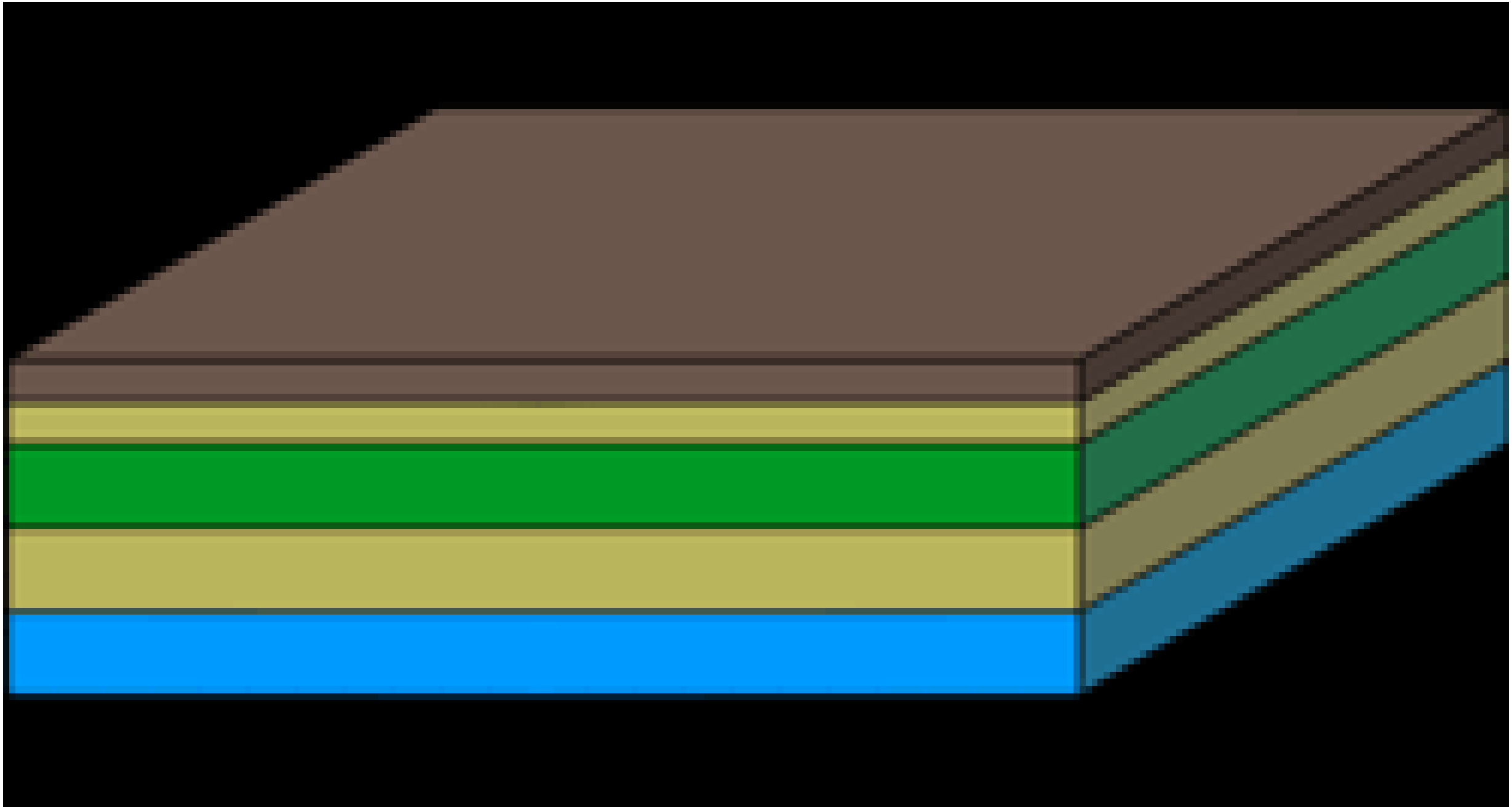
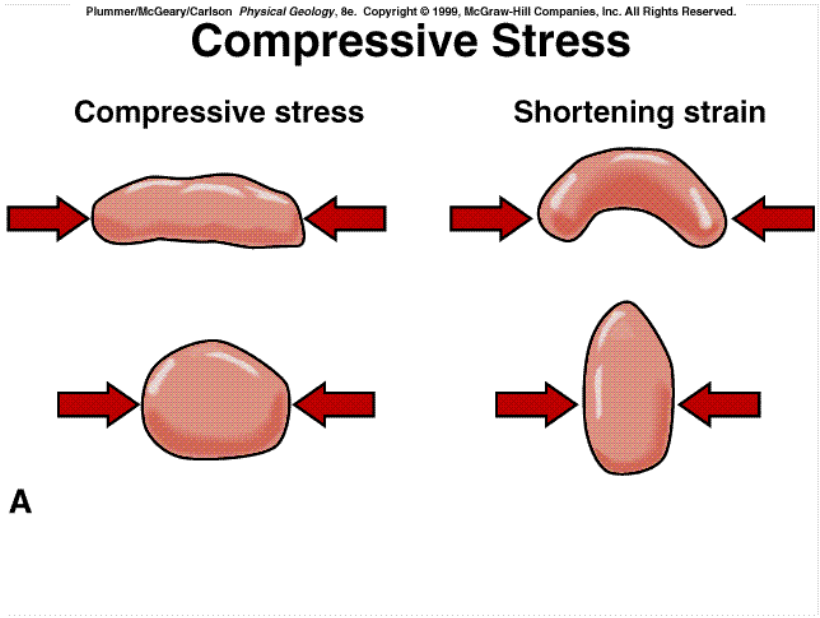
Course Name: Geomorphology
Paper Code: GGY-HC-1016

