by submergence of small streams. They are similar to estuaries only that they are smaller. Best examples of creeks are mfwapa, Tudor, reitz and kilifi all formed due to sinking of small rivers and streams along the East African coast.

6. **Mudflats and lagoons.**

Mudflats are deposits of fine silt and alluvium of rivers to form plat forms of mud. Sediments are deposited in shallow water either behind shingle, bars, sand spits, or sheltered parts of estuaries and bays. At the Coast, such deposits enclose water and separate it from the rest of the sea to form a lagoon.

LANDFORMS FORMED DUE TO EMERGENCE

GENERAL ILLUSTRATION SHOWING THE DIFFERENCE LANDFORMS.

1. **Raised cliff**

Initially a Cliff is formed where the sea is in contact with the land. Through the phases of hydraulic action and abrasion, a notch is created and it becomes deeper due to continued wave erosion. When the above land loses support it collapses and a cliff is formed. when the sea level falls, the cliff is left isolated and it's no longer in contact with the water and therefore it's left behind at high tide to form a landform known as a raised cliff.

2. **Raised terraces**

Initially a wave cut platform develops at the coast as a cliff retreats. When the sea level falls, the Former wave cut platform is no longer in contact with the water and is now known as a raised terrace. An example of a terrace is at Lutembe beach where it was formed when the water level of Lake Victoria fell at one time.

3. **Raised beach**

This is formed when sea level falls such that the former beach is now left above the new water level which is above the present zone of deposition. This beach which is left suspended above the present water level is referred to as a raised beach. Best examples are found at Bagamyoyo in Tanzania where three layers of raised beaches can be found and at the Mamangina in Mombasa-Kenya.

4. **Raised caves**

Initially a hole develops in the cliff face where there is a joint in the cliff. Through continued hydraulic action and abrasion, the hole becomes larger and finally the cave forms. When the sea level falls, the cave is left high above the high tide level and with no anymore contact with the sea which is now known as a raised cave. 8

5. **A raised geo**

It's formed where the entire roof of a cave collapses through erosion to form a narrow water inlet called a geo. When the sea level falls, it will not be in contact with the sea level and therefore it will have no water in it. It's now called a raised geo.

Economic importance of features resulting from sea level changes

- Rias and fiords are used in the construction of natural harbours e.g. kilindini and Dar-es-salaam harbors.
- The landforms formed due to rise and fall in sea level are important tourist attractions and this brings in both local and foreign income in the respective countries
- The landforms are important sites for education and research.
- Mudflats are reclaimed for agriculture purposes and this improves on the food security in the country.
- Rias form natural route ways inland
- The raised beaches are used for sand mining.

Negative

Settlement is difficult along the sides of a fiord because of lack of level land.

the mudflats, swamps and marshes are breeding places for disease causing vectors eg mosquitoes etc.

there is a problem of occasional flooding especially in areas covered by Mudflats and this leads to destruction of property.

CORAL REEFS

Coral reefs are rock Platforms formed from the continued deposition and accumulation of shells or skeletons of marine organisms known as coral polyps.

Coral is a limestone rock made up of the skeletons of the tiny marine organisms ie coral polyps. The polyps usually live in closely peached colonies of thousands and their skeletons are made up of calcium carbonate.

When the polyps die, their skeletons and shells accumulate at the bottom of the sea and they are eventually compressed together with time by their own weight, consolidated and cemented together to build a coral reef. other organisms such as echinoderms and calcareous algae help to cement the space between the skeletons.

After a long time, hard rocks known as coral reefs are formed. Example are found at the east African coast along Kenya and Tanzania

CONDITIONS NECESSARY FOR THE FORMATION OF CORAL REEFS

Requires hot temperatures if the tropical climate ranging between 20-30^0 C which are ideal for the growth of coral polyps. They are found manly in the tropical and in the near tropical seas and oceans within 30^{0}N and S of the equator. They are mostly found on the Eastern side of land masses where warm ocean currents increase the sea temperatures hence allowing the growth of corals.

On the western side of landmasses, there are cold ocean currents which lower the temperatures hence preventing coral growth.

It requires salty, oxygenated sea water of between 27-40 parts per 1000 for calcium carbonate to precipitate hence enabling the growth of coral polyps. Salinity encourages coral growth since coral polyps take up calcium carbonate from sea water to build their shells.

It requires a shallow continental shelf with a depth of between 20-60m to allow the penetration of sunlight which is ideal for the growth of coral polyps.

There should be presence of clear silt free water and calm or stable water. The clear water allows light to penetrate to lower levels while the calm water allows the accumulation of coral polyps to form coral reefs. Coral reefs grow away from River mouths where silt laden water pours into the sea and dilute the salt concentration and destabilize coral formation.

There is need for a solid rock bed along the coast upon which coral reefs form or accumulate.

Availability of planktons which act as food for the coral polyps. Food supplies are usually most plentiful on the sea ward of a growing reef so that corals tend to grow more rapidly outwards.

Sea level changes caused by submergence of the coast which encourage coral deposition. A fall in the sea level exposes the coral polyps and they eventually die.

Presence of Minute sea organisms (very tiny) called polyps which die and their skeletons pile and accumulate to form Coral reefs.

TYPES OF CORAL REEFS

There are three types of coral reefs namely

Fringing reefs

Barrier reefs

atoll reefs

FRINGING REEFS

This consists of a platform of coral which is joined to the coast and extending sea wards for about 1km. It's separated from the coast by shallow and narrow lagoon of about 500 -2000m. Best examples can be found at kilifi and Tiwi at the coast of the Indian Ocean.

Illustration

BARRIER REEFS

These are coral platforms which are separated from the coast by a wide and deep lagoon. Barrier reefs are found several kilometers off the coast.

Illustration

ATOLL REEF

This is a circular shaped coral platform enclosing a mass of water to form an atoll. It has a fairly deep lagoon but it's generally broken in places by a narrow channel. Eg the Gilbert and Ellie islands on the Pacific Ocean and chumbe Island South of Zanzibar.

Illustration

NOTE

The process of coral formation involves:

- Coral landforms or reefs form when coral polyps die

- Skeletons of dead polyps drop and accumulate on the continental shelf.
- With continued accumulation of skeletons of polyps over time, there follows compression, compaction, cementation and consolidation of fossils thus corals are transformed into coral reefs.
- Living organisms e.g. algae help in cementation to turn limestone rocks into Coral reefs.

THEORIES FOR THE FORMATION OF CORAL REEFS

The formation of barrier reefs and atolls have created a lot of controversy as they have been found at far greater depth, in some cases exceeding 1000m a level where polyps cannot survive. As a result, relevant theories have been formulated to account for the origin of coral reefs.

These theories include the following;

Darwin's theory

John Murray's antecedent theory

Daly’s theory of deglaciation

DARWIN’S THEORY OF SUBSIDENCE / SUBSIDENCE THEORY.

Darwin proposed his subsidence theory in 1842 when he was trying to account for the formation of coral reefs. According to this theory, it's states that originally there was presence of a volcano or volcanic island on the sea floor. The coral polyps colonized the edges of the volcano and later formed a fringing reef.

The volcanic island together with its fringing reef that had formed subsided or sunk as a result of isostatic re-adjustments that followed subsequent eruptions. Such subsidence increased the water depth beyond the level at which coral polyps can survive. The coral polyps subsequently died while some tried to grow to keep pace with changes in water depth.

The fringing reefs on the flanks of volcanic islands grow upwards and eventually grow into barrier reefs and finally into atolls When the volcano has completely submerged or sunk.

Illustration

RELEVANCE OF DARWIN'S THEORY

The theory is relevant because there was actual submergence of the east African coastline evidenced by the presence of Rias and Mudflats in the submerged coastal areas.

There is presence of volcanic islands off the East African coast in the Indian Ocean.

However, critics of Darwin's theory down Play its relevance by arguing that some coral reefs have also been found in areas where there is no evidence at all of submergence and also that some coral reefs have also been found at a great depth denying the assumption that when sea level increases or rises, coral reefs grow to keep pace with increase in the water level.

JOHN MURRAY'S ANTECEDENT THEORY

This theory assumes that coral reefs developed on a platform of pelagic deposits. Murray assumed that there were uneven growth rates of coral reefs grew up on the banks of their own debris and there was more rapid growth on the sea ward than on the land ward sides.

The platform provided a base for atoll formation. Corals first grew as fringing reefs then into barrier reefs then finally as atolls.

As the reefs grew upwards and outwards, those on the inner or landward were deprived of food causing them to die. The skeletons of sea organisms dissolved into water such that a feel lagoon formed or developed inside the reefs. According to Murray, there was no subsidence in it.

Illustration

RELEVANCE OF MURRAY'S ANTECEDENT THEORY

The proposers of this theory identified the barrier and fringing reef at Maryote between Madagascar and Mozambique. Atoll were formed around Aldabara as evidence to support this theory.

More pronounced coral polyps grow on the sea ward side than the Land Ward Side.

fragments of coral do exist in lagoons between reefs proving the idea of dissolving dead corals to form lagoons.

The steepness of the coral reefs is greater on the seaward side than on the landward side.

DALY'S THEORY OF DEGLACIATION

According to this theory, there existed submarine platforms or hills from which peri-glacial coral reefs were eroded and planed to the sea level. Barrier reefs and atolls started formation on the flanks or foot hills of these hills as fringing reefs.

Deglaciation emptied vast quantities of melt waters into the sea such that there was a rise in sea level.

As sea level rose, the coral reefs which had started growing on the platforms or hills as fringing reefs gradually transformed into barrier reefs and finally into atolls when the hills were completely submerged. This took place because the upward and outward growth of corals was able to keep pace with the rate of rise in sea level and be maintained at the water surface.

Illustration

ECONOMIC IMPORTANCE OF CORAL REEFS

- Some corals are precious e.g. this with a hard core are used by craft men to curve out jewelry materials.
- The lagoons cut off from the ocean are good for water sporting and swimming since they are normally free from dangerous fish e.g. sharks and whales.
- Reefs especially the fringing type shelter the coast from strong waves. The water above the reef is shallow which helps to check the speed of the approaching waves leading to the development of sheltered harbors.
- Research shows that the existence of corals is an indication of the possible presence of petroleum at the east African coast. The polyps which die have fats which accumulate into oil wells in sedimentary rocks. Therefore, the east African coast has some deposits of oil which when exploitation begins, they may help in economic development.
- The variety of shapes in which they appear e.g. sea fan corals, dwarf corals, reef building corals, mushroom corals, soft corals are a tourist attraction. Tourists to the east African coast normally carry them as souvenirs.
- Corals are important sources of calcium carbonate which is limestone which when processed into cement is an important raw material in the building and construction industry of both Kenya and Tanzania e.g. Bamburi cement industry in Mombasa and Waze cement works in Tanga Tanzania both use coral limestone.

- Coral reefs are also used for research purposes by scholars and for education purposes.
- Some corals weather into good soils making the coastal soils rich in nutrients and can support agriculture e.g. cloves at the east African coast.
- The corals have also supported aquaculture (tilapia), a crocodile farm and Agro forestry where by Bananas, vegetables and trees are planted on the Tanzanian coast and also farms e.g. at Bamburi quarry in Kenya.

Negative

- Where the coral reefs are found, the water is shallow and so they can cause damage on large ships in the ocean.
- The sharp reefs also tear fishing nets and may interfere with the fishing**.**

OCEAN CURRENTS

Ocean currents are general movements or drifts of the surface water of the ocean in a fairly defined direction. They are continuous general movement of masses of surface ocean waters horizontally and in a fairly defined direction. They tend to be persistent. Most ocean currents drift very slowly and that is why they are commonly referred to as drifts.
Ocean currents may be either warm or cold i.e. there are warm ocean currents and cold ocean currents.

Causes of ocean currents

1. **The prevailing winds**; winds influence oceanic circulation, this is because as winds blow friction is generated between the wind and water surface causing the water to move in the general direction of the wind. Some winds such as trade winds which almost continuously blow in the same direction cause surface waters over which they blow to move in the direction to which they blow e.g. across the Atlantic ocean westerlies produce the North Atlantic drift and Kuro Siwo currents (in the Pacific).

2. **Rotation of the earth**; the earth's rotation influences the direction of movement of ocean currents. It causes the currents to be deflected to the right in the direction to which they flow in the northern hemisphere and in the southern hemisphere the currents tend to be deflected towards the left.
   It is generally because of the Coriolis force that the ocean currents are deflected.

3. **Differences in temperature**; ocean currents may be caused by differences in temperature. Such currents are generally referred to as convection currents.
   Heating by the sun in the low altitudes makes the waters less dense and the waters therefore drift pole wards.
   In the equatorial belt, temperatures are high and therefore waters are warm and tend to be less dense, unlike the polar region or high latitude region waters. As a result, the warm waters of the equatorial region drift towards the higher latitudes.

4. **Salinity of the waters**; salinity may increase the density of the waters. Saline waters (these of high PH/basic waters) tend to be denser than waters of low salinity. It is generally noted that waters of high salinity tend to flow to areas of low salinity e.g. the surface water current from the Mediterranean Sea which enters the Atlantic Ocean

is due to difference in salinity. The high rate of evaporation and limited rainfall may result into high salinity.
This means that the Mediterranean Sea is made up of waters of high salinity and therefore flows into relatively less saline waters of the Atlantic Ocean while the under current flows in the opposite direction.

5. **Coastal configuration**; the alignment the coast and the existence of sub marine ridges is partly responsible for the direction of flow of ocean currents. The shape of the land helps in the direction of moving currents e.g. the North equatorial current tends to be deflected north wards because of the shape of the horn of Africa.

Ocean currents may be characterized by under currents. These are return or compensating currents that normally flow within the equatorial latitudes. They flow in the opposite direction from which the opposite currents are flowing. They are normally known as counter currents that replace the surface waters that may have moved to another region.

WARM OCEAN CURRENTS

These are ocean currents with warm waters and may include, the warm Mozambique current or the warm Agulhas current or South equatorial current in Africa. Other warm currents include; the warm gulf stream, the North Atlantic drift, the North pacific current, the Kuro siwo current, the East Australia current, the Brazilian current and the North east monsoon drift.

Characteristics of warm ocean currents

1. They have higher temperatures i.e. tend to be warm.
2. They generally tend to flow on the eastern side of the continental landmasses in the low latitudes (except for Guinea current).
3. They generally tend to flow on the western side of the continental landmasses in the mid and high latitudes e.g. the Pacific current and the North Atlantic drift.
4. They tend to flow from the lower latitudes to the higher latitudes i.e. flow pole ward away from the equator.
5. In the northern hemisphere, their circulation tends to be clockwise while in the southern, their circulation tends to be anti-clockwise.
6. They generally tend to be of lower density/high salinity.
7. They flow on the surface but later lose temperatures and become under water currents.

