

Note: These Geog. Paper 1 notes are for all S.3 Streams BUT be careful as you sort out where ended and continue. New page means New topic / sub topic on fresh page.

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GEOMORPHOLOGY OF EAST AFRICA / LANDFORM EVOLUTION IN EAST AFRICA

Landforms / physical features in East Africa were developed and formed by several processes / forces that are broadly categorized into two;

(i) **Endogenic or tectonic / internal processes** which originate and generate from the interior of the earth crust or operate within the earth crust leading to indirect and direct effects on the earth's surface in form of relief features and these forces are faulting, vulcanicity, folding, warping and earth quakes.

All these forces are as a result of convection currents caused by intense heat and pressure of the mantle generated from geochemical and geophysical reactions as well as radioactivity in the interior of earth.

Some tectonic forces are referred to as earth movements because they cause displacement of the crustal rocks vertically and laterally (horizontally) namely; faulting, folding, warping and earth quakes while vulcanicity is exclusive because for it involves external and internal eruption of lava.

(ii) **Exogenic / external processes** which generate and operate on the surface of the earth and these are weathering, erosion, transportation and deposition. However the first three forces are generally known as denudation processes (weathering, erosion and transportation) because they cause break up of rocks and their movement for the latter (deposition).

NB. Endogenic processes are responsible for building up landforms while Exogenic processes are responsible for wearing down or removal and modification of landforms.

FAULTING

Faulting is an endogenic process / a tectonic process but as well an earth movement involving the fracturing / cracking within the earth's crust which is followed by relative dislocation and displacement of rocks normally and in reversal due to strain and stress caused by tension and compression forces operating in the earth crust brought about by convective currents in form of rising light molten rocks underneath the crust generated from intense heat and pressure which are produced by radio-activity, geo physical and geo-chemical reactions within the interior of the earth (mantle and core).

Faulting has been responsible for the formation of several relief features like rift valley, block mountains, fault scarps / escarpments, grabens, tilt block landscape and fault guided valleys.

1. FAULT SCARPS \ ESCARPMENTS

A fault scarp is a steep slope or rock face along a single fault line that overlooks a low land.

A fault scarp is formed when normal faulting of vertical forces lead to the development of a single fault which is followed by one block sliding **downwards** relative to another to create a steep slope called an escarpment.

Examples are; Butiaba near Lake Albert, Kyambura in Kasese and Kichwamba in Kabarole in Uganda; Mau, Nandi and Elgeyo in Kenya; and Manyara, Msolwa, Kilosa and Echunya fault scarps in Tanzania.

2. THE GREAT EAST AFRICAN RIFT VALLEY

A rift valley is an elongated trough or depression bordered by parallel fault scarps in-facing each other.

The Great East African Rift valley has two arms; the western and the Eastern.

There are various theories put forward to explain the formation of the rift valley but in East Africa, there are mainly two namely; tensional and compressional theories.

NB: In an exam, use at least one theory stated above to explain the formation of the rift valley unless otherwise.

Tension theory

This theory was put forward by J.W Gregory in explaining the formation of the Eastern arm of the rift valley.

According to him, geo-chemical and geo-physical reactions as well as radio-activity generated intense heat and pressure that produced convective currents in the mantle which turned into tensional forces within the crust of East Africa.

Tensional forces caused strain of pulling the crust in opposite direction leading to the development of **normal faults within** the rock strata.

Consequently, the side blocks were pulled apart or away from each other while the middle / central block sunk down due to its own weight displacing the rocks to form **a depression while** side blocks remain standing to form the escarpments **which is later** modified by **denudational** forces to form a **rift valley**.

Diagram Leave 17 lines

Compression theory

This theory was put forward by E.J Wayland in explaining the formation of the Western arm of the East African rift valley.

According to Wayland, geo-chemical and geo-physical reactions as well as radio-activity generated intense heat and pressure that produced convective currents in the mantle which turned into compressional forces within the crust of East Africa.

Compressional forces caused the stress of pushing the crust in the same direction resulting into **reversed fault lines within the earth crust (rock strata)**.

Then due to continued compression (stress), the side blocks were overrode (up-thrusted) the central / middle block which remained stable at a relatively lower level to form a trough with hanging fault scarps.

Later hanging fault scarps were modified by denudation forces of weathering and erosion to create a rift valley.