FOLDING



- Wave-like bends in the crustal rocks
- Formed due to tangential compressive force resulting from horizontal movement.
- This is caused by the endogenetic force originating deep within the earth.
- Such bends are called "folds" where some parts are bent up and some parts are bent down.
- The process associated with development is known as "folding".
- Folding is more common in sedimentary rocks because they are relatively flexible.
- Hard rocks are less likely to bend when compressed (More likely to develop fractures even under compressive forces)
- Symmetrical fold appears when the arms of the fold have an equal slope from the axis of the fold.

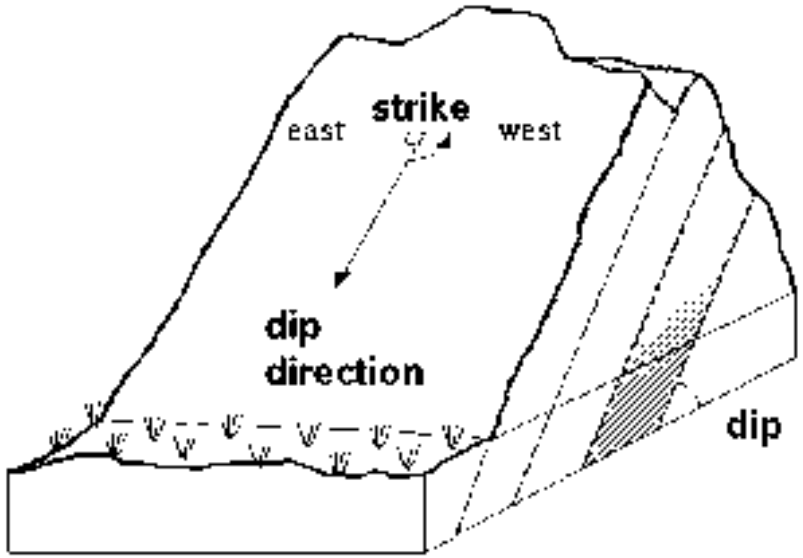


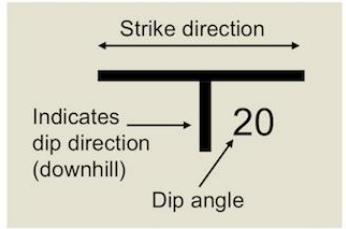
Strike and Dip

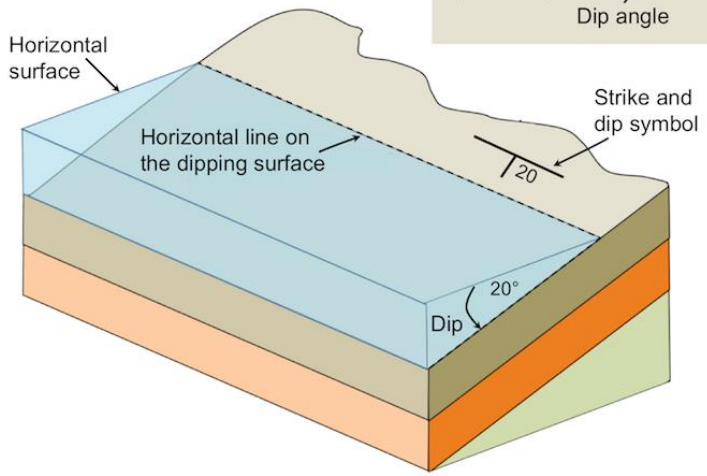
To understand the structural form

- **Dip:** The inclination of rock beds with respect to horizontal plane is termed as dip:
    i. The direction of maximum slope down a bedding plane
    ii. The angle between the maximum slope and the horizontal plane.

