

Quadrant II – Notes

Programme: Bachelor of Science (Third Year)

Subject: Geology

Paper Code: (DSC) GEC-106

Paper Title: Structural Geology

Unit: Structural Geology I

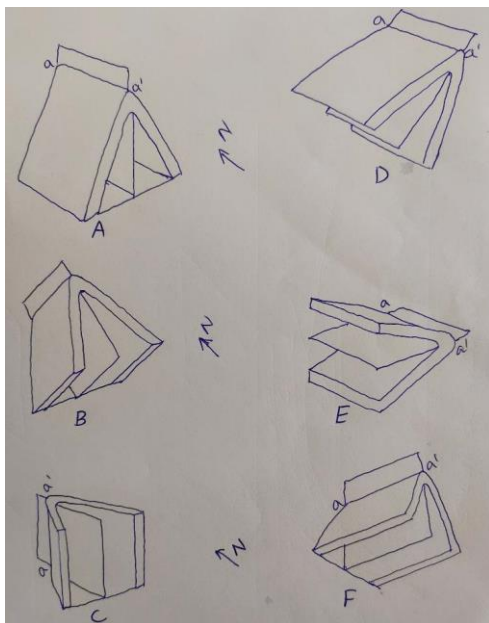
Module Name: Folds Part 2

Module No: 7

Name of the Presenter: Raghav R Gadgil

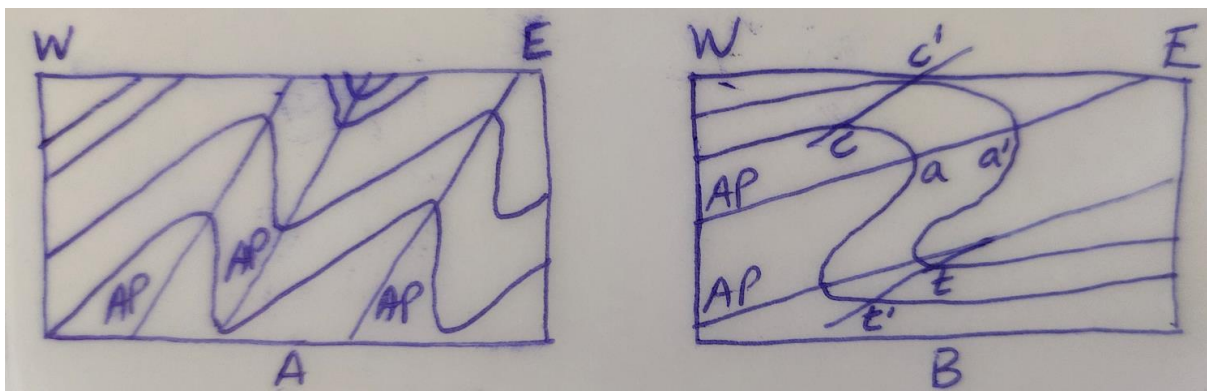
Notes:

Parts of a fold:



- The hinge of a fold (aa') is a line of maximum curvature in a folded bed. It is characterized by orientation and position.
- The hinges may be horizontal (A, D, E), inclined (B, F) or vertical (C)

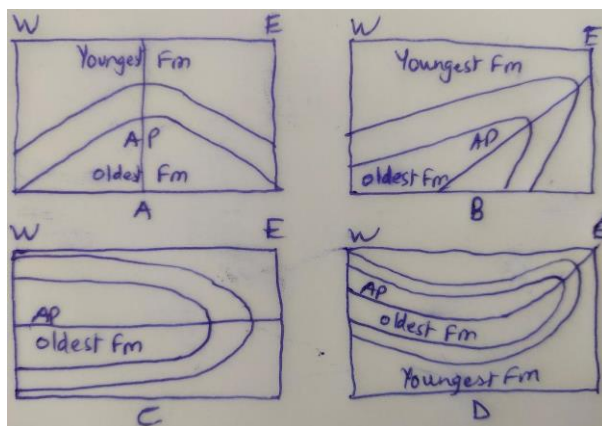
- The axial plane (AP) is the surface connecting all the hinges. It may be a simple plane or curved surface. In cross sections, the AP is represented by a line.
- In some folds, the AP is vertical (A, B, C), in others inclined (D, F), and horizontal (E).
- Although in many folds, the axial surface is a relatively smooth plane, it may be curved.
- The attitude of the AP is defined by its strike and dip.
- In these figures, the North is towards the upper left-hand corner.
- In A, B, C the AP strikes north and has a vertical dip.
- In D, the strike is North and dips 45° W.
- In F, AP strikes N, and 60° W, in E it is horizontal.



