Fold Geometry

Folded surface

Folded layer

Synform, Antiform,
Neutral fold

Syncline and Anticline

Geometry of a Folded Surface

Cylindrical vs. Noncylindrical

examples of noncyl folds:

sheath folds, conical folds

Geometry on fold profile plane:

(**section perpendicular to the fold axis**)

limbs, closure, hinge point, hinge zone, inflection point, interlimb angle, tightness, curvature distribution, symmetry

Hinge line and Axial Surface

Fold Orientation

The attitude (orientation) of a fold in space is completely defined if both <u>the PLUNGE of its hingeline</u> and <u>the DIP of its axial plane</u> are known.

HL plunge: **horizontal, gently plunging, moderately plunging, steeply plunging, vertical**

AP dip: **upright, steeply-inclined, moderately inclined, gently inclined, recumbent**

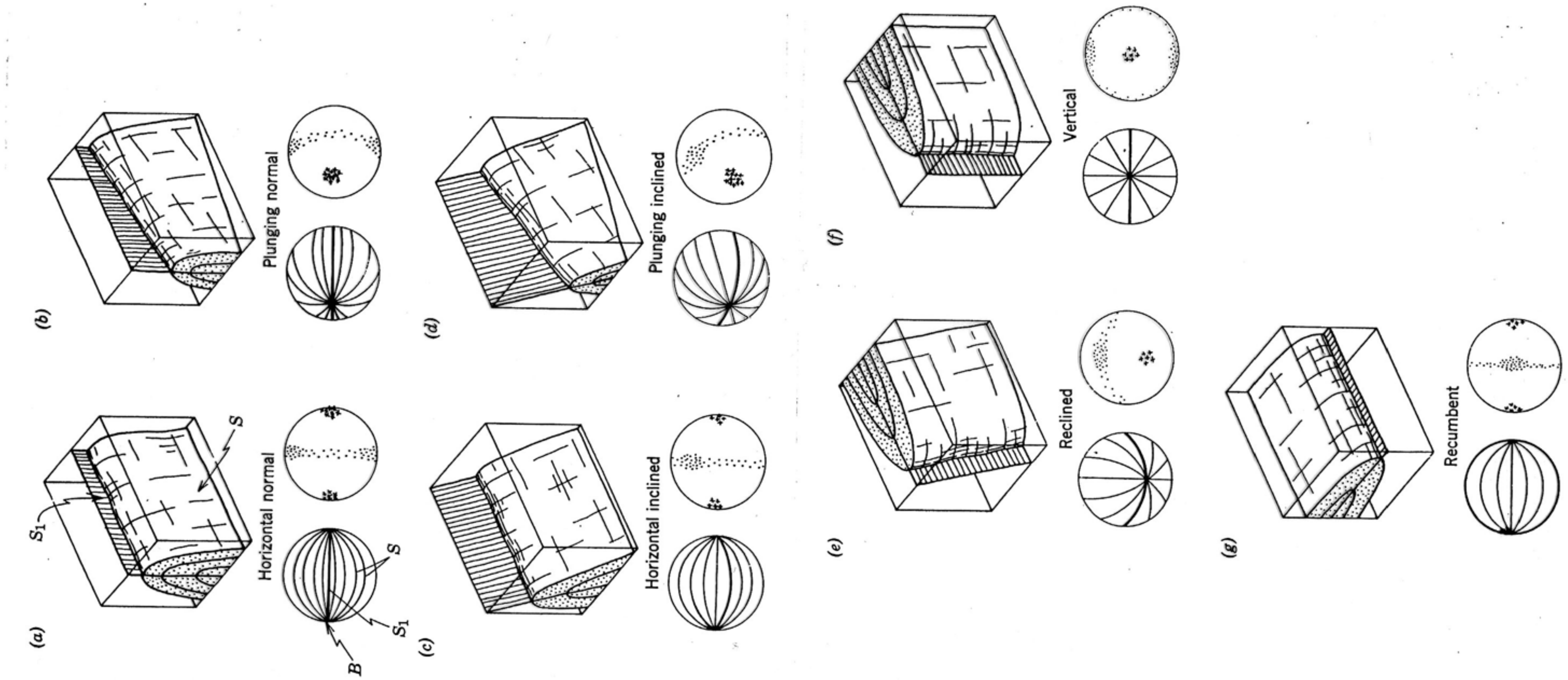
Reclined fold: **fold with the pitch of HL on AP greater than 80 degree.**

Stereographic Projection of a Cylindrical Fold

For a perfect cylindrical folds:

Fold surface dips plotted as great circles intersect at a single point, which is the HL plot (β-diagram).

Fold surface dips plotted as plane poles lie in a great circle, the pole to which is the HL plot (π-diagram).