    Dip is measured by clinometer
- **Strike:** The strike of an inclined bed is the direction of any horizontal line along a bedding plane.
- The direction of dip is always at right angle to the strike.







Components of Folds

Crest: The line running through the highest points in an uparched fold.

Trough: The line running through the lowest points in downarched fold.

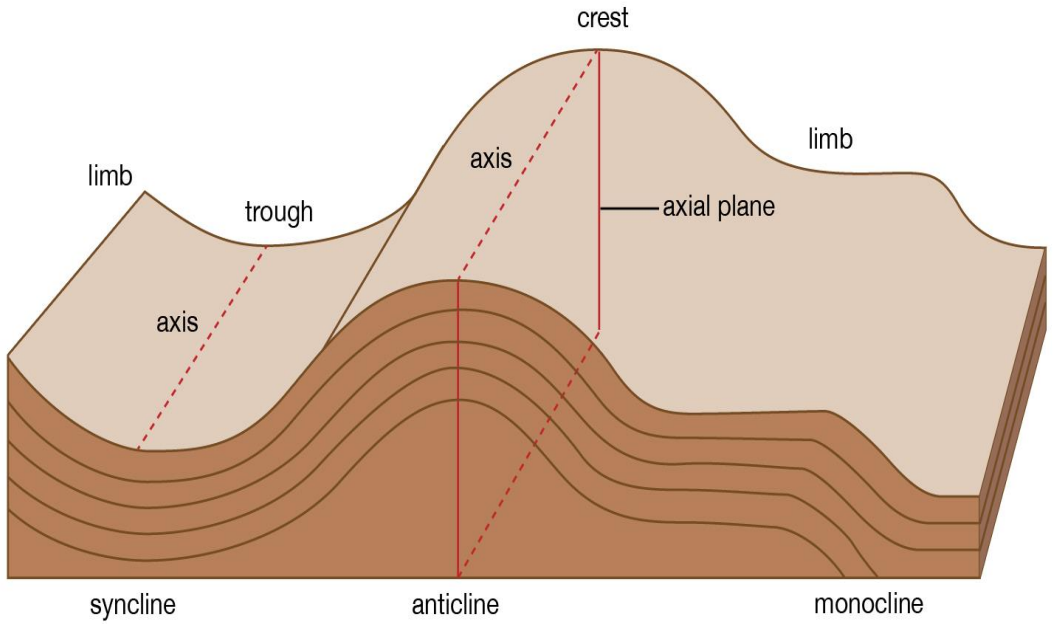
Limbs: The two sides of a fold are called limbs

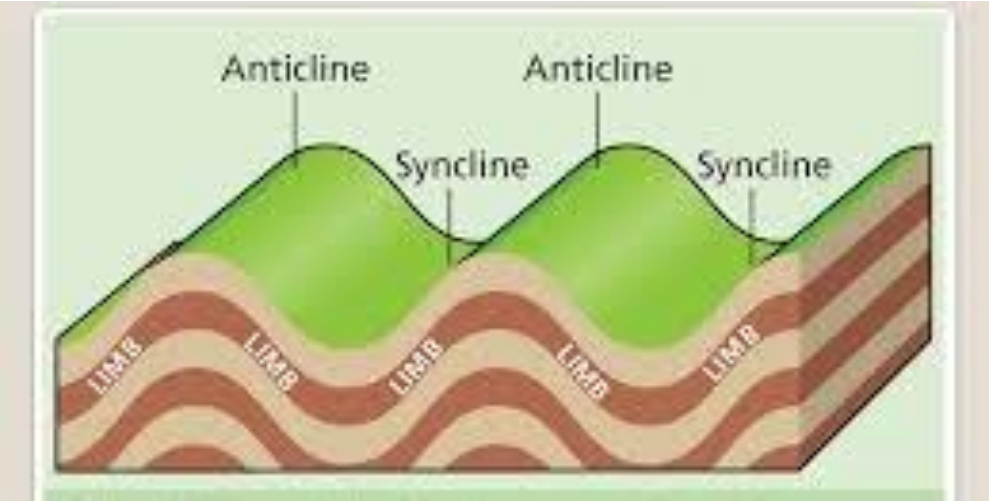
Middle limb: Limb shared by both anticline and syncline

Axial plane: The plane which bisects the angle between the two limbs of the anticline and syncline. On the basis of anticline and syncline these planes are called as axis of anticline and axis of syncline.

