Faulting is the fracturing/ breaking/ rapturing/cracking of rocks due to strain and stress which subsequently leads to the dislocation and displacement of rock strata.

Faulting is caused by convectivity and radio-activity within the mantle which generates heat that melts mantle rocks; creating convection currents which exert forces on the earth's crust.

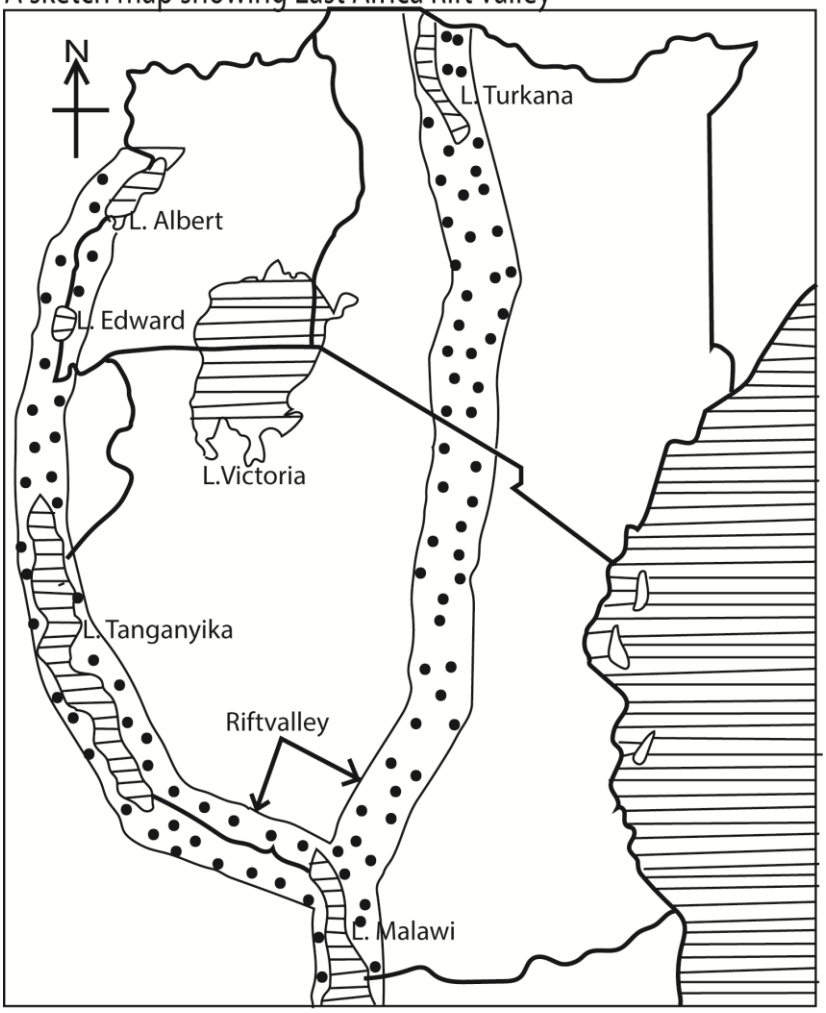
Faulting is responsible for the formation of a wide range of features in East Africa which include rift valley, block mountains, grabens, tilt block, escarpments, and fault guided valleys.

The Rift Valley

A riff valley is an elongated trough bordered or surrounded by two or more inward facing fault scarps.

The rift valley in East Africa is in two arms: i.e. the Eastern arm and Western arm shown on the map below

A sketch map showing East Africa Rift valley



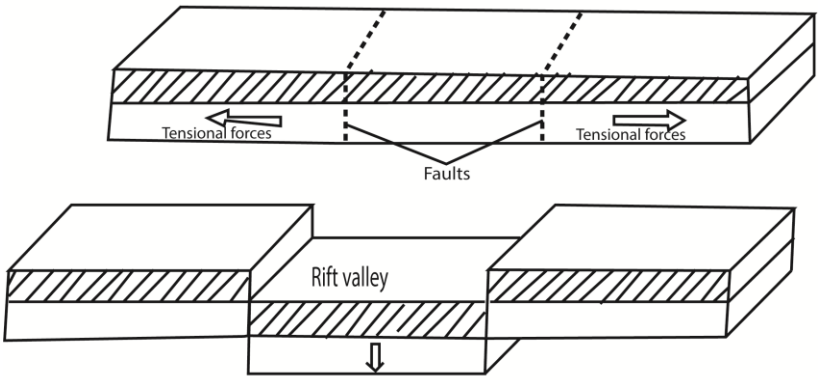
Theories explaining the formation of the rift valley

