

8. SPHERICAL PROJECTIONS (I)

I Main Topics

A What is a spherical projection?

B Equal-angle (stereographic) projection of a line

C Equal-angle (stereographic) projection of a plane

D Intersection of two planes

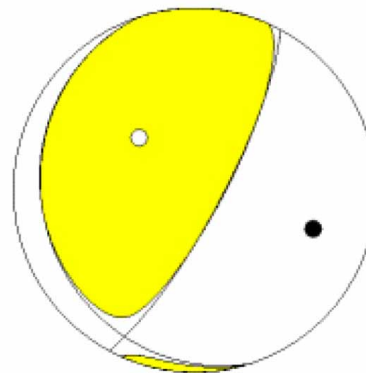
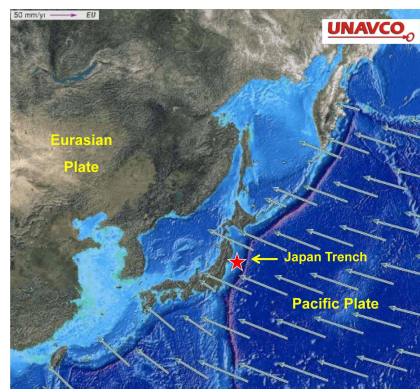
9/14/16

GG303

1

8. SPHERICAL PROJECTIONS (I)

Focal Mechanism, Sendai (Tohoku) Earthquake, M_w 9.0, March 11, 2011



<http://www.virtualuppermantle.info/2011-Sendai-Japan.htm>

9/14/16

GG303

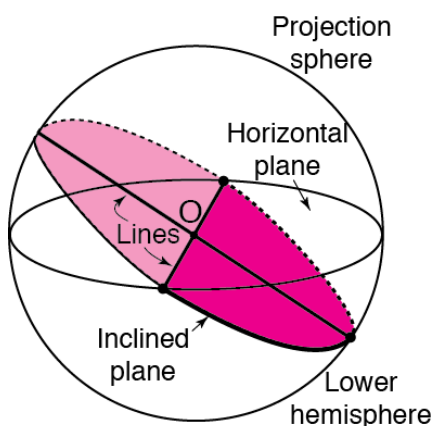
2

8. SPHERICAL PROJECTIONS (I)

II What is a spherical projection?

A A 2-D projection describing the orientation of 3-D features.

B A projection of the intersection of a line or plane with the surface of a (hemi)sphere, where the line or plane passes through the center of the (hemi)sphere.



9/14/16

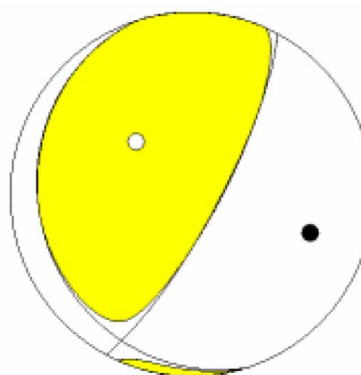
GG303

3

8. SPHERICAL PROJECTIONS (I)

II What is a spherical projection?
(cont.)

- C Uses in geology and geophysics
- 1 Maps
 - 2 Representation of the orientation of planar features (e.g., bedding, fractures, crystal faces)
 - 3 Representation of the orientation of linear features (e.g., poles to planes, fold axes)
 - 4 Representation of first motion data from earthquakes



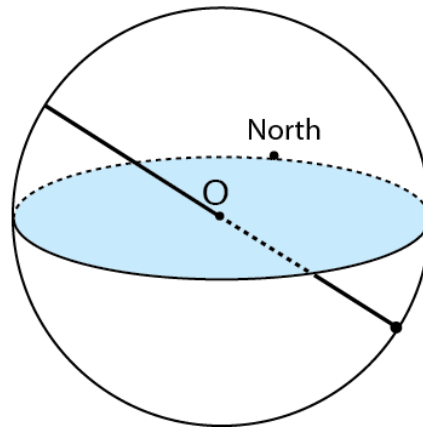
9/14/16

GG303

4

8. SPHERICAL PROJECTIONS (I)

III Equal-angle
(stereographic)
projection of a line
A A line through the
center of the
projection sphere
intersects the lower
hemisphere at a
point