Hinge line: line connecting the points of maximum curvature on the fold profile.

Hinge zone: the zone of maximum curvature on the fold profile





Anticlines: The uphold rock strata in arch-like form are called are called Anticlines

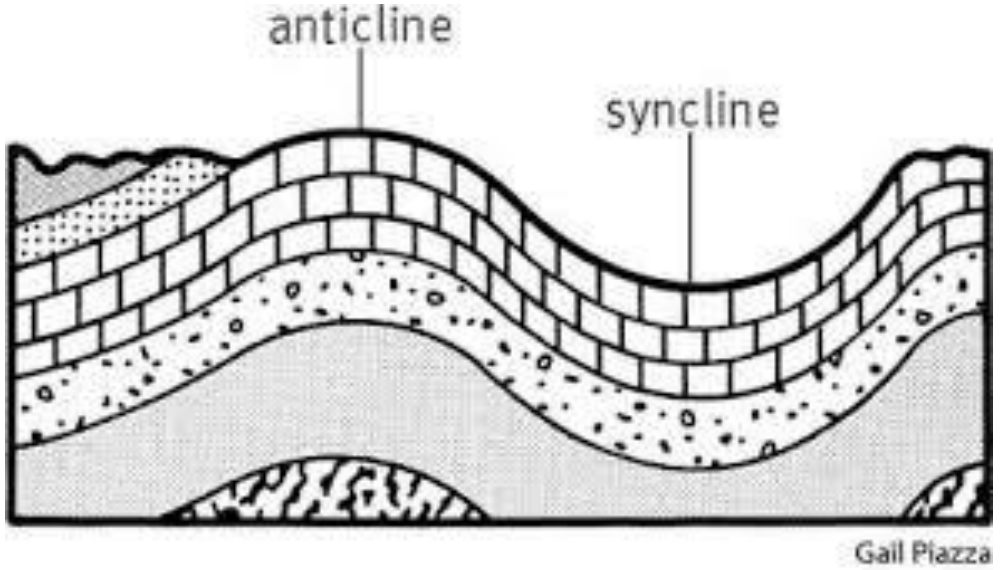
- In simple fold the rock strata of both the limbs dip in opposite direction
- **Symmetrical anticline:** When the slopes of both the limbs or sides are uniform
- **Asymmetrical anticline:** When the slopes are unequal
- Anticlines are divided into two types:
  - **Gentle anticline** (Dip angle less than 40°, or 1° or 2°)
  - **Steep anticline** (Dip angle between 40° to 90°)

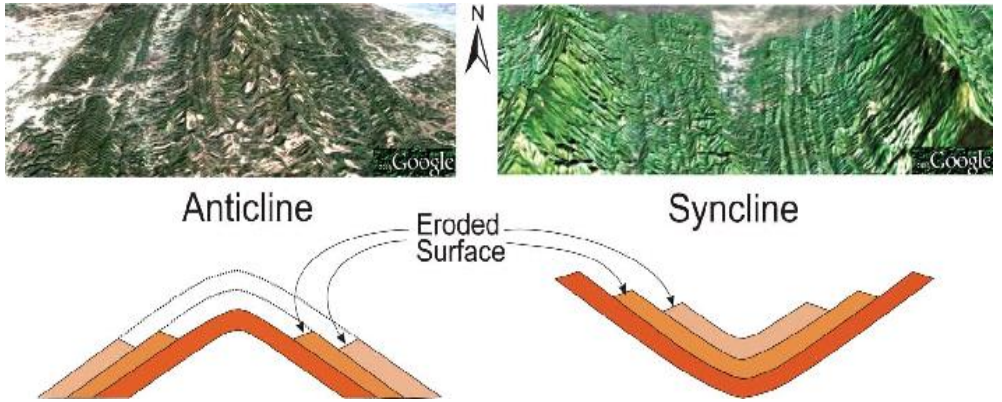
Syncline: The downfolded structure forming trough-like feature is called Syncline.

Anticlinorium: A series of minor anticlines and synclines in one extensive anticline. Also called fan fold.

Synclinorium: A series of minor anticlines and synclines in one extensive syncline

Formed due to difference in the intensity of compressive forces and irregular forces.





