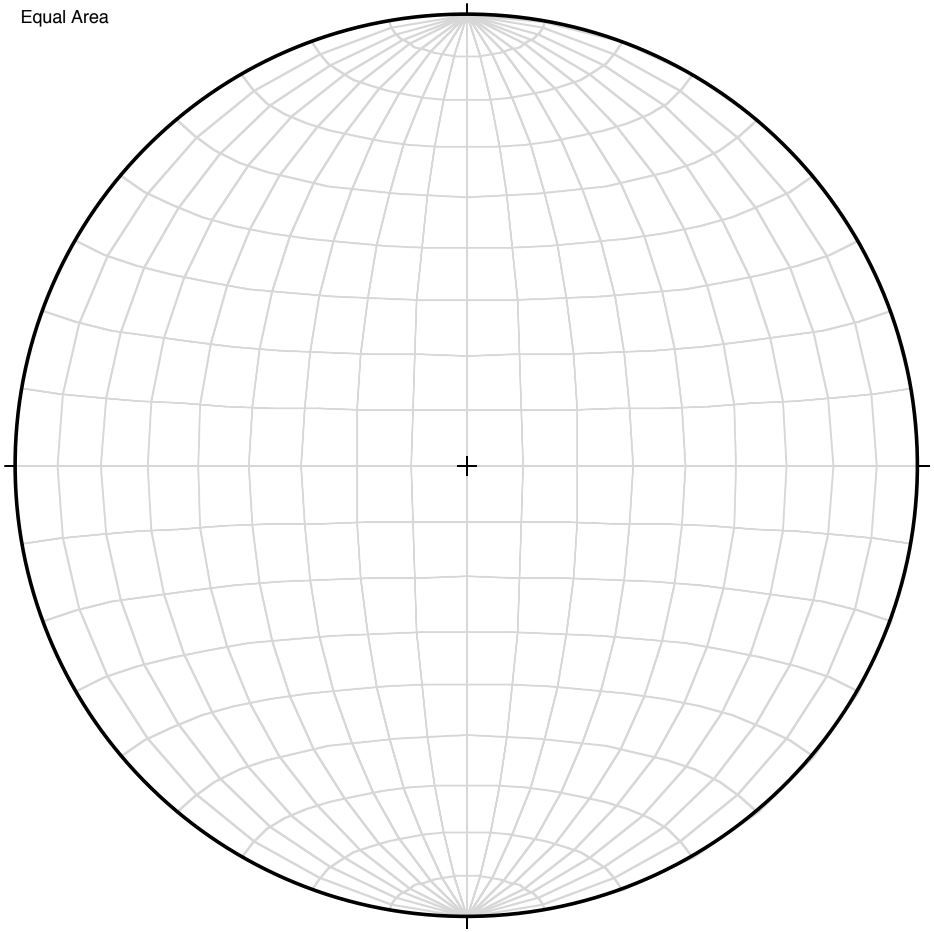
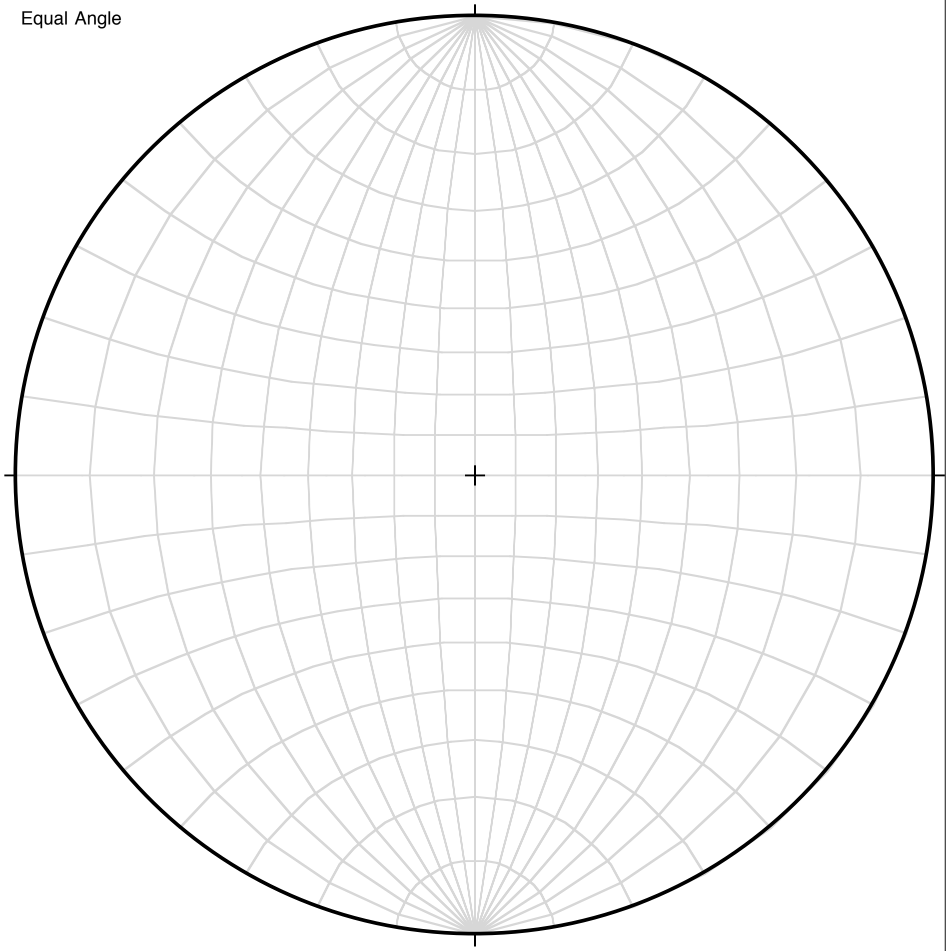
GRAPHICAL PRESENTATION AND STATISTICAL ORIENTATION OF STRUCTURAL DATA PRESENTED WITH STEREOGRAPHIC PROJECTIONS FOR 3-D ANALYSES. COMMONLY USED PLOTTING AND CONTOURING TOOLS CAN BE DOWNLOADED FOR VARIOUS OPERATING SYSTEMS FROM THE WEB.

Commonly used in structural geology



Commonly used in min/crystal



GRAPHICAL PRESENTATION AND STATISTICAL ORIENTATION OF STRUCTURAL DATA PRESENTED WITH STEREOGRAPHIC PROJECTIONS FOR 3-D ANALYSES. COMMONLY USED PLOTTING AND CONTOURING TOOLS CAN BE DOWNLOADED FOR VARIOUS OPERATING SYSTEMS FROM THE WEB.

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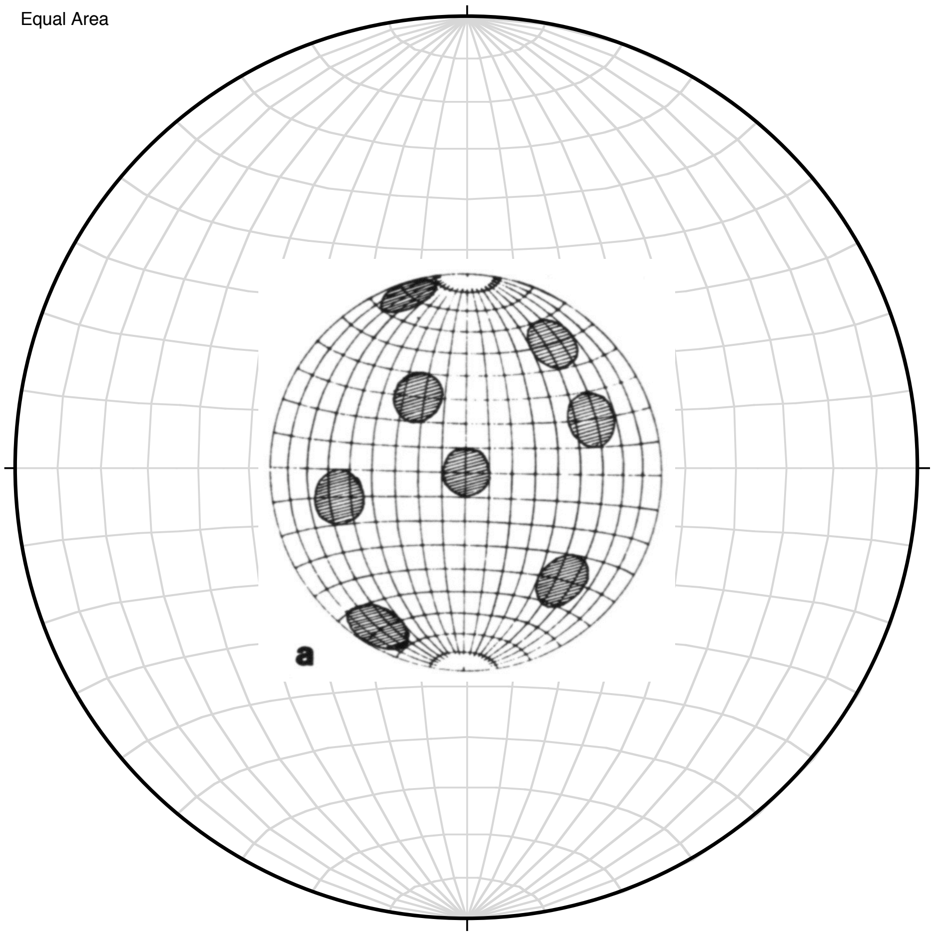
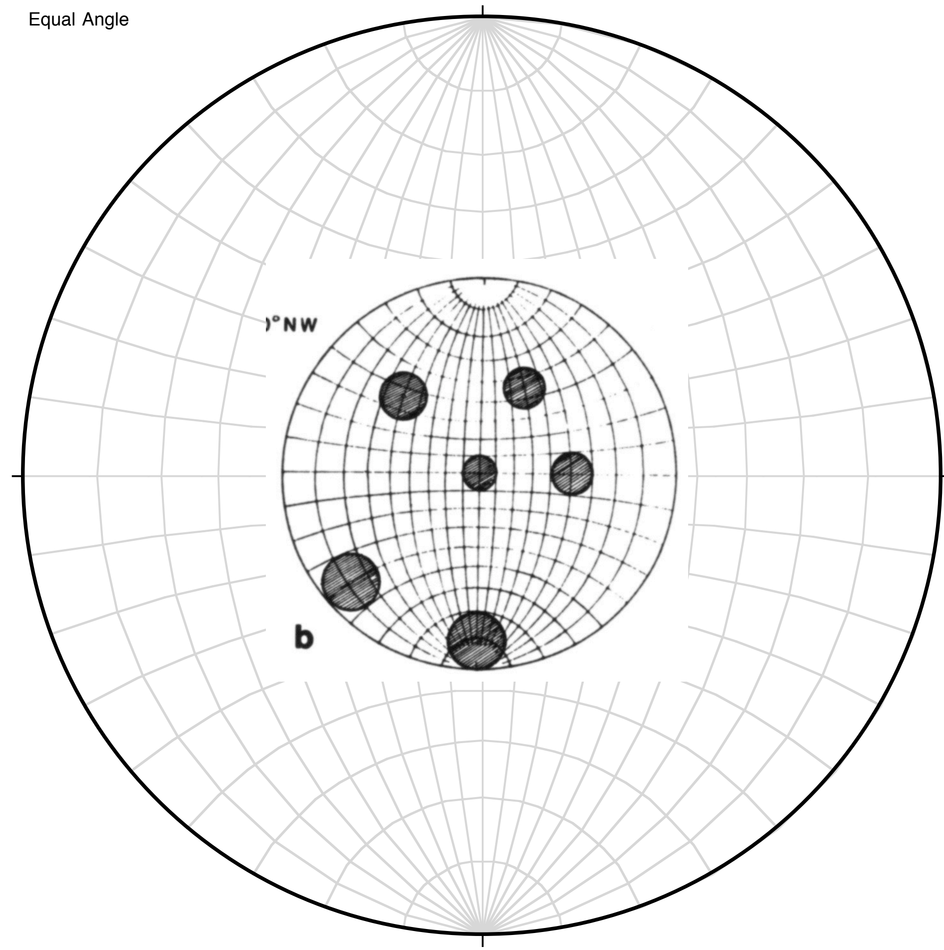
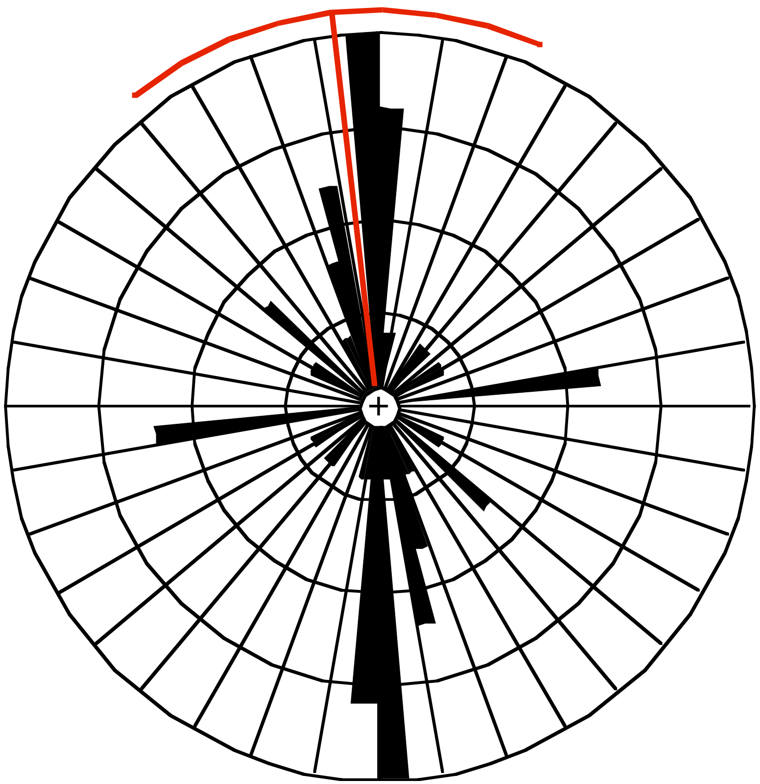


