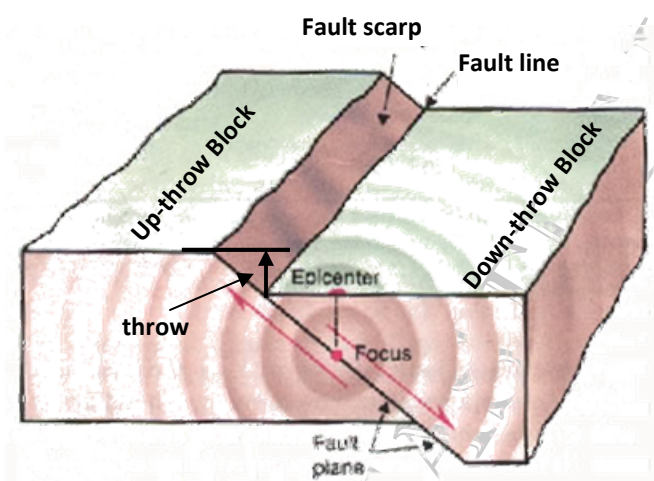


The main forces which cause faulting and folding

The main forces that affect folding and faulting are

- (i) **tensional force** - when two forces act away from each other. Tension result in the extension of the surface of the earth and forms joints and normal faults. \longleftrightarrow
- (ii) **compressional force** - when two forces act towards each other. Compression result in the contraction of the earth's surface and form folds, reversed fault and thrust faults. $\longrightarrow \longleftarrow$
- (iii) **shearing force** - when two forces act parallel to each other, though in opposite direction. Shear force result in two rock masses sliding pass each other. \longleftrightarrow

Parts of a fault



- Fault plane** - The plane that extends into the earth and along which slippage occurs.
- Fault scarp** - The steep face of an exposed block.
- Fault line** - The trace of the fault along the surface
- Up-throw** - An upward displacement (movement) of rock on.
- Down-throw** - The sudden drop or depression of the strata of rocks on one side of a fault.
- Throw** - the vertical change of rocks as a result of their displacement by faulting.

Faulting

Fractures of the rock strata of the Earth's crust are called **faults**. They are generally caused by movement at plate margins, but can occur in other areas where the rocks are subject to great stresses.

Faults occur in rocks when they are unable to resist the pressure to which they are subjected and crack, resulting in **fractures** or **joints**.

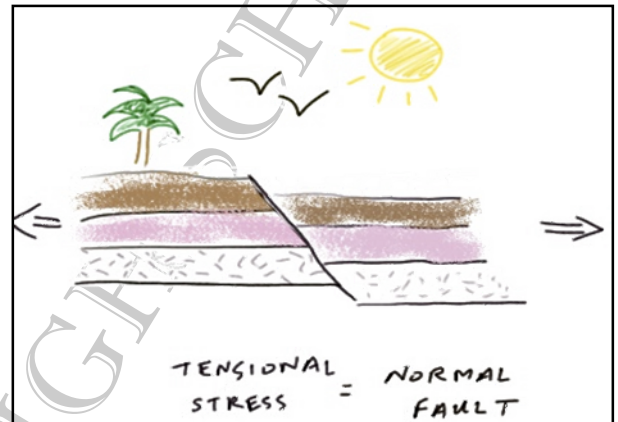
When a fault occurs, the rocks on either side of the fault are displaced. The two blocks slip relative to each other, on opposite sides, either vertically or horizontally, so that strata no longer match.

Types of fault

Tensional or normal fault

A tensional or normal fault results from two forces moving in a horizontal plane in opposite directions. The rock strata are under tension and finally break, causing the rocks to become jointed with normal faults occurring. The tension in the rocks is normally caused by tectonic plates moving apart.

Forces move away from each other, causing compression — divergent plate boundaries

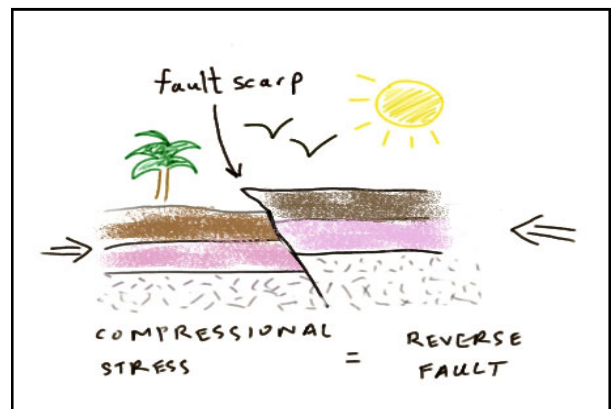


Compressional or reverse fault

A Compressional or reverse fault is caused by compression of the rock strata in convergent plate zones. This can cause bending and folding of the rock layers and may result in the faulting of the rock strata.