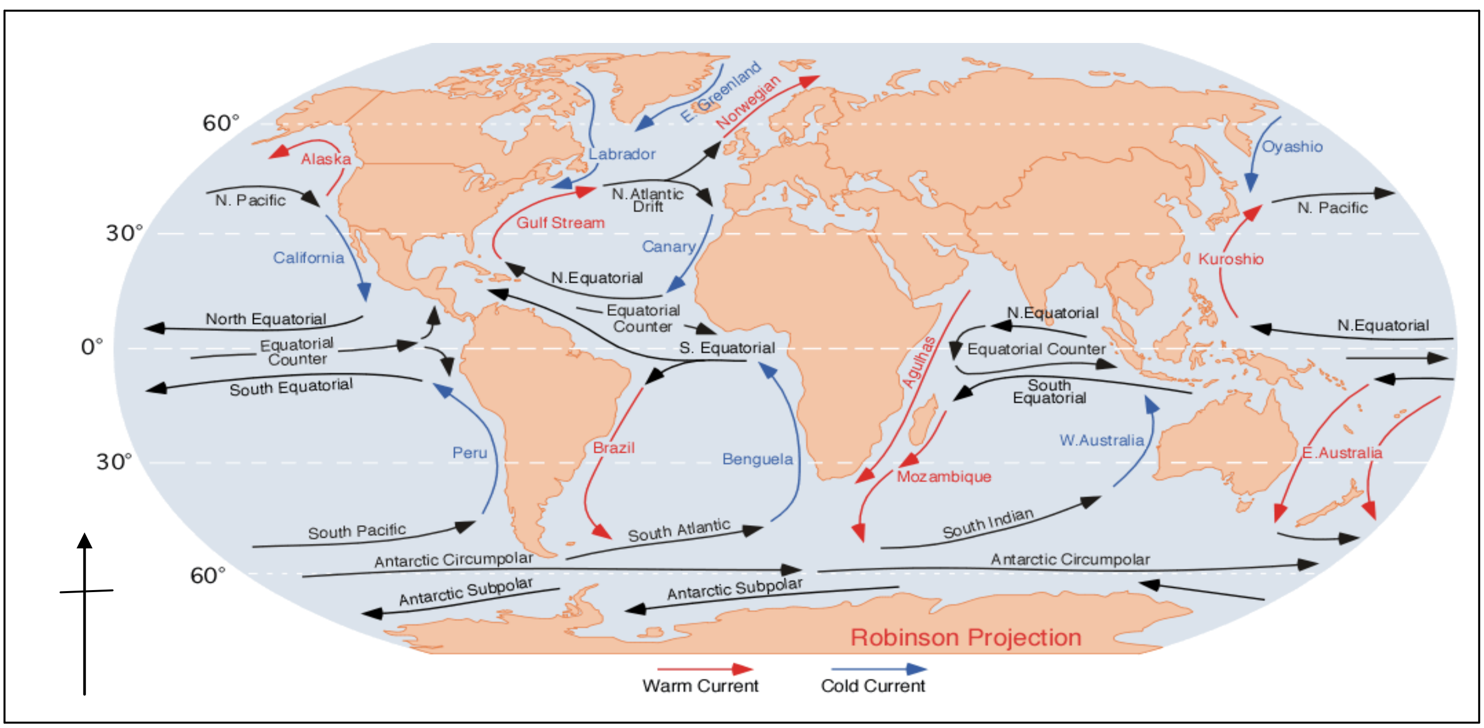
COLD OCEAN CURRENTS

These are ocean currents with waters of low temperature, i.e. the waters are cold. In Africa the main cold ocean currents include; the cold Benguella current and the cold canary current. Elsewhere examples include the Californian current, cold Peruvian current, the North equatorial current, East Greenland current and the West Australian current.

Characteristics of cold ocean currents

1. They are characterized by low temperatures, i.e. they have low waters.
2. They tend to flow from high latitude regions to regions of low latitude, i.e. they flow equator wards from regions of cold conditions.
3. They generally flow on the western side of the continental landmasses. This is true in the lower latitude regions.
4. In the mid and high latitude regions, they tend to flow on the eastern sides of the continents e.g. the Labrador Current, the Oya siwo current.
5. They tend to characterized by high density/low salinity.
6. In the northern hemisphere their circulation tends to be anti-clockwise while in the southern hemisphere their circulation tends to be clockwise.
7. They are also characterized by up-welling of waters at the coasts.

World map showing the various ocean currents



EFFECTS OF OCEAN CURRENTS

Ocean currents influence the climate and environmental conditions of adjacent lands.

Effects of warm ocean currents

Warm ocean currents have influenced the climate or environmental conditions of the areas adjacent to them in the following ways;

1) They lead to warm conditions, i.e. they tend to warm or raise the temperature of the adjacent area, this is because the winds which blow over them are warmed up and as they blow onshore they bring in warm conditions e.g. the North Atlantic drift raises the temperatures of the coasts of Portugal, France, Britain, the Netherlands etc. and the ocean ports remain ice free in winter.
   Durban on the eastern coast of South Africa is affected by the warm Mozambique current and has temperatures of 24.4^0C compared to Port Noloth on the west coast along the same latitude which has temperatures of 15.5^0C because of the cold Benguela current.

2) Warm ocean currents lead to heavy rainfall conditions on the adjacent coastal lands. This is because over warm ocean currents there is high rate of evaporation and the winds that blow over them pick the moisture which winds later rise, cool down and condense to form rainfall e.g. along the East Africa coast and along the west African coast there is heavy rainfall because of the warm Mozambique and warm Guinea currents respectively. For instance Beira receives 1,521 mm and Durban receives 1,008 mm of rainfall per annum.

3) They results into humid conditions, i.e. high humidity. This is because warm ocean currents are associated with high humidity due to the relatively high temperatures. All these tend to increase the humidity of the surrounding areas e.g. the Natal Province of South Africa and the coasts of Western Europe.

4) Warm ocean currents influence the temperatures of winds and result into warm winds. Winds that tend to originate from areas with warm currents are generally regarded as warm maritime winds.

5) They lead to increased cloud cover over the adjacent coastal lands. This is because of the high rate of evaporation. The water vapour rises, cools and condenses to form dense clouds (cumulonimbus clouds) which later result into heavy rainfall.

Effects of cold ocean currents

Cold ocean currents influence the climate and environmental conditions of the adjacent land masses in the following ways;

1. Cold ocean currents tend to control the temperatures of the surrounding land masses due to the influence of the land and sea breezes. E.g. the Benguela lowers the temperatures of surrounding areas in Namibia e.g. Walvis Bay has temperatures of 16^0C as compared to Durban's 25^0C and yet they lie at almost the same latitude.

2. Cold ocean currents lead to arid conditions or the formation of marine deserts on the adjacent coastal lands. This is because of limited evaporation and winds that blow over them hardly pick any moisture.
   The winds also generally tend to be off shore winds meaning that the level of condensation that will result into rainfall is low.
   Examples of marine deserts include the Namib Desert which is due to the cold Benguela current. The Californian desert is due to the cold Californian current and the Atacama Desert due to the cold Peruvian current.

3. They tend to result into low humidity; this is because of the low rate of evaporation. This consequently leads to limited cloud cover because of the limited atmospheric moisture.

4. Cold ocean currents lead to the formation of cold offshore fog or misty conditions as a result of rapid radiation cooling.
   It may also be due to when slightly warm air blows over the cold ocean currents resulting into steam fog e.g. there are frequent foggy conditions in San Francisco in southern California and in the Labrador region in eastern Canada.

Effects of ocean currents on human activities along the coastal areas

The nature of ocean currents has influenced human activities in the coastal regions.

Effects of warm ocean currents

1. The resultant high rainfall experienced has encouraged crop cultivation or rain fed-agriculture.

This is common along the east African coast and West African coast where a number of crops are grown, e.g. cloves, sisal, and sugarcane along the East African coast. Along the West African coast crops like cocoa are grown in Ghana.

2. The high rainfall experienced encourages the growth of forests and people may be involved in forestry activities, e.g. in Gabon, forestry activities such as lumbering are practiced. On the east African coast lumbering is also carried out in the mangrove forests.

3. The high temperatures or warm conditions along the East African coast are conducive for the growth of coral polyps and the resultant rocks and land forms like coral reefs.
   These coral rocks have been a potential for the manufacture of cement from the coral limestone e.g. the Bamburi cement.
   In addition the coral reefs have been a tourist attraction and have promoted tourist activities along the coast of east Africa. Furthermore, the fringing reefs have tended to be a hindrance to deep sea fishing along the east African coast.

4. The heavy rainfall that may result may be associated with thunderstorms which tend to be destructive to the crops and property and also disrupts the economic activities.

Effects of cold ocean currents

a) The arid conditions lead to the growth of pastures of short grass which has encouraged pastoralism. It is important to note that pastoralism is common in semi-arid areas such as the Namib Desert and Kalahari Desert.

b) The arid or desert conditions have promoted tourism. Such areas have been gazetted as wildlife conservation sites e.g. Namib Desert.

c) The arid or desert conditions have also provided a conducive environment for the film industry. Film making has been carried out in the arid areas such as the Namib Desert.

d) The ocean currents cause upwelling of ocean waters creating conducive conditions for the growth of planktons and this has encouraged fishing in these areas. The upwelling may be rich in phosphates and nitrates that promote plankton growth e.g. fishing has been an important activity in the coastal waters of Morocco, South Africa, Angola and Mauritania.

e) Cold ocean currents lead to the formation of fog which tends to reduce on visibility over water and air thereby hindering navigation and aviation.

RIVER PROJECTS

River dam projects refer to the transformation of river water to uses like power production, irrigation and flood control. Dams that perform more than one of the above functions are referred to as multi-purpose in nature.

River dam projects in Africa include;

- Kainji dam on river Niger in Nigeria.
- Akasombo dam on river Volta in Ghana.
- Aswan High Dam on river Nile in Egypt.
- Senar dam on Blue Nile in Sudan.
- Kiira dam on river Nile in Uganda.
- Seven Folks dam on river Tana in Kenya.
- Caborabosa dam on river Zambezi in Mozambique.
- Nziro dam on river Congo in DRC.
- Inga dam on river Congo in DRC.
- Kisangani dam on river Kisangani in DRC
- Vaal dam on river Vaal in South Africa.
- Bbenfountain dam on river orange in South Africa.
- Kariba dam on river Zambezi in Zambia.

General aims of dam establishment

1. Need to generate Hydro Electric Power (HEP).

2. To improve agriculture through irrigation.

3. To control flooding of associated river.

4. Create employment opportunities.

5. To create inland waterway connecting different parts of the country.

6. To improve fishing.

Importance of river dam projects

Positives

1. Provision of water for irrigation which leads to increase in agriculture for example wheat farms of about 400,000 hectares of land are under irrigation in Egypt.

2. Control of floods especially in the agricultural fields for example the Mpenda-Uncua scheme in Mozambique and on Gezira in Sudan.

3. Increase of foreign exchange earnings after exportation of agriculture products and electricity for example Mozambique exports power to South Africa, Uganda exports power to Rwanda, South Sudan, Kenya and DRC.

4. Hydro Electric Power (HEP) has been generated out of the various dams for example Owen Nalubale dam on river Nile in Jinja.

5. Industrialization has been facilitated through cheap power supply for example the textile industry in Jinja uses power from Nalubale dam.

6. Provision of employment opportunities to both skilled and semi-skilled manpower for example over 40,000 men and women are employed in dam related projects at Aswan High dam in Egypt.

7. Development of tourism industry based on irrigation projects, technology, power production and distribution.

8. Increased government revenue through taxing dam related projects like HEP

9. Has facilitated the exploitation of other resources like minerals for example Bauxite mining in Ghana, copper mining in Congo using power from river Nziro.

10. Transport has been provided by the dam for example navigation upstream on river Zambezi, Lake Nasser linking up the Central and Eastern parts of Egypt.

11. Urbanization has been facilitated around dam projects like Jinja in Uganda and Kisangani in DRC.

12. Climate modification by the existing reservoirs through land and sea breeze.

Negatives

1. Resettlement of the displaced people is very expensive for the government and affected people.

2. Cultural ties and friendships are broken down in the process of resettling people hence a setback in cultures.

3. Urban problems like prostitution, high crime rate and poor sanitation.

4. Increased pollution by existing industries hence degrading the environment.

5. Reduced potential for fishing usually after the construction of the dam much of the fish is trapped behind the dam.

6. Siltation of the dam leads to flooding and hence low agriculture in the flood plains.

7. Profit repatriation by foreign companies for example power production at Owen fall dam (Nalubale) in Jinja by UMEME from South Africa.

8. Destruction of the already established communication systems hence a setback to the economy for example east and west railway and road system bridges at Adami and Sagakope were destroyed in construction of Volta dam separating the east from the west.

9. Spread of diseases like malaria since stagnant water act as breeding grounds for disease vectors like mosquitoes.

10. Leads to destruction of forests and swamps hence global warming.

11. Diversion of labour from other sectors for example agriculture hence leading to labour deficiency and low production.

Question:

Asses the role of either Akasombo or Aswan high dam river project the economic development of the country they serve.

Approach:

Introduction:

- Define river dam project
- Case study
- Location
- Aims

Body:

- Advantages and disadvantages

Conclusion:

SOIL

Soil refers to the top most material on the earth's surface and constitutes the outer most layer of the earth's crust. It is made up of weathered rock particles and decayed plant and animal matter. Soil provides a medium for the plant roots to grow. The nature of the soils depends on the rocks from which they were formed as well as the environmental conditions and various soil forming processes.

Constituents of Soil

(i) Inorganic matter (rock particles).
(ii) Organic matter/humus (decayed plants and animal matter).
(iii) Living organisms such as bacteria, worms, and insects.
(iv) Water/moisture.
(v) Air/gases.

Soil basically results from the breakdown of parent rock through weathering processes i.e. physical and chemical weathering lead to the decomposition and disintegration of rock into soil. The weathered material may then be modified by other soil forming processes to give a wide range of soil types.

The soil that has been formed may combine with organic matter to give an ideal soil type. Soil formation has been as a result of a wide range of conditions.

Factors affecting Soil formation

1. Nature of the parent material/parent rock.

The parent rock material is the rock material that breaks down into rock particles and may influence the nature of the soil in terms of fertility, mineral composition, depth, colour and the final soil profile. Parent rock may be hard or it may be soft. Hard parent rock is normally resistant to weathering and as a result skeletal soils are formed. On the other hand relatively soft rocks are easily broken down into soil particles and the results into a higher rate of soil formation.

The parent rock structure may be characterised by joints or lines of weakness or may be just a block of massive rock. Well-jointed rocks are susceptible to weathering and easily break down to give rise to soil particles. On the other hand, massive rocks may not easily allow agents of weathering to penetrate and therefore there is a low rate of weathering and soil formation.