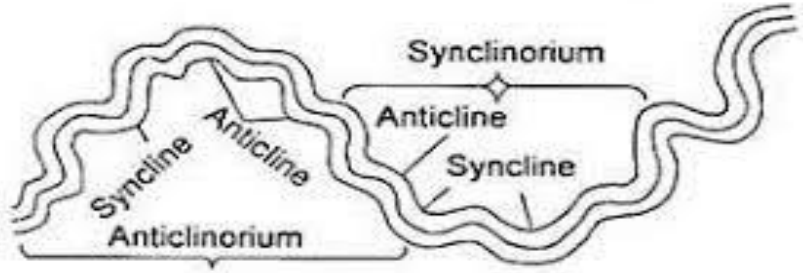


Fig. 7.5 : Illustration of anticlinorium and synclinorium.

TYPES OF FOLD

- The nature of folds depends of several factors:
  - The nature of rocks (Hard rock and soft rock)
  - The nature and intensity of compressive forces
  - Duration of the operation of compressive forces
- The elasticity of rocks largely affects the nature and the magnitude of folding process
- Soft and elastic rocks are subjected to intense folding
- Hard or rigid and less elastic are folded moderately
- The intensity and magnitude of compressive forces causes variations in the characteristics of folds.
- Limb inclination of different folds are different.

Based on the inclination of limbs folds are divided into 5 major types:

1. Symmetrical fold
2. Asymmetrical fold
3. Monoclinal fold
4. Isoclinal fold
5. Recumbent fold
6. Overturned fold
7. Plunge fold
8. Fan fold
9. Open fold
10. Closed fold

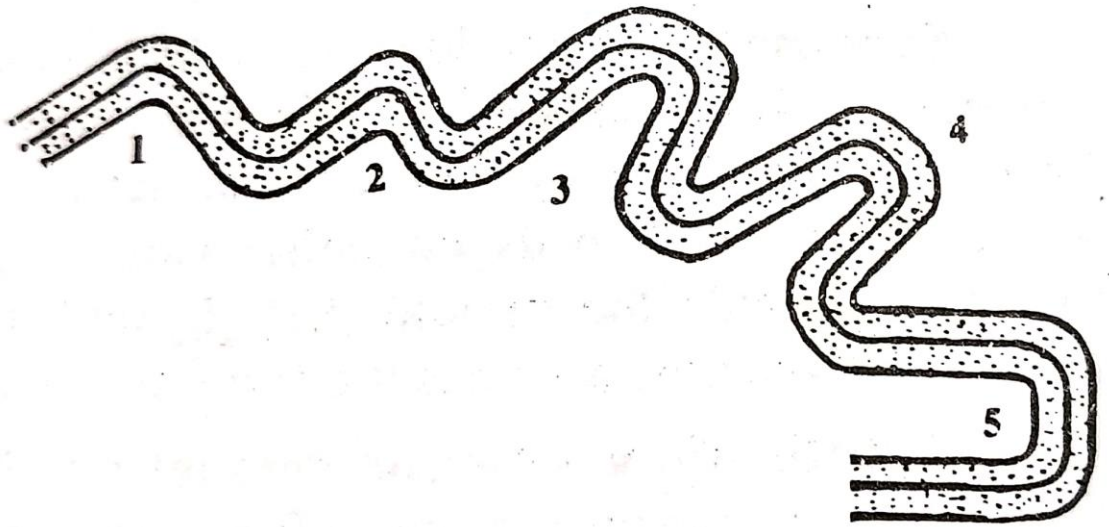
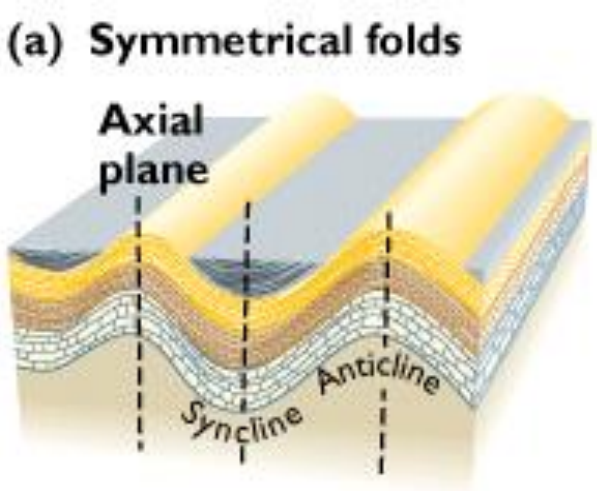
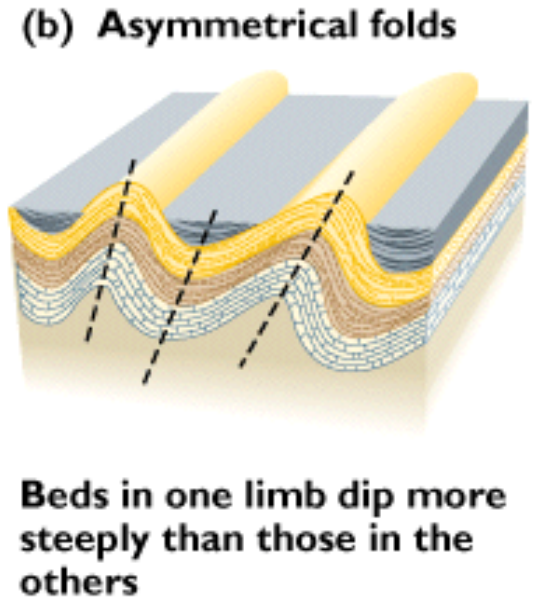


