Low-grade metamorphic rocks and folds
EPSC 240, Geology in the Field
Oct 22, 2018

Key concepts for Week 8:

Folds: Folds are common geological structures defined by a curve or bend in an originally straight surface. The surface which is folded might be bedding, foliation, a dyke or vein, or any other surface in a rock. The straight segments in between curved *hinges* are *limbs*. The *hinge* is defined as the line of maximum curvature along the folded surface. This could be a curve or a straight line (see Figure 1). If a hinge is approximately straight, it is called a *fold axis*. A fold where the hinge line is very close to the fold axis is called a *cylindrical fold*. The *axial surface* is the surface containing the hinges or fold axes, as drawn on multiple layers within the fold. In this example (Figure 1), the axial surface is near planar, so we call it the *axial plane* and can use its strike and dip, along with the trend and plunge of the fold axis, to describe the orientation of the fold.

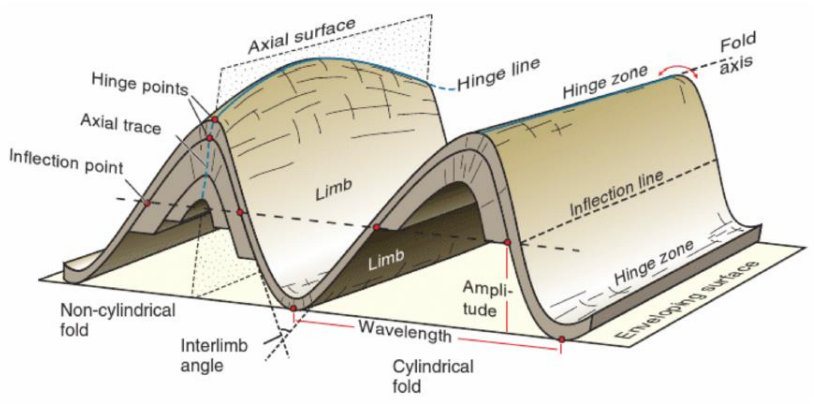


Figure 1: Names for parts of folds, from Fossen, H., (2011) Structural Geology, Cambridge University Press, Figure 11.1.

Strain: Strain is a *quantitative* measure of the change in shape, size, volume, orientation, or position of any deformed feature in a rock.

Elongation: A one-dimensional measure of strain (see Figure 2). To measure elongation, it is necessary to find a deformed feature in the rock whose original length can be reasonably estimated. Folded surfaces in low-grade metamorphic rocks (especially buckle folds, see below) are ideal for this, because they typically undergo a minimum of stretching and distortion during folding. The elongation is the change in length divided by the original length of any feature in the rock. Elongation can be measured at any scale, from an individual mineral grain to the change in width of an entire mountain range. If elongation is negative, then the strain is described as *shortening*. If elongation is positive, the strain is described as extension.

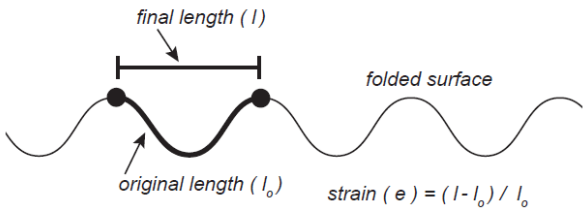


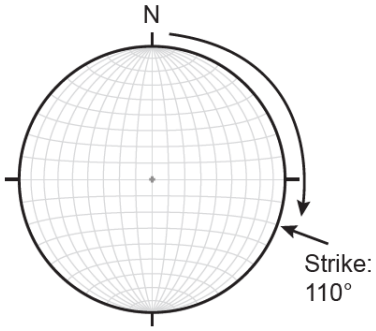
Figure 2: Convention for measuring elongation across sinusoidal folds.

Buckle folds: Folds formed by end-to-end shortening parallel to the folded layer. They often have a sinusoidal shape, and can be used to quantitatively measure shortening strain.

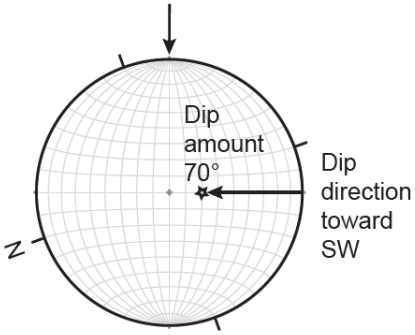
Axial planar cleavage: The axial plane of a fold is a geometric construct and usually not represented by a real plane in the rock (i.e., something you can put your Brunton on). Sometimes, mostly in mica-rich rocks with slaty or schistose cleavage, the cleavage will align with the theoretical axial plane. This is explained by the alignment of micas perpendicular to the shortening direction if they grow during deformation (easier growth in the direction of least stress).

Stereonets: A plot used by geologists to visualize 3D orientations of lines and planes on a 2D representation.

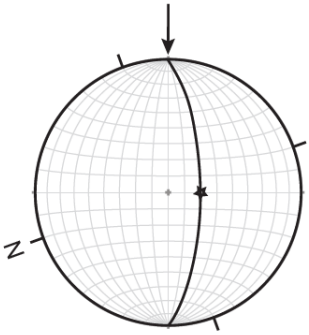
PLOTTING PLANES AS GREAT CIRCLES
Example: 110/70SW



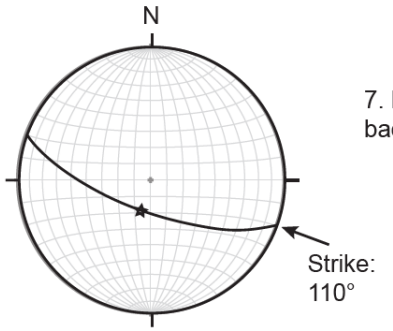
1. Trace outer circle on tracing paper, mark N direction.
2. Mark on the strike by counting around the outside.



3. Rotate tracing paper so the strike mark moves to the top of the stereonet.
4. Establish dip direction.
5. Count in the dip amount from left or right of stereonet.

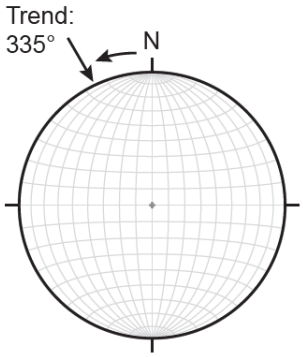


6. Trace the great circle corresponding to the dip amount onto the tracing paper.

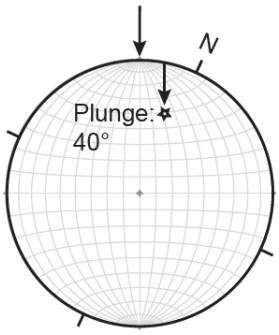


7. Rotate tracing paper so N is back at the top of the stereonet.

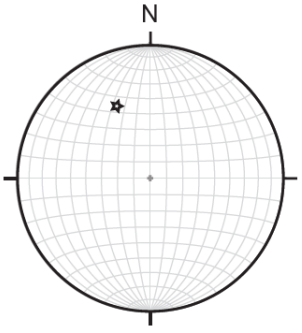
PLOTTING LINES AS POINTS
Example: 40° - 335°



1. Draw primitive circle on tracing paper, mark N direction.
2. Mark on the trend by counting round the outside.



3. Rotate tracing paper so the trend mark moves to the top of the stereonet.
4. Count in the plunge amount from top of stereonet.



5. Rotate tracing paper so that N is back at the top of the stereonet.