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ECONOMIC ACTIVITIES CARRIED OUT IN THE GREAT RIFT VALLEY (IMPORTANCE)

- Rift valley and its features have promoted tourism because they act as beautiful sceneries which are tourist attractions bringing in foreign exchange for international trade and national investment like Butiaba escarpments, the rift valley lakes of Edward and Albert.
- Rift valley floor has grabens with fresh waters have encouraged fishing due to the presence of different fish species like tilapia, lung fish, cat fish and silver fish resulting into great sources of protein foods to man like in L. George and Edward
- It has acted as a mining ground for valuable minerals like copper, cobalt, salt from Lake Katwe, limestone, soda ash from Lake Magadi and oil deposits from Lake Albert and Turkana leading to development of industries and provision of employment opportunities.
- Promoted transport routes of road and water due to natural way, navigable rivers and graben lakes leading to cheap movement of passengers as well as cargo and development of trade and commerce like on Kazinga channel connects Lake George to Lake Edward.
- Encouraged crop farming because of heavy relief on windward shoulders and convectional rainfall of over 1500mm per annum as well as fertile alluvial soils leading to increased food production like rice, maize and cotton growing at Mubuku irrigation in Kasese.
- Promoted livestock farming and bee keeping due to natural pastures on the escarpments and thickets which flower for bees resulting into the production of meat and milk and honey collection like Balaalo in Buliisa, Basongora at Muhokya in Kasese, Masai, Turkana pastoralists and Alur bee keepers in Nebbi.
- Education and research purposes for students from Higher Institute of learning, Universities as well as secondary schools due to fieldwork study areas as unique formation and nature leading to acquisition of more geographical skills and knowledge like escarpments and Murchison falls in Buliisa.
- It has acted as natural boundary or the border of E.A and DR Congo because of the elongated shape from north to south bringing about peace and harmony.
- Water supply due to fresh water rivers and lakes in grabens like R. Nyamwamba in Kasese for domestic consumption; industrial use and commercial irrigation.
- Human settlement because of gently sloping and relatively flat landscape as well as heavy rains and fertile soils leading to attraction of high population densities for development of towns like Kasese, Fort Portal and Nakuru towns.
- Wild life conservation like crocodiles and hippopotamus due to suitable condition for habitation in forests, savanna grasslands and lakes bringing in foreign exchange from tourists such as Queen Elizabeth NP in Kasese and Lake Nakuru for flamingos.
- Power generation in form of HEP and geothermal due to waterfalls across rivers from escarpments and hot springs on the rift valley floor for domestic and industrial use such as Bugoye and Mobuku electric and Olkaria stream power stations.
- Lumbering and forestry because of different tree species and forest types in the rift valley floor leading to timber production and other furniture as well as ecotourism like Semliki forests in Bundibugyo
- Building and construction due to as well as weathered and quarried stones within the floor resulting into improved houses and infrastructures such as sand and pebbles along R. Nyamwamba in Kasese.
- Hunting due to rift valley grasslands and forests with wild games for edible wild meat.
- Source of leisure and entertainment due to magnificent sceneries leading to attraction of holiday makers and leisure lovers for enjoyment and relaxation.
- Photography and filming due to beautiful sceneries as capturing sites leading to advertisement of East African resources.

PROBLEMS FACED BY PEOPLE LIVING IN THE RIFT VALLEY AREAS (Negative importance)

- Some rift valley areas have inhabited dangerous pests and other disease carrying vectors due to breeding conditions like mosquitoes, for malaria, rinder pest disease and tsetse flies for sleeping sickness and nagana leading to poor health conditions to man and livestock.
- It has accelerated severe soil erosion due to heavy rainfall and steep escarpments leading to loss of soil fertility for crop farming.
- Encouraged frequent landslides / mass wasting because of heavy rainfall and steep slopes resulting into destruction of crop farms, people and roads.
- Received little and unreliable rainfall due to rain shadow effect on leeward side of rift valley shoulders causing aridity conditions in areas of Kasese, Albert flatlands and Masailands.
- Experienced very hot temperatures above 30°C due to low altitude in floor at resulting into limited human settlement and crop farming.
- Dwelled with dangerous wild animals because of their hiding and natural conducive sites in forests causing threats and insecurity to people and crop farms like lions and monkeys within the Queen Elizabeth National Park.
 - Restricted fishing activities and navigation due to deep and narrow faulted lakes in the floor as well as strong storms and waves on graben lakes leading to low fish catch and capsizing of boats like in Lake Tanganyika.
- Hindered the construction and development of different infrastructure like roads and rails due to steep slopes and rugged surface resulting into inaccessibility like along Butiaba in Buliisa and Kichwamba escarpments in Kasese.
 - Led to difficulty in construction of human settlement due to steep slopes and rugged surface resulting into remoteness.
 - Led to difficulty in mechanized agriculture because of steep slopes and rugged surface resulting into limited food production and famine (wastelands).
- Vulnerable / subjected to natural hazards of earth quakes and volcanic eruptions in Bundibugyo and Kasese due to constant earth crustal instabilities within the floor causing the destruction of human lives, crop farms and loss of property.
- Experienced seasonal flooding due to low altitude and heavy rainfall leading to destruction of human settlement, crop farms and infrastructures like R. Nyamwamba in Kasese.
- Fueled territorial conflicts between E.A and DRC due to shared ownership of rift valley features resulting into misunderstanding and political instability like L. Albert with oil deposits.
- Harbored anti- governmental elements (rebels) because of hiding places in forests leading to insecurity like Semliki and Mt. Rwenzori forests in Bundibugyo with ADF rebels
 - Some rift valley areas have contained immature, infertile skeletal and sandy soils due to weathering on escarpments leading to crop farming difficulty.
 - Led to shortage of fresh water due to salty lake waters in the rift valley leading to thirsty and human dehydration.