Faulting may accompany folding of the rock strata or may occur instead of folding.

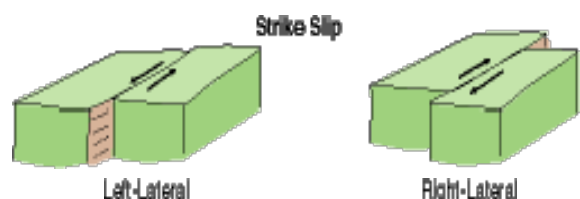
Forces move towards each other, causing compression and reverse faulting — convergent plate boundaries



Tear fault or strike fault

A **tear fault** or **strike fault** occurs when two plates slide past each other, along a transform zone boundary. The plates slide past each other, with no vertical movement. However, the evidence of horizontal displacement can be quite marked.

Features form by faulting

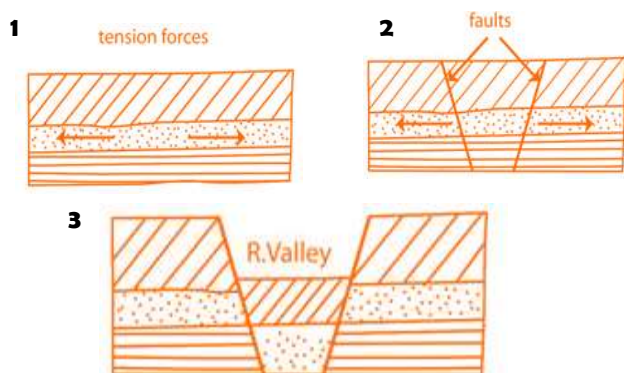


(1) Rift valleys or grabens

This is an elongated trough formed by the subsidence of a segment of the Earth's crust between normal, faults.

A rift valley forms where the Earth's crust, or outermost layer, is spreading or splitting apart.

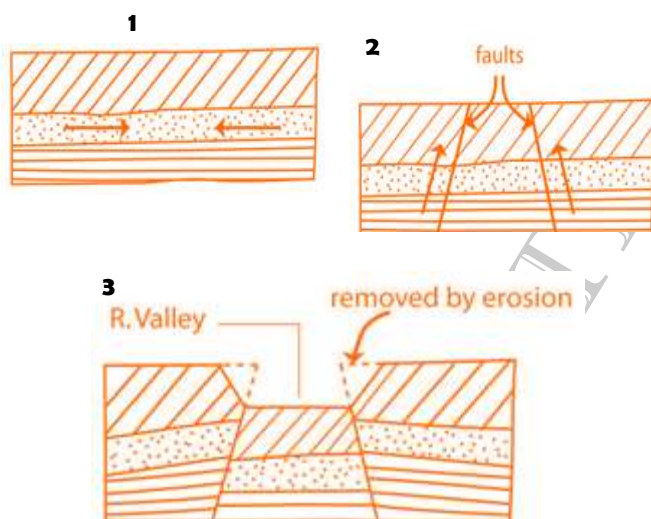
Rift valleys can be the result of normal faulting in which one side of a fault subsides relative to the other. The valleys are formed due to tensional forces in areas of divergent plate boundaries.



Rift Valley formed by tension

Rift valleys can also be formed by compressional forces which push up the land on each side of a central mass or block, resulting in the central mass subsiding.

The uplifted area is called a block mountain or hoist. These are found in areas of convergent plate boundaries.



Rift Valley formed by compression

Examples of Rift valley

The most extensive continental rift valleys are those of:

- (a) the East African Rift System;
- (b) Russia's Baikal Rift Valley
- (c) and Germany's Rhine Rift Valley.