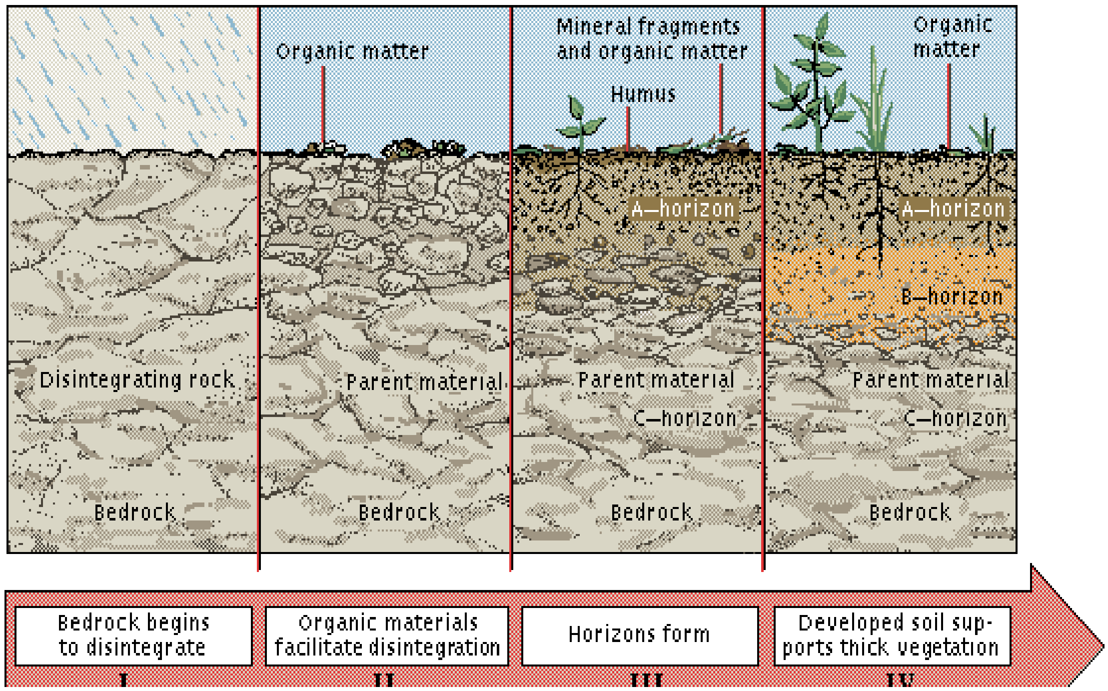
The colour of the parent rock also influences the rate at which soil is formed. This is because light coloured or shiny parent rock may be more resistant to weathering. On the other hand dark coloured rocks absorb heat, expand and later contract leading to the break down of rocks through the weathering process of thermal expansion or exfoliation. This therefore means that with the dark coloured rock soil formation is faster.

The mineral composition of the parent rock determines the nature of the soil nutrients or soil fertility. Rocks of limestone nature will give rise to soils that are rich in lime. In addition mineral composition may determine the nature and rate of chemical decomposition of the rocks.

Porosity or permeability of the parent rock may also determine the rate of soil formation. Porous rocks allow in the agents of weathering such as moisture and air, which accelerate the chemical break down of rocks into soil.

On the other hand non-permeable rocks may lead to the formation of thin soils because of the low rate of soil formation.

Stages of soil formation



2. Climate

Climate influences soil formation through its role in weathering that leads to the formation of soil. In areas of heavy rainfall adequate moisture is provided for the process of chemical weathering. In addition, in the desert areas soil formation through physical weathering processes like exfoliation are common. High temperatures accelerate chemical weathering leading to high rate of soil formation unlike in areas of lower temperatures where soil formation through chemical weathering is limited. In very cold regions like mountain tops, the nature of soil formation is through physical weathering processes like frost action or freeze and thaw. Climate also determines the nature of vegetation and animal life that consequently contribute to the soil formation through the addition of humus.

3. Living Organisms/Biota

These include bacteria, insects, mammals (animals), human beings and plants. Bacteria play an important role in the breakdown of rocks through complex processes. Organisms such as earthworms, termites also play an important role in the breakdown of rocks into simple or smaller substances that constitute soil. Rodents e.g. rats, moles, squirrels etc physically breakdown rocks as they dig holes into the ground. Man also influences soil formation through activities like mining/Quarrying and digging. As a result masses of rock are physically weathered by man to produce soil.

On the other hand plant roots physically break rocks as they grow into the ground. Plant roots also secrete substances that chemically decompose rocks to produce soil.

Plant leaves or branches may fall down and decay to form humus that is added to the soil through the soil forming processes of Humification and consequently mineralisation. That is why in areas of thick vegetative over the soils are rich in organic content while in desert areas or areas of limited vegetation cover the soils have limited humus

4. Relief

Relief influences soil formation through erosion and deposition. The nature of the relief influences the rate and nature of the soils formed. Steep slopes are easily eroded and this implies that the weathered material on the steep slope soils tend to be skeletal because of erosion. However the rate of soil formation is high because erosion exposes the parent rock to further weathering.

On the other hand in the gentle slopes, soils tend to be deep, mature and with a well developed profile. In the lowlands or flatlands where rainfall is high leaching takes place and may lead to the formation of Laterite soils that are poor in terms of plant nutrients.

5. Time

This refers to the duration of the interaction of soil forming processes and factors. Soil formation requires adequate time, time is important in that the nature of the soils depends on how long the processes and factors have been interacting.

If a parent rock has been exposed to the weathering processes for a long time, soil formation will complete as compared to a parent rock exposed for a relatively shorter period.

SOIL PROFILE

This refers to the vertical arrangement of the various soil layers from the top layer down to the parent rock or bottom layer. It is a vertical section through the soil horizons extending into the parent material or the bedrock. It describes the sections down wards through the soil which comprises of differing characteristics in terms of texture, colour, mineral composition, ratio of combination of organic and inorganic matter, hardness and rate of weathering.

The different layers are referred to as horizons.

Soil horizon is a well-defined layer within the soil profile parallel to the local round surface.

There are four main horizons namely: A horizon, B horizon, C horizon and D horizon. Each horizon has different physical and chemical properties, which result from various soil forming processes such as weathering, introduction of humus and movement of minerals.

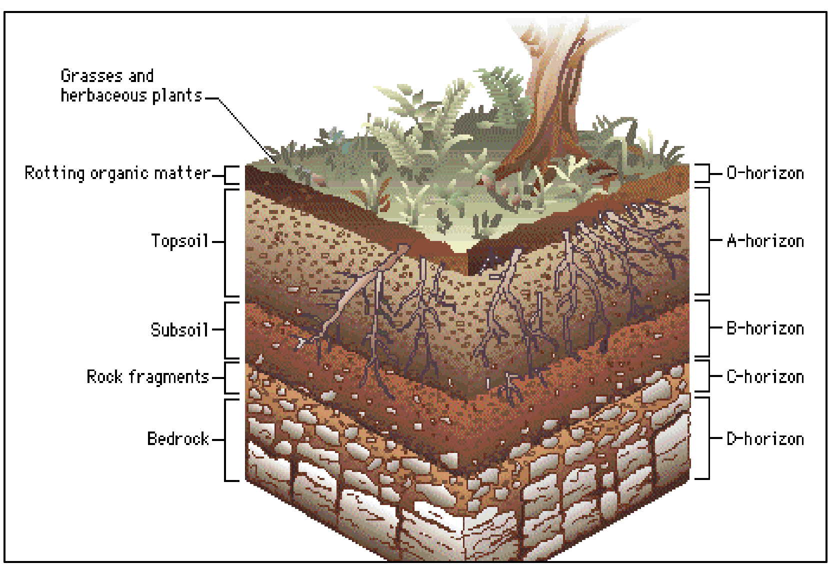
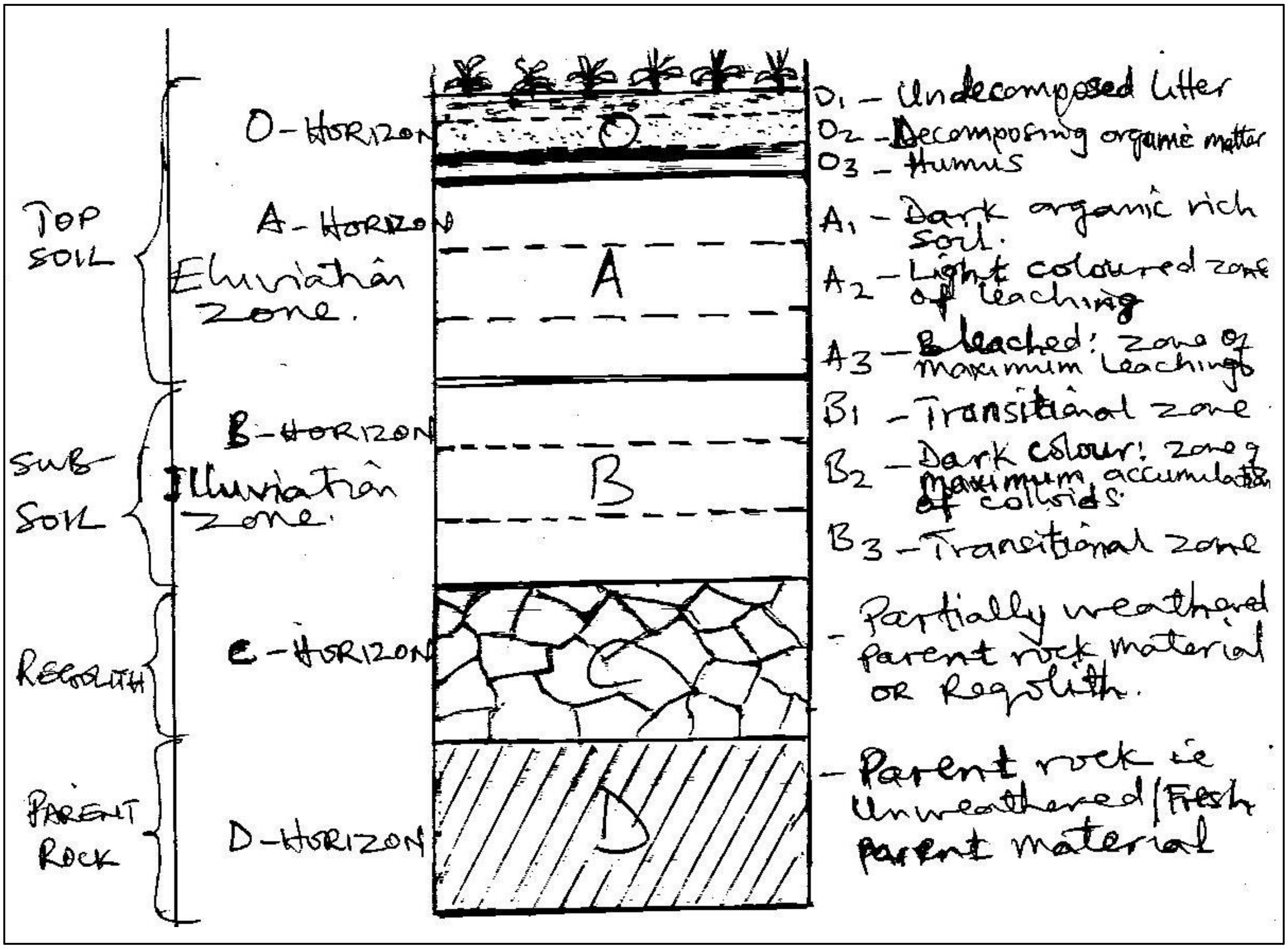


Diagram of an Idealised Soil Profile



O-HORIZON

This is the top most/ surface layer of the soil comprising of organic matter. The constituents of this layer include un-decomposed litter, decomposing organic matter and humus.

A-HORIZON

This is also known as the topsoil and it is rich in organic matter which organic matter accounts for the dark colour. Leaching and Eluviation may at times impoverish the topsoil.

B-HORIZON

This is known as the sub soil. Nutrients removed from the A horizon through leaching and Eluviation accumulate or are deposited in this horizon. The process of plant nutrients precipitating or accumulating in this horizon is known as illuviation.

This horizon may also be characterised by hard pans due to the accumulation of large quantities of clay and other nutrients.

C-HORIZON

This consists of partially weathered rock, this is because weathering and other soil forming processes may not effectively operate at this depth.

D-HORIZON

This consists of the solid parent rock or unweathered rock or fresh parent material. It is also known as the bedrock. It has no soil particles but has potential for future soil formation.

Soil profile development

The nature of the soil profile may be such that it is fully developed or partially developed implying that soils may be deep or skeletal or soils of medium depth. Soil profile development is influenced by a number of factors namely:

1. Nature of the parent rock

The parent material is the nature of rock upon which weathering and other soil forming processes operate to create to create soil. In the first place the parent material provides the basis for soil profile development. It influences soil profile development in the following ways;

(a) Hard or resistant rocks lead to the development of thin soils i.e. with poorly developed profiles. On the other hand softer rocks are easily weathered and acted upon by other soil forming processes leading to the formation of deep soils with a well developed profile.

(b) The rocks with lines of weakness or joints have facilitated weathering and other soil forming processes leading to the formation of fairly deep soils. Such soils normally lead to a well-developed soil profile.

(c) Young parent material has led to poorly developed soil or poor soil profile while older rocks have had enough time to be weathered and to develop into well developed soil profiles.

(d) Permeable or porous rocks have enabled the easy infiltration of agents of weathering resulting into deep weathering and consequently deep soils with a well developed profile unlike impervious rocks.

2. Climate

Rainfall and temperature determine the nature and rate of weathering and soil forming processes. Climate also determines the growth of plants and animals that contribute to the soil profile through weathering and through the addition of humus. Therefore different climatic conditions influence soil profile developments differently.

In areas where the climate enhances weathering and other soil forming processes there is a well-developed soil profile.

3. Living organisms

Vegetation provides the needed organic matter for the soils therefore a well-vegetated area has a better-developed soil profile. In addition, animals influence the mechanical break down of rocks therefore contributing to soil profile development.

Man’s activities such as cultivation, mining, construction tend to physically weather rocks thereby contributing to the development of soil profile therefore areas of abundant biodiversity have a well developed soil profile as compared to those with limited biodiversity.

4. Topography/Relief

The nature or shape of the earth's surface influences soil profile development. Highly or steeply sloping areas tend to have less developed soil profiles unlike areas of gentle slopes. This is because the rate of erosion is greater on the steep slopes and this removes the topsoil resulting into shallow or skeletal soils. On the other hand, in the gently sloping lands and generally flat lands, soil profile tends to be more developed i.e. there are deep soils.