SOLUTIONS TO THE ABOVE PROBLEMS

- ✓ Resettling people away from the rift valley to reduce effects of landslides and earthquakes.
- ✓ Irrigating the rain shadow areas to provide water to overcome scarcity of water.
- ✓ Terracing and contour ploughing on steep slopes to trap surface runoff to reduce on soil erosion.

- ✓ Carrying out re-afforestation and afforestation on steep slopes to hold the landscape firm so as to control landslides and soil erosion.
- ✓ Spraying with pesticides to kill pests so as to control pests and diseases within the rift valley.
- ✓ Fencing and gazettement some areas of rift valley as national parks and wildlife reserves to ensure security of people from dangerous wild animals.
- ✓ Etc.

3. BLOCK MOUNTAINS / HORSTS

Block Mountain or horst is a **raised fault block / faulted upland** bordered by fault scarps on one or more sides.

Examples of horsts in East Africa are;

Rwenzori in western Uganda;

Pare, Usambara, Nguru, Uluguru, Mahenge, Kipengere / Poroto / Livingstone, Matengo / Umatengo, Iramba, Ufipa and Kasulu in Tanzania; and

Ndoto, Nyiru, Mathews, Mau, Nandi, Kamasiya and Aberdare in Kenya.

A horst or block mountain is formed as a result of faulting but there are various theories put forward to explain its formation though in East Africa, there are mainly two believed in namely; tensional and compressional theories.

NB: In an exam, use at least one theory stated above to explain the formation of the horst unless otherwise.

Compression theory

This theory was put forward by E.J Wayland in explaining the formation of the horst.

According to him, geo-chemical and geo-physical reactions as well as radio-activity generated intense heat and pressure that produced convective currents in the mantle which turned into compressional forces within the crust of East Africa.

Compressional forces caused the stress of pushing the crust in the same direction resulting into **reversed fault lines within the earth crust (rock strata)**.

Then due to continued pushing, the central block was forced to rise / thrust up / up-lift higher than outer blocks which remained static leading to the formation of raised block called horst.

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Tension theory

This theory was put forward by J.W Gregory in explaining the formation of the horst.

According to him, geo-chemical and geo-physical reactions as well as radio-activity generated intense heat and pressure that produced convective currents in the mantle which turned into tensional forces within the crust of East Africa.

Tensional forces caused strain of pulling the crust in opposite direction leading to the development of **normal faults within** the rock strata.

Later, the side blocks were pulled apart or away from each other to sink downwards while the middle / central block remained up standing as a faulted block with hanging fault scarps **which were then removed** by denudation forces of weathering and erosion to form a horst.

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ECONOMIC IMPORTANCE OF BLOCK MOUNTAINS IN EAST AFRICA

- Block Mountains have encouraged seasonal and perennial growing of crops due to the formation of orographic rainfall and fertile alluvial and moraine soils which has led to source of income and increased food production like beans, sweet potatoes, cotton, vegetables, maize, passion fruits, Irish potatoes, onions and other cereal crops.
- Promoted livestock rearing like sheep, goats, donkeys, cattle, etc + good natural grassland as pasture lands and flowering plants on the slopes + production of milk and meat.
- Lumbering activities / forestry + growth of thick forests and various tree species + production of timber and other furniture as well as ecological studies
 - Collecting of bamboo materials + bamboo trees on the slopes + for making houses, fences and other handcraft materials.
 - Tourism + beautiful sceneries such as the snow-capped peaks + attraction of tourists to bring foreign exchange for trade and infrastructural investment.
 - Wild life conservation and preservation + natural homes / habitants in forests on the slopes + eco diversity and ecotourism for research studies and foreign exchange.
 - Mining + valuable minerals such as cobalt and copper deposits at Kilembe in Kasese + set up of manufacturing industries and export trade.
 - Building and construction / Stone quarrying and boulder collection + beautiful stones on the foothills and boulders on the river banks + improved houses, roads and compound decorations
 - Water supply + water catchment areas of rivers from glaciers and forests + domestic, industrial and irrigation purposes like R. Sebwe in Kasese is used by Mubuku irrigation scheme.
 - Power generation (HEP) + fast radiating rivers with waterfalls + domestic and industrial use like R. Sebwe is harnessed at Mubuku and Bugoye power plants.
 - Defensive settlement by some tribes like Bakonjo and Bamba people in Uganda + safe hiding places + best human survival / reduced extinction of indigenous race and growth of trading centres
 - Fruit gathering and herb and honey collection + different mount forests + improved means of survival for food and medicine.
 - Research and educational study purpose + fieldwork grounds and study centres of earthquakes + more geological skills and knowledge.
 - Filming and photography + beautiful scenery + advertisement of East African resources.
 - Entertainment and leisure activities + unique and magnificent features + enjoyment and relaxation (recreation).