Fold orientations and associated β- and π–diagrams

Dealing with Imperfect Folds

Using β- and π- diagrams

Ramsay (1987):

Perfect cylindrical fold: a fold with π-poles lying precisely on a great circle.

Cylindrical fold: a fold with 90% of its π-poles lying within 10 degrees of the mean great circle.

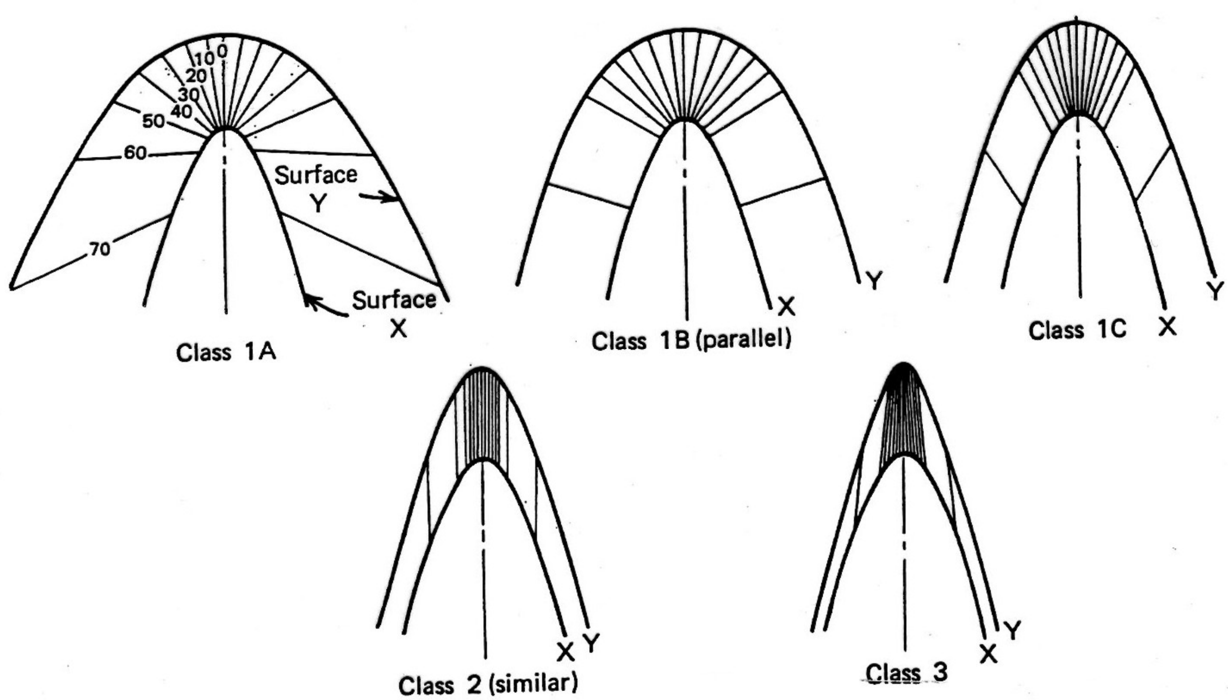
Subcylindrical fold: a fold with 90% of its π-poles lying within 20 degrees of the mean great circle.

Noncylindrical fold: a fold with >10% of its π-poles lying outside a 20 degree zone around the mean great circle.

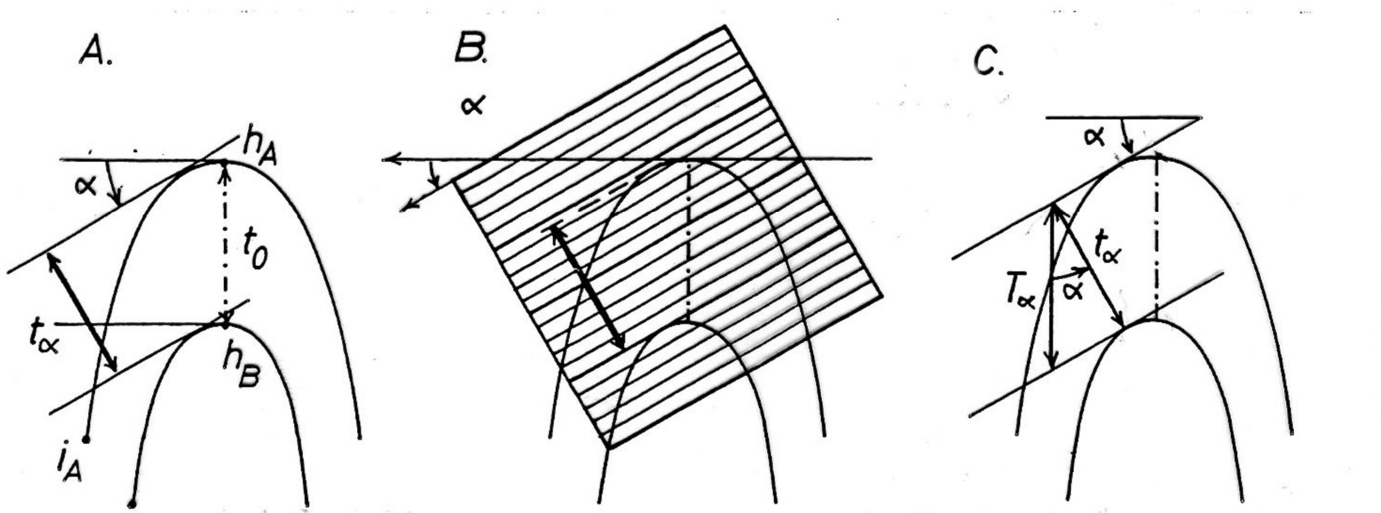
Folded Layer
Single-layer and Multilayer Folds