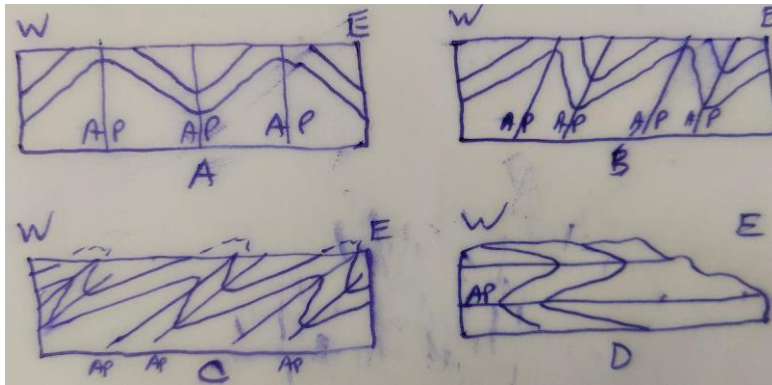
- The axis is a line parallel to the hinges. It is that straight line moving parallel to itself that generates the fold.
- the sides of a fold are called as the limbs or flanks. A limb extends from the axial plane in one fold to the axial plane in the next (a'b in A).
- Although in many instances, the hinge is at the highest part of a fold (in A), this is not necessarily the case (in B)
- In B, aa' are hinges and cc' are the highest points on the folds.
- The crest is a line along the highest part of the fold OR the line connecting the highest points on the same bed in an infinite number of cross sections.
- There is a separate crest for each bed.

- The plane or surface formed by all the crests is called the crestal plane (cc' in B)
- However, in economic geology terms, accumulation of oil and gas occurs in the crest and crestal plane rather by the hinge and axial plane.
- The trough is the line occupying the lowest part of the fold OR the line connecting the lowest parts on the same bed in an infinite number of cross sections (tt' in B). The plane connecting such lines may be called a trough plane.

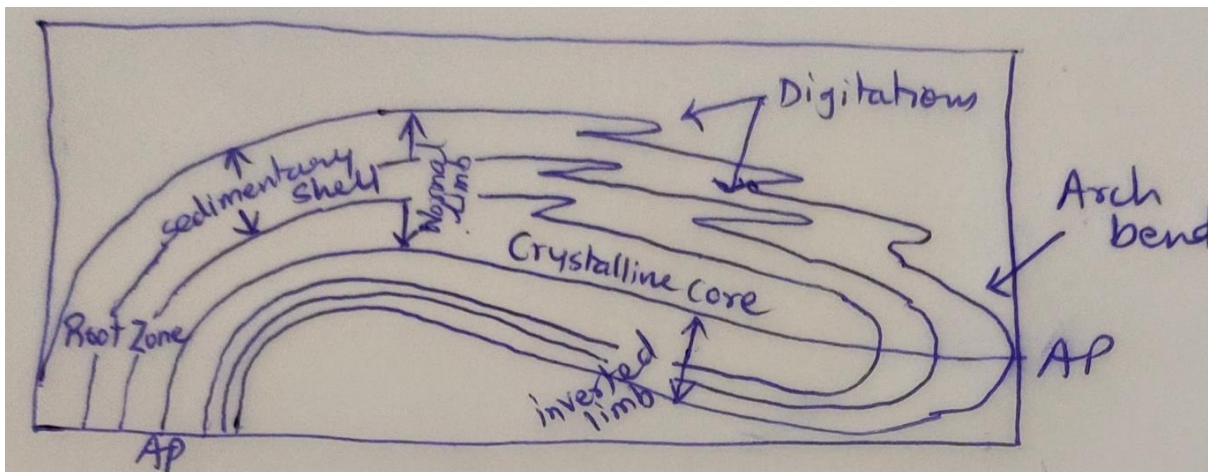
Nomenclature of folds



- In general, an anticline is defined as a fold that is convex upward or the fold that has oldest rocks in the center (A)
- The term anticline is used in simplest conditions of limbs dipping away from each other but also in limbs dipping in same directions but at different angles (B, C and D)
- Here, the age of the rocks is known, i.e. older are in the center.
- In general, a syncline is defined as a fold that is convex downward. The two limbs dip towards each other.
- But the term is also extended to those folds in B, C and D.