PROBLEMS FACED BY PEOPLE LIVING NEAR THE BLOCK MOUNTAINS (Negatives)

- Block Mountains receive little / unreliable rainfall due to rain shadow effects on the leeward side resulting into dry climatic conditions or arid conditions in areas of Kasese and masailands limit crop farming and settlement.
- Difficulty in the development of transport and communication systems + the steep slopes and rugged surface + inaccessibility
- Landslides and mass wasting + high gradient, steep slopes and heavy relief rainfall + destructive to human life, farm crops and property

- Periodic natural hazards of earthquakes + earth instabilities + dangerous to human life, farm crops and property
- Wasteland and idle land + occupancy of large land + restricted land uses or economic activities such as agriculture and settlement
- Hinderance to construction of human houses (settlement) + steepness, rugged nature and coldness on its higher slopes + remoteness and disease like pneumonia
- Severe soil erosion tendencies + heavy relief rainfall and the steep gradient + loss of soil fertility hence less productive for agriculture.
- Blocked mechanized agriculture + steep slopes and rugged surface + shortage of food and famine as well as wastelands.
- Seasonal flooding on the lower slopes + heavy relief rainfall and radiating rivers such as Nyamwamba in Kasese + destroying people's lives, crop farms and roads as well as easy spread of diseases like cholera and typhoid
- Dangerous pests and disease carrying vectors like tsetse flies, snails and mosquitoes + breeding sites in Mount forests and flowing rivers + transmission of dangerous diseases like sleeping sickness, Nagana, Bilharzias and malaria to human beings and livestock
- Harmful wild animals such as lions, hyenas, leopards, baboons and monkeys in Mt. Rwenzori N.P + hiding places and natural homes + feasting on people, even destroying their crops and killing their livestock.
- Territorial conflicts between Uganda and DRC + shared ownership of mountain features like R. Semliki in Bundibugyo + misunderstanding and instability.
- Anti-governmental elements / bandits like ADF rebels in Bundibugyo + hiding places in Mount forests + national insecurity.

4. GRABEN / FAULTED HOLLOW

A graben is a narrow faulted trough between parallel faults within the rift valley floor.

It is formed when secondary faulting occurred on the rift valley floor due to tensional and compressional forces leading to localized fracturing and displacement where some parts of the floor sunk downwards to form a faulted basin called a graben.

This graben was later filled with water from rainfall, rivers and streams to form rift valley lake and such grabens occupied by water are; Lake Albert, and George, Edward in Uganda, Turkana, Baringo, Nakuru, Magadi, Naivasha, Elmenteita, etc in Kenya, Tanganyika, Natron, Manyara, Malawi and Eyasi in Tanzania.

NB: Rift valley lakes are characterized by being deep, having steep shores / banks , being narrow and elongated with regular shore line and salty waters.

Diagram ahead under formation of Lakes

5. TILTED BLOCK

Tilted block is an angular faulted landscape of ridges and narrow depressions.

It is formed when tensional and compressional forces were accompanied / followed by vertical operating forces led to multiple fault lines within the crustal blocks which were rose up / up-lifted and tilted the faulted blocks on one side to form a series of inclined faulted ridges such as Aberdare ranges in Kenya.

NB: When narrow depressions separating the tilted blocks are filled with water form small tilted block lakes like L. Olbollosat in Aberdare ranges.

6. FAULT - GUIDED RIVER VALLEY

A fault guided river valley is an elongated narrow trough along a fault line.

A fault guided river valley is formed where a single fault developed within the crust due to faulting leading to horizontal displacement and shattering of crustal rocks which were easily deepened by running water and widened by denudation forces of weathering and erosion to form a fault guided valley.

Later, the river abandoned its original course and started flowing following the fault line, hence the name fault-guided river valley such as river Aswa valley in Northern Uganda, Kerio valley between Elgeyo escarpment and Kamasiya ridge in Kenya.

NOTE: Indirectly faulting has led to formation of drainage features in East Africa namely;

1. Tilted block lake found on Mt. Stanley on Rwenzori ranges
2. Faulted / graben / rift valley lakes such as L. Albert in Buliisa
3. Fault guided river valleys such as R. Achwa in Northern Uganda.
4. Faulted waterfalls such as Murchison falls along Victoria Nile, Athi falls along R. Athi
5. Parallel drainage pattern like R. Nkusi runs parallel to R. Hoima
6. Antecedent / superimposed drainage pattern like R. Birira
7. Radial drainage pattern on Mt. Rwenzori
8. Trellis / rectangular drainage pattern like R. Achwa
9. Hooked / Barbed drainage pattern / reversed rivers like R. Kafu, Katonga, Kagera, Mara, Nyando, Nzoia, etc.
10. New water shed such as R. Katonga and Mpanga, R. Kafu and Nkusi and R. Kagera and Birira.