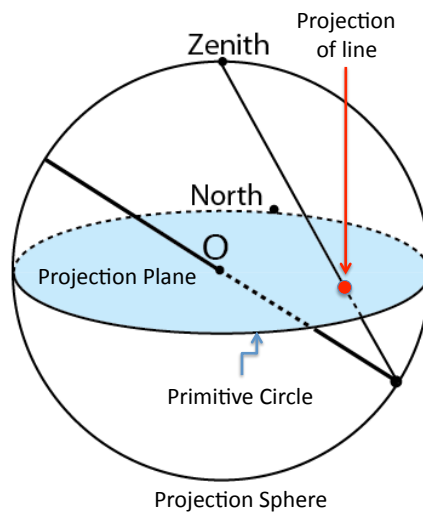
9/14/16

GG303

5

8. SPHERICAL PROJECTIONS (I)

III Equal-angle
(stereographic) projection
of a line (cont.)
B The projection is where
the line between the
zenith and the point on
the projection sphere
intersects the
horizontal projection
plane.



9/14/16

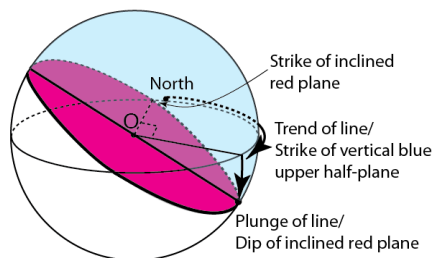
GG303

6

8. SPHERICAL PROJECTIONS (I)

III Equal-angle (stereographic) projection of a line (cont.)

- A A line is at the intersection of two planes:
- 1 a vertical plane containing the line
 - 2 an inclined plane with a dip matching the plunge of the line.
- B Plots as a point



9/14/16

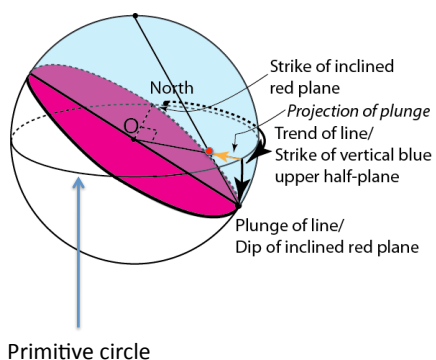
GG303

7

8. SPHERICAL PROJECTIONS (I)

III Equal-angle (stereographic) projection of a line (cont.)

- C Trend
- 1 The point representing a line plots away from the center of the spherical plot in the direction of the trend of the line.
 - 2 Measured along a horizontal great circle.
- D Plunge (inclination from horizontal)
- 1 Measured along a vertical great circle containing the line
 - 2 As plunge increases, projection nears center of primitive circle.



9/14/16

GG303

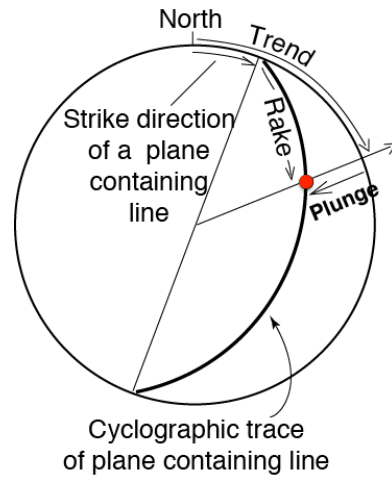
8

8. SPHERICAL PROJECTIONS (I)

III Spherical projection of a line (cont.)

C Rake (pitch)

- 1 Measured along the cyclographic trace of the great circle representing that plane
- 2 Measured from the direction of strike
- 3 Like measuring in the plane of a protractor



9/14/16

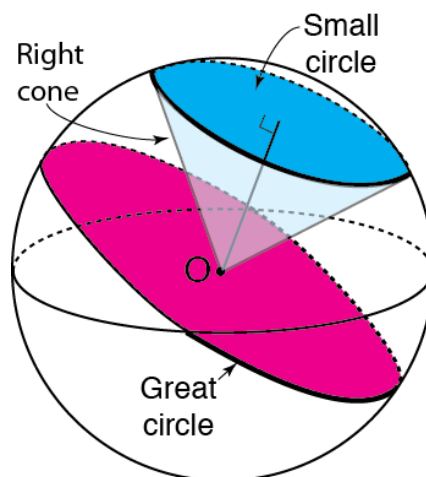
GG303

9

8. SPHERICAL PROJECTIONS (I)

IV Equal-angle (stereographic) projection of a plane

- A Great circle: intersection of the surface of a sphere with a plane that passes through the center of the sphere (e.g., lines of longitude)
- B Small circle: intersection of the surface of a sphere with a plane that does not pass through the center of the sphere (e.g., lines of latitude). A line rotated about an axis traces a cone that yields a small circle too.