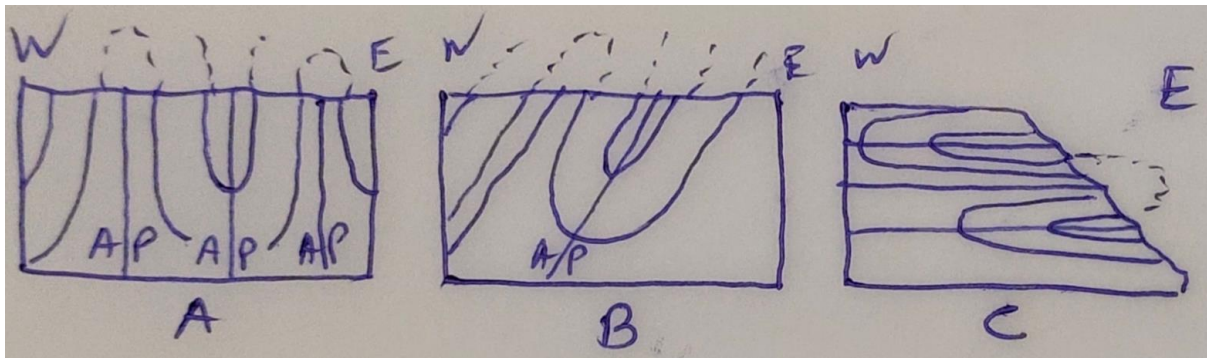
- A symmetrical fold (upright): AP is essentially vertical (A); Conversely, an asymmetrical fold: AP is inclined (B)
- Overturned fold: AP is inclined, and both limbs dip in the same direction usually at different angles (C).
- The overturned, inverted or reversed limb is the one that has been rotated through more than 90° to attain its present attitude.
- The normal limb is the one that is right side up
- A recumbent fold is the one in which the AP is essentially horizontal (D)
- Rather elaborate terminology is present to describe such folds.



The strata in the inverted limb are generally much thinner than the corresponding beds in the normal limb. The term arch bend has been used for the curved part of the fold between the normal and inverted limbs.

The term 'core' and 'shell' refer respectively to inner and outer parts of a fold. Many recumbent folds have subsidiary recumbent anticlines attached to them called 'digitations' because they look like great fingers extending from a hand.

All recumbent folds may be traced back to a root-zone, i.e., to the place on the surface of the Earth from which they arise, in other words where the AP becomes much steeper.

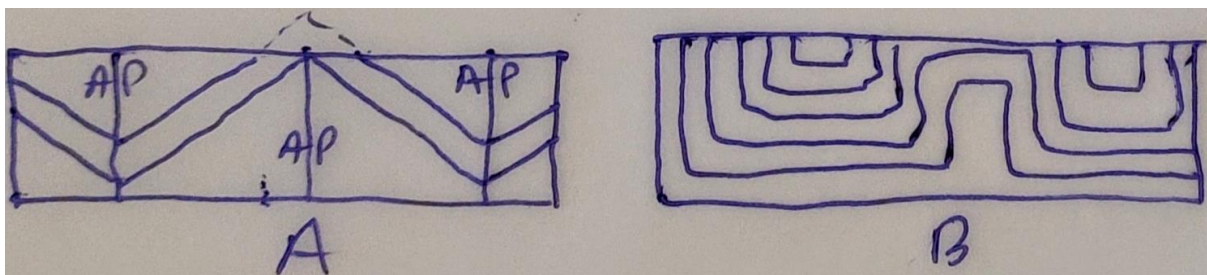


An isoclinal fold (means equally inclined) refers to folds in which the two folds dip at equal angles in the same direction.