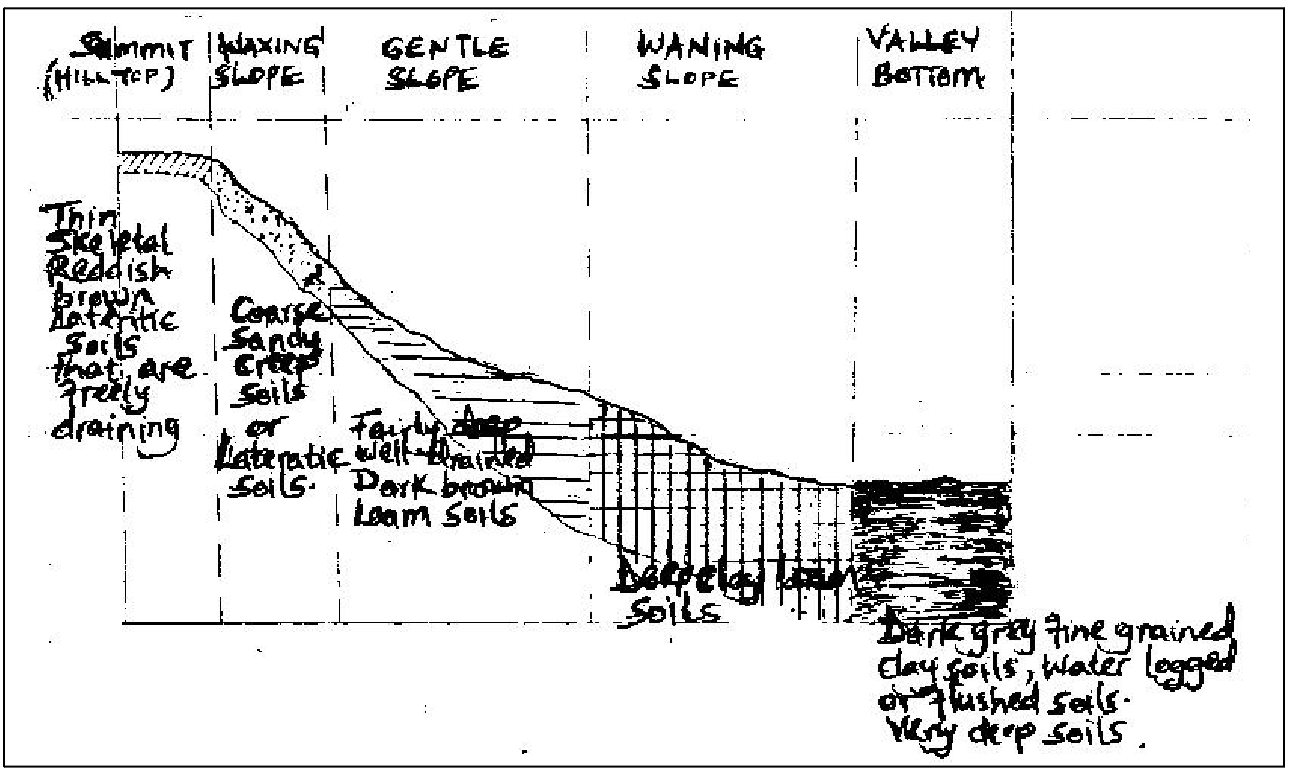
5. Time

It takes time for the soil profile to be fully developed. A typical or well developed profile of soil must have undergone adequate time, therefore the longer the time to which the rocks are exposed to weathering and other soil forming processes, the more the developed profile.
Young rocks normally yield skeletal soils i.e. with poorly development profile.

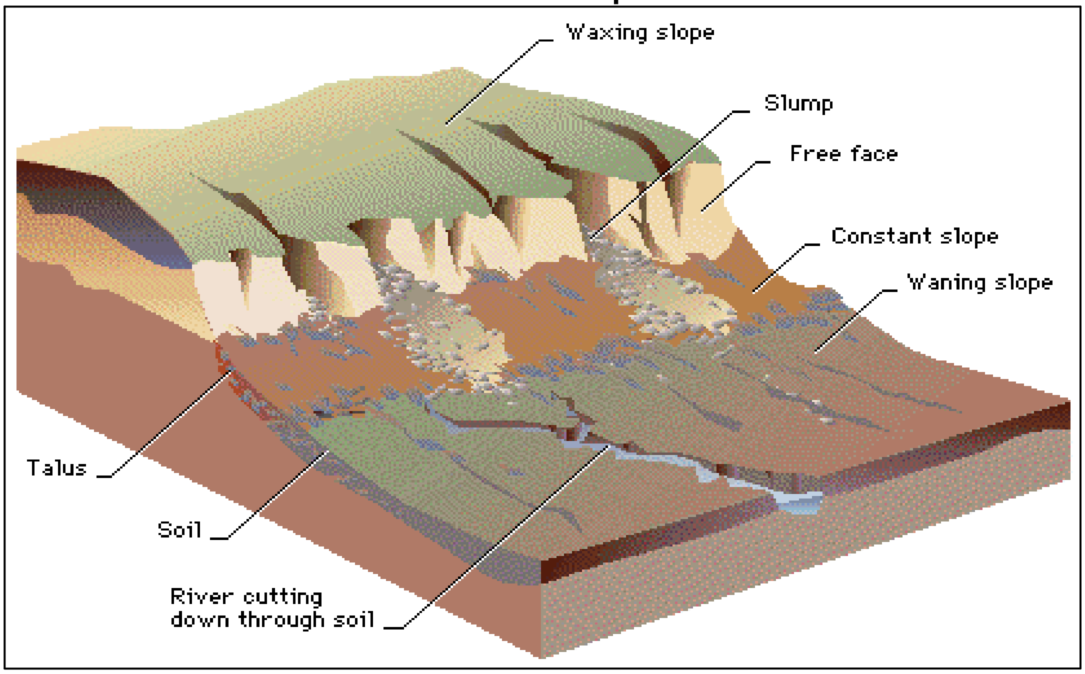
SOIL CATENA

This is the successive arrangement or sequence of arrangement of differing soil types along the slope from the hill top (summit) to the valley bottom.
This sequence varies with relief and drainage though it may be derived from the same parent material e.g. the soils at the valley bottom are likely to be different from those of the hill top.
Soil catena may be due to factors like relief, climate, living organisms and time.

Diagram illustrating soil Catena.



Profile of a slope



The factors influencing the development of soil catena:

Relief: which is the physical appearance (morphology) of the landscape affects or influences the development of soil catena in such a way that differences in relief affect the nature or soil type due to the fact that they influence erosion, deposition and human activities.

- Hill tops have lateritic capping with the resultant thin/ skeletal soils.
- The very steep slope/free face hardly has any soil i.e. has bare rock.
- The waxing slope/ convex slope is characterised by coarse, stony, creep soils due to erosion.
- The waning slope is fairly deep with clay loam soils.
- The low lying area/ valley bottom has fine particles of clay. It is deep and poorly drained. It is generally a zone of deposition or illuviation i.e. zone of accumulation.

The steep slope encourages erosion and hence has shallow soils. The gentle slopes are well drained and experience some down slope translocation of soil particles while the valley bottom experiences deposition hence accounting for the deep soils.

Climate: Influences the development of soil catena in the following ways:

- Heavy rainfall encourages erosion on the upper slopes (waxing slope) and deposition on the lower slopes and valley bottom.
- Heavy rainfall also encourages leaching leading to the development of lateritic soils along the waxing slope.
- Heavy rainfall also leads to flooding in the valley bottom and lower slopes resulting into clayey water logged soils.

Living organisms: These include plants, animals and man.

- Well vegetated areas lead to development of the loamy soils or those with adequate humus especially on the middle and lower slopes.
- Forested slopes check on the rate of soil erosion hence influencing the depth of the soil.
- Man's activities like deforestation and cultivation encourage erosion thereby leading to thinner soils especially on the steeper slopes while on the other hand encouraging deposition on the lower slopes and the valley bottom.

Nature of the parent rock: The differences in the soil types along the slope could be as a result of them having developed from different parent materials.

Time: The development of soil catena needs ample time. The processes involved take long and therefore the longer the geological time scale, the more developed of soil catena of an area.

SOIL TEXTURE

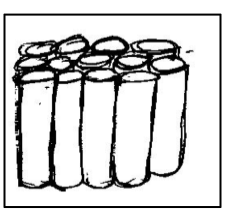
Soil texture refers to the size of soil particles. These particles may be classified as gravel sand, silt and clay. Soil particles like gravel have a coarse texture while particles like clay have a very fine texture. Soil that is commonly referred to as sand may include silt and clay. That is why we may have sandy loam soils, silty loam soils and clay loam soils. Soil texture is important in that it determines the water transmission capacity and the water retention properties of the soil.

SOIL STRUCTURE

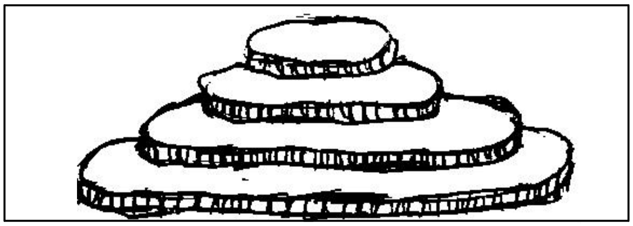
This refers to how soil particles are held together into large pieces or aggregates. Tiny particles or organic matter and mineral substances in solution known as colloids hold soil particles together. Soil structure may be derived from the fact that soil grains or mineral particles are grouped together in various ways.

The different types of soil structure include the following;

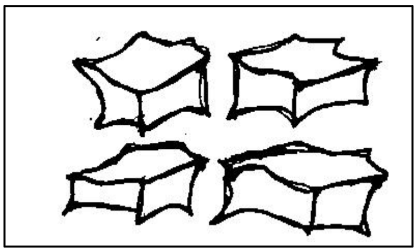
1. **Prismatic structure;** this is where mineral particles are grouped together in form of vertical long prisms or columns. These allow free vertical movement of soil water.



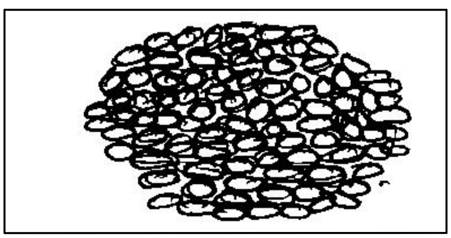
2. **Platy structure;** this is where the soil particles are arranged in flat thin horizontal layers. Such a structure hinders plant root development and the vertical water movement.



3. **Blocky structure;** this is where the soil is made up of sharp edged irregular blocks. This allows both vertical and horizontal movement of soil water.

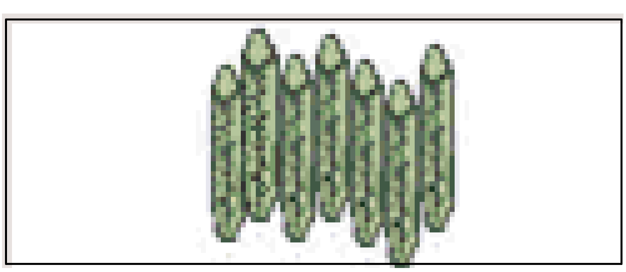


4. **Granular and Crumb structure**; this is where rounded or spherical soil particles are grouped in loosely arranged aggregates. Granular structure is normally located in the top soils and soils of granular structure are normally porous.



5 Columnar structure:

This is a column – like structure with rounded caps and sides. The particles tend to fit closely together. It is common in the B and C horizons and mostly found in alkaline and desert soils.



SOIL PH

This refers to the measure of the concentration of hydrogen ions in a solution. It is therefore the degree of acidity or alkalinity of soil. High concentration of hydrogen ions means the soil is acidic and low concentration means the soil is alkaline. The decay of organic matter increases the acidity of soils. On the other hand bases like calcium, sodium, potassium, make the soils more alkaline. The PH scale that measures from 1-14 is used to estimate the degree of acidity or alkalinity. A PH of 7 is neutral. If it is below 7 the soil is said to be acidic and if it is above 7 the soil is said to be alkaline.

Soil PH determines the mineral contents that will remain in the topsoil after others have been leached. This is because most minerals dissolve under acidic conditions. It therefore implies that leaching is more in acidic soil than in alkaline soils. In relation to human activities like agriculture, soil PH determines whether the farmer should add humus or lime to the soils so as to produce good agricultural soils.

PROCESSES OF SOIL FORMATION AND SOIL PROFILE DEVELOPMENT

1. **Weathering**

This is the physical disintegration or chemical decomposition of rocks. Rocks break down through various physical and chemical processes leading to soil formation.

High rate of weathering result into deep and mature soils meaning that with high rates of weathering, a mature soil profile is easily reached. In the tropics weathering under hot humid conditions has led to deep Latosols and tropical black earths. Weathering under humid temperate conditions have led to the development of deep podsols (poorly drained soils found in the temperate regions) and brown earths. In areas of seasonal rainfall deep chernozem soils have developed while in semi-arid regions, deep chestnut, coloured soils have developed. Weathering in high latitude climatic zones has yielded deep and mature tundra and arctic soils.

On the other hand areas of more resistance to weathering have lead to shallow soils or soils of poorly developed profile. Such include the recent volcanic soils, mountain soils, glacial soils and marine soils.

2. **Laterisation:**

This involves weathering under hot and damp conditions followed by leaching within the tropics to form Laterite. Silica is leached out of the A-Horizon leaving behind iron and alluminium compounds. Laterisation leads to the formation of a stratified profile consisting of an indurated zone known as duricrust.

Laterisation may also be described as the process by which silica is leached out and iron and alluminium compounds become concentrated in the A-horizon due to leaching and consequent drying. This gives rise to Laterite soils. Such soils that have been formed from weathered material that has not been fully leached are referred to as Latosols. Laterite is usually reddish brown colour and it tends to be sticky when wet i.e. it is plastic or cohesive.

They tend to harden when exposed to the dry atmosphere. In East Africa, Laterite is commonly known as murram. In the process of the formation of Laterite soils, it is important to note that iron and alluminium compounds do not dissolve easily and therefore get concentrated on the top soil. In the first place, the alluminium and iron compounds form small stones or gravel on the top or within of the weathered material known as Laterite gravel. After sometime the Laterite gravel is cemented together to form Laterite. It is important to note that the formation of Laterite is favoured by some conditions which include the following;

(a) Heavy rainfall that encourages chemical weathering and consequent leaching of silica.
(b) High temperatures to encourage deep chemical weathering.
(c) Clearing of vegetation (deforestation) i.e. man's influence that exposes the soil to the full force of rain and heat.
(d) Dry conditions that then enable the Laterite to harden.

It is important to note that Laterite can form from any type of soil.