9/14/16

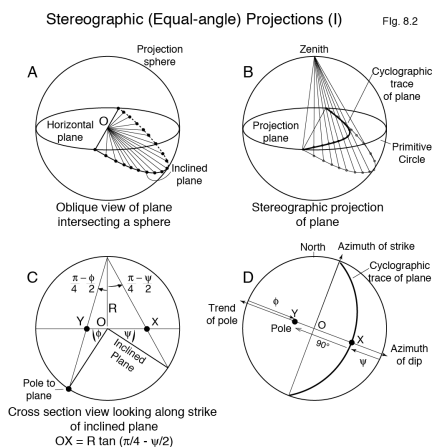
GG303

10

8. SPHERICAL PROJECTIONS (I)

IV Equal-angle (stereographic) projection of a plane

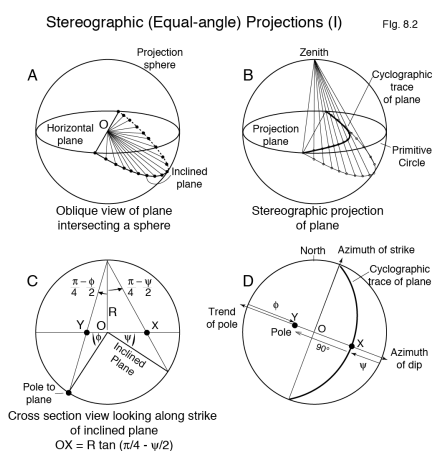
- C A plane plots as the cyclographic trace of a great circle
- D Strike: measured around the perimeter of the primitive circle
- E Dip: measured along a vertical great circle perpendicular to the line of strike.



8. SPHERICAL PROJECTIONS (I)

IV Equal-angle (stereographic) projection of a plane

- F Pole
 - 1 Trend
 - a Strike of plane – 90°
 - B Opposite azimuth of dip
 - 2 Plunge
 - a 90° - dip of plane
 - b Plots 90° away from “dip vector” (X)

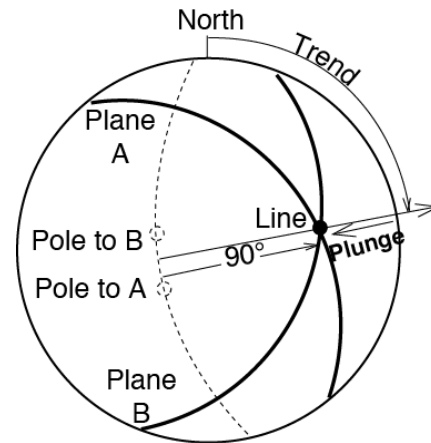


8. SPHERICAL PROJECTIONS (I)

V Intersection of two arbitrary planes

A Line of intersection projects as a point.

B Represented by intersection of the cyclographic traces of the two planes.



9/14/16

GG303

13

8. SPHERICAL PROJECTIONS (I)

V Intersection of two arbitrary planes (cont.)

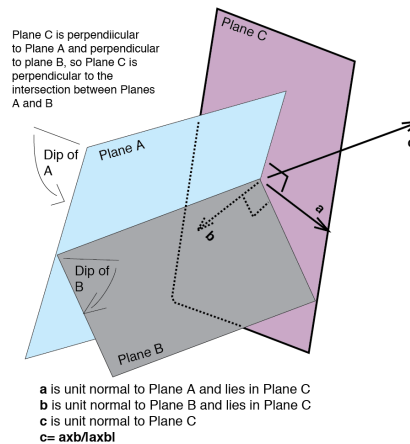
C Plane C, perpendicular to line of intersection **c**, is perpendicular to both intersecting planes (A&B)

D Pole to each intersecting plane lies in the plane perpendicular to the line of intersection (i.e., **a** & **b** lie in plane C)

E The line of intersection **c** is normal to the plane with poles **a** and **b**

F Analogous to finding the cross product between poles **a** and **b**

Direction of Intersection of Two Planes



9/14/16

GG303

14

8. SPHERICAL PROJECTIONS (I)

V Intersection of two arbitrary planes
(cont.)

- G Plane C, perpendicular to line of intersection **c**, is perpendicular to both intersecting planes (A&B)
- H Pole to each intersecting plane lies in the plane perpendicular to the line of intersection (i.e., **a** & **b** lie in plane C)
- I The line of intersection **c** is normal to the plane with poles **a** and **b**
- J Analogous to finding the cross product between poles **a** and **b**