Thickness variation across a fold

Ramsay's fold classification



A more efficient way of constructing the dip isogons



A standard way of constructing the dip-isogons on a fold profile plane

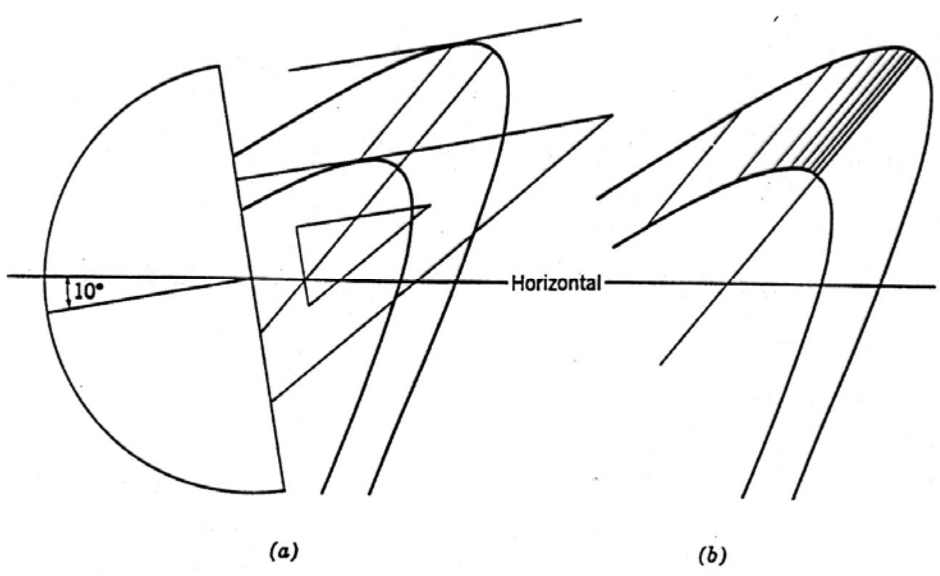


FIGURE 11.7 Construction of dip isogons.

- Class 1 folds: **dip-isogons fan out from the inner fold surface to the outer fold surface**

  1A: hinge thinner than limbs

  1B: constant thickness of the fold layer (hence called parallel fold)

  1C: hinge thicker than limbs

Class 2 folds: **dip-isogons are parallel to each other (similar folds)**

Class 3 folds: **dip-isogons converge from the inner fold surface to the outer fold surface**

Use of Ramsay's Classification

Strong (competent) layers tend to fold into class 1B and 1C folds.

Weak (incompetent) layers tend to fold into class 3 folds.

Passive folding tend to produce class 2 folds.

Class 1A folds may be formed with loading normal to the layer, such as in the situation of diapiric intrusion of weaker and buoyant material.

Thus, fold shapes provide us clues into mechanical properties of rocks at the time of folding.

Why are folds different ?

Mechanical properties of the layer(s) and the matrix rock

Competence and competence contrasts:

<u>Sedimentary rocks:</u>

dolomite, arkose, qtz sanstone, greywacke, limestone, siltstone, marl, shale, anhydrite/halite

<u>Metamorphic rocks:</u>

meta-basalt, granite, qtz-fspar-mica gneiss, qtz, marble, mica schist

Folds Occur on Various Scales

Parasitic folds: M-, S-, Z-folds

Anticlinorium, Synclinorium

Enveloping surface

The Use fold symmetry

Fold Mechanisms

- Buckling: layer-parallel shortening
  - Competent layers: class 1B, 1C folds
  - Incompetent layers: class 3 folds
  - Collectively, class 2 fold

- Flexural slip (flow): class 1B folds generally

- Slip-folding: Class 2, similar folds

- Passive folding: Class 2 folds


Final state
0
20cm