Latosols

These are zonal or lateritic soils formed in humid tropical regions. They tend to be reddish brown in colour; are free-draining; have an acid reaction; and are rich in hydroxides of iron and alluminium or manganese. They result from deep weathering of rocks in tropical climates. The high temperatures and high rainfall plus free drainage cause deep chemical disintegration or decomposition and rapid removal of silica and bases through leaching leaving a concentration of sesquioxides of iron and alluminium. The texture varies from clay to loamy sand. There are five (5) divisions of Latosols namely:
(i) Weathered ferralitic soils.
(ii) Ferruginous soils.
(iii) Leached ferralitic soils.
(iv) Basisols.
(v) Humic Latosols.

Importance of Laterite

Laterite has both positive and negative importance.

Positive importance (Uses)
(i) Laterite is used for brick making for construction purposes i.e. it has promoted the brick making industry.
(ii) It is used for road making i.e. the construction of good murram roads.
(iii) Hardened Laterite provides a firm foundation for construction of buildings and other structures.
(iv) It may result into possible deposits of bauxite thereby encouraging mining.

Negative importance
(i) Laterite soils lack a variety of plant nutrients and may not sustainably support plant growth.
(ii) Laterite encourages soil erosion due to the low infiltration capacity.
(iii) Laterite is hard and difficult to work and therefore may hinder agricultural mechanisation.

3. **Leaching**

Leaching refers to the removal of solvable mineral nutrients by water from the upper layers of the soil profile to the underlying ones i.e. minerals like salt and carbonates dissolve in water in the top soil and move in solution form to the sub soil. Leaching results into an impoverished A-horizon.

4. **Eluviation**

This involves the movement of soil material in solution or suspension form from one place to another within the soil. This movement can be horizontal or vertical. Eluviation is commonly referred to as the movement in form of colloids or suspension. Eluviation generally leads to the development of an impoverished A- horizon i.e. the top soil is impoverished of soil nutrients.

5. Illuviation

This is the precipitation and accumulation of the leached and eluviated material in the B-horizon of the soil profile i.e. eluviated material and leached materials concentrate in the B-horizon. Illuviation is responsible for the B_2 layer (darker colour zone) where maximum accumulation of colloids takes place.

6. Humification

Is the process through which organic matter is decomposed to form humus that is then mixed with the inorganic content. It is common in wet, warm and densely vegetated areas such as equatorial or moist tropical regions. This process influences the development of the A_O and A_1 layers of the A-horizon or the O-Horizon.

7. Mineralisation

Occurs under extreme conditions in which decomposition of organic matter may extend further than Humification. Organic matter is further broken down into basic parts or components e.g. carbon dioxide, water and Silica. This greatly influences the formation of the A-horizon.

8. Calcification

Is a soil forming process, which takes place in dry or arid areas as a result of upward movement of capillary water with dissolved nutrients through capillary attraction moves from the lower parts of the soil the top or surface. This process is common in areas of limestone geology on East Africa. The soils formed comprise of a lot of calcite or calcium compounds. Calcification leads to the development of shallow soil profiles.

9. Gleization/ Gleying

This soil forming process occurs in climatic environments where there is impeded drainage i.e. where there are swamps or wetlands. Usually the process leads to the development of hydromorphic soil. In addition, the oxygen deficient conditions of water- loggedness leads to the reduction of ferric oxide to ferrous oxide giving a grey colour. Such soils are intrazonal hydromorphic soils with poorly developed profiles.

10. Podsolisation.

This process occurs under cool moist climatic conditions i.e. temperate climatic conditions. It involves the removal of iron and alluminium oxides known as sesquioxides due to intense leaching especially where soils are sandy or well drained. It results into soils with an impoverished A-horizon.

11. Salinisation

Is the process by which soils are enriched with salt. This is due to evaporation from the soil surface which draws up soils in solution by capillary movement. Salinisation may also be induced by man through intense irrigation. It gives rise to saline top soils (intrazonal soils of high salt concentration especially in the semi-arid areas. Salinisation gives rise to a poor A-horizon.

12. Chelluviation

This is the process that involves chemical bonding of metallic ions and organic matter. In this case when organic matter decomposes it releases chelating agents (organic acids) that attack rocks thereby producing iron, alluminium and magnesium compounds which then move downwards affecting soil movement or development. It normally results into rich nutrient A-horizon soils.

13. Lessivage

Is the process of soil formation especially the break down of peds where clay particles are carried downwards from the upper soils in suspension form leading to an impoverished A-horizon and hard pans in the B-horizon?

Classification of soils

Soils may be classified as zonal, intrazonal soils and azonal soils.

Zonal soils

These are soil types largely resulting from the climatic factors, which contribute to soil forming processes. They are well developed or mature soils with well developed profiles due to prolonged action of climate and vegetation. They develop under conditions of good soil drainage i.e. under well drained soils. The soils develop on gently sloping or rather flat landscapes. They develop from parent rocks that are neither very acid nor very alkaline. Zonal soils are mainly categorized into two groups namely;

(a) **Pedocals:** These are soils with a high calcium carbonate content that tend to develop under conditions of low rainfall e.g. chernozems, chestnut or brown soils, sierozems etc.

(b) **Pedalfers:** These are soils with a high content of alluminium and iron i.e. they are rich in alluminium and iron and have low calcium carbonate content mainly due to leaching. Such soils include podsols, the Latosols and prairies soils. Generally, types of zonal soils tend to be restricted to certain latitudinal regions. The resultant type of zonal soils is closely related to the nature of weathering that takes place under a specific type of climate for instance;

(i) In low latitude areas/ tropics, the hot humid conditions give rise to Latosols and tropical black earths (Basisols).

(ii) In mid latitude climates, humid conditions are associated with the development of podsols and brown earths.
(iii) In areas of seasonal rainfall chernozem soils develop e.g. on the Canadian prairies.
(iv) Semi-arid conditions and arid conditions yield chestnut coloured soils.
(v) High latitude climates lead to the development of Tundra and arctic brown soils.

Azonal soils
These are young soils without a clear soil profile; they have not been exposed to soil forming processes for long so as to develop mature characteristics. They tend to be skeletal with an underdeveloped soil profile. They also tend to show characteristics of their original parent rock material. They are derived from unconsolidated material such as alluvium, sand and volcanic ash. Examples of azonal soils include the mountain soils, alluvial soils, marine soils, glacial soils, wind blown soils and recent volcanic soils.

Factors influencing the formation of azonal soils

- Weathering of the parent rock leads to the formation of screes on the mountain slopes. These soils normally show characteristics of their original parent material and resist change.
- Volcanic activity leading to the extrusion and deposition of lava resulting into the formation lava/ash soils, cinder and pumice.
- Erosion, transportation and deposition through agents such as.
  - Wave action leading to formation of mudflat soils/marine clays.
  - Wind action leading to the formation of windblown soils like sand sheets, sand dunes and loess.
  - Glacial action (fluvio-glacial action) resulting into the formation of fluvio-glacial soils such as tills, outwash sands and gravel as well as resorted clays (Deposited in glacial lakes).
  - River action leading to the formation of alluvial soils.
- Climate influences azonal soil formation in the following ways:
  - Heavy rainfall results into river floods that lead to the formation of alluvial soils in the lower course.
  - High rainfall causes erosion on steep slopes and deposition in the lowlands leading to the formation of alluvial soils.
  - Temperature changes on the mountain slopes influences physical weathering consequently leading to the formation of rock screes.
- Relief: The nature of relief influences erosion of screes on the mountain slopes and their subsequent deposition hence forming new soils.
- Human activities like quarrying and mining lead to the breaking of parent rock into simpler particles leave alone dumping of rock waste material leading to the formation of azonal soils. In addition deforestation, bush burning and overgrazing expose the parent rock to weathering processes that lead to the formation of young soils.
- Time lapse: Azonal soils are immature soils and this mainly depends upon the short period of time entailed in their course of formation.

Intrazonal soils

These are mature soils that result from particular conditions or constituents. They are not therefore restricted to latitudinal zones like the zonal soils.

They are developed under special prevailing conditions as a result of local factors such as relief and the parent material.

Examples of intrazonal soils include; the bog/peat soils (hydromorphic soils), saline soils (balomophic soils). In addition there are also soils that develop over calcareous parent material leading to the development of calcimorphic soils. Intra zonal soils also include meadow soils.

Vegetation in East Africa

Refers to the living mantle occurring on the earth's surface or the plant life on the earth's surface.

Vegetation can be classifies as, natural (God given) and artificial vegetation.

Types of vegetation

- Equatorial forests/ Tropical rainforests
- Mangrove forests
- Montane forests (Bamboo, Heath and Moorland, and Temperate forests)
- Savanna vegetation (woodland, grassland and dry bush)
- Swamp vegetation
- Semi-arid/Semi-desert vegetation

Equatorial Forests/ Tropical Rainforests

This is found around the equator 10^{o} North and South i.e. in areas which receive heavy rainfall, hot temperature and high humidity almost throughout the year. For example around Lake Victoria shores, Mabira forest, Budongo forest etc.

Characteristics of Tropical Rainforests

- They are very tall and straight with broad leaves to allow loss of excessive water. The process through which trees lose excessive water is called Evapo-transpiration.
- Tropical rainforests are ever green i.e. the trees never shed all their leaves. They shed as they grow leaves at the same time.
- They are made up of various tree species which do not grow in pure stand. Over 25 species are believed to grow on an acre of land.
- Many large trees grow buttress roots and these are thin triangular shrub of hardwood that spread out from the bases of their tracts perhaps provide extra support.
- They have climbing plants (Lianas). These can be seen climbing all over the forests while their leaves and flowers appear only among trees tops.
- They have epiphytes these are plants that grow on the other plants but don't actually feed on them.

- Rainforests have thick undergrowth, but only in a few places where some trees have been destroyed by lighting or cleared by man.
- They grow in distinctive layers or canopy. The 1st layer row up to 10 meters high. The second grow up 25 meters and the third grow over 50 meters high.
- They mostly yield hardwood for example mahogany, Ebony, and therefore difficult to work on
- They are very tall and straight attaining a height of 50-60 meters which is about 150-180ft high.
- The tree species are generally broad leafed to reduce excessive loss of water through Evapo- transpiration.
- Forests are thick and luxuriant and sometimes impenetrable. This is due to the hot temperature and wet conditions with heavy rains throughout the year.

Conditions favouring the growth of Tropical Rainforests

- Presence of deep fertile well drained soil on mountain slopes like mountain Elgon, and other lowland tropical areas like Mabira, Budongo, and Kalangala etc.
- In terms of relief by large tropical rainforests grow in lowlying areas like around shores of lake victoria and lower slopes of mountains e.g. at Rwenzori, Elgon etc.
- Tropical rainforests also grow in areas of which receive heavy rainfall, almost throughout the year usually over 1000mm e.g. around Kenyan highland, Kalangala etc.
- There must be warm temperature to enable the growth of tropical rainforests
- In terms of latitude tropical rainforests grow in lower latitudes usually between 0-15^{o} North and South.
- Government policy of gazzeting tropical rainforests is the reason why they continue to exist in places like Elgon slopes, Budongo, Kalangala etc.
- They are thick which makes access very difficult and this help in their conservation indirectly as it is very expensive to put utilities like roads which would increase encroachment on them.

Land-use in Tropical Rainforests

- Tourism and wildlife conservation
- Lumbering
- Research grounds
- Agriculture
- Herbal medicine
- Source food from wild fruits, vegetables and root tubers

- Source of fuel (firewood, charcoal)
- Fishing from rivers that go through them
- Art and craft
- Mining as they habour minerals
- Wind breakers
- Water catchment areas
- Soil erosion controllers

Question

Describe the characteristics of tropical rainforests

Account for the growth of tropical rainforests in East Africa

Savanna Vegetation

Is the most dominant type of vegetation in East Africa and it is divided into 3;

- Savanna woodland
- Savanna grassland
- Dry savanna

Savanna Woodland

It is found in areas just after tropical rainforest i.e. areas which receive heavy rainfall and fairly fertile soils e.g. in central Tanzania (Miombo-Woodland)

Characteristics of Savanna woodland

- More continuous cover of trees i.e. dominated by trees and less grass cover.
- The height of trees is medium about 15-30 meters high.
- Trees shade off leaves during the dry season and regain them in wet season shading of leaves in dry season helps them to reduce water loss through Evapo-transpiration.
- They are umbrella shaped to preserve moisture around the stem and root zone.
- The major tree species are acacia and Baobab.
- The trees are hardwood species with a long gestation period.
- Trees wear tap roots to enable them absorb water from deeper soil layers for survival in long dry seasons.

Savanna Grasslands

These are found after Savanna woodland in places like Northern Uganda and Nyika plateau.

Characteristics of Savanna Grassland

- They are dominated by grass with a few scattered trees.
- Trees are short compared to those in Characteristics of Savanna woodland.
- The grasses are tall about 2-8 meters above the ground e.g elephant grass and spear grass.
- Trees have tap roots
- Trees are umbrella shaped
- Trees have thick barks
- Major tree species are Acacia and Baobab
- Trees and grasses are drought resistant (Xerophitic)

Dry Savanna

This is found at the margin of savanna grassland in areas receiving little and unreliable rainfall below 350mm e.g. in North East Uganda and North West Kenya.

Characteristics of Dry Savanna

- Trees are very short and stunted due to infertile soils.
- Trees wear thorns to store more water
- There are lots of thicket and shrub
- Grasses dry up in dry season
- They are drought resistant (Xerophitic)

Factors for the growth of Savanna vegetation in East Africa

- Little and unreliable rainfall of about 350 mm and below.
- Presence of fairly fertile soils leading to the growth of Savanna grassland and dry savanna.
- Altitude also influences the distribution of savanna in that savanna survives well in lower altitude.
- Latitudinal location also influences the distribution of savanna in that savanna also survives in the middle latitude zones.
- Government policy of gazzeting savanna is the reason why they continue to exist in places like national parks.
- Man’s activities like deforestation, bush burning, overgrazing have modified savanna vegetation from woodland to grassland and sometime to dry savanna.

Question

To what extent is man responsible for the modification of Savanna vegetation in East Africa?