Commonly used in min/crystal

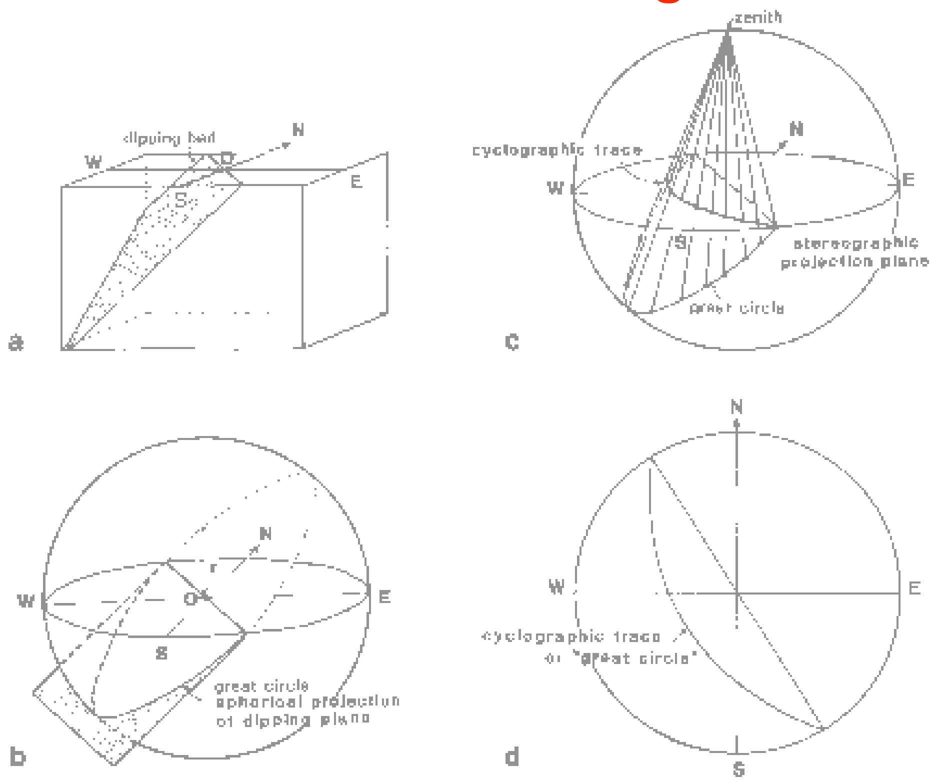


ROSE DIAGRAM, only 2-d

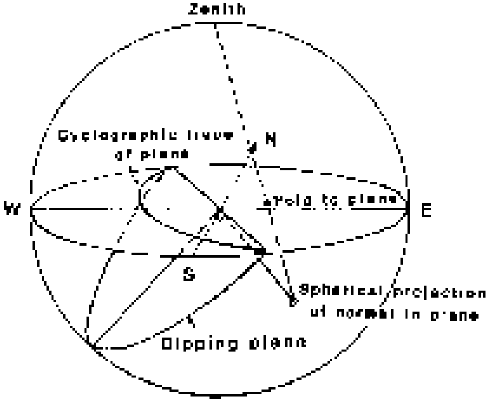


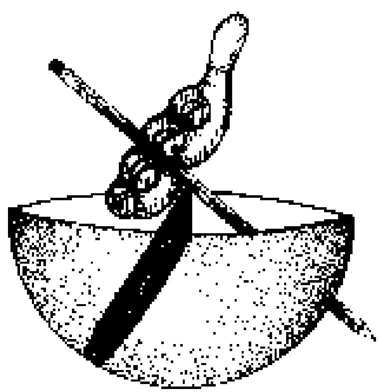
Våganecracks	Statistics
N = 30 Class Interval = 5 degrees Maximum Percentage = 16.7 Mean Percentage = 5.88 Standard Deviation = 4.11	Vector Mean = 353.3 Conf. Angle = 31.23 R Magnitude = 0.439 Rayleigh = 0.0031