SKETCH MAP OF EAST AFRICA SHOWING THE MAJOR FAULTED FEATURES AND AREAS

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WARPING

Warping is a tectonic process but as well an earth movement involving the down sagging and uplifting within the crust.

Warping is caused by downward moving convective currents that pulled the crust to down sag leading to the formation of saucer – shaped basin known as crustal down warped depression, currently occupied by Lake Victoria, Kyoga, Kwana, Opet, Bisina, Wamala, Mburo, Nakivali, Kijanebalola, Kachira and Lukaya due to reversed river flows of Kagera, Kafu, Katonga, Ruizi, Mara, Nyando, Nzoia and others.

While upward moving convective currents that pushed the crust to uplift leading to the creation of uplifted shoulders of the rift valleys of western Kenya and Uganda (ridges / watersheds) and plateaus of central and lake region of East Africa.

NB: Down warped lakes are characterized by being shallow, having gentle shores, being wide and indented with irregular shoreline and fresh waters.

Diagram full page

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FOLDING

Folding is a tectonic process but as well an earth movement involving the bending or cramping of the crustal blocks composed of young sedimentary rocks.

Folding is caused by compressional forces due to converging convective currents that pushed and squeezed the crust toward each other / in the same direction leading to the formation of bent undulating structures made of arches / upward bends called anticlines and troughs / valleys / downward bends called synclines.

Examples of folded areas are; in Karagwe region in Northern Tanzania and others in Rukungiri, Mutundwe, along Kampala - Entebbe road, etc.

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VULCANICITY

Vulcanicity is a tectonic process / an endogenic but not an earth movement involving injected / intruded into the crust and ejected / extruded onto the surface of the earth crust of solid, liquid and gaseous molten rocks / magma through vent / fissures / fault lines leading to formation of intrusive and extrusive volcanic features respectively.

Vulcanicity therefore combines both intrusive and extrusive volcanic activities.

Vulcanicity is caused by temperature / heat differences and pressure differences generated from the core by radio activity and geo-chemical reactions in the interior of the earth leading to the melting of mantle rock into molten rock / magma which finally rose towards the surface through lines of weakness such as vent / fissures / fault lines created by tectonic forces / movements mainly faulting.

INTRUSIVE VOLCANIC FEATURES

Intrusive vulcanicity is the process by which molten rock / magma rises, cool and solidifies (injects) within the earth crust from the interior of the earth before reaching the surface leading to the formation of intrusive volcanic landforms such as batholith, sill, dyke, lapolith and laccolith.

Intrusive volcanic landforms remain invisible until they are being exposed on the earth surface by denudation processes of weathering, wasting and erosion that remove the overlying less resistant rocks or strata.

These intrusive features are;

Batholith is a very large dome-shaped intrusion made of crystalline granite rock at the root of major volcanic mountain and formed when a large mass of acidic magma cools down very deep in the earth's crust but can be exposed on the surface by the denudational forces to form an upland / a hill rock out crop known as inselberg or residual hill.

Examples are found at Singo hills in Mubende, Sukuru hills in Tororo, Parabong, Nakasongola, Labwor, Voi, Maragoli and Sangalo hills in western Kenya, Morogoro, Iringa, Karagwe, Songea, etc.

Sill is a horizontal sheet of igneous rock structure lying between the bedding planes of sedimentary rocks or concordant to the bedding planes and formed when a sheet of basic magma rises and solidifies horizontally along the bedding planes in the earth's crust but it forms a ridge-like escarpment when exposed by erosion causing waterfalls and rapids when they are crossed by a river.

Examples are along Pakwach-Arua road, Mubende, Tororo, Sippi falls in Kapchorwa, Kisiizi falls in Rukungiri and Thika falls in Kenya.

Dyke is a vertical or steeply inclined sheet of igneous rock structures cutting across rock strata or discordant to the bedding planes and formed when a mass of magma solidified vertically in fissures across the bedding planes in the crust but when exposed, it forms a wall-like feature.

Examples are found in the Rungwa complex in Kisumu, Thika falls in Kenya, ridges in Busia, dykes south of Lake Turkana, Sukuru, Isingiro, and Tororo rock.

Laccolith is a mushroom or dome-shaped intrusive igneous rock structures with a flat base and formed when viscous / acidic magma bulges into the rock layer, solidifies and forces the overlying / upper rock strata to bend upwards forming dome - shaped intrusion but when exposed by denudational forces, laccoliths have formed uplands.

Examples are found in Kitui and Voi areas in Kenya.

Lapolith is a saucer-shaped intrusive feature and formed when formed when a sheet of basic magma rises, spreads, solidifies horizontally along the bedding planes and forces the underlying / lower rock strata to move downwards leading to the formation of saucer - shaped intruded structure but when exposed by erosion, it forms saucer-shaped depression known as an arena like in Rubanda in Kisoro.