Fig. 9.6 : Types of folds - 1, symmetrical folds, 2. asymmetrical folds, 3. monoclinal folds, 4. isoclinal folds and 5. recumbent folds.

1. **Symmetrical fold:**
   - Simple folds
   - Limbs incline uniformly
   - Example of open fold
   - Moderate intensity compressive forces
   - Rarely found in the field

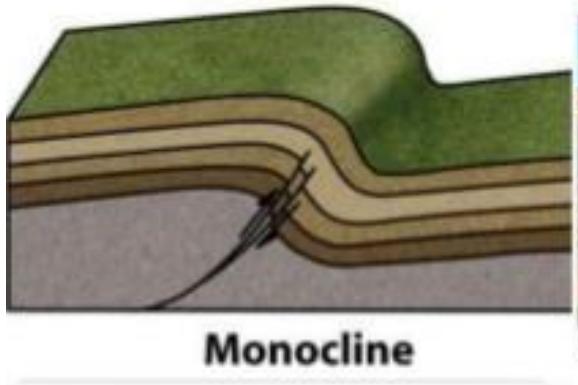
2. **Asymmetrical fold:**
   - Unequal and irregular limbs
   - Limbs incline at different angles
   - One limb is relatively larger and regular while the other is shorter with steep inclination
   - Asymmetrical in terms of inclination and length

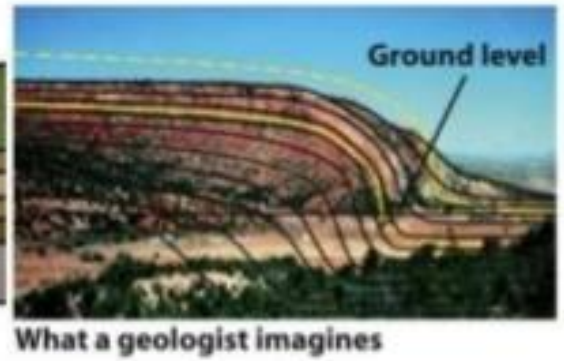


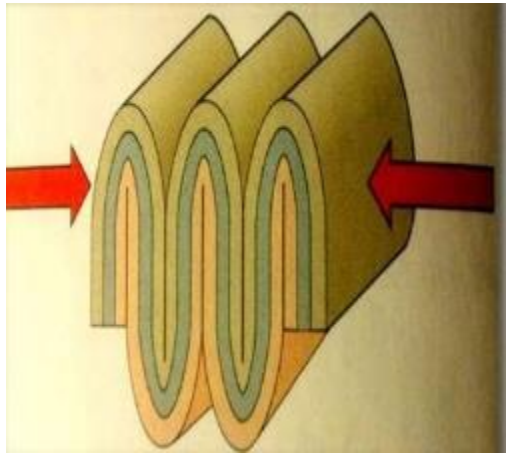


3. **Monoclinal folds:**

- One limb inclines moderately with regular slope while the other limb inclines steeply at right angle
- Slope is almost vertical
- Vertical force and movement are responsible
- Splitting of the limbs due to intense folding
- Unequal horizontal compressive forces coming from both the sides
- Eg: Colorado National Monument