Approach

Define vegetation

Identify various vegetation types

Characteristics

Body: Role of man and other factors

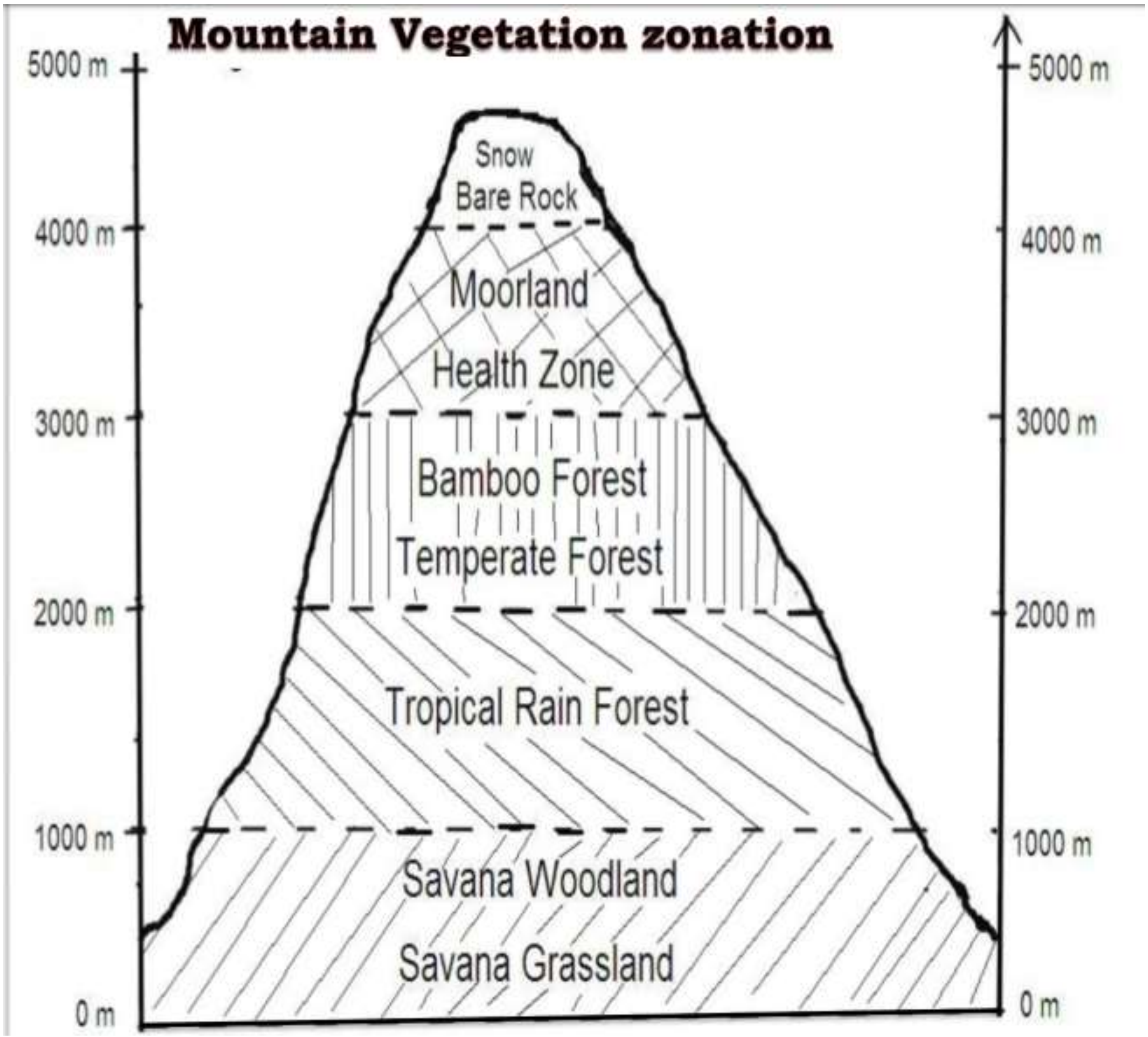
Conclusion

Land-use in Savanna

- Tourism and wildlife conservation
- Animal grazing
- Bee keeping
- Lumbering
- Promotes research
- Source of fuel (firewood charcoal)
- Arable farming
- Art and craft
- Brick making

Montane Vegetation

This type of vegetation is restricted to highland areas of East Africa like mountain Rwenzori, Elgon, etc. In these areas there exist vegetation zones which vary with altitude. Montane forests are categorized into;



- Bamboo forests
- Temperate forests

Characteristics of Bamboo forests

- Ever green throughout the year.
- They have hollow streams.
- They have small and pointed leaves.
- Limited undergrowth because of dump conditions.
- They form closed canopies usual appearing in one layer.

Temperate Forests

These are located after Bamboo that is a greater height where climate condition especially temperatures determine the existence of temperate forests.

Characteristics of Temperate forests

- They are very tall and straight growing up to 30 meters or 150 feet high
- Their leaves are ever green, narrow and needlelike to reduce excessive loss of water through Evapo-transpiration.
- Their leaves have waxy covering which protect them from frost during winter.
- Trees have a conical shape to allow snow to slide off and have inflexible boundary where snow slide out without affecting them.
- The back of the trees consist of a sticky substance which help them to store food in extreme coldness
- They have limited undergrowth due to the presence of snow.
- Temperate forests grow in pure stands i.e. single species of tree in one area for example Spruce, Western Hemlock which make extraction easy.
- Most temperate forests have softwood tree species which are light in weight.
- The trees have a short gestation period which is about 8-20 years to reach maturity.

Characteristics of Heath and Moorland

- They appear short and stunted
- Limited undergrowth
- Some plants are greyish in colour
- They have waxes on leaves and stems

Account for vegetation zonation on any one mountain in East Africa.

Approach

Define vegetation	*Characteristics*
Identify various vegetation types	*Distribution*

Body

Factors for existence at different levels

Conclusion

Mangrove Forests

These are mainly found along the coast of East Africa

Characteristics of Mangrove Forests

- Trees are relatively short
- They are ever green because of fertile soils and heavy rainfall.
- Limited undergrowth because of dump conditions.
- The foliage have greyish colour.
- They have Ariel roots
- They grow in poorly drained soils
- They grow in lowlying places about 200m above sea level
- They grow in places with relatively warm temperatures

Semi-arid/Semi-desert vegetation

In East Africa, is found in places with very little rain hot temperatures e.g. Ankole-Masaka Corridor, Karamoja, Masai and Turkana land etc.

Characteristics of Semi-arid/Semi-desert vegetation

- Most plants are drought resistant (Xerophitic)
- Trees are very short and stunted
- Most trees are deciduous i.e. they shade leaves in dry season to limit loss of water through Evapo-transpiration.
- The trees have thick barks to enable them store water for survival in prolonged dry season.
- Grasses dry up in dry season
- Tree leaves are very tiny and sometime modify into thorns
- Trees are umbrella shaped
- Trees have big tap root to enable them draw water from deeper soil layers

Conditions for the growth of Semi-arid/Semi-desert vegetation

- Very little rainfall below 350mm
- Temperature is constantly high almost throughout the year
- There is low humidity below 30 almost throughout the year
- Presence of infertile soils
- Limited water bodies
- Man's activities such as overgrazing, bush burning, deforestation, sinking boreholes, overstocking etc.

Land-use in Semi-arid/Semi-desert vegetation

- Nomadic pastoralism
- Mining
- Tourism and wildlife conservation
- Research
- Irrigation farming
- Brick making

Swamp Vegetation

This is restricted to lowlying areas like river valleys and coastlines.

Characteristics of Swamp Vegetation

- Mainly composed of papyrus, Lilies and water logged friendly plants.
- Vegetation is ever green
- There is limited undergrowth
- They have adventitious roots

Question

To what extent is man responsible for the distribution of vegetation in East Africa?

To what extent are climatic factors responsible for the distribution of

TECTONIC MOVEMENTS (TECTONISM)

This refers to all natural forces of internal origin which bring about destruction and irregularities on the earth surface. Tectonism refers to all endogenic processes including earth movements (diastrophism and vulcanicity. Diastrophism are endogenic processes that don't involve the introduction of new materials they include ***faulting, warping, folding*** and ***earth quakes***.

Nb. **Vulacanism** is not an **earth movement** or **diastrophic** process because it involves ***the introduction of new material (magma***) into the earth's crust or on the earth's surface.

Earth movements can be grouped into two mainly

a) Epieorogenic forces (vertical earth movements)

These are large scale vertical forces that disturb the earths internal structure vertical uplift or subsidence resulting from isostatic readjustments. These vertical earth movements occur along the earth's radius either towards the earth's surface or towards its center. Forces pushing upwards cause up warping while those pushing down wards cause down warping. Uneven up warping results into tilting of the earth's crustal layers ***(differential uplift and down lift).*** The major vertical movement is ***Warping.***

b) Orogenic forces (Horizontal/Lateral movements)

These are forces which act laterally or horizontally involving both ***compression, tension in the crust and shearing of the crustal rocks.*** These normally act along the horizontal plane. When horizontal forces are moving away from each other, they cause ***tensional forces*** which result into ***stretching of the crustal rocks in the center.***

When the horizontal forces push towards each other they cause ***compressional forces***. Such forces cause the crustal rocks to ***shorten or to be squeezed***.

Shearing takes place when horizontal forces are **operating in the same direction**. It may also occur when forces ***operate in opposite direction and move past each other***. It causes displacement of rocks horizontally by slipping past each other. They result into **faulting, folding and earth quakes.**

Causes of earth movements/ origins of earth movements

These include;

a. Convective currents in the mantle. These result from ***heating by radio activity, geo chemical and geo physical reactions.*** These currents rise in **a circular motion** and on approaching the base of the crust they **move horizontally**. This horizontal movement causes a frictional drag of crustal rocks to move horizontally.
b. Magma movement within the earth's crust. Magma rises in form of convective currents and on reaching the base of the crust ***some overlying rocks may be forced to gradually tilt upwards***. Some rocks may bulge upwards.

c. Gravitational forces. This is a force of the earth that pulls bodies towards its center. After magma eruptions hollows and voids are created in the upper mantle. Presence of such voids and gravitational pull ***encourages the down ward movement of crustal rocks.***

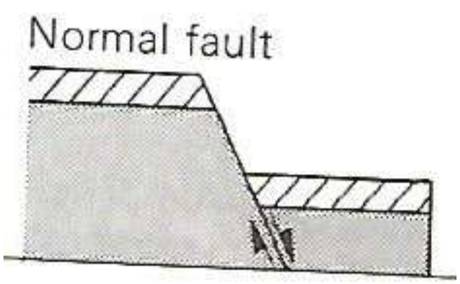
FAULTING

Faulting refers to the fracturing of the rocks on the earth's crust due to strain and stress which subsequently leads to displacement of rock strata to form faults. A fault is a surface rapture or fracture of rock strata involving permanent dislocation and displacement within the crust.

Faulting is caused by ***heating by radio activity, geo chemical and geo physical reactions*** leading to ***convective currents.*** These currents rise in **a circular motion** and on approaching the base of the crust they **move horizontally**. Forces moving ***towards*** the Centre cause ***compressional forces*** while forces ***moving away*** from the Centre cause ***tensional forces***. These forces are associated with the following faults.

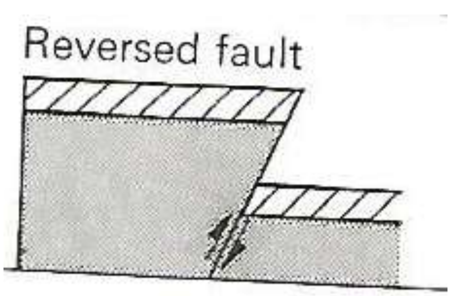
1. Normal Faults

These are also referred to as tensional faults. They are caused by the tensional forces leading to one fault block sliding down relative to the other. Here, the inclination of fault planes and the direction of the down throw are both on the same side of the fault.



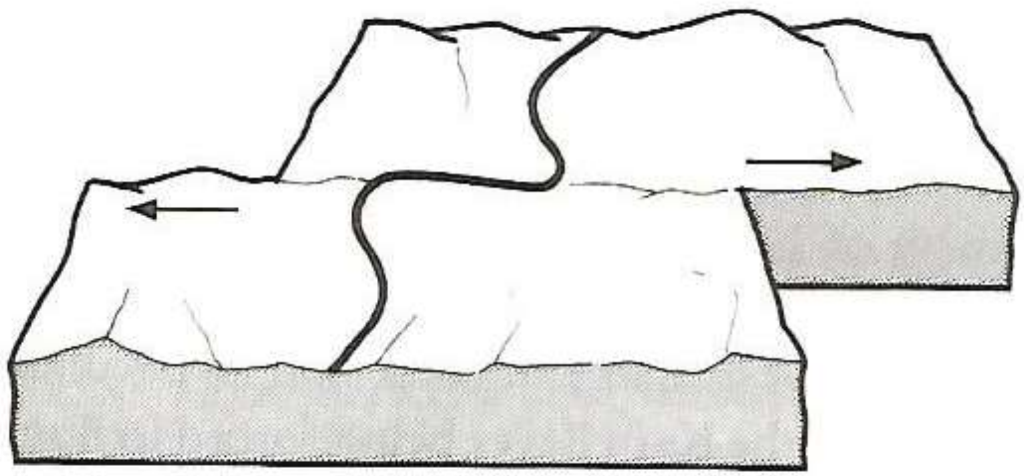
2. Reversed Faults

These are caused by compressional forces i.e. forces from different directions towards the same focal Centre. This forces the beds on one side of the fault plane to thrust.



3. Tear Faults

These are also known as horizontal strike or wrench faults. They are caused by horizontal movement of the plates alongside each other with no vertical movement. They occurs when faulted rock beds slide past each other laterally. Examples include Aswa fault in Northern Uganda.



4. Splinter Faults

These are faults which don't fully develop. They produce low escarpments which run for a few kilometres and then disappear e.g. Ngurman escarpment West of L. Magadi in Kenya.

FEATURES FROM FAULTING

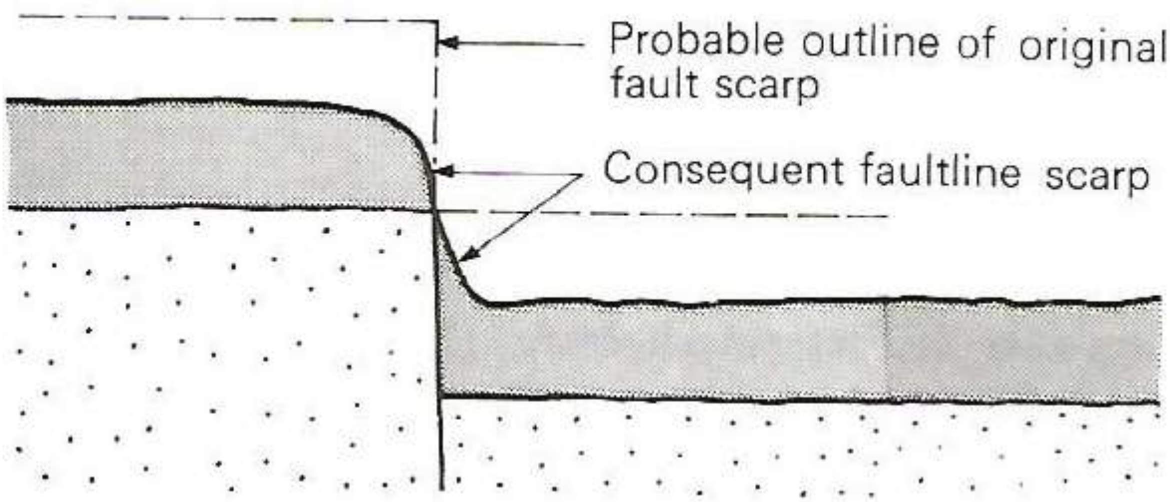
1. The Fault Scarp/fault escarpment

The fault scarp or an escarpment is a steep slope where land suddenly drops from higher to lower levels. It is a landform produced by vertical movement of the earth's blocks along a fault. One block along the fault line is thrust up while the other is thrust downwards to create a steep slope between them. Examples include; Butiaba, Kichwamba and Kyambura escarpments in Uganda, Elgeyo faults scarp, Mau fault scarp, Aberdare fault scarp in Kenya, Manyara and Chunya in Tanzania.