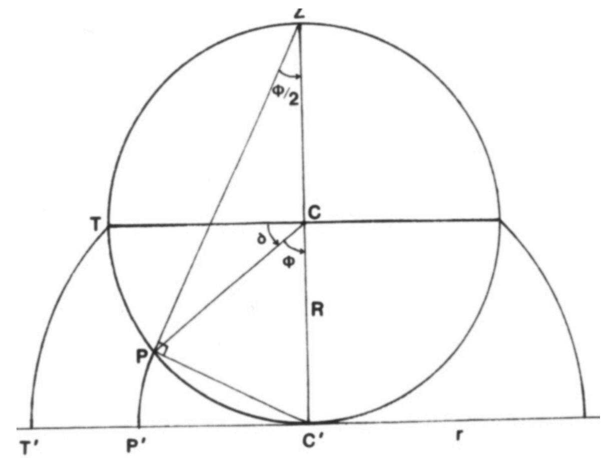
From 3 dimensions to stereogram



From great circle to pole

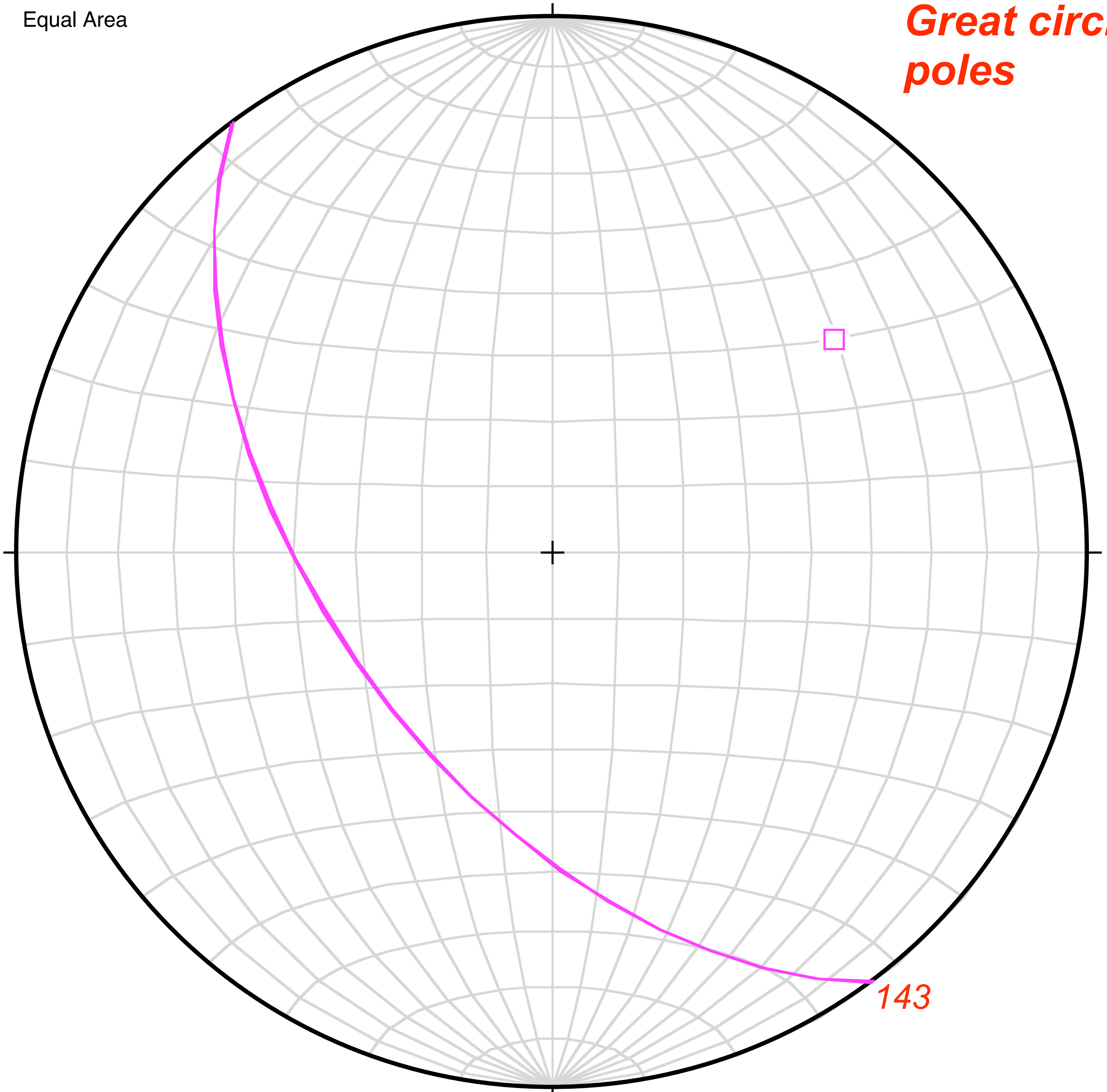






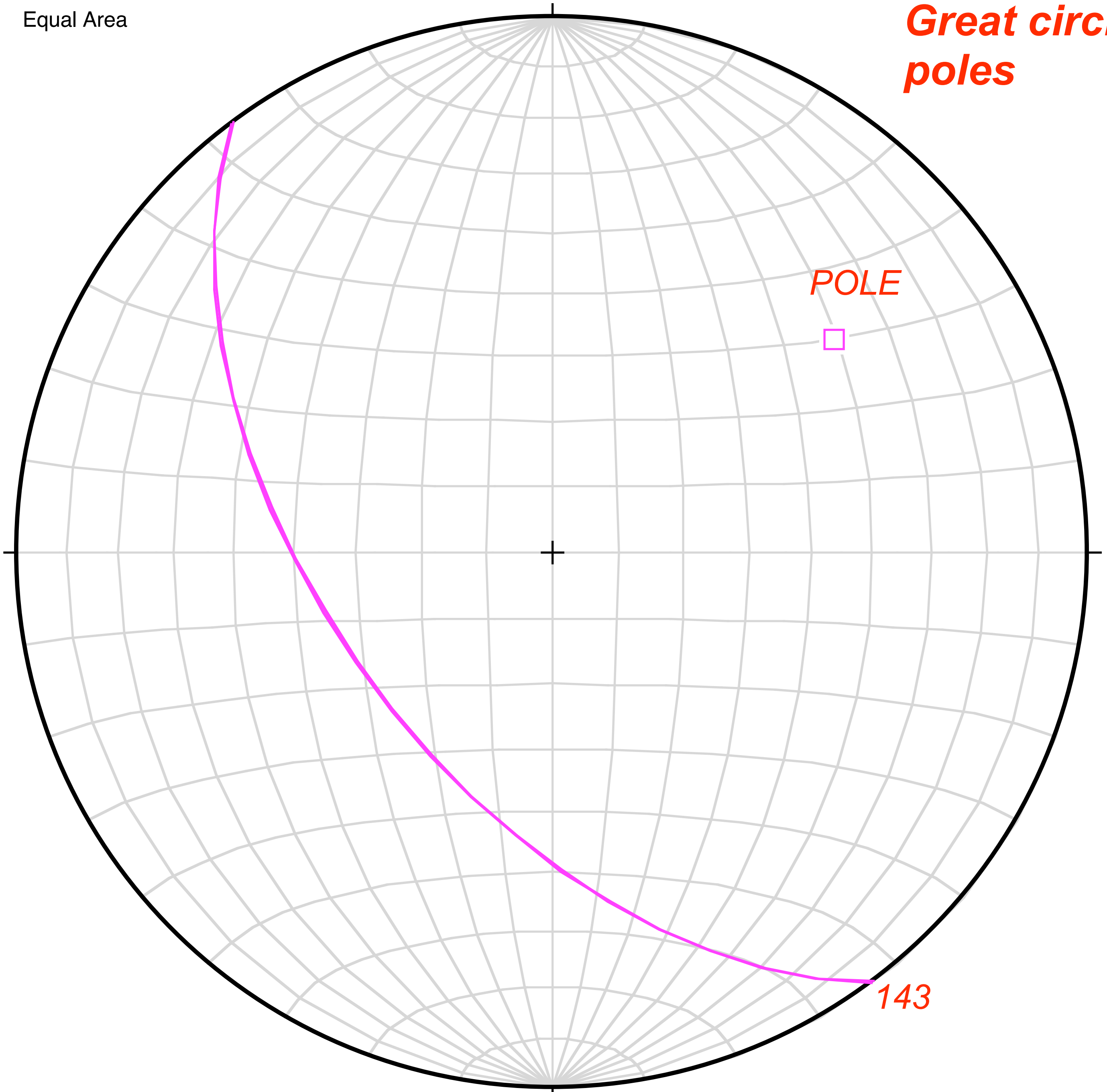
Equal area projections

Great circles and poles



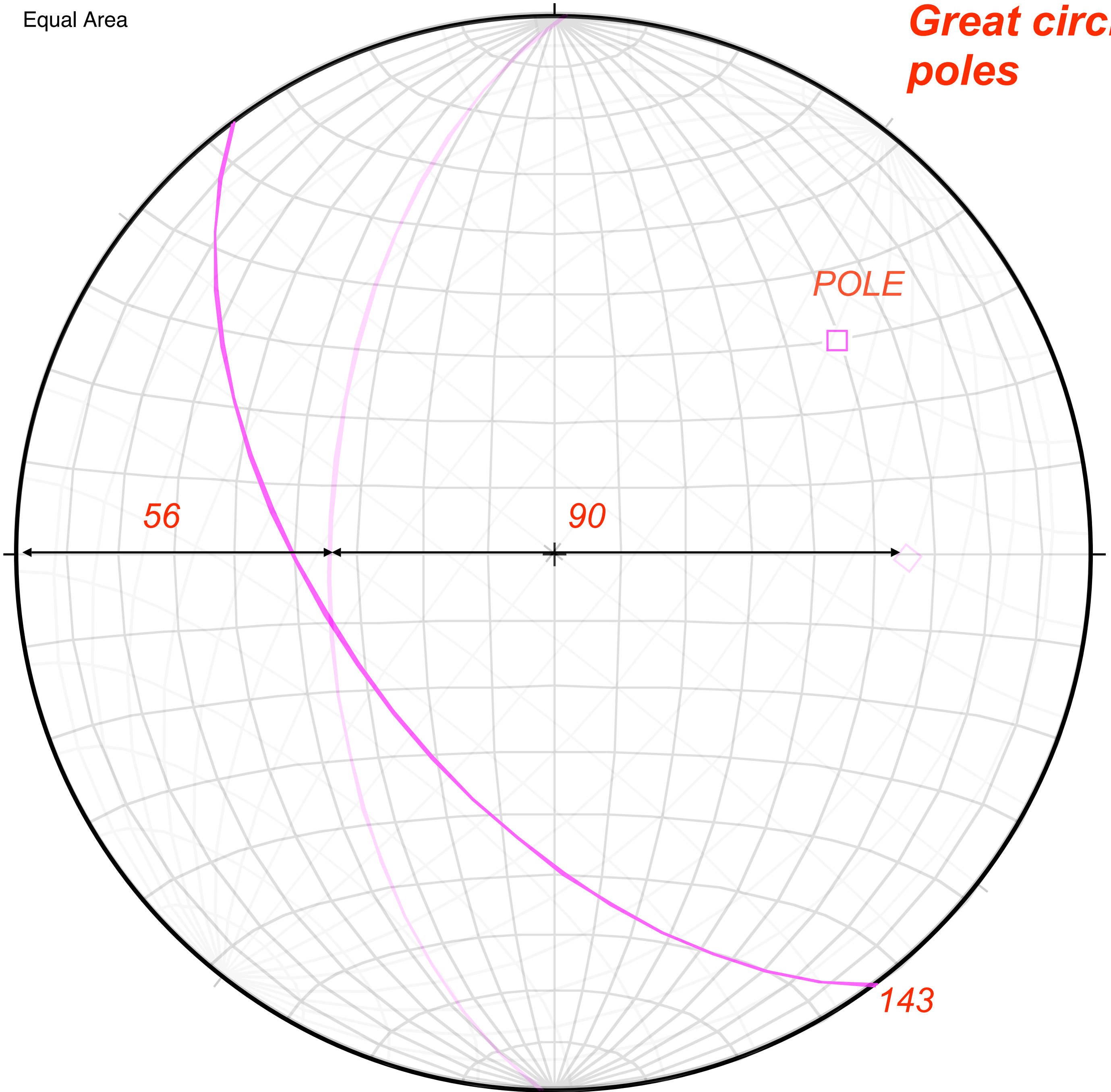
PLOT PLANE 143/56 (data recorded as right-hand-rule)

Great circles and poles



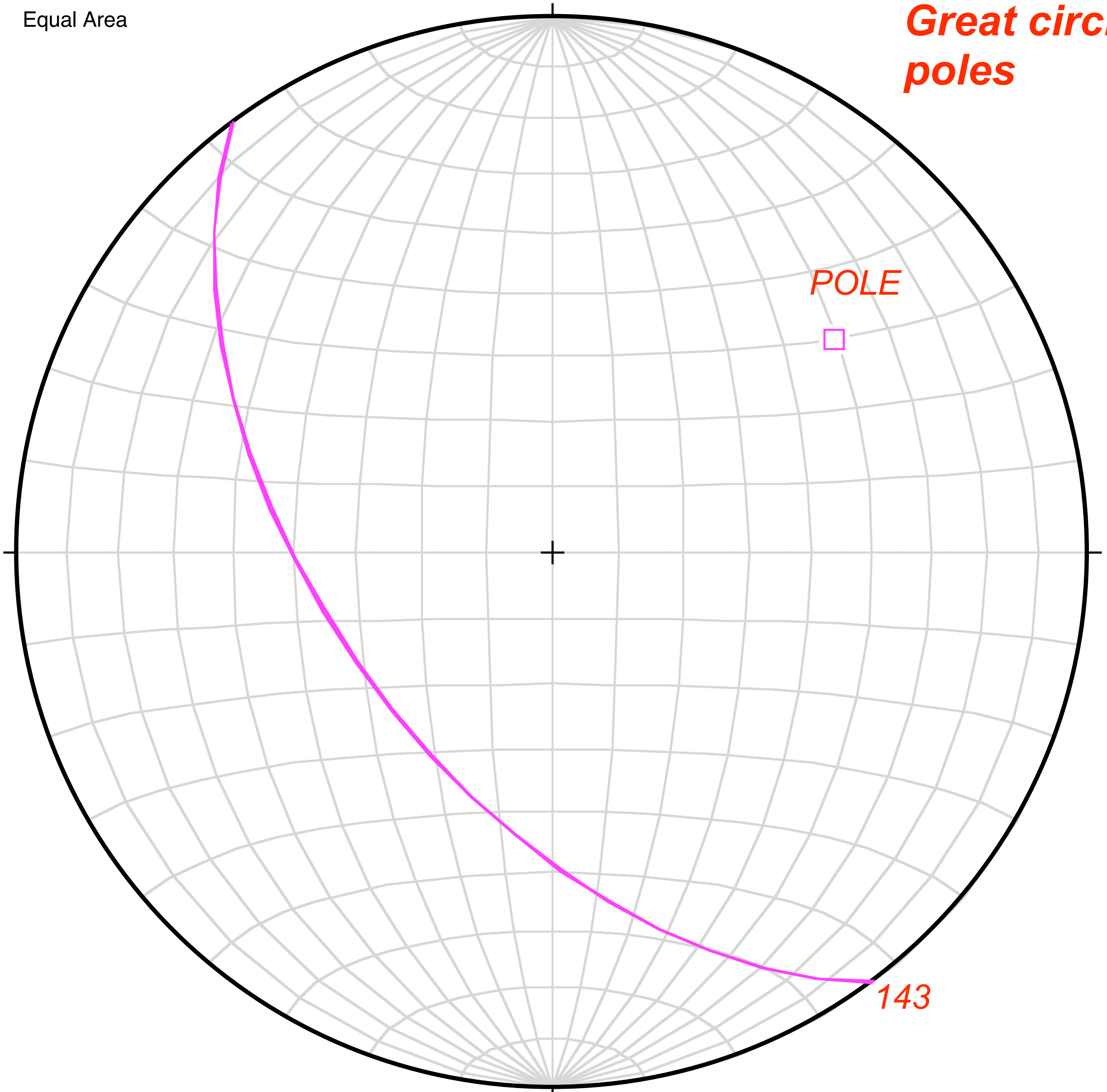
PLOT PLANE 143/56 (data recorded as right-hand-rule)