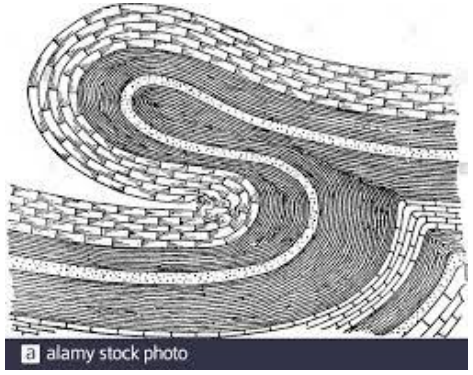






4. **Isoclinal folds:** Very strong compressive fold that both the limbs becomes parallel but not horizontal

5. **Recumbent folds:** Very strong compressive fold that both the limbs becomes parallel as well as horizontal



6. **Overturned folds:** One limb of the fold is thrust upon another fold due to intense compressive forces

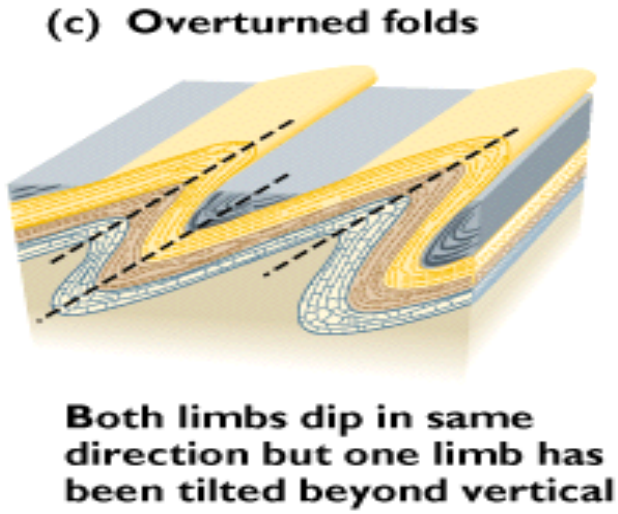
7. **Plunge folds:** It becomes tilted and forms plunge angle which is the angle between the axis and the horizontal plane

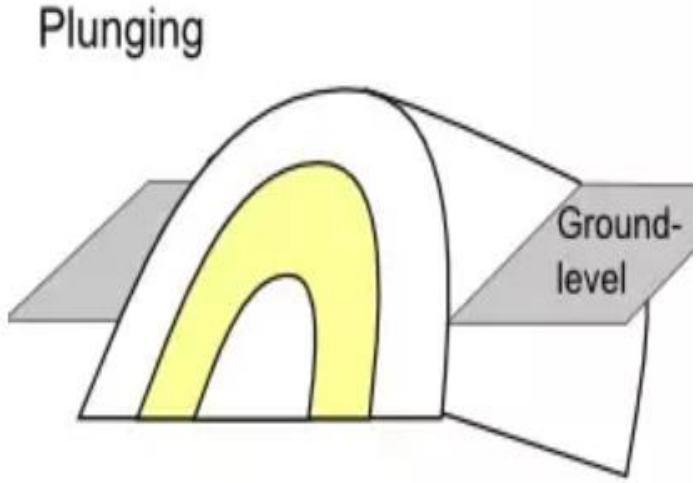
8. **Fan folds:** An extensive and broad fold consisting of several minor anticlines and synclines

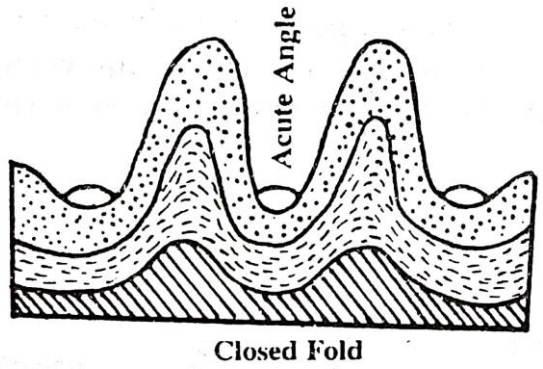
9. **Open folds:** Angle between two limbs of the fold is more than 90° and less than 180° (Obtuse angle)

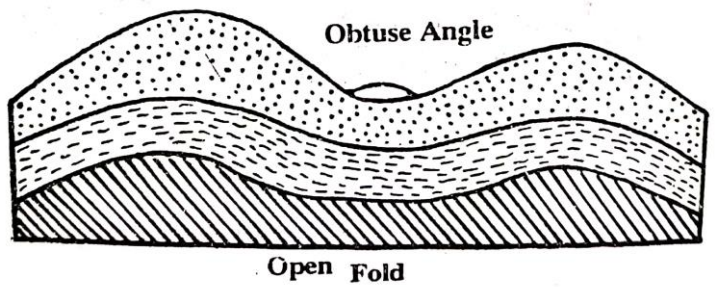
10. **Closed folds:** Angle between two limbs of a fold is acute angle due to intense compressive force.