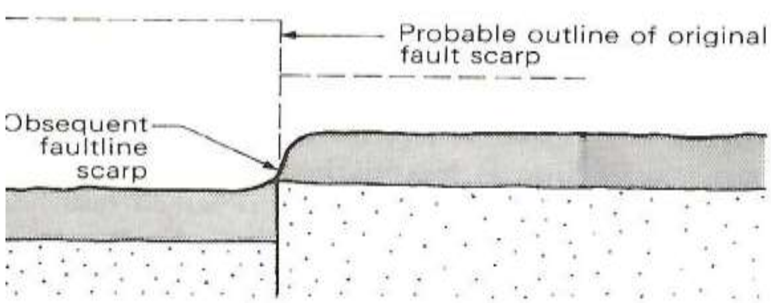
2. The Fault Line Scarp

This occurs as a result of indirect effect of faulting. It is formed as a result of long periods of erosion along a fault line. It occurs when faulting brings rocks of different resistance into Juxtaposition. The rocks will be eroded at different rates as a result of their resistance. Fault line scarps may be of two different types. They may be consequent or normal fault line scarps or they may be obsequent fault line scarps. Examples are Mutilo scarp East of Kitui hills in Kenya, and Kilosa-Msolwa Scarp-South-West of Morogoro in Tanzania

a) Normal/Consequent Fault Line scarp



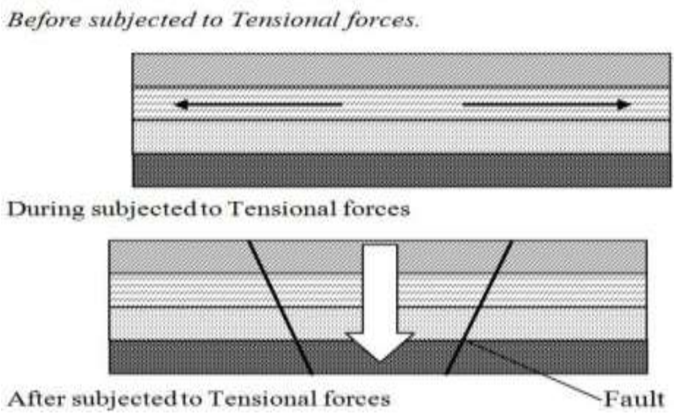
b) A scarp facing the opposite direction to the original scarp is called a reverse or obsequent fault line scarp.

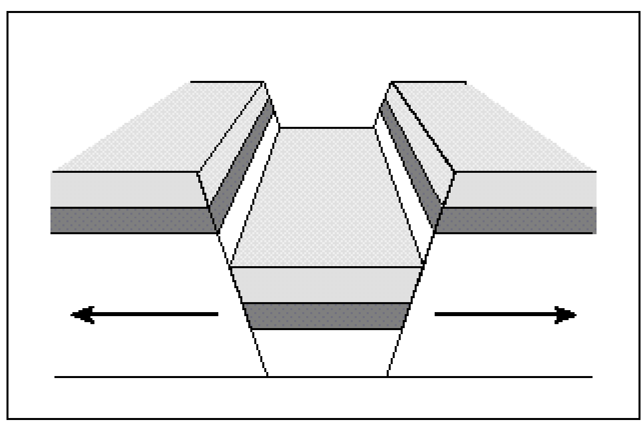


3. Rift valley

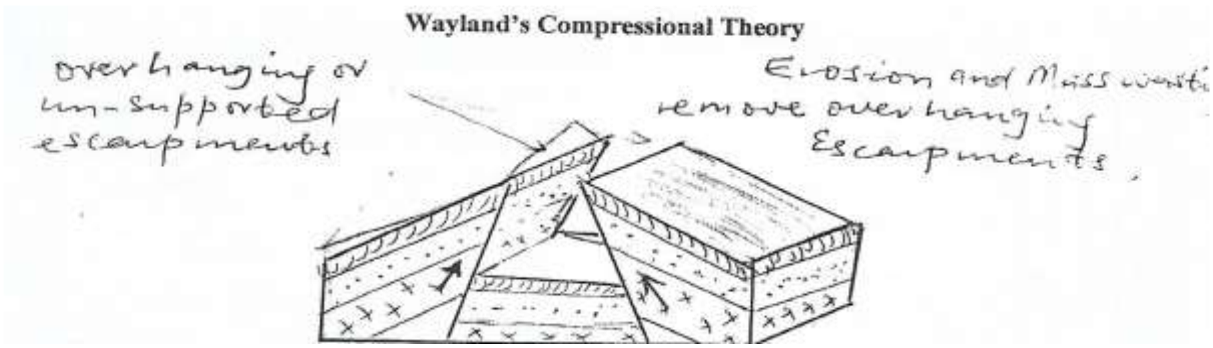
A rift valley is a large elongated depression or trough-like valley bordered and bounded by in facing fault scarps or escarpments which slope towards the valley in more or less parallel faults. The origin and formation of the rift valley is still not fully understood. However, several theories have been put forward to explain the formation of the rift valley.

a) **The tensional force theory.** According to J.W Gregory, **heating by radio activity and geo chemical reactions resulted into divergent forces or *Tensional forces*** within the crust led to the formation of ***normal faults*** which pulled the fault blocks apart leaving the fault block between the parallel fault lines to subside/sink under its own weight forming a rift valley.

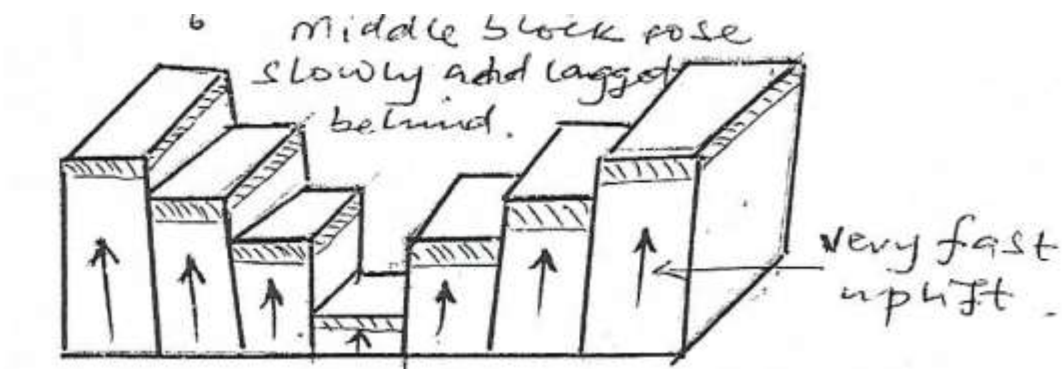




b) ***The compressional force theory.*** According B. Willis and E.J. Wayland the rift valley was formed by compressional forces**.** ***Heating by radio activity and geo chemical reactions*** resulted into ***convergent forces /compressional forces*** created ***reversed faults***. Continued compression caused the ***up thrust*** of the blocks on either side of the middle block giving the middle block a **down throw** to form the rift valley as shown below:-

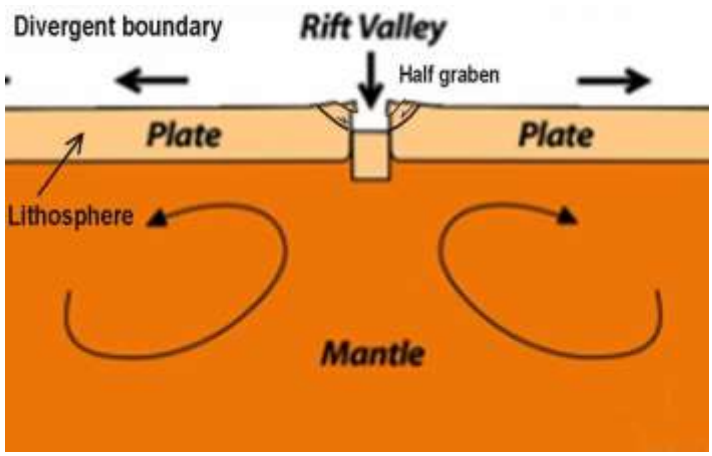


c) ***Differential uplift theory.*** According to Dixey's and troupe the theory is related uplifting or swelling of land, a series of **parallel fault lines** were created by faulting. After the formation of the fault lines, there was gradual uplifting of the whole faulted region, but the ***blocks on the either side*** of the central fault block ***rose much faster than the central block***. The central block that ***rose slowly*** formed a ***rift valley***.



d) Anticlinal arching theory or basin and swell theory. Forces originate from inside the earth and push the earth's crust upwards. The layers of rock bend upwards into a big arch or anticline. Continued upward push leads to increased stress at the crest of the anticlines. Cracks develop at the crest forming a wider valley.

e) **Plate tectonics theory.** This is related to plate movement. A plate refers to crustal block. These plates float on the mantle in the direction of the movement of convective currents in the mantle. It was formed when two divergent plates moved away from each other as a result of tensional forces pulling away from the center of the crust. This explains the formation of the Eastern arm of the rift valley.

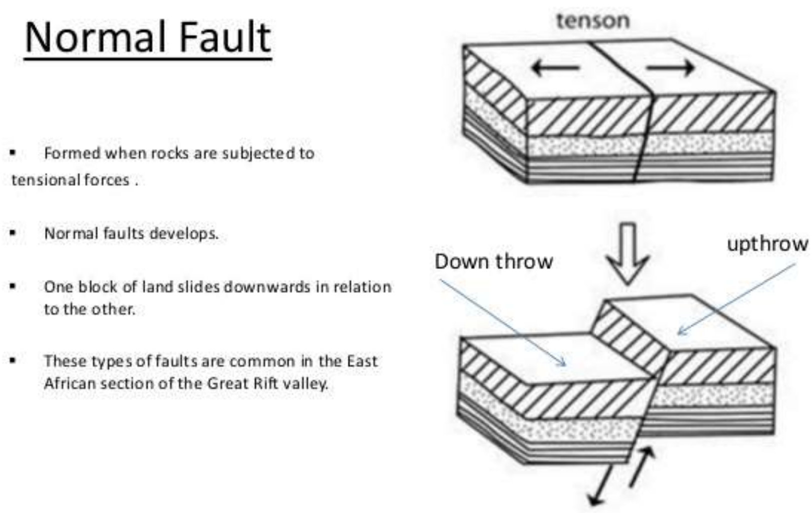


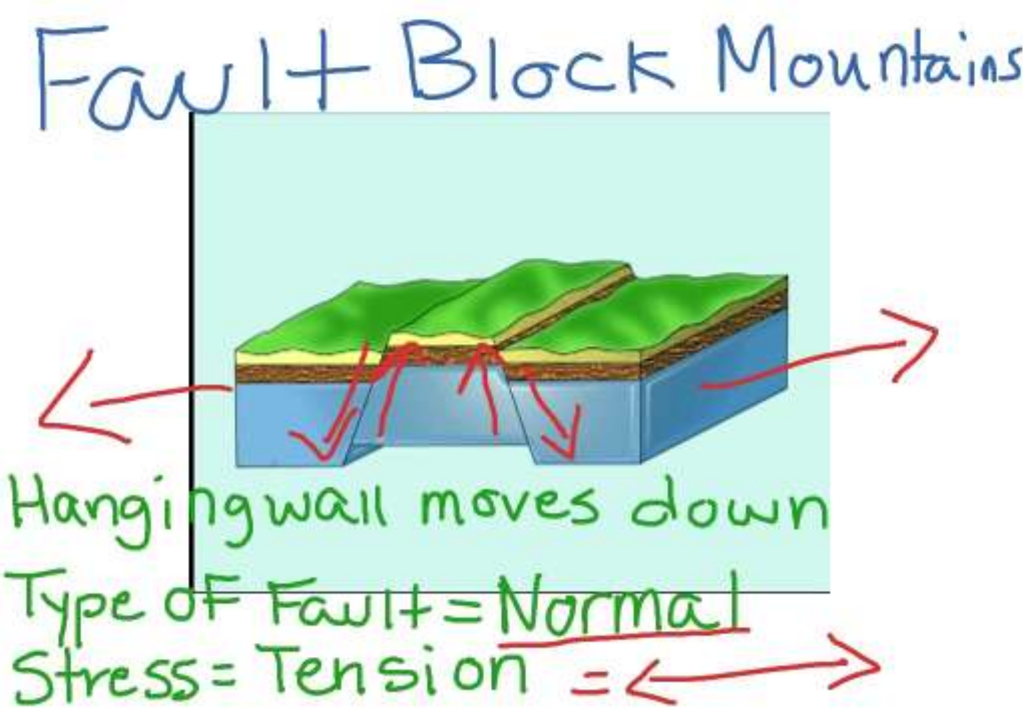
e) According to King's Theory, he suggested that, as the main land of the earth rose (arched) ancient fractures formed zones of weakness at the top of the hills which led to the formation of the rift valley. King suggested that, the rift valley in E. Africa was formed on a huge upward swell. The central proportion of this arch sagged to form a down warped region occupied by L. Victoria, while the flanks have been up warped and faulted to create western and eastern arms of the rift valley.

4. Block Mountains

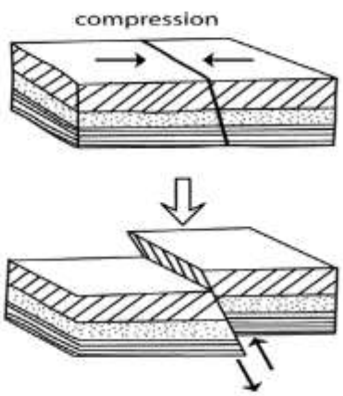
A block mountain or horst is an upland bordered by faults on one or more sides. Sometimes, earth movements cause the crust to be divided into rectangular shaped blocks. This is known as block faulting. Because of continued horizontal forces, these blocks may further be made to rise or sink. The uplifted blocks then form Block Mountains. Examples are Rwenzori ranges, Pare, Uluguru, Ngiro, Usambara and Ndoto ranges. Many theories have been put foward to explain the formation of Block Mountains.