- The Tension force theory by Gregory
- The compression force by Wayland
- Vertical displacement theory by Dixey

Tension theory by J. W. Gregory

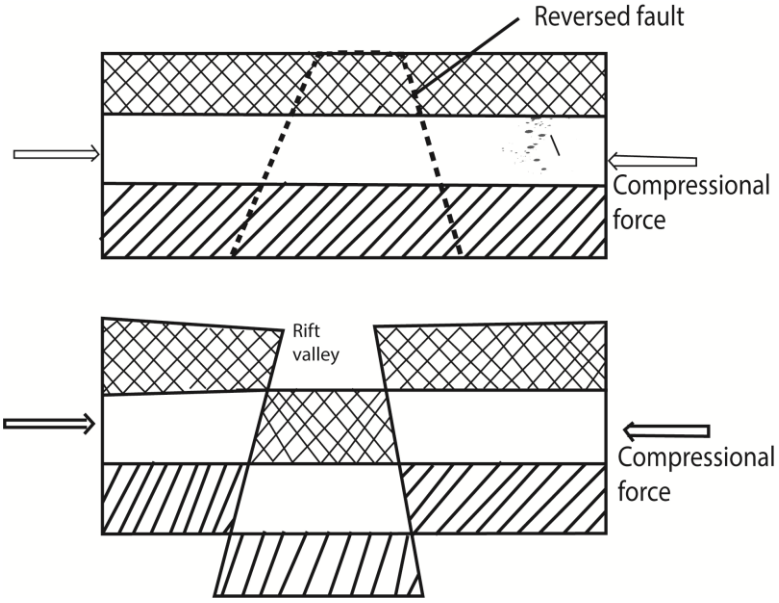
- The radio-active and convective currents produced tension forces within the earth crust.
- Tension forces acted/ pulled apart/ in opposite directions.
- Normal faults were produced, displacing rock strata.
- Side blocks were separated from the middle block, which later lowered/ sunk under its own weight forming a rift valley with gentle slopes.

- Erosion and mass wasting modified the slopes.
- The theory is more applicable to the Eastern Kenya Rift valley (Gregory Rift).



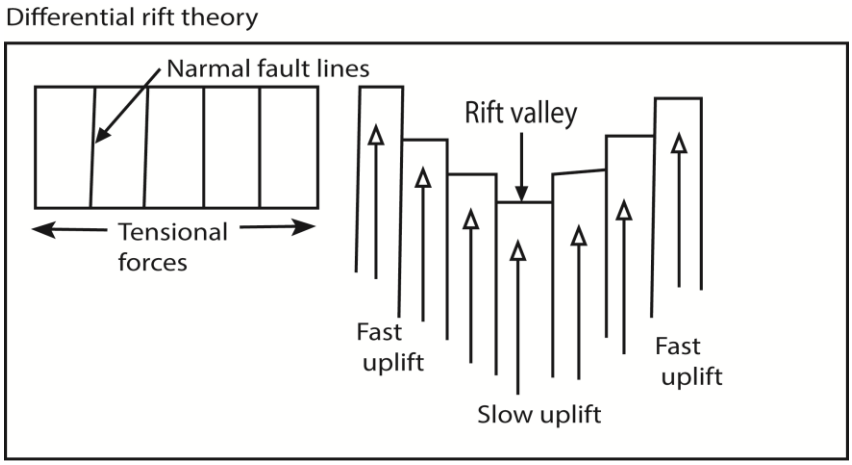
Compression force theory by E. J. Wayland

- That strain developed in the East Africa crust as compressional forces pushed/moved in the same directions (convergent).
- Reversed faults were produced.
- The side blocks were forced to over-ride (up thrust), hanging above the central block. The central block thus formed rift valley with steep/ sharp edges.
- The sharp edges were later modified by erosion and mass wasting.
- The theory is more relevant to Western arm of the East African Rift Valley, especially the Albertine Rift valley.