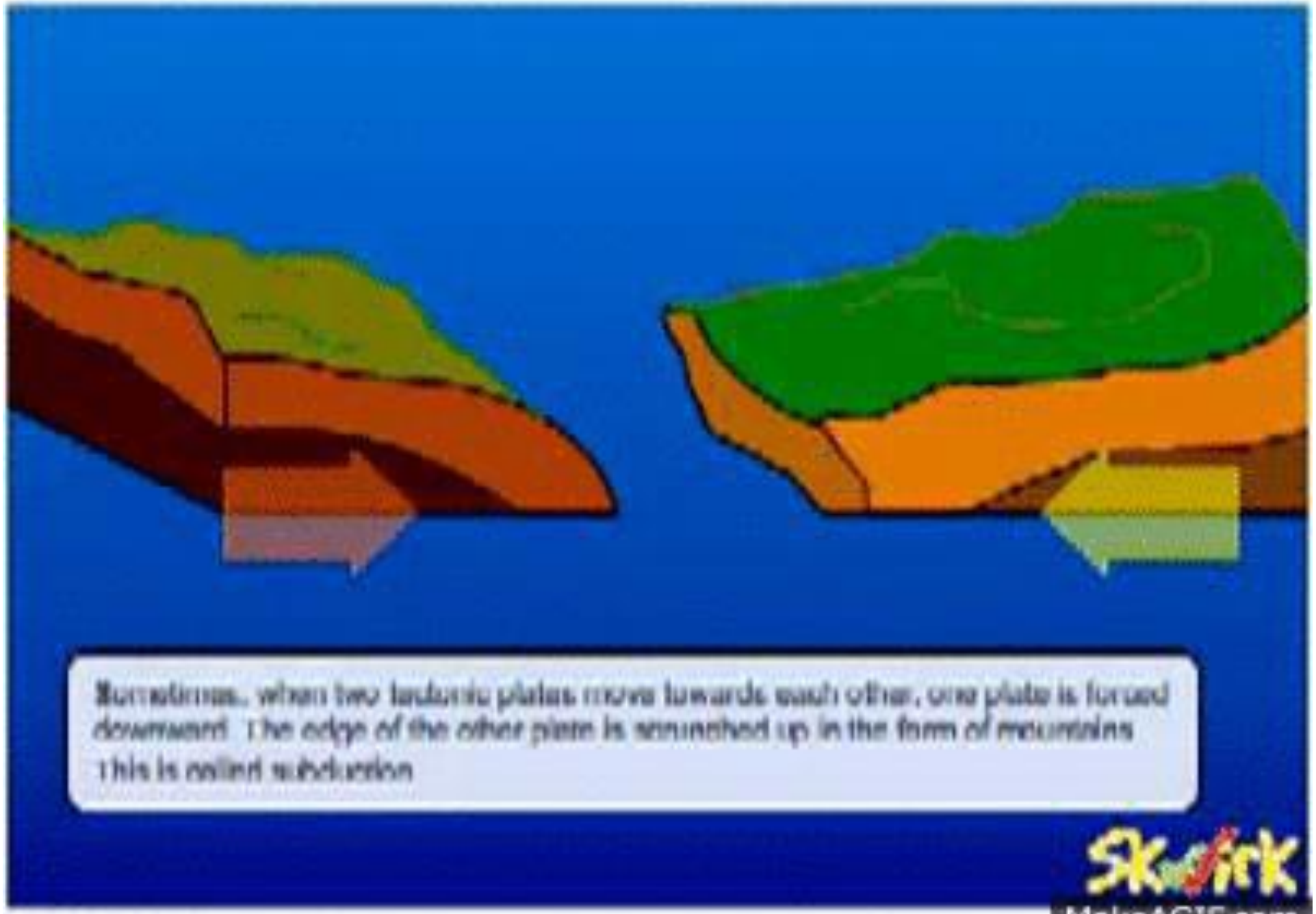
Nappes are folds results from complex folding mechanism by intense horizontal movement and resultant compressive force.










Sometimes, when two tectonic plates move towards each other, one plate is forced downward. The edge of the other plate is sometimes up in the form of mountains
This is called subduction
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