Diagram 10 lines

EXTRUSIVE VOLCANIC FEATURES

Extrusive vulcanicity / volcanicity is the process by which molten rock rises, cool and solidifies (ejects / extrudes) through the vent or fissures onto the earth's surface leading to the formation of volcanic landforms such as ash and cinder cones, composite cones, shield and lava plateaus, explosion craters, craters, caldera, cumulo domes, volcanic plugs and neck, hot springs, fumaroles and geysers.

These extrusive features are;

Composite cone / strato volcano is a large raised upland with fairly steep slopes and broad bases of alternate layers of ash and lava ejected through a single vent over a long period of time.

It is formed when a first violent eruption breaks down into volcanic dust called ashes laid down around the vent to form the first layer and then, lava pours out on top of the ashes to form the second layer due to reduced pressure.

Later successive / subsequent eruptions build up a large upland of alternating layers of ash and lava at different intervals rising thousand of meters high above the surrounding surface called composite cone / volcano.

With time, parasitic cones develop on the sides when the vent is sealed during the gentle eruption and finally secondary eruption creates large crater (caldera) at the top by blowing off the top of the cone or when volcano building ceases, a funnel like-depression is left on top of the volcano called a crater.

Examples are; Mountain Kilimanjaro, Meru, Kenya, Oldoinyo Lengai in Tanzania and Mufumbiro (Muhavura), Elgon, Moroto, Kadam, Napak, Mbeya / Rungwe, Longonot, Suswa, etc.

- N.B.** Volcanoes are grouped according to their present status and these are 3 types of volcanoes namely;
- (i) Active volcano; one which has erupted in recent years and still shows signs of eruption like Muhavura ranges, Oldoinyo Lengai, Longonot, etc.
 - (ii) Dormant volcano; one which has taken a very long time without erupting but still shows some signs of eruption like Mt Kilimanjaro, Mt Kenya, Mt. Meru and Mt. Elgon.
 - (iii) Extinct volcano; one which shows no signs of further eruptions and the original shape of the mountain has been destroyed by denudational processes like Mt. Moroto.

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Ash and cinder / Scoria cone is a steep sided symmetrical hill / concave shaped cone of ashes and rock fragments approximately 150 metres above the ground and formed when acidic lava with a lot of gas erupts explosively and violently at the surface of the earth which breaks into small sizes with volcanic dust (**ash**) and rock fragments (**cinder**) around the vent to build ash and cinder cone with a large crater on a whole summit. They usually occur in groups or near / on flanks of large volcanoes as parasite cones.

Examples of cinder cones are; Likaiyu, Teleki and Sarambwe cones in Kenya, Nabunyatoni and Abili – Agituk cones in North eastern Uganda, in Kenya.

Cumulo dome is a steep sided convex dome of acidic and inter-mediate lava in a round appearance and formed when viscous and acidic lava is pushed slowly out of the crust under low pressure and swells on the surface and piles up around the vent where the outer layers solidify quickly on exposure to air while the magma inside remains in semi liquid state as the outer layers bulges / swells into a dome shape or a ball-like structure with steep slopes / a round appearance.

Examples are; Mtumbi dome near Mbeya in Southern Tanzania and in the caldera on mount Rungwe in Tanzania.

Shield (Basalt) volcano / dome is a gently sloping sided and elongated cone of low height, broad and extensive base with a large shallow and steep-sided crater and formed when basic lava comes out from the crust through several fissures or openings to flow for a long distance and over a wide area before cooling and solidifying on the surface leading to a longer stretched lava cone called shield / basaltic cone.

Examples of basalt domes are; Kenya highlands and the Muhavura ranges.

Lava plain / plateau is an extensive and stretched upland with generally leveled summit of successive layers of basaltic lava and formed when basic lava slowly pushes to the surface through several fissures in the earth crust and spreads out to cover the original landscape of hills and valleys to solidify and form a sheet of basalt lava.

Examples are; Laikipian, Kericho and Yatta plateau, Nyika plateau, Uasin-Gishu and Kaputiel in Kenya, Kisoro, Kasere, Ntungamo in Uganda.

Crater is a small shallow and funnel shaped / narrow circular depression on the top of the cone usually less than a kilometer in diameter and formed when magma fails to reach the top of the cone within the vent due to insufficient pressure and solidifies to form a funnel-like depression called a crater but when filled up with water, it becomes a crater lake.

Example of craters are; Simbi, Katungi in Bushenyi, Gisozi in Kisoro, Wagagai on Mount Elgon, Kenya, Kilimanjaro and Muhavura and Paradise on Mount Marsabit.

Explosion crater is a large shallow and wide circular depression on the surface of the earth crust usually about 500m wide in diameter and less 50m deep and formed when a violent gaseous explosion that blow off the overlying crystalline country rocks which fall back as fragments called pyroclasts and pile up around the depression as a low rim to form an explosion crater but when filled with water, it form an explosion crater lake.