Great circles and poles



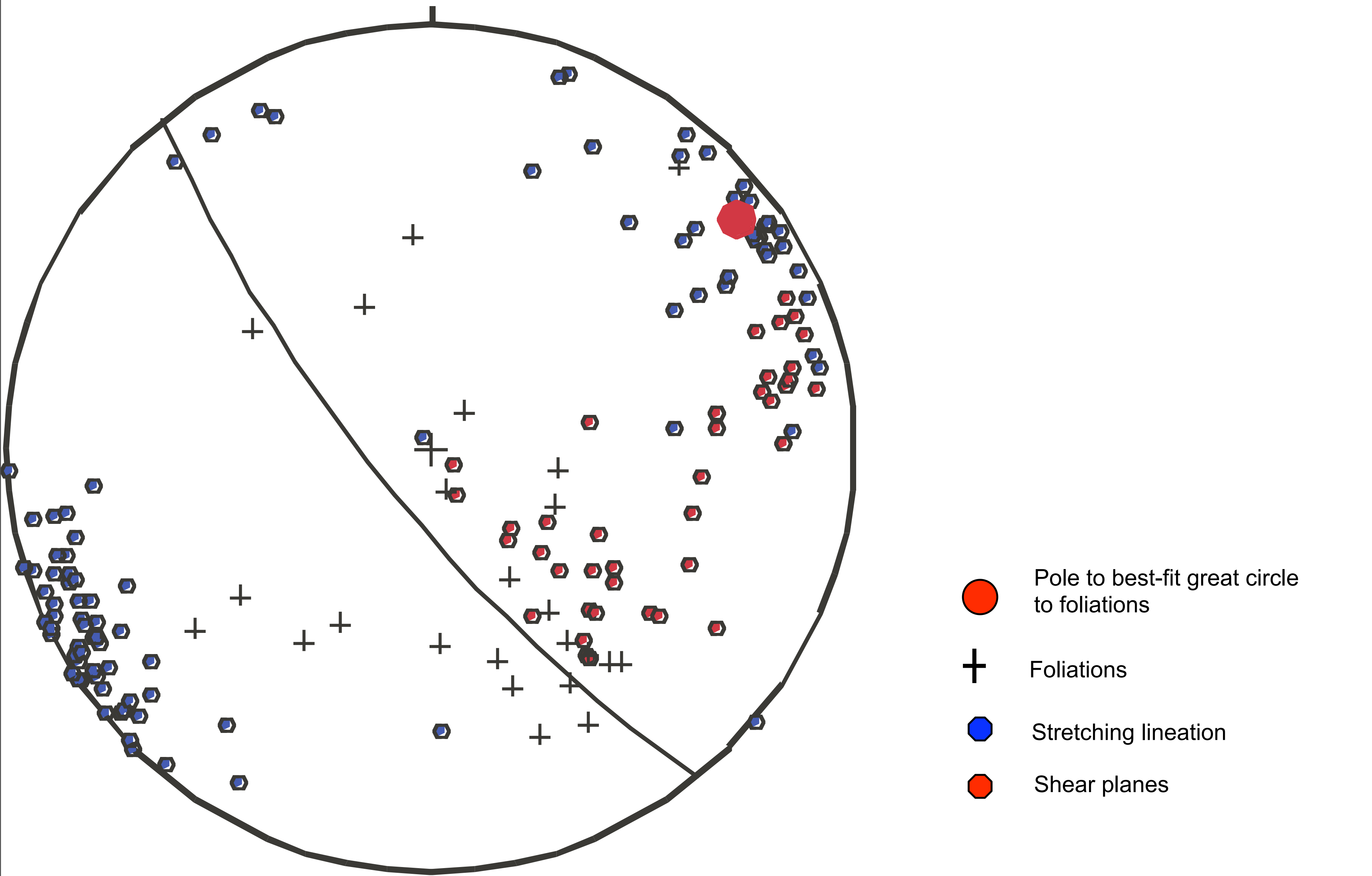
PLOT PLANE 143/56 (data recorded as right-hand-rule)

Great circles and poles



PLOT PLANE 143/56 (data recorded as right-hand-rule)

TYPICAL STRUCTURAL DATA PLOT FROM A LOCALITY/AREA.
Crowded plots may be clearer with contouring of the data.



There are various forms of contouring, NB! notice what method you choose in the plotting program.

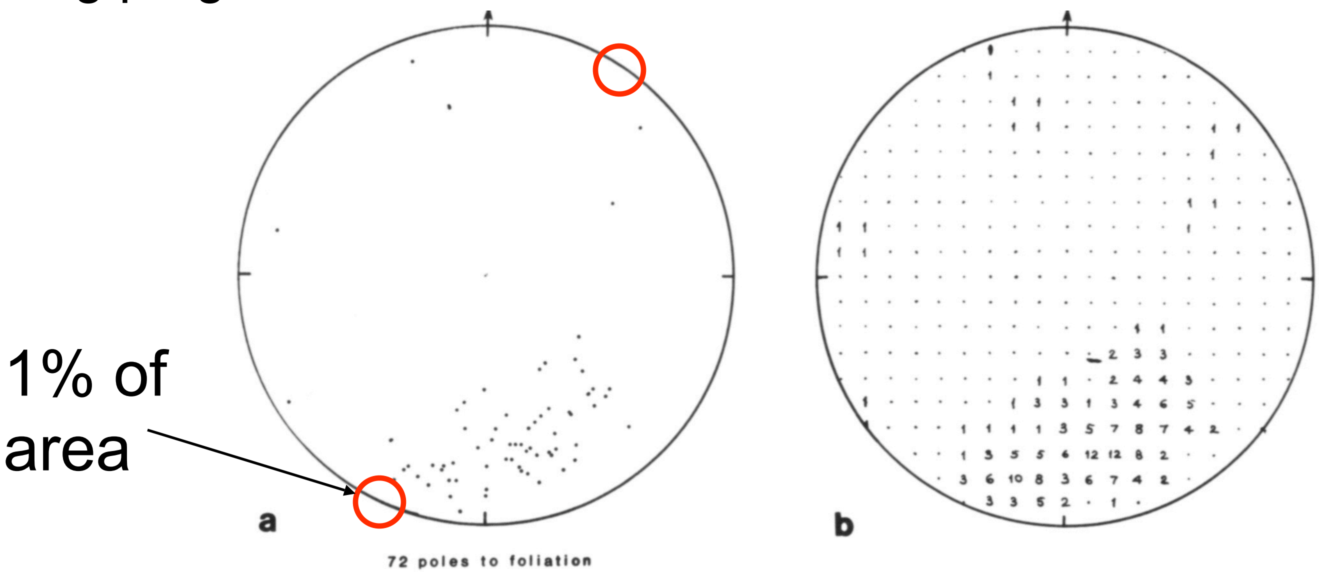
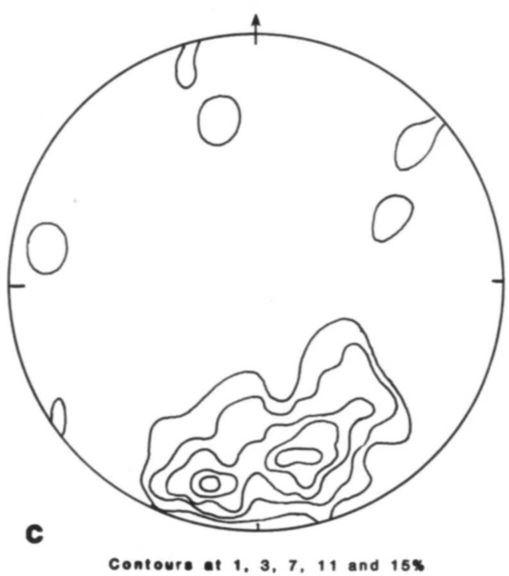
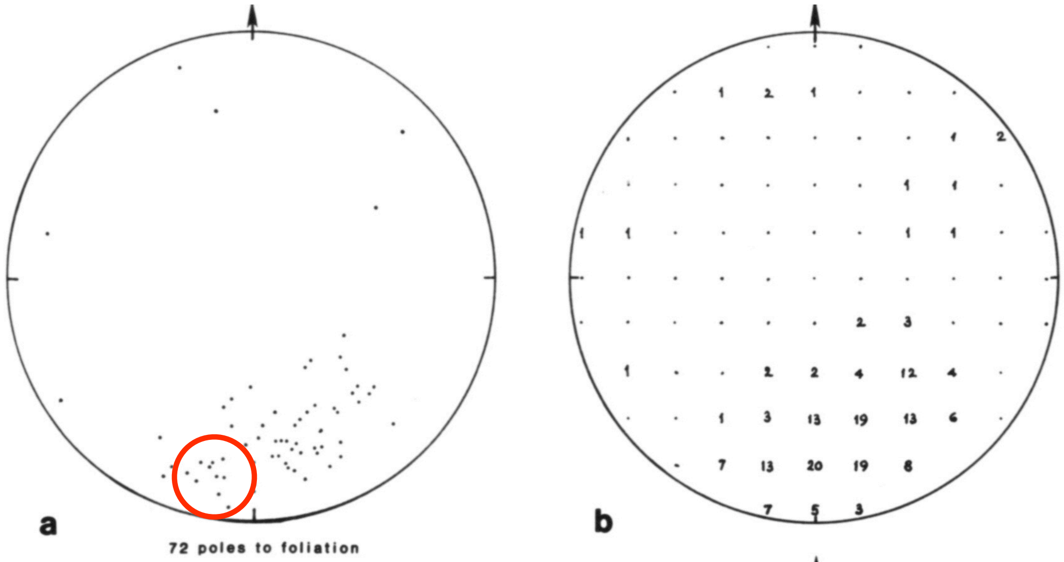


Figure 8-8. Procedure for contouring described in Problem 8-1. (a) Equal-area projection of poles to 72 foliation measurements; (b) point count using grid and Schmidt counter; (c) the final contoured diagram with contours at 1, 3, 7, 11, and 15%. A Schmidt counting grid is available in Appendix 4.