Differential uplift theory

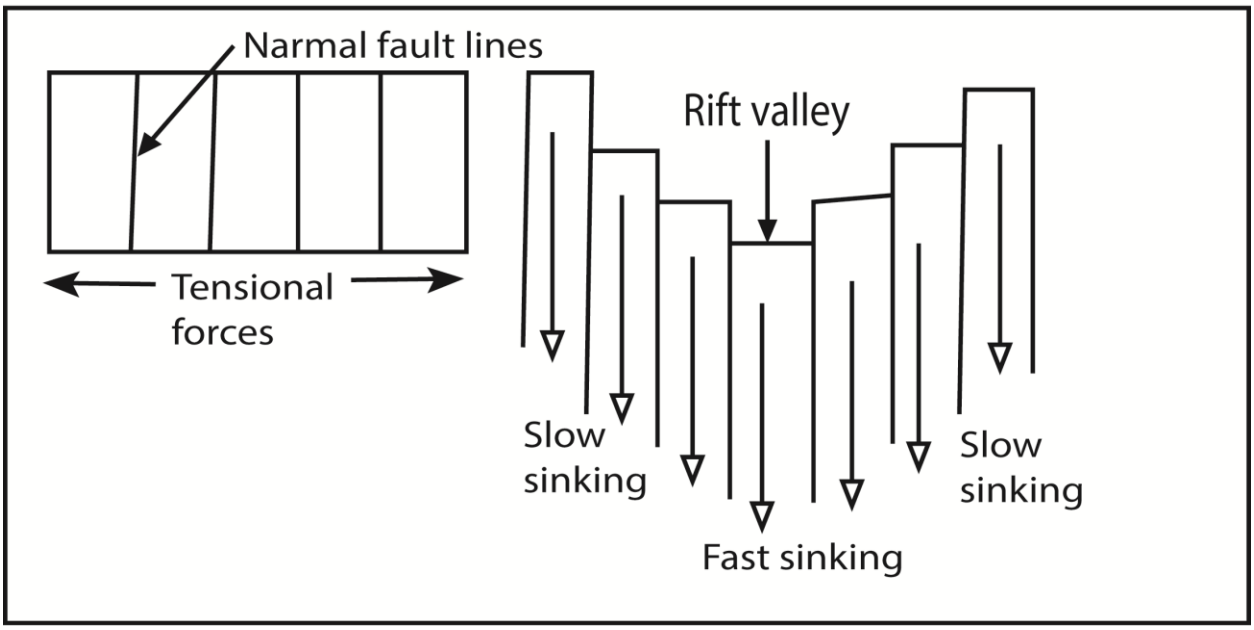
- Dealt with the Nairobi part of the East African Rift valley of Kenya that is step faulted.
- That there was a period of general uplift of part of the East African Crust.
- It led to the formation of several parallel fault-lines.
- Blocks on either side of the central block rose faster as the middle lagged behind in stages.
- At each stage, a mass or block formed a terrace·
- Examples include Kendang scar near Nairobi appearing as several terraces rising from the Rift Valley floor.
- The gaps in the middle of terraces formed the rift valley.
- Diagrammatic illustration of differential uplift



Relative Sinking (subsidence theory)

- Just like in differential uplift theory, there was extensive faulting in East Africa which created multiple parallel faults.
- Within the mantle / interior of the earth, there is intense heat originating from radioactivity and geochemical reactions.
- The heat melts down the interior rocks and they begin to move in form of convective currents upwards towards the crustal plates.
- When they become colder and therefore heavy, they sink or flow back down in the mantle and as they do so they exert a drag force which pull the crustal blocks downwards thus sagging of crustal blocks along each fault.
- The central blocks sagged more than those on the extreme ends to form a step or terraced rift valley

Relative sinking theory



Importance of rift valley

- Habitat for wild animals
- Tourist attraction
- Presence of minerals and petroleum product
- Rift valley lakes provide fish, and water
- Rift valley lakes are used for transport
- Academic purpose
- Rift valley lakes and mountains modify climate

Block Mountain or horst

A block mountain is an upland bordered by fault scarps on either side. Examples of the Block Mountains are Rwenzori ranges in Uganda, Usambara, Pare in Tanzania.