Other Examples

- (d) Porus Graben - Jamaica
- (e) the Takutu Basin - Guyana

(2) Block Mountain or Horst

- (a) A block mountain or **horst** is the raised fault block bounded by normal faults or rift valley.
- (b) An elongate (stretched out) blocks of the Earth's crust that have been raised compared to their surrounding areas as a direct effect of faulting.

How block mountains are formed

The cracks formed on the Earth's surface are called "faults". Due to tectonic or seismic movements, there are movements along these faults. As a result, block of rocks are moved on either side of these faults. They can get tilted sideways or can be uplifted with

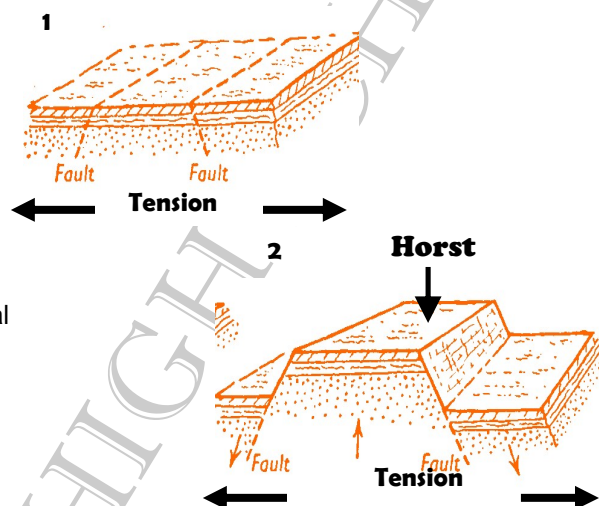
incredible force.

There are two formation theories of **Block Mountains**.

Block Mountain formed by tension

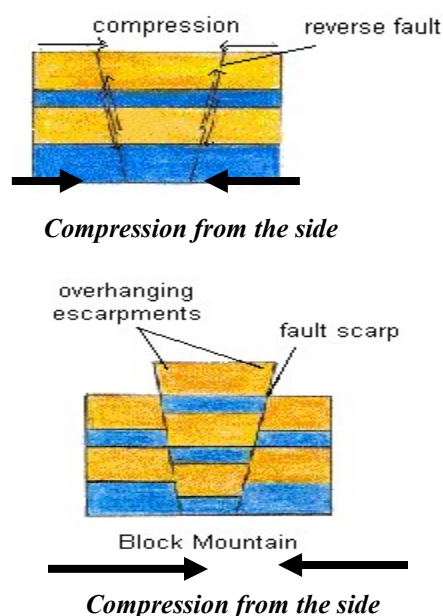
Rock layers being pulled apart by tensional forces going in opposite directions. Tensional forces cause rocks to break and normal faults develop.

As a result, the side rocks went down. And in the middle, the central block remained at an higher than the outer blocks.



Block Mountains formed by compressions

According to this theory, the rock layers compressed the middle block. Due to this compression, the middle block rose forming the **Block Mountains**. The middle block remained at a higher elevation than the side rock blocks.



Types of Block Mountains:

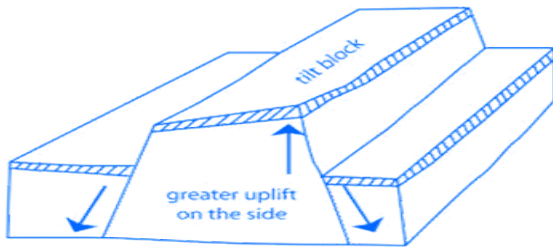
Lifted

Lifted block mountains has two steep sides. Both side scarps are exposed. Example Sierra Nevada and Teton Mountains in Wyoming (North America) are the best examples of lifted type Block Mountains.

Tilted

Tilted block mountains has one gentle slope. The other steep has an exposed scarp. These type of mountains are commonly seen in the Range and Basin region of the western United States, Rhine valley and south-central New England.

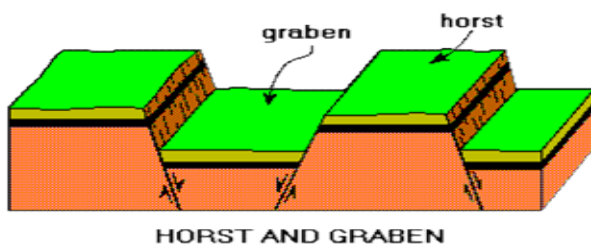
Tilted Block mountain



Example: John Crow Mountain, Jamaica.