Common method, % = n(100)/N (N- total number of points)

Kamb contouring statistical significance of point concentration on equal area stereograms: binominal distribution with mean - $\mu = (NA)$ and standard deviation - $\sigma = NA[(1-A)/NA]^{1/2}$ or $\sigma/NA = [(1-A)/NA]^{1/2}$



A is chosen so that if the population has no preferred orientation, the number of points (NA) expected to fall within the counting circle is 3σ of the number of points (n) that actually fall within the counting circle under random sampling of the population

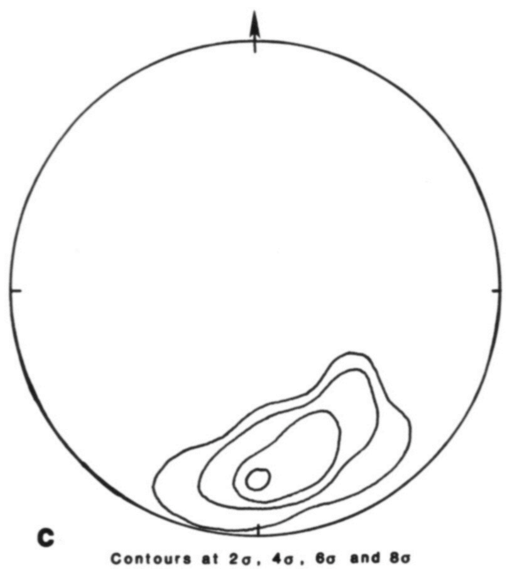
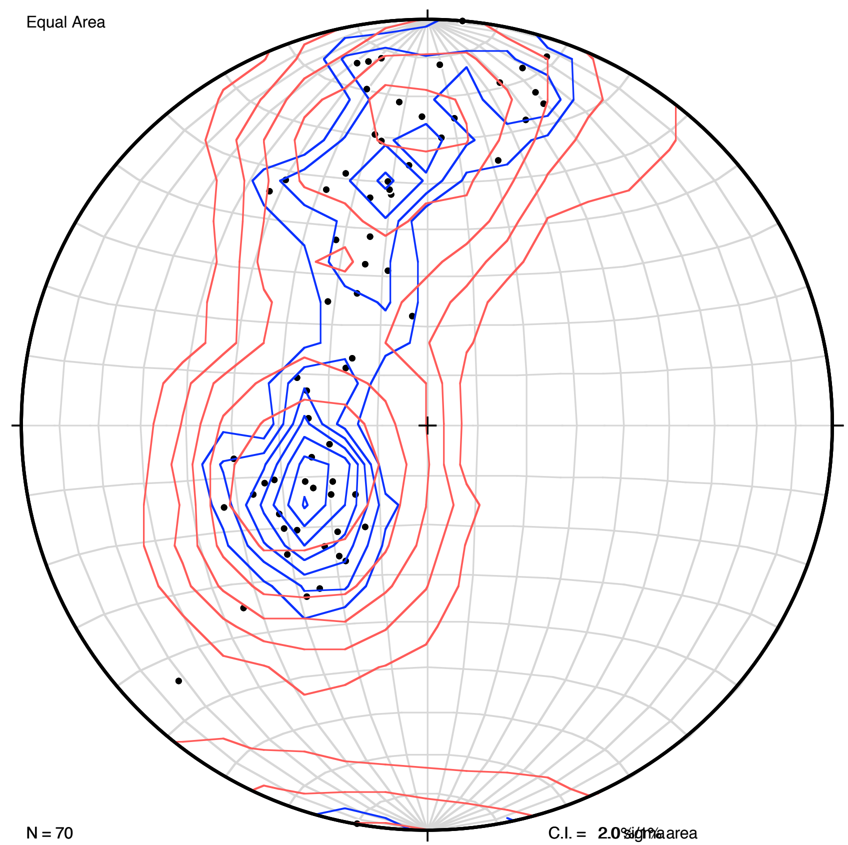


Figure 8-12. The Kamb method of contouring described in Problem 8-4, for the same data as Problem 8-1. Contours drawn at 2σ, 4σ, 6σ, and 8σ.

N - number of points, A area of counting circle, if uniform distribution (NA) - expected number of points inside counting circle and [N x (1-A)] points outside the circle

Poles to bedding S-domain, Kvamshesten basin.

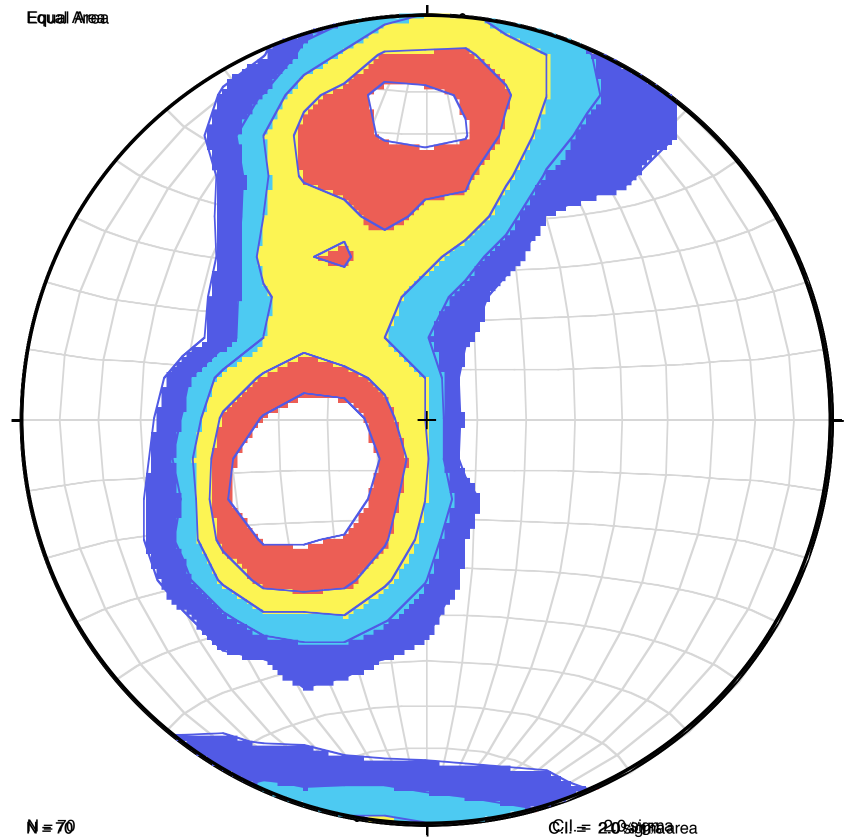


NB! the contouring is different with different methods!

```
Scatter  Plot:
  N =    70 ;    Symbol  = •
1  %  Area  Contour:
  N =    70;    Contour Interval  =   2.0 %/1% area

Kamb  Contour:
  N =    70 ;    first line =    1 ;    last line =    70
  Contour Int.  =    2.0 sigma;    Counting Area =   11.4%
  Expected Num.  =    7.97    Signif. Level  = 3.0 sigma
```