A vertical isoclinal fold (A) in one in AP is vertical; an inclined or overturned isoclinal fold is one in which the AP is inclined (B)

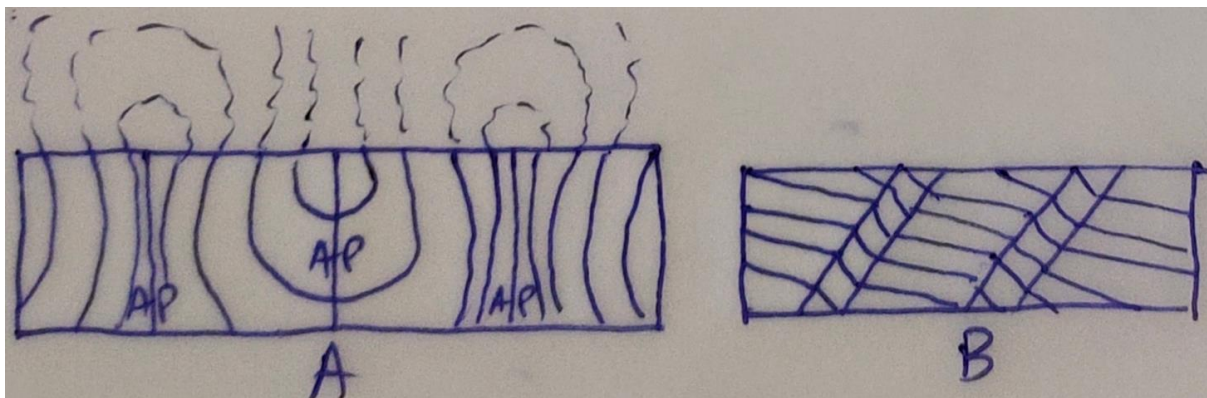
A recumbent isoclinal fold is one in which the AP is horizontal (C)

Many recumbent folds are isoclinal



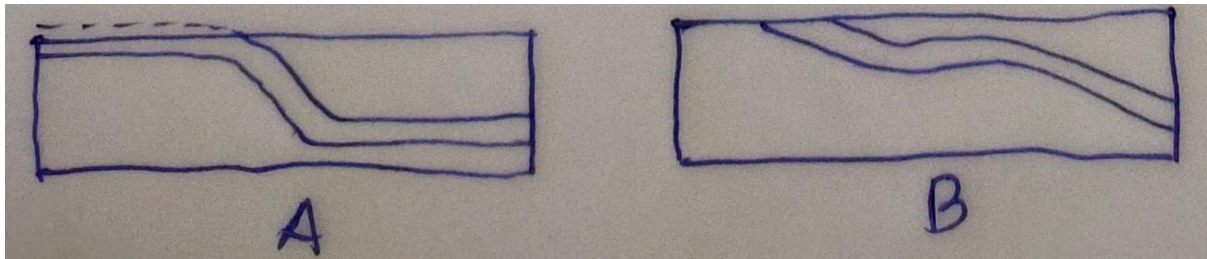
A chevron fold is one in which the hinges are sharp and angular (A)

A box fold is one in which the crest is broad and flat; two hinges are present, one on either side of the flat crest (B)



A fan fold is one in which both limbs are overturned (A). In the anticlinal fan fold, the two limbs dip toward each other; in the synclinal fan fold, the two limbs dip away from each other.

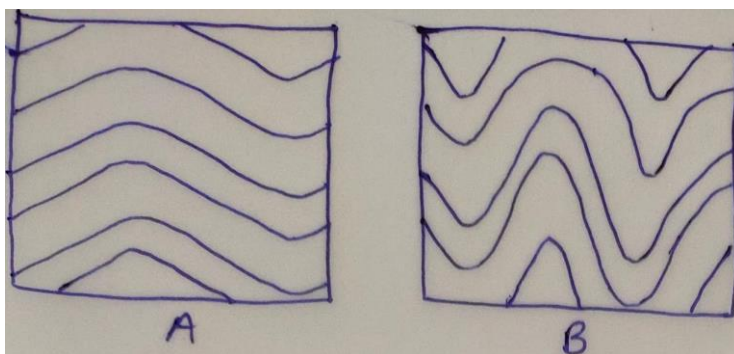
Kink bands are narrow bands (B), usually only a few inches or a few feet wide; in which the beds assume a dip that is steeper or gentler than that in the adjacent beds.



In plateau areas, where the bedding is relatively flat, the strata may locally assume a steeper dip (A), such fold is a monocline. The beds in a monocline may dip at angles ranging from few degrees to 90° , and the elevation of the same bed on opposite sides of the monoclines may differ by hundreds or even thousands of feet.