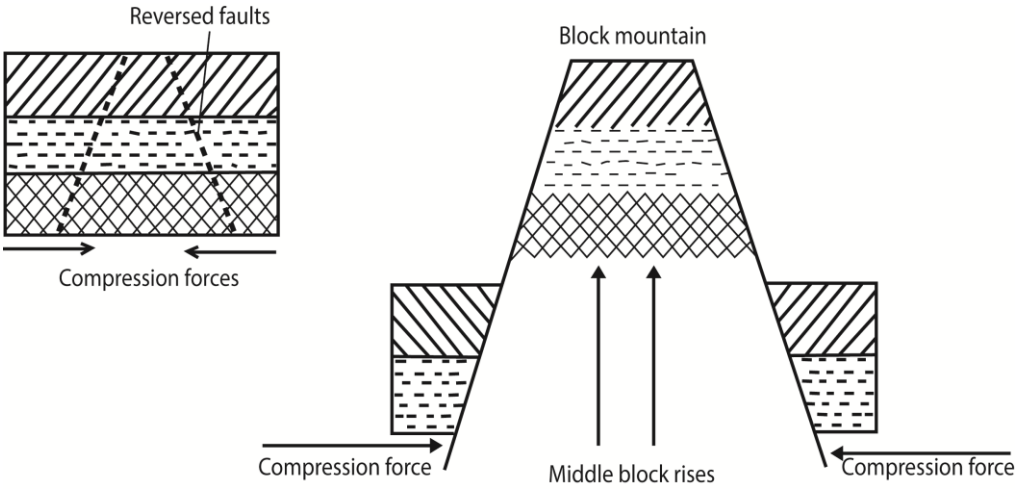
The formation of Block Mountains is explained by three theories:

- The compression force theory by Wayland
- The Tension force theory by Gregory
- Vertical displacement theory by Dixey

NB: Candidates should choose only one theory to explain the formation of a Horst with relevant diagrams

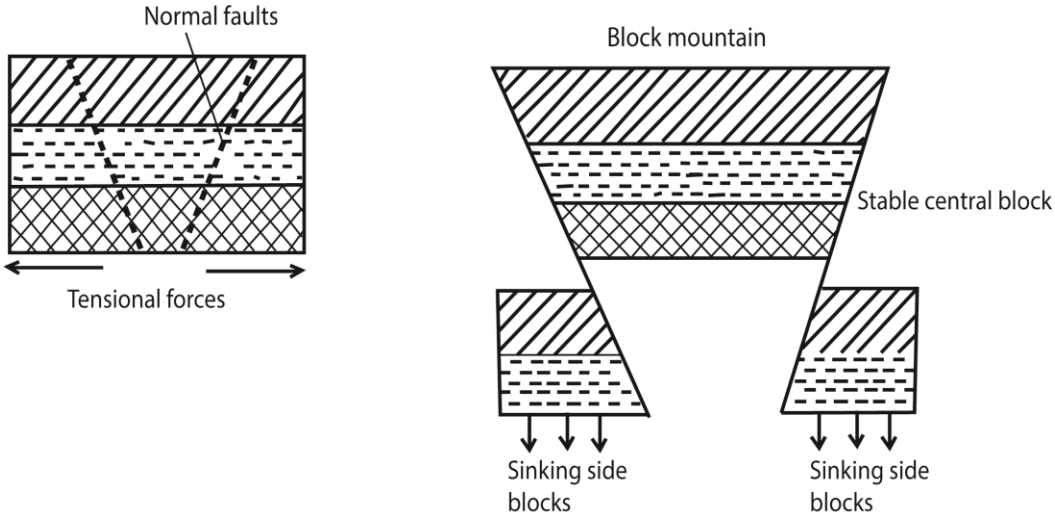
Formation of a block mountain by compression forces

- Compression forces pushed a crystal block of land on either sides resulting into stressing hence the development of reversed fault lines.
- The fault lines divided the crystal block into three parts.
- As the action of compression forces continued the middle/ central block was thrust upwards above the two adjacent blocks/ surrounding blocks to form a block mountain.
- This is illustrated as shown below:



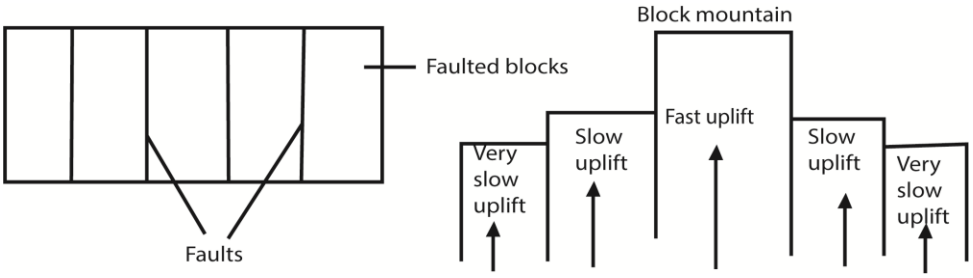
Formation of a block mountain by tension forces

- Tension forces act on the earth's crust by pulling in opposite direction from each other.
- This is when convectional currents move horizontally in different directions hence the development of parallel normal faults in the crust.
- The faults divide the crust into three parts.
- The continued tension forces lead to the subsidence (sinking) of the side blocks.
- The middle block remained stable high above the side blocks to form a block mountain.



Formation of a block mountain by differential uplift theory;

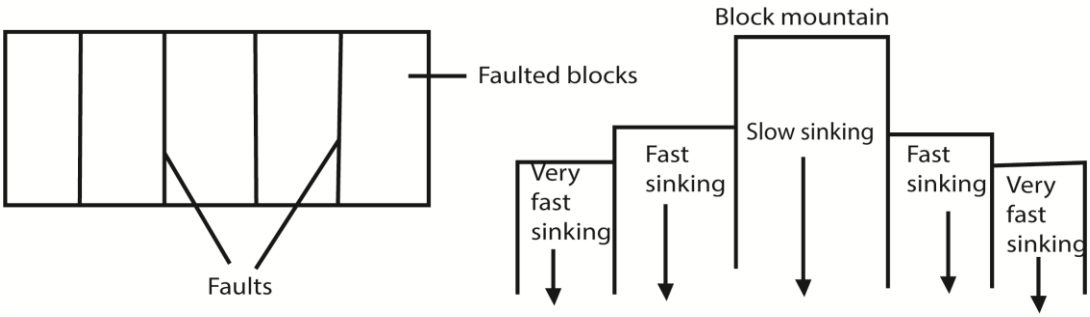
- Multiple faulting formed a series of crystal blocks of varying sizes and densities.
- Then the forces of uplift acted on the crystal blocks with varying strength.
- Uplift force was strongest on the central blocks; they were forced to rise higher to form peaks of the horst.
- The side blocks did not rise high enough but formed the sides of the horst in stages as illustrated below;



Formation by relative sinking

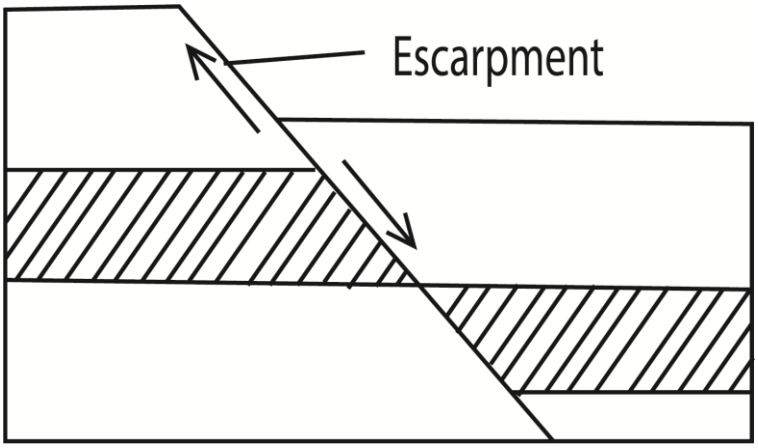
- Multiple faulting formed a series of crystal blocks of varying sizes and densities.

- Then faulted blocks experienced sinking which was not uniform. The side blocks sank faster than the central block.
- The central block remained relatively higher to form the peak of the horn as illustrated below;



Fault scarps/ fault escarpments.