Poles to bedding S-domain, Kvamshesten basin.




```
Scatter  Plot:
  N =   70 ;   Symbol = •
1  %  Area  Contour:
  N =   70;   Contour Interval =  2.0 %/1% area

Kamb  Contour:
  N =   70 ;   first line =   1 ;   last line =   70
 Contour Int. =    2.0 sigma;   Counting Area =   11.4%
 Expected Num. =    7.97   Signif. Level = 3.0 sigma
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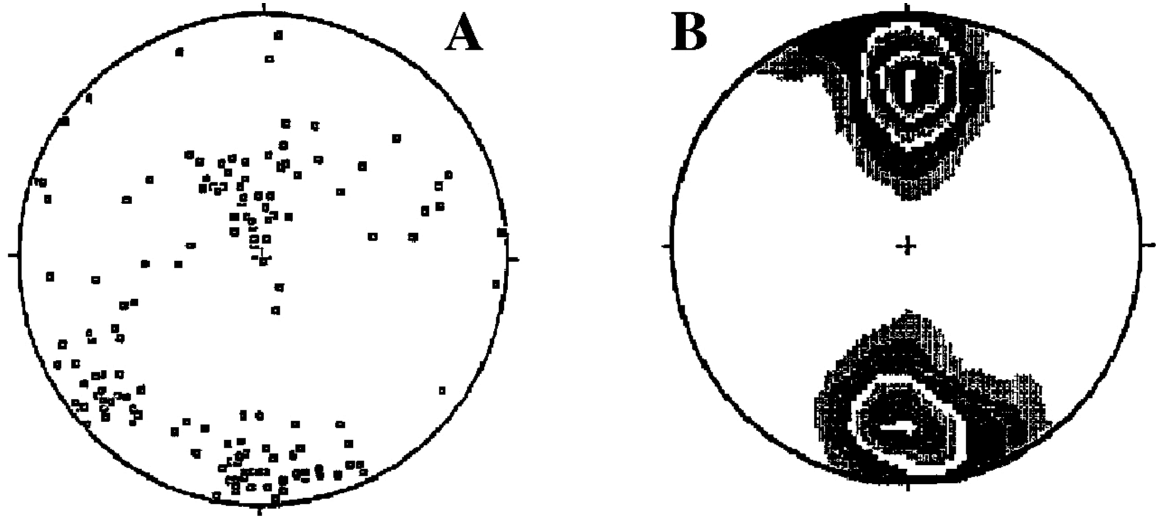
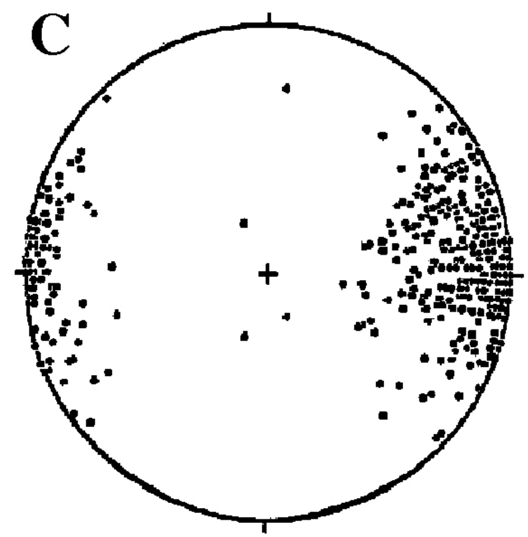


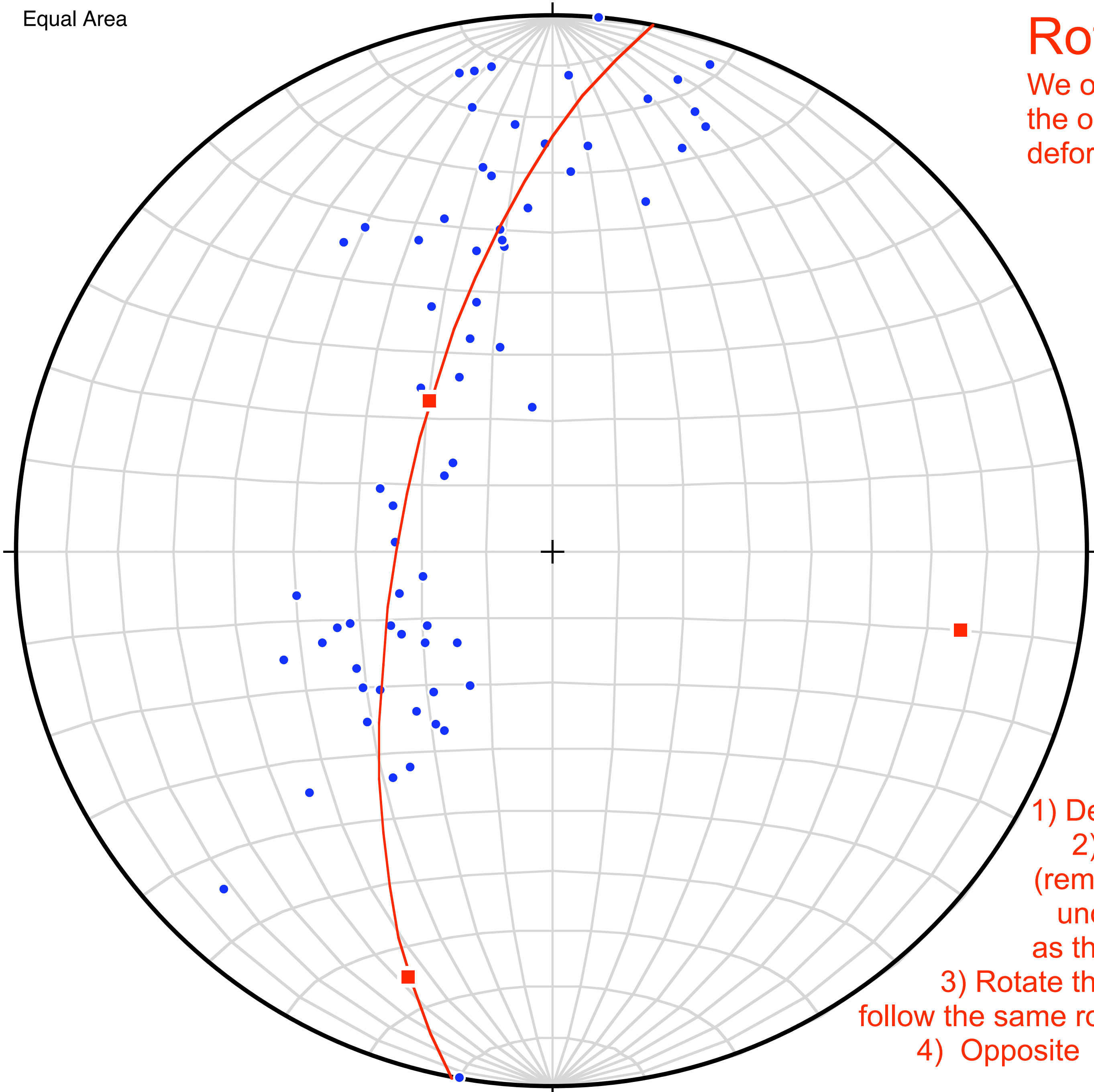


STEREOGRAM, STRUCTURAL NORDFJORD.

A) Eclogite facies pyroxene lineation

B) Contoured amphibolite facies foliations (Kamb contour, n=380)

C) Amphibolite facies lineations



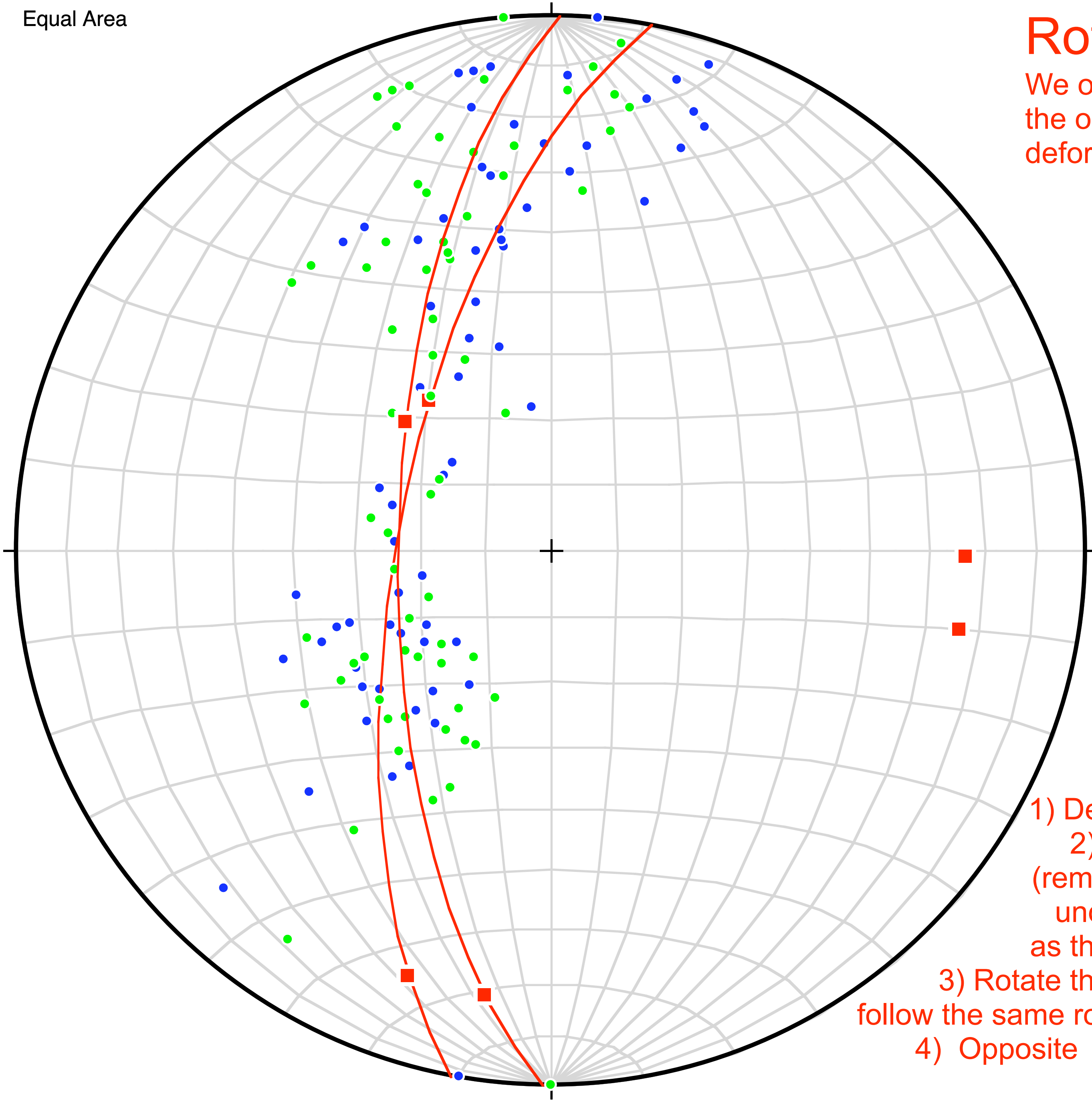
Rotation of data.

We often want to find the orientation of pre deformation structures

1) Determine the rotations axis
2) Make the axis horizontal, (remember that all points must undergoes the same rotation as the axis along small circles)
3) Rotate the desired angle (all points follow the same rotation along small circles)
4) Opposite order back to present-day

Rotation of data.

We often want to find the orientation of pre deformation structures



1) Determine the rotations axis
2) Make the axis horizontal, (remember that all points must undergoes the same rotation as the axis along small circles)