Faulted Block

Fault blocks are very large blocks of rock, sometimes hundreds of kilometers in extent, created by tectonic and localized stresses in the Earth's crust. Large areas of bedrock are broken up into blocks by faults.



What is folding

The bending or crumpling of strata as a result of compressive forces in the earth's crust. These folds range from a gentle flexure of a few centimeters in size to folds that produce the world's great mountain systems of the world.

Orogenesis

Mountains are built by movements of the rocks in the Earth's crust. This process is known as orogenesis or orogeny, which simply means mountain building. The process by which the strata of rocks bend to form wave-like undulations is known as folding. Mountains formed by the process of folding are known as fold mountains.

Parts of a fold

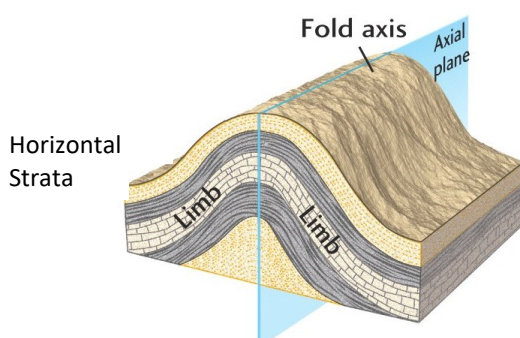
Axial plane - A plane through a rock fold that includes the axis and divides the fold as symmetrically as possible.

Axis - The central line of a fold from which the strata dip away or rise

Limb - The rock strata on either side of the fold.

Anticline - The up part of the fold (up-fold).

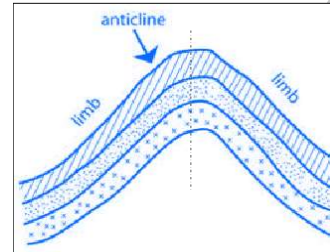
Syncline - the down part of the fold (down-fold).



Types of folds

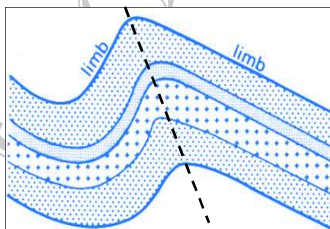
There is a wide variety of different fold sizes and types that can be observed in the rocks of fold mountain areas. The variations are related to rock types and thicknesses, as well as to the direction of the compressional forces being applied to them.

(i) **Open fold/Simple folds/symmetrical fold** - these are folds in which axial plane is vertical. The sides are symmetrical. This is the simplest type of fold.



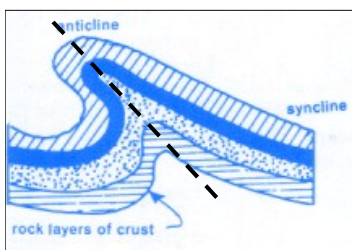
Upright folds - axial planes vertical. - limbs are of equal size.

(ii) **Asymmetrical Fold** - A fold in which one limb dips more steeply than the other. In this fold the limbs dip at different angles. An asymmetrical fold is one in which the axial plane is inclined.



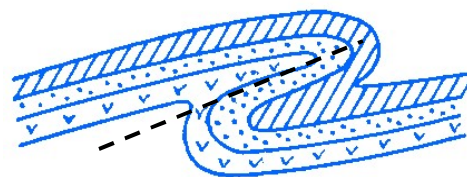
axial planes inclined. - limbs are of different size.

(iii) **Overfold /overturned fold** - An over fold is formed when one limb is pushed over the other limb. This process occurs when the compressional forces from one side are greater than from the other side.

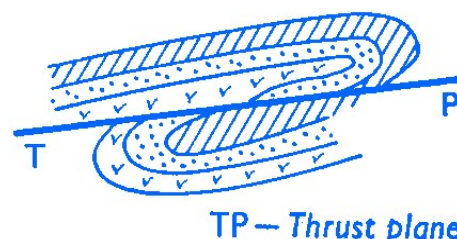


axial planes inclined. - limbs on either side of the axial plane dip in the same direction.

(iv) **Recumbent fold** - An overturned fold in which the axial surface is horizontal or nearly so or a fold in which the axial plane is almost horizontal.