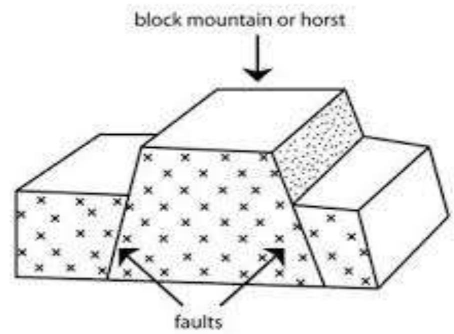
a) ***Tensional force theory.*** According to this theory heating by radio activity geo physical and geo chemical reactions led to tensional forces. These forces pulled away from the Centre of the crust forming normal faults .as the pulling continued side blocks were forced to sink while the middle block was left stable to form a block mountain.



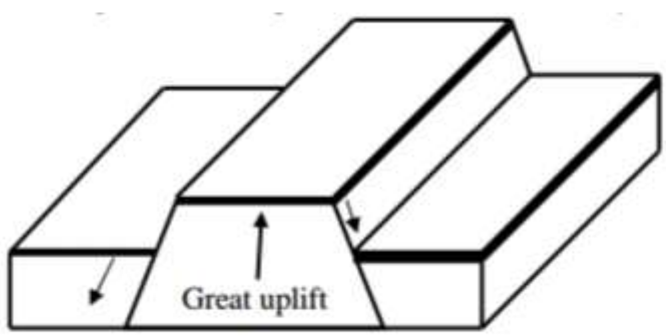


b) ***According to the theory of compression,*** compressional forces led to the formation of reverse faults. Because of continued compression, the central block was upthrust leaving the lateral blocks stable resulting into the formation of Block Mountains.

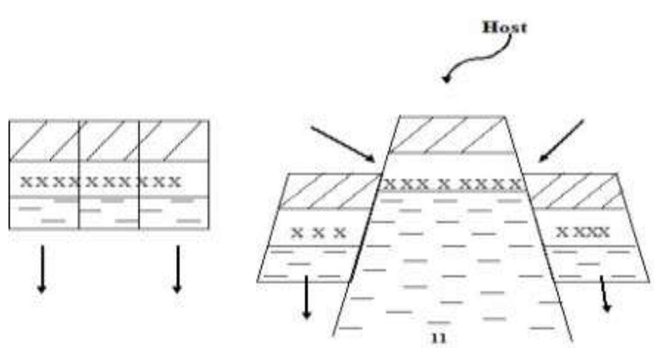




c) According to the theory of differential uplift tensional forces in the interior of the earth created parallel faults followed by a general uplift of the whole faulted region but the fault block in the middle rose much faster than the blocks at the sides. The middle block projected up above the outer block forming a block mountain.

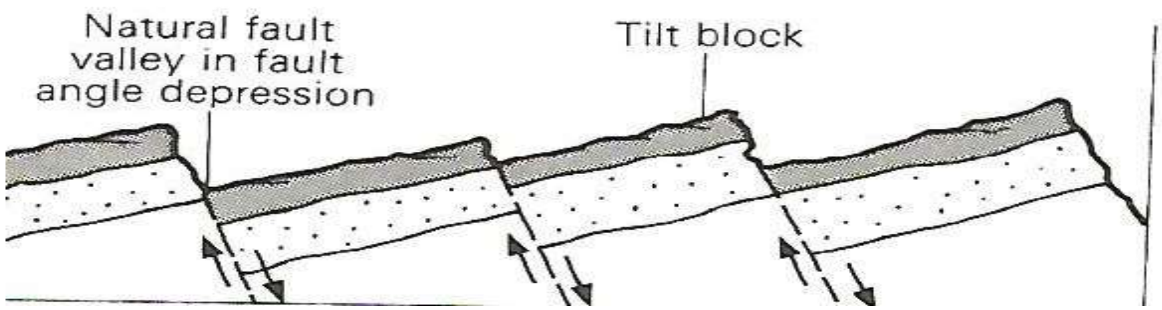


d) According to the theory of relative sinking tensional forces led to the formation of parallel faults followed by a general subsidence of the whole faulted region. The faulted block in the middle did not sink so fast as the blocks at the sides and therefore, it remained standing up as a block mountain.

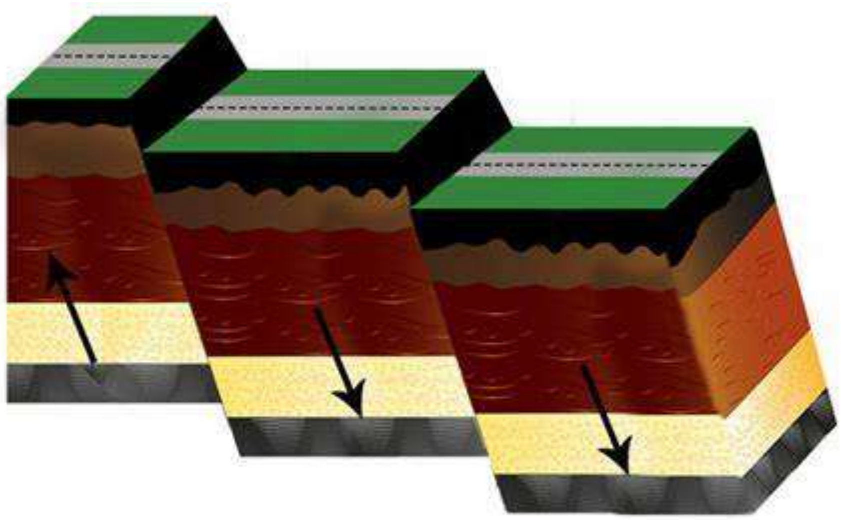


5. Tilt block landscape.

These are fault blocks produced by the stretching of the earth crust. They occur at the side of the rift valley. Tilt block landscape is a land scarp made of angular ridges and depressions formed from the series of tilted blocks which have been down warped on a large scale. The faulting is accompanied by tilting leading to the formation of a tilt blocks e.g. Nyiru, Aberdare region. etc.



6. Step Faults. These are produced from parallel faulting when subjected to forces of tension which force the faulted block to rise or sink to form gigantic steps e.g. five series of step faults appear at the foot of Kedong Fault scarp West of Nairobi along L. Magadi road in Kenya where it descends to the rift valley.



7. Fault Guided Valley. This is a valley/depression located on a single fault line. It arises due to displacement of rocks along a fault which causes the rocks along the fault line to be shattered or crushed. The shattered rocks are then eroded which result into the creation of depression along which a river may flow e.g. Aswa valley in Northern Uganda, Kerio valley between Elgeyo escarpment and Kamasiya ridge in Kenya.

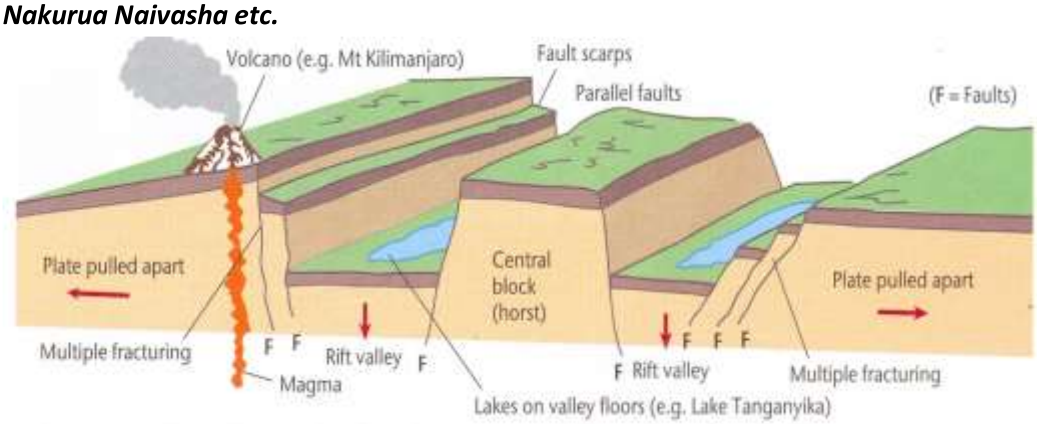
8. Graben Hollows. These are narrow troughs between parallel faults formed due to secondary faulting within the rift valley leading to the formation of large basins which may be filled with water. e.g. L. Albert, Edward e.t.c.

Nb. Grabens are discussed in plate tectonics theory.

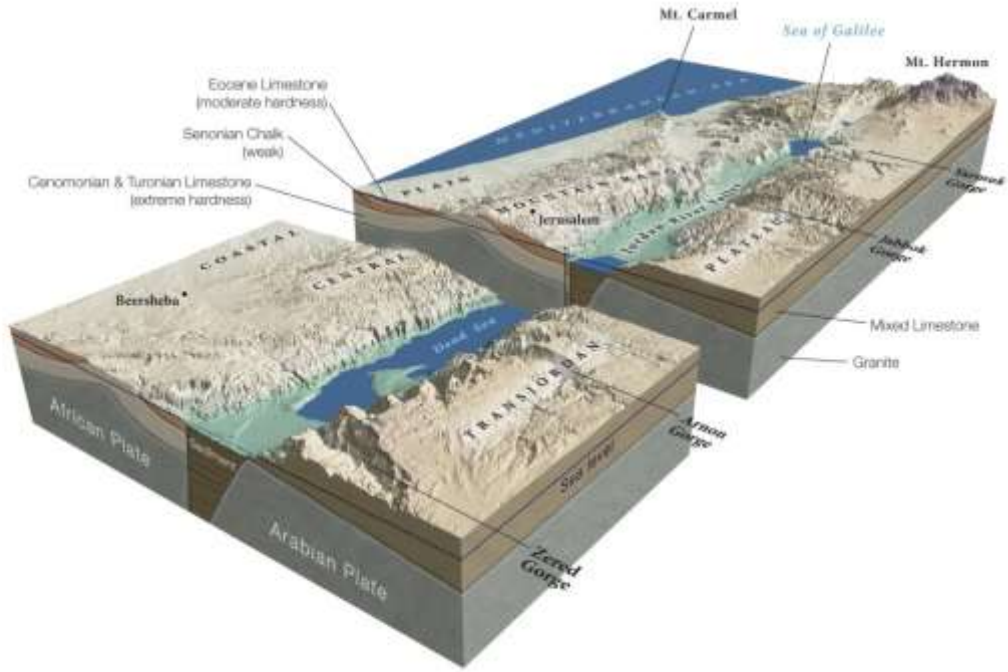
Influence of faulting on drainage.

The fracturing of rocks along which displacement occurs results into formation of several land forms which affect the drainage system. Faulting results into the formation of the following drainage features;

1. Rift valley lakes/graben lakes; these are long, narrow deep depression filled with water. They are small depressions formed on the rift valley floor. In other words they are referred to as **"valley within a valley".** They are formed by ***secondary faulting.***
   At the *divergent boundary*, two plates moved away from each other forming a rift valley. Due to ***secondary faulting*** on the rift valley floor, a small, long narrow depression formed on the rift valley floor called a graben. It's later filled with water from rivers and rainfall forming a ***rift valley lake.***
   Examples are the numerous lakes in the eastern arm of the rift valley like Turkana, Nakurua Naivasha etc.



2. Faulting led to the formation fault guided rivers. These are streams that follow along a fault guided valley. Faulting took place along single fault line leading to the crushing and weakening of rocks as a result of friction of rocks during the movement. However these weak rocks are later eroded away by a streams forming ***a fault guided valley***. Rivers begin following on this valley forming fault guided rivers like ***Aswa in*** northern Uganda and ***Wassa in the semuliki valley*** in western Uganda.



3. Faulting has led to formation of ***Horst Mountains/ block mountains*** which are sources of *rivers.* Due to vertical movement in the faulted zone high towering highlands and ridges are formed due to differential uplift. These highlands rise higher than the snow line of 4500m above the sea level. This results into accumulation of snow forming snowcapped mountain peaks. Due to melting of this Snow, Rivers begin radiating from these block mountains.

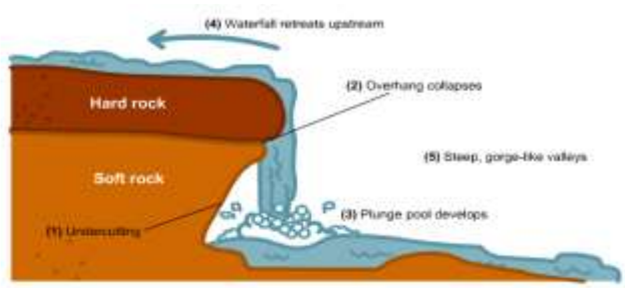
   For example, mountain Rwenzori the highest block mountain in the world stands at 5,109m. Several rivers ***like Mubuku, Ssebwe, Nyamugasani, Mpanga, Rubhiriha, and Nyamwamba*** radiate from this mountain. They are responsible for the ***George-Kazinga channel -Edward-Semuliki- Albert-Nile*** hydrological system and **George-Katonga-Victoria-Nile** hydrological system.

A section of river Mubuku in the upper slopes of mount Rwenzori.

4. Faulting is partly responsible for ***river reversal and the impeded drainage system***. During the formation of the east African arm of the rift valley, the eastern shoulder for the western arm was tilted upwards likewise the western arm of the eastern arm. This up warping caused river Katonga and river Kagera to change their direction of flow because the rate of uplift exceeded the rate at which rivers could incise their beds. They reversed east wards and poured into the Victoria basin. This is clearly seen in the swampy divides between the rift valley lakes in western Uganda and Lake Victoria. Lake Kyoga was formed in the same way like Victoria when River Kafu reversed eastwards. These rivers are swampy and impeded water flows at a slow pace. They are consistently flooding during rainy season.

The impeded Katonga river system after reversal.

5. Faulting is responsible for the formation of **water falls on fault scarps or escarpments.** A water fall is a sharp break of water over a vertical slope. During vertical faulting escarpments are formed over which a stream passes and plunges downstream as a water fall. Examples of such water falls include, **Murchison falls** on river Nile.



FORMATION OF A WATERFALL

Murchison falls on river Nile

Questions.

1a).Distinguish between horizontal and vertical earth movements**.** ***(10 marks***)

b). examine the influence of earth movements on land form development. ***(15 marks)***

2. Discuss the role of tectonism on land form development. (***25 marks)***

3. Examine the influence of faulting on landforms in east Africa. ***(25 marks)***

4. Account for the formation of the East African rift valley. (***25 marks)***

5. Explain the theories for the formation of mount Rwenzori? ***(25 marks)***

6. Examine the influence of faulting on the drainage of East Africa ***(25 marks)***

7. Account for the formation of Lake Turkana in Kenya. (***25 marks)***

8a). differentiate between diastrophic forces from vulcanicity. ***(10 marks)***

b). explain the role of diastrophism in land form development**.** ***(15 marks)***