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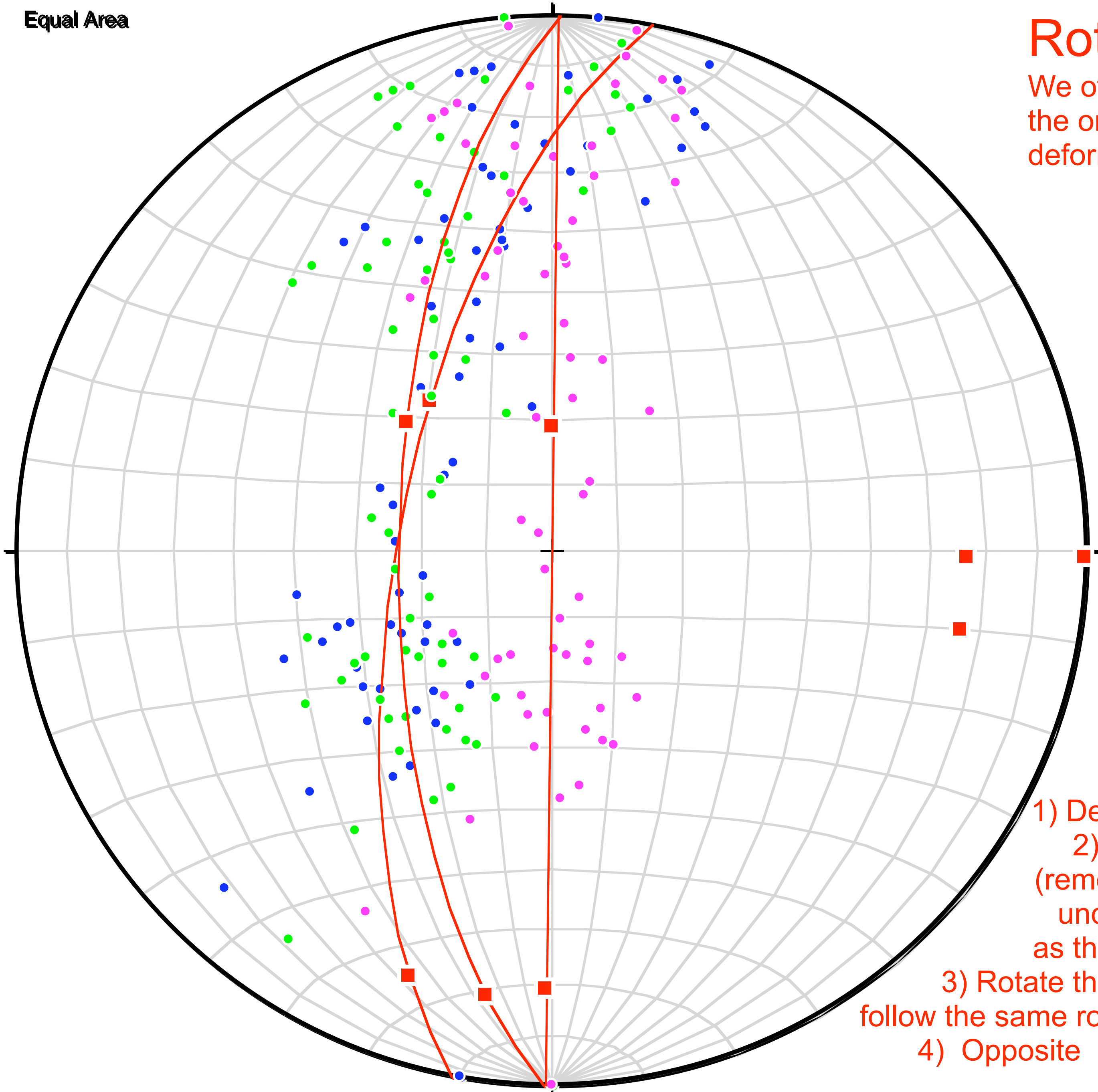
Rotation of data.

We often want to find the orientation of pre deformation structures



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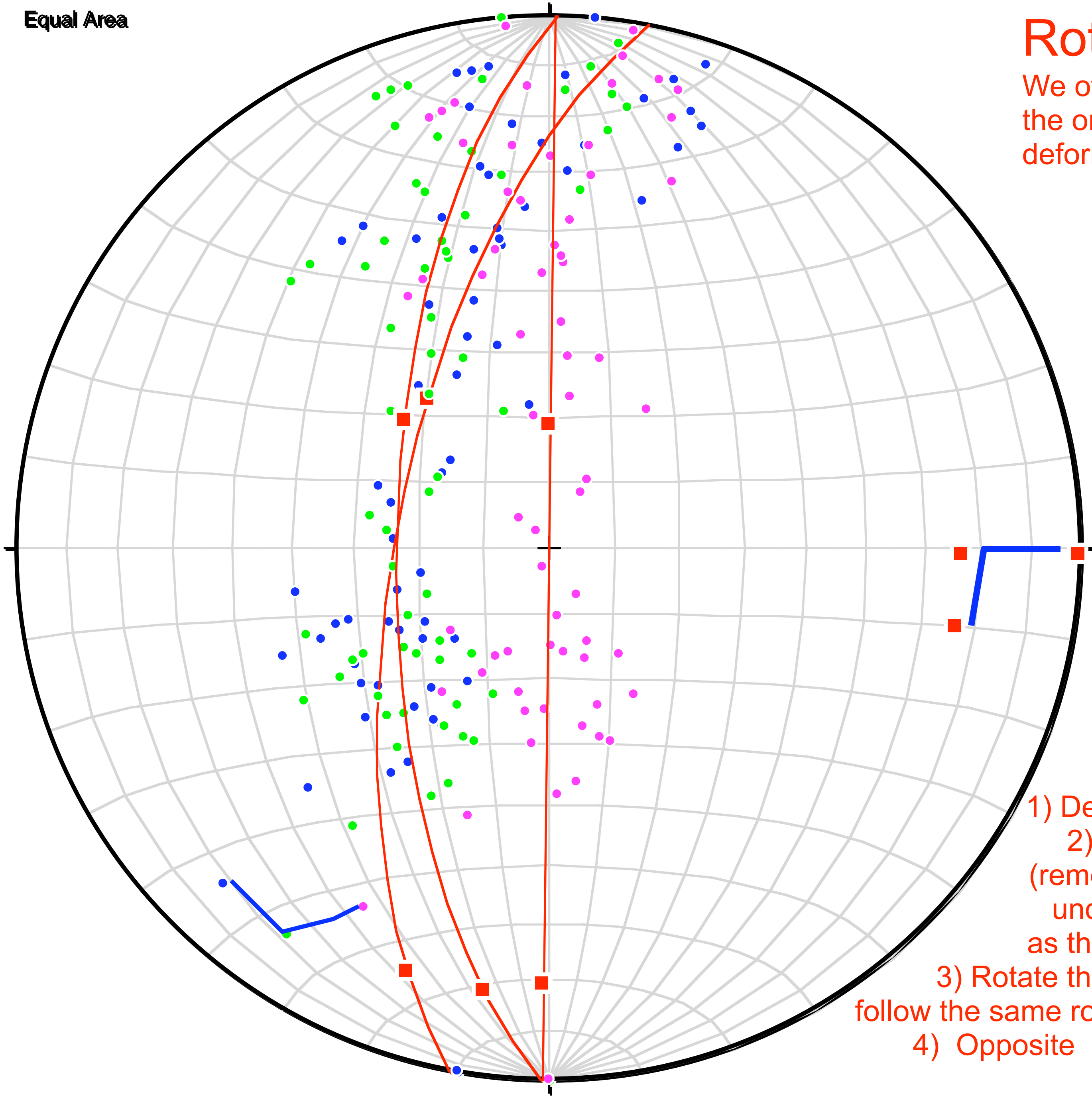
2) Make the axis horizontal, (remember that all points must undergoes the same rotation as the axis along small circles)
3) Rotate the desired angle (all points follow the same rotation along small circles)
4) Opposite order back to present-day



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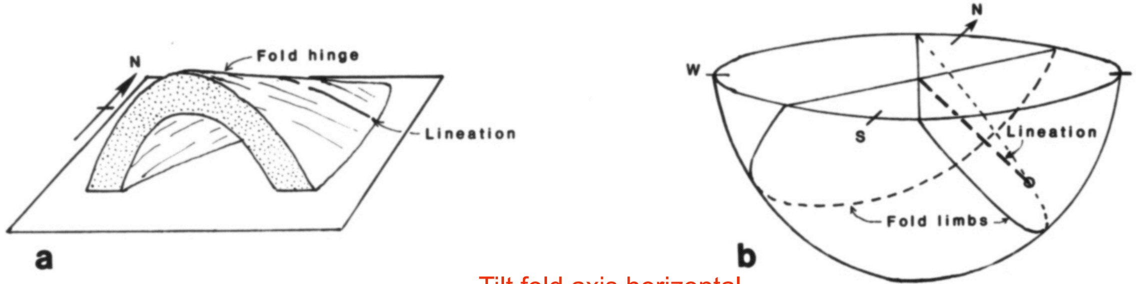
3) Rotate the desired angle (all points follow the same rotation along small circles)
4) Opposite order back to present-day

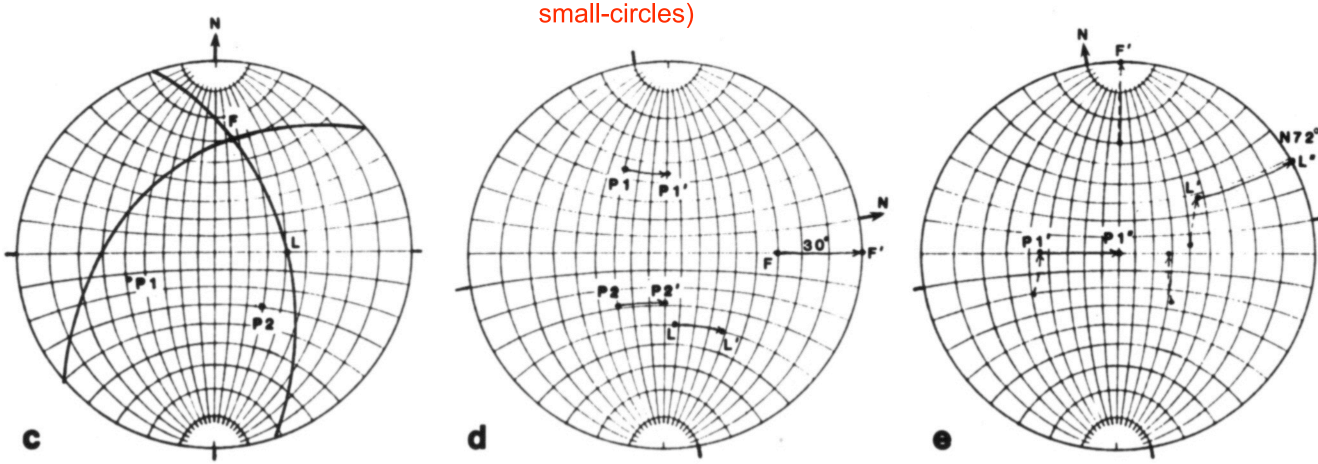
Plunging fold:

1) Determine pre-fold sedimentary lineation

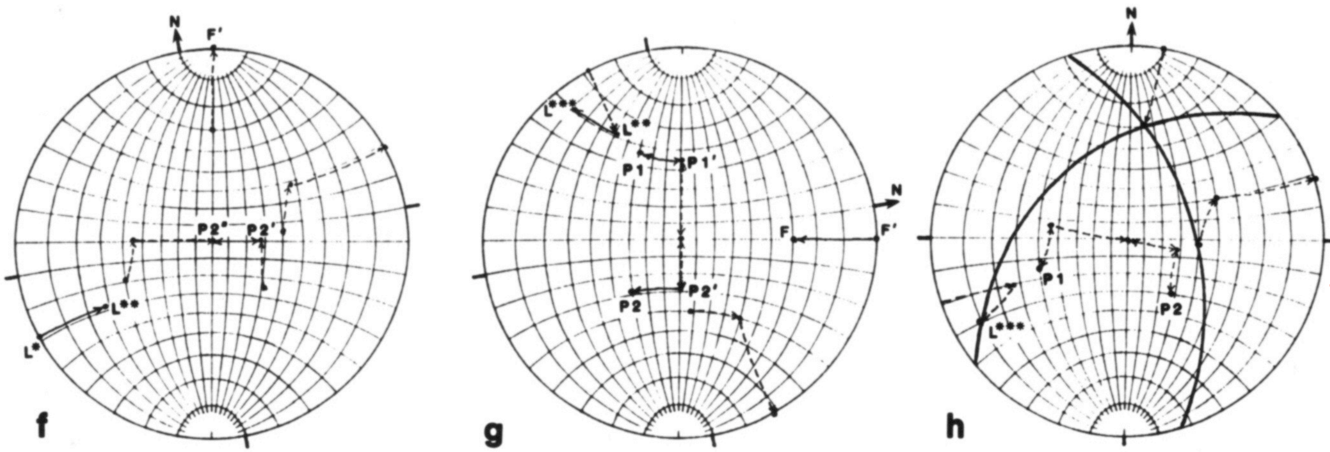
2) Determine post fold lineation on western limb.



Tilt fold axis horizontal
(and all other points follow
small-circles)



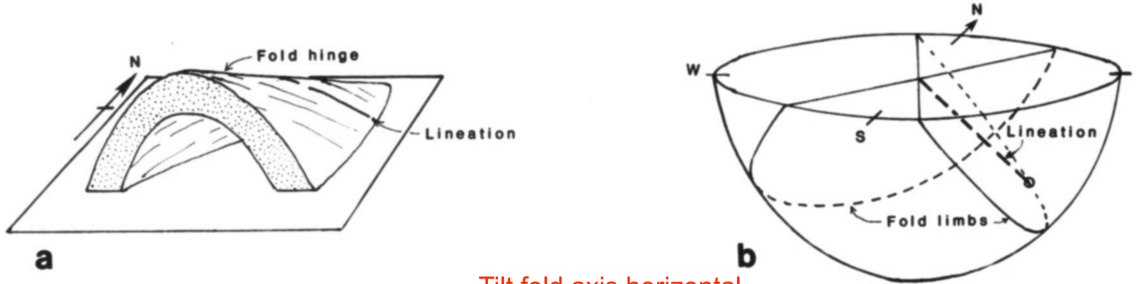
Rotate around the fold axis until
pole to limb P1 is horizontal.
All poles rotate along small circles
The original sedimentary lineation
072/00 must have been horizontal
since it was formed on a horizontal bed.