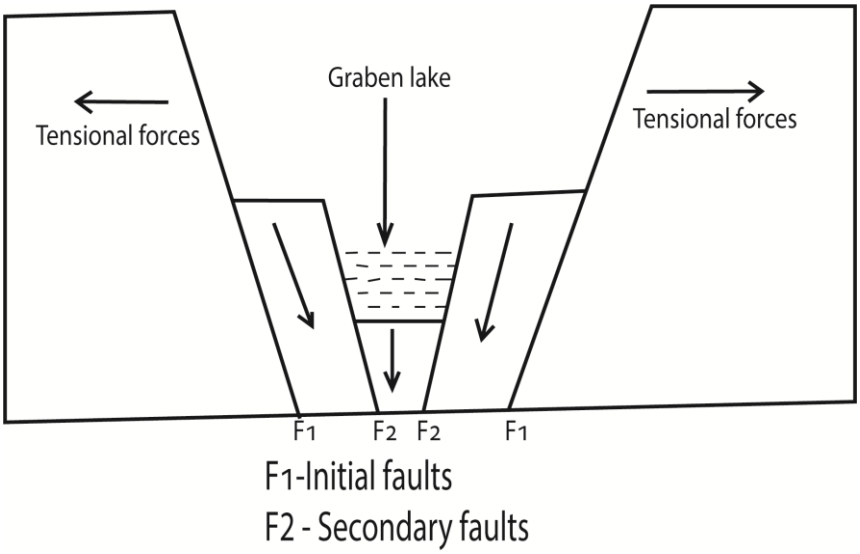
It's a steep slope along a fault formed when one block along the fault line was thrown up above the other. e.g. Butiaba, Kicwamba in Uganda and Mau Escarpments in Kenya, Manyara, Elgeyo, Chunga etc.



Grabens

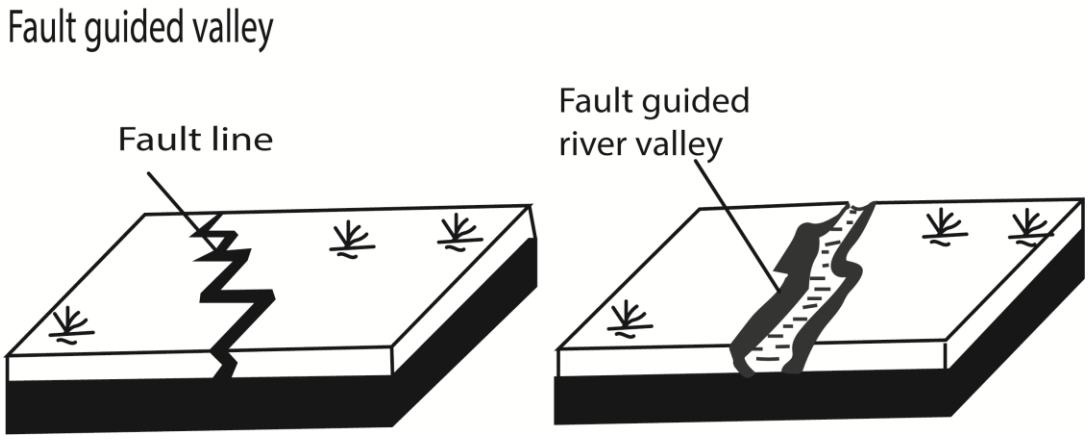
These are narrow, regular shaped and deep depressions on the floor of the rift valley formed as a result of secondary faulting.

Secondary faulting led to the formation of secondary normal faults and subsequent displacement of rock blocks to the formation of Grabens e.g. Grabens occupied by Lake Tanganyika, Turkana, Albert, Edward etc.



Fault guided valleys

Fault guided valleys were formed along single fault where the fault zone was crushed and to exposed weathering and erosion.