Examples of explosion craters are; Katwe, Nyungu, Nyamunuka, Kyamwiga, Nkugute, Nyamusingiri, Rutoto, Kyegere, all in western Uganda and Basoti in Tanzania.

Caldera is a large circular and rounded shallow depression on top of a volcanic mountain usually 1km in diameter and formed;

Either when the summit / top of a volcano collapses / subsides into the magma chamber below under its own weight because of the movement of supporting magma to leave bigger chasm called a caldera and this process is known as **cauldron subsidence**.

Examples are; Napak, Kadam, Menengai, Ngorongoro, Embagai and Suswa calderas

Or when the upper part of the dormant volcano is blown off in a violent explosive secondary eruption leaving behind a large depression called a caldera.

Examples are; Oldoinyo Lengai, Ngozi and Longonot calderas.

Volcanic (lava) plug / neck is a cylindrical mass of hard rock of acidic / viscous lava standing out vertically on the surface of the earth and formed when acidic magma cools, solidifies and builds up within the vent and finally exposed as a result of erosion leaving behind a standing hard and resistant rock of lava.

Examples are; Tororo rock and Alekitek near Napak caldera in Uganda, Mwadui plug and Mawenzi plug in Tanzania, Loldiani, Tinderet and Timboro in the Kano plains of Kenya.

Hot spring, Fumarole and Geyser is a mass / spring of warm boiling water; of steam and gases; and mixed steam and water at the earth surface and formed when rain water together with underground water aquifers comes into contact with the hot underlying rock and then water is pushed out due to increased pressure to escape and eject at the surface through a small opening as springs / jets of warm water, warm stream or as a mixture of warm water and steam.

NB: They are potential sites for the generation of geo-thermal power like Olkaria geo-thermal plant at Naivasha in Kenya.

Examples of hot springs are; Kitagata in Bushenyi, Sempaya in Bundibugyo, Kisizi in Rukungiri, Rubare in Ntungamo in Uganda, Maji Moto in Tanzania, and near Lake Bogoria in Kenya.

Fumaroles are; at the sides of Nyamulagira and Longonot Mountain

Geysers are; around Lake Bogoria and Lake Hannington in Kenya and in Bundibugyo district in Uganda.

Lava dammed basin is a depression behind a dam of lava **and** formed when a mass of flowing lava from a nearby volcano blocks a river channel to form a lava dammed trough but when river waters back ponds in it, it creates a lava dammed lake.

Examples are; Bunyonyi, Mutanda, Mulehe, Chahafi, Kayumba and Muhondo in Uganda.

NOTE: Directly and indirectly vulcanicity has led to formation of drainage features in East Africa namely;

- **Explosion crater lake** like Lake Katwe, Nyamunuka, Kasenyi, Kikorongo, etc.
- **Mountain crater lake** like Lake Katungi in Bushenyi, Gisozi in Kisoro, Wagagai on Mount Elgon, Kenya, Kilimanjaro, Muhavura, Lake Simbi in Nyanza district (Kenya) and Lake Paradise on Mount Marsabit.
- **Caldera lake** such as Lake Menengai, Ngozi, Embagai and Ngorongoro in Tanzania.
- **Lava dammed lake** like Lake Bunyonyi, Mutanda, Kyahifi, Kayumba and Mulehe and Lake Saka in Fort Portal.
- **Radial drainage** pattern like on volcanic mountains like Kenya, Elgon and Kilimanjaro
- **Dendritic drainage pattern** like Manafwa, Sironko, Malaba and Nzoia on Mount Elgon and those on Mountain Kenya, Kilimanjaro and Muhavura.
- **Limited surface drainage** like on basaltic plains in Kisoro area and Bunyaruguru
- **Waterfalls and rapids** across dykes and sills like Sippi falls in Kapchorwa, Thika and Kisiizi falls in Rukungiri.
- Other related features like **gorges, plunge pools, etc like** Murchison gorge
- **Hot spring**
- **Fumarole**
- **Geyser**

ECONOMIC IMPORTANCE OF VULCANICITY / VOLCANIC FEATURES IN EAST AFRICA

Positive importance

- Vulcanicity has promoted crop farming through the formation of volcanic mountains and lakes with fertile volcanic and alluvial soils as well as heavy rainfall, which has resulted into production of various food and cash crops e.g. Mt. Elgon, and Kigezi highlands for growing of Arabica coffee, Bananas, Irish potatoes and vegetables
- The different volcanic features have supported tourism industry as major tourist attractions because of their beautiful sceneries to the viewers bringing in foreign exchange for development e.g. crater lake Katwe, Sempaya hot springs, Bunyonyi lava dammed lake and Kenya volcano.
- Volcanic lakes like lava dammed lakes and rivers originating from volcano like Manafwa and Sironko from Mt. Elgon are fishing areas for various fish species which is a body building food for many Ugandans.
- Volcanic rocks have encouraged building and construction sector as they are quarried and excavated to produce stones for better structures, bridges, roads etc.
- Volcanic landforms have promoted the mining industry as they contain valuable and commercial minerals exposed on / near the earth by vulcanicity leading to set up of processing industries e.g. the Tororo volcanic rock has limestone and phosphates used in making building lime, cement and phosphate fertilizers.
- Volcanic features like hot springs are potential sites for generation of geothermal energy due to hot water and stream, which may be used in small factories and for domestic appliances like Olkaria hot springs for Olkaria geo- thermal power station in Kenya.
- Volcanic Mountains have attracted dense population / settlement mostly on their foothills because of fertile soils, heavy relief rainfall and cool temperatures leading to development of towns like in Mbale, Arusha and Nairobi.

