Structural Geology Lab 7: Stereographic Analysis of Folds

I. Graphical Representation of Lines and Planes in Structural Analysis

A. Stereonets Revisited

1. Stereographic projection of lines and planes onto a circular grid or net
   a. Essentially taking a 3-D sphere and projecting it to a 2-D piece of paper (analogous to projecting the globe on world maps)

   b. Schmidt Net or Equal Area Net

      (1) Areas on the 3-D sphere are preserved as true on the 2-D projection of the net

         (a) Angles are not preserved, they become distorted

         (b) Most commonly used since structural problems require assessment of areal density distribution

   c. Wulff Net or Stereographic Net

      (1) Areas are not preserved, but angle are.

2. Schmidt Net Basics

   a. Primitive Circle = outline of sphere
   b. North-South and East-West Reference Lines
   c. Plane Projection

      (1) Lower Hemisphere Projections of Planes

         (a) Great circles formed by intersection of inclined plane with lower hemisphere of the reference sphere
         (b) Great circles are plotted on the stereonet

            i) horizontal plane: dip = 0, plots as great circle on primitive circle of net
            ii) vertical plane: dip = 90, plots as straight line passing through center

      (2) Lower Hemisphere Projections of lines

         (a) Lines plot as points of intersection between line and lower hemisphere
         (b) horizontal lines plot as points on outer primitive circle
         (c) vertical lines plot as points at center of net.

   d. Poles to planes

      (1) Imagine a line drawn perpendicular to plane, passing to lower hemisphere of reference sphere

(a) will plot as point on stereonet

e. Techniques for Plotting Planes, Lines and Poles to Planes on the Schmidt Net

(1) Read detailed instructions on p. 61 and 62 of lab manual

Part II. Stereographic Analysis of Folded Rocks

II. Techniques of stereographic analysis of folds

A. Beta Diagrams

1. Beta axis: line formed by the intersection of any two planes drawn tangent to a folded surface
   a. Beta axis line is parallel to fold axis of fold

2. Drawing a Beta Diagram (For a perfectly cylindrical fold: rare)

   a. Determine attitude of several bedding orientations across a folded surface.
   b. Plot the bedding attitudes as great circles
   c. The point of intersection of the great circles on the fold defines the Beta axis
      (1) Beta axis = fold axis which is a line in space with trend and plunge.

B. Pi Diagrams

1. In a cylindrical fold, poles to bedding (s-poles) will lie in a great circle (the Pi circle)

   a. The pole to the Pi circle is the Pi axis, which is parallel to and defines the fold axis.

2. Drawing a Pi diagram

   a. Determine attitude of several bedding orientations across a folded surface.
   b. plot the poles to bedding
   c. In a cylindrical fold, the poles will lie along a great circle (Pi circle)
      (1) Determine and plot pole to Pi circle
      (2) This is the fold axis, determine the trend and plunge of the fold axis.
      (3) The Pi axis lines on a great circle that defines the axial plane of the fold.

C. Contouring of Pi Diagrams

1. Problem: rarely are folds perfectly cylindrical in nature, often times s-poles of Pi diagrams are "scattered" and require statistical analysis to

determine the great circle orientations and Pi axis.

2. Technique:

   a. lay grid on stereonet (equal area net)
   b. use a 1% circle (1 % of area of stereonet), and move it in grid fashion across the Pi diagram
   c. At each grid node, count the number of points in the circle, and plot no. at grid node.
      (1) each point may be counted several times as you move across the grid nodes
   d. Draw contour lines showing Pi-pint densities
      (1) highest density of points = "pi-maxima"
      (2) approximate a great circle passing through the "pi-maxima", and determine the Pi-axis, and hence fold axis orientation.

Lab Exercise Instructions:

Problems 7.1 and 7.2