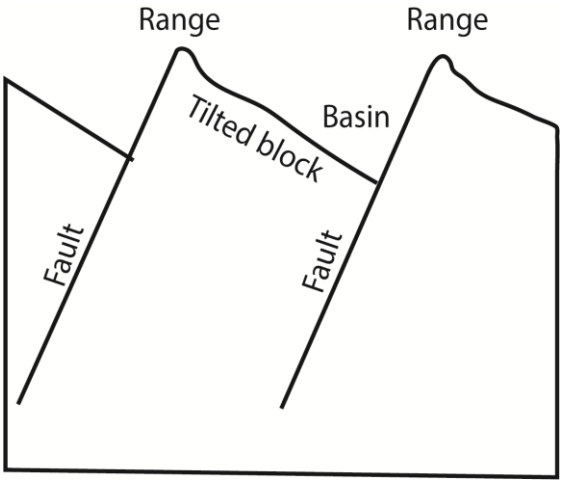
Examples of fault guided valleys are River Aswa in Nonhem Uganda, Kerio Valley between Eigeyo Escarpment and Kamasiya Ridge in Kenya.

Tilt block land scape

This is an upland of inclined crustal block

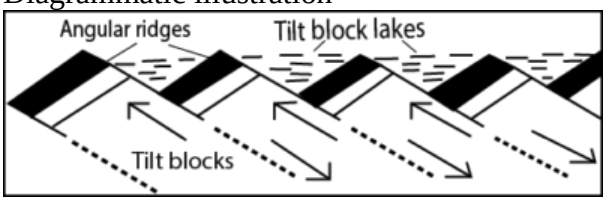
It has angular inclined ridges and depressions formed by multiple faulting and vertical movements which displaced the faulted crustal blocks at different rates to form a series of tilted faulted blocks.

Examples are Aberdare ranges in Kenya, Kichwamba in Uganda etc.



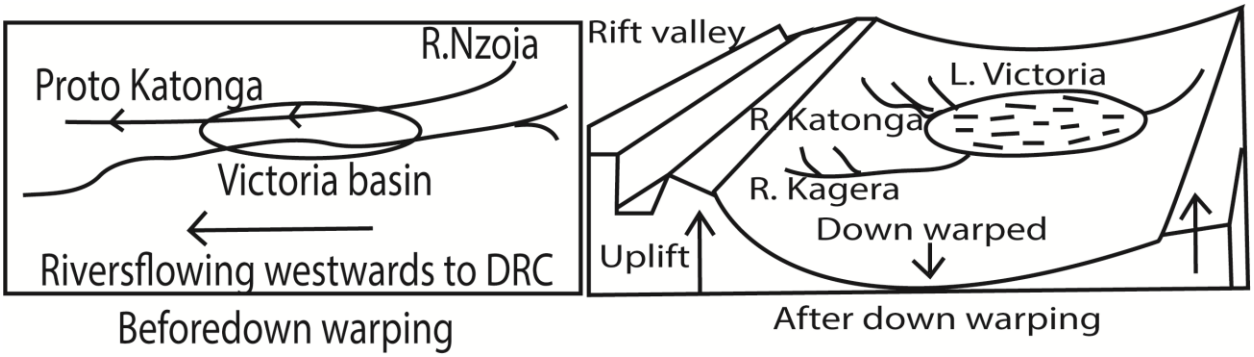
Tilt block lakes occupy depressions between tilted uplands/ridges.
- Tension and compression forces led to formation of several parallel faults dividing up the crust into several blocks.
- Faulted landscape was then subjected to uplift or sinking at different rates and then tilting in one direction forming angular ridges and depressions.
- Water from rain /rivers fill the depressions to form a lake(s) e.g. Lake olbolossat in Aberdares in Kenya.

Diagrammatic illustration



Crustal warping
The extensive downward and upward movement of the crust led to formation of depressions and uplands.

Down warping occurred in central and South Eastern Uganda to form depressions occupied by lakes Victoria, Kyoga, Wamala and Nakivale.
• Before warping took place, land in central Uganda was sloping to the West and rivers like Katonga, Kagera, Rwizi, Kafu were flowing to the west.
• During warping, Eastern and Western Uganda were up warped while central Uganda down warped forming basins.
• After warping, rivers reversed their flow eastwards; emptying their waters into the basins to form lakes Victoria and Kyoga.
Diagram(s) to illustrate river flows



• The formed lakes are shallow in depth, having fresh water, irregular outlines/shore lines and extensive swamps around them bays/headland.