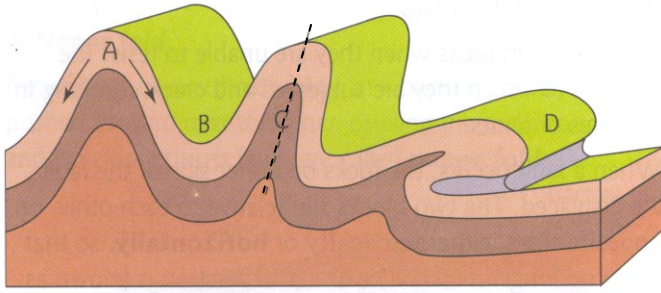


(v) **Overthrust fold/Nappe** - a large body or sheet of rock that has been moved by faulting or folding some distance from its original position. In overthrust fold compressional force is so great that the rock strata are broken and slide over the other. One area of the crust slides over and overrides the other.



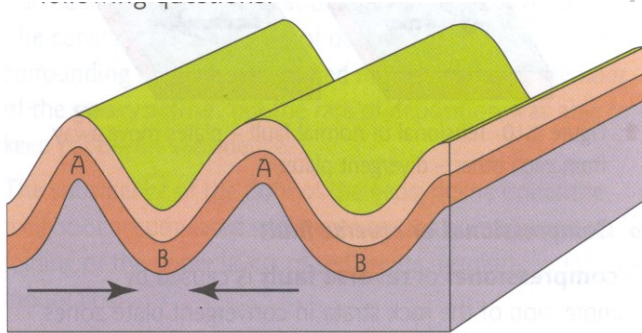
Questions

- (1) Study the diagram below, which illustrates a series of folds in a mountain area, then answer the following questions.



- (a) Name the structural features at A and B.
 - (b) Name the feature represented by the broken line through C.
 - (c) Which of the areas marked A, B and C represents a simple fold?
 - (d) Identify the type of fold shown at D.
 - (e) Describe how the features shown in the diagram could have been formed.
- (2) (a) (i) Define the terms folding and faulting.
(ii) Name the type of plate movement associated with folding.
iii What is:
(A) an anticline (B) a syncline?
- (b) Name a mountain range in:
(i) South America
(ii) North America
(iii) Asia

- (3) Study the diagram below, then answer the following questions.



- (a) Identify the major landform illustrated above.
 - (b) Identify the features at either A or B.
 - (c) Name the forces indicated by the two arrows which produced the major landform identified in (a) above.
1. The compass line of direction between a rock layer and a horizontal plane is the ridge's _____.
a) strike
b) angle of dip
c) direction of dip
d) line of thrust
 2. When plates slide past each other, compressional stresses produce which type of fault?
a) Normal
b) Reverse
c) Transverse
d) Tensional
 3. When plates diverge and when the crust is subjected to spreading, processes elsewhere produce what type of stress?
a) Reverse
b) Transverse
c) Thrust
d) Tensional

4. A sunken block between two parallel normal faults is a(n) _____.
a) horst
b) echelon
c) graben
d) anticline
5. All of the following are associated with horizontal plate movement except _____.
a) transcurrent faults
b) transform faults
c) strike-slip faults
d) reverse faults
6. A fracture in the crust without displacement is a _____.
a) joint
b) fault
c) transform fault
d) recumbent fold
7. The throw of a fault is the _____.
a) vertical displacement
b) horizontal displacement
c) direction of dip
d) direction of strike
8. A(n) _____ is formed by an upthrow block that lies between two reverse faults that run parallel to each other.
a) Upthrow
b) Downthrow
c) Normal fault
d) Block mountain
9. A thrust fault results from which type of force?
a) Tension
b) Compression
c) Transverse
d) Thrust
10. A normal fault results from which type of force?
a) Tension
b) Compression
c) Transverse
d) Thrust
11. A rift valley results from which type of force?
a) Tension
b) Compression
c) Transverse
d) Thrust
12. When a block of crustal rock moves laterally, motion along the fault plane is _____.
a) vertical
b) horizontal
c) transcurrent
d) transforming
13. A transcurrent fault is the same thing as a strike-slip fault.
a) True
b) False
14. Anticlines are downfolds and synclines are upfolds.
a) True
b) False