- Volcanic landforms stimulated wild life conservation due to conducive natural habitats for wild game which have been turned into gazetted areas as national parks and forest reserves resulting into attraction of tourists for forex like Muhavura national park a home of monkeys, baboons and chimpanzees
- Volcanic hot springs have acted as traditional medicine due to warm boiling water for treating various diseases like Kitagata hot springs in Bushenyi is used to cure skin diseases, impotence, backaches, anaemia and others.
- Volcanic mountains and other features like sills have waterfalls which are potential areas for generation of H.E.P used in homes and industries e.g. Karuma falls and Thika falls.
- Volcanic highlands have supplied fresh waters from radiating rivers and lake like Mt. Elgon has river Manafwa, Sippi, Turkwel and Namatala leading to provision of water for irrigation, domestic use and industrial use.
- Volcanic mountains have facilitated lumbering, forestry and collection of poles due to their association with fertile volcanic soils and heavy relief rainfall resulting into thick and luxuriant forests leading to production of timber like on Mt. Mufumbiro, Kenya and Kilimanjaro forests.
- Volcanic features and other activities have favoured education and research as they are a good field work study and research areas for students and researchers for more skills and knowledge.
- Volcanic lakes and rivers associated with volcanicity have facilitated water transport as they are navigation for stimulating trade and commerce like Lava dammed lake Bunyonyi and river Manafwa.
- Volcanic cones are associated bamboo trees which are used as decorative materials for beautifying homes as well as food leaves known as Malewa for better food diet among the Bagisu.
- The slopes of volcanic mountains have encouraged forest conservation (forestry) because of different forest types leading to ecology, ecosystem balance and ecotourism.
- Volcanic mountains and other features have promoted recreational activities, filming and photography due to their uniqueness and appearance resulting into entertainment of people and advertisement of the East African resources.

Negative importance (Problems associated)

- Some active volcanos are subjected to natural hazards of hot magma due to expected eruptions which are dangerous to human lives, crops and animals.
- Volcanic mountain ranges have hindered transport and communication like construction of roads and other communication links because of steep slopes and rugged surface creating inaccessibility in some areas.
- Volcanic highlands and other volcanic uplands are prone to deadly mass wasting / landslides due to steep slopes and heavy rainfall which are destructive to human lives, crops and property in the nearby areas.
- Volcanic highlands and uplands are vulnerable to severe soil erosion because of steep slopes and heavy rainfall resulting into loss of soil fertility which limits crop growing.
- Volcanic mountains produce young, poor and infertile soils due to the constant erosion, weathering and deposition which are unsuitable for growing of crops resulting into wastelands.
- Volcanic highlands have hindered mechanized agriculture due to steep slopes and rugged ground resulting into crippled the commercialized agriculture and shortage of food production.
- Volcanic mountains have led to water scarcity and loss due to little and unreliable rainfall on the leeward side, salty volcanic lakes as well as porous or impermeable rocks leading to thirsty, drought and desertification.

- Volcanic highlands have totally hindered human settlement because of the steep slopes, rugged surfaces and cold temperatures leading to remoteness.
- Some volcanic features are habitats of dangerous wild animals due to forests, woodlands, rivers and lakes scaring away human beings as well as destroying crops and livestock.
- Some volcanic features are also a home for dangerous pests and disease carrying vectors like mosquitoes due to breeding conditions in forests, woodlands, rivers and lakes which are destructive and harmful to lives. crops and livestock.
- Volcanic mountains have encouraged bandits / anti-governmental elements as they are hiding places causing national insecurity.
- Some volcanic features have led to inter-territory conflicts among countries due to being shared on borders leading to instability and misunderstandings.
- Volcanic areas are susceptible to air pollution due to the gas emission of sulphur-dioxide and carbon monoxide during and after eruption activity which may result into acidic rains and global warming.
- Volcanic highlands are exposed to seasonal flooding due to outward flowing rivers during the rainy seasons causing destruction to human lives, crop farms, livestock and infrastructures.

SKETCH MAP OF EAST AFRICA SHOWING MAJOR VOLCANIC FEATURES (MOUNTAINS, LAKES AND AREAS)

Leave a full page for the map

New page

LAKES IN EAST AFRICA