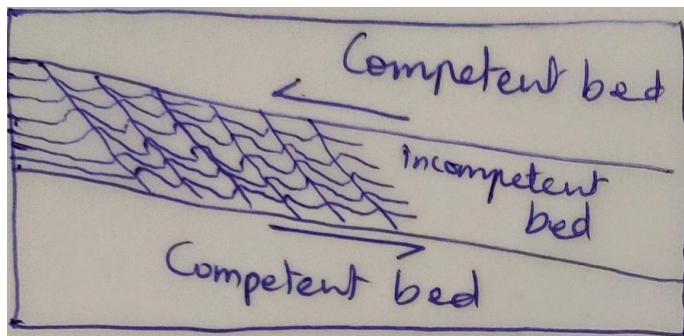
The term homocline, may be applied to strata that dip in one direction at a relatively uniform angle.

In areas where dipping strata locally assume a horizontal attitude, structural terrace is formed (B).



A closed or tight fold is one in which the deformation has been sufficiently intense to cause flowage of the more mobile beds so that these beds thicken and thin (B)

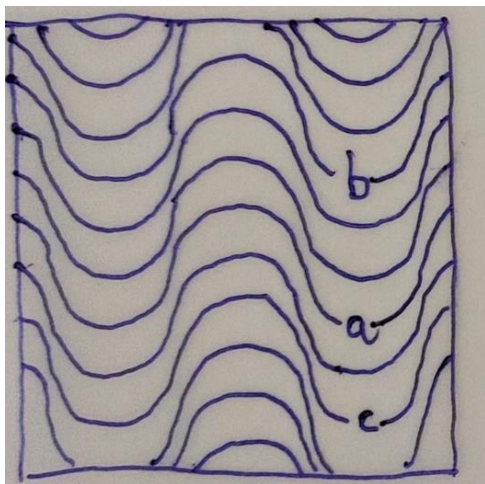
Conversely the open fold is one in which this flowage has not taken place (A)



Drag folds form when competent beds slide past an incompetent. Such minor folds may form on the limbs of larger folds because of the slipping of beds past each other. The AP of the drag folds are not perpendicular to the bedding of the competent strata, but are inclined at an angle.

The traces of the axial planes of the folds are formed.

The acute angles between the axial planes and the main bedding plane point in the direction of the differential movement.



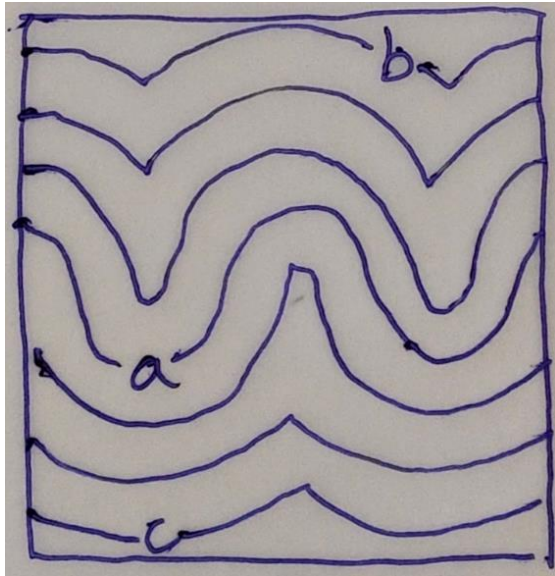
The shape of the folds may vary along the AP at right angles to the fold axes.

Line 'a' is taken as the form of the fold shown by one bedding plane. The other lines have been drawn on the assumption that they have the same form as line 'a'.

In this way the form of the fold is propagated indefinitely upward and downward. Moreover, lines 'b' and 'c' have the same length as 'a'.

Here, thinning along the limbs and thickening along the hinges takes place. Considerable plastic movement of material away from the limbs and toward the hinges

In natural folds the competent beds preserve relatively uniform thickness, but the weaker, less competent beds adjust themselves by flowage and folding.



Parallel folding (concentric folding).

Line 'a' is taken as the form of the fold shown by one bedding plane. The rest of the beds preserve the thickness due to folding.

Under such conditions, the form of the fold must change upward and downward. The anticlines become sharper with depth, but broader and more open upward. Conversely, the synclines become broader with depth, but sharper upward. The folds die out downward and upward.