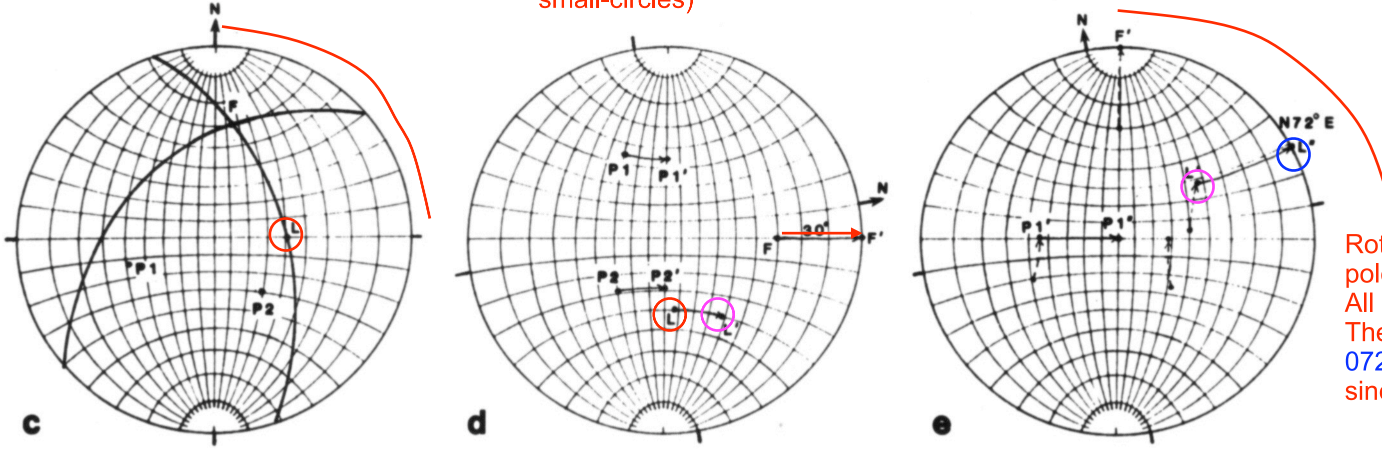
The original sedimentary lineation
072/00 or 252/00
Rotate P2 back to folded position around
F and the lineation follows on small circle
Rotate F back to EW and restore it to original
Plunge, all poles follow on small circles.
Restore to original orientation of axis.
Lineation on western limb is found 231/09

Figure 6-16. Procedure for unfolding and folding a plunging fold and determining the orientation of a prefolding lineation.

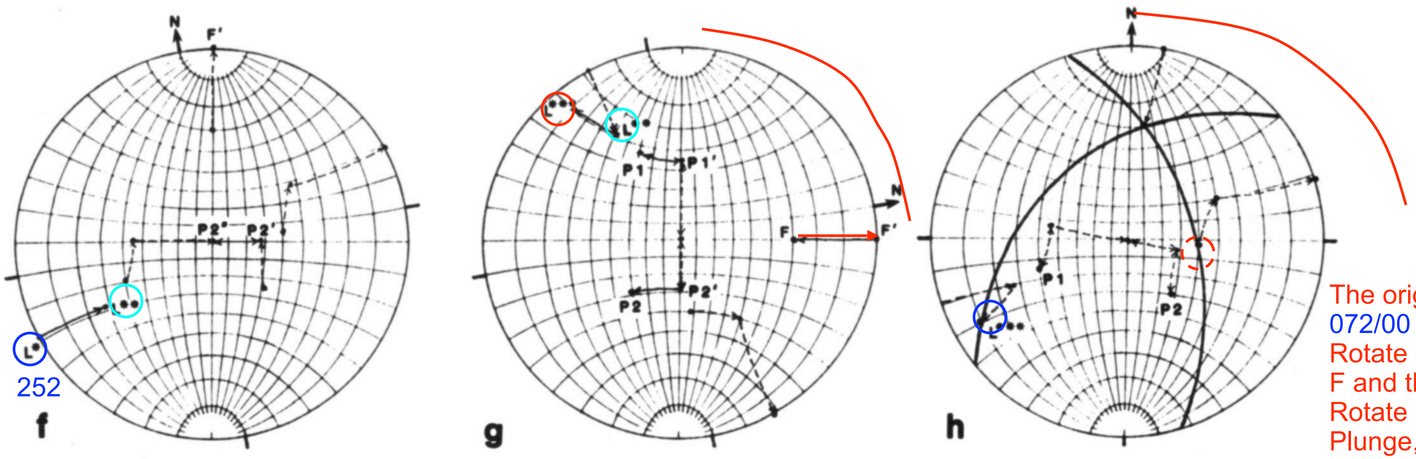
Plunging fold:
1) Determine pre-fold sedimentary lineation
2) Determine post fold lineation on western limb.



Tilt fold axis horizontal
(and all other points follow
small-circles)

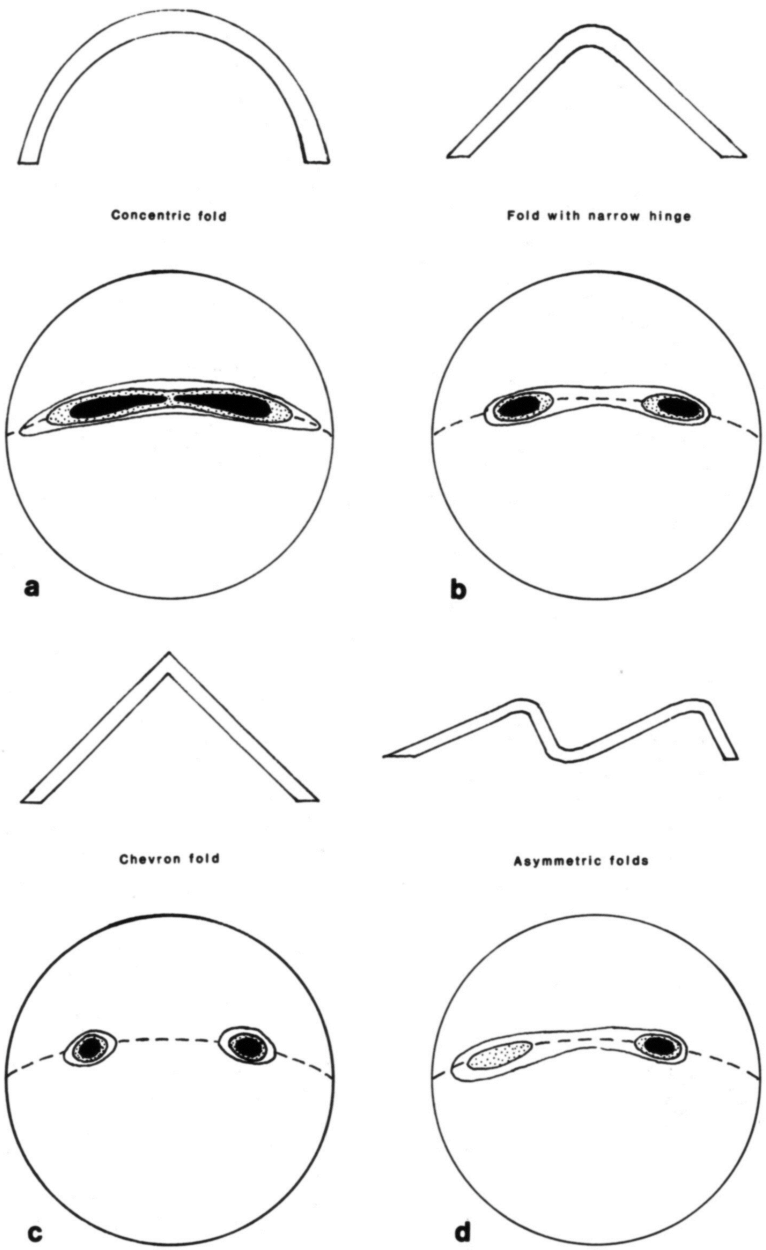


Rotate around the fold axis until
pole to limb P1 is horizontal.
All poles rotate along small circles
The original sedimentary lineation
072/00 must have been horizontal
since it was formed on a horizontal bed.



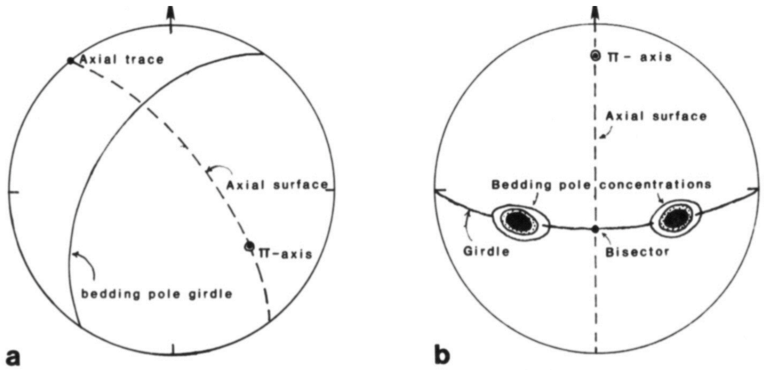
The original sedimentary lineation
072/00 or 252/00
Rotate P2 back to folded position around
F and the lineation follows on small circle
Rotate F back to EW and restore it to original
Plunge, all poles follow on small circles.
Restore to original orientation of axis.
Lineation on western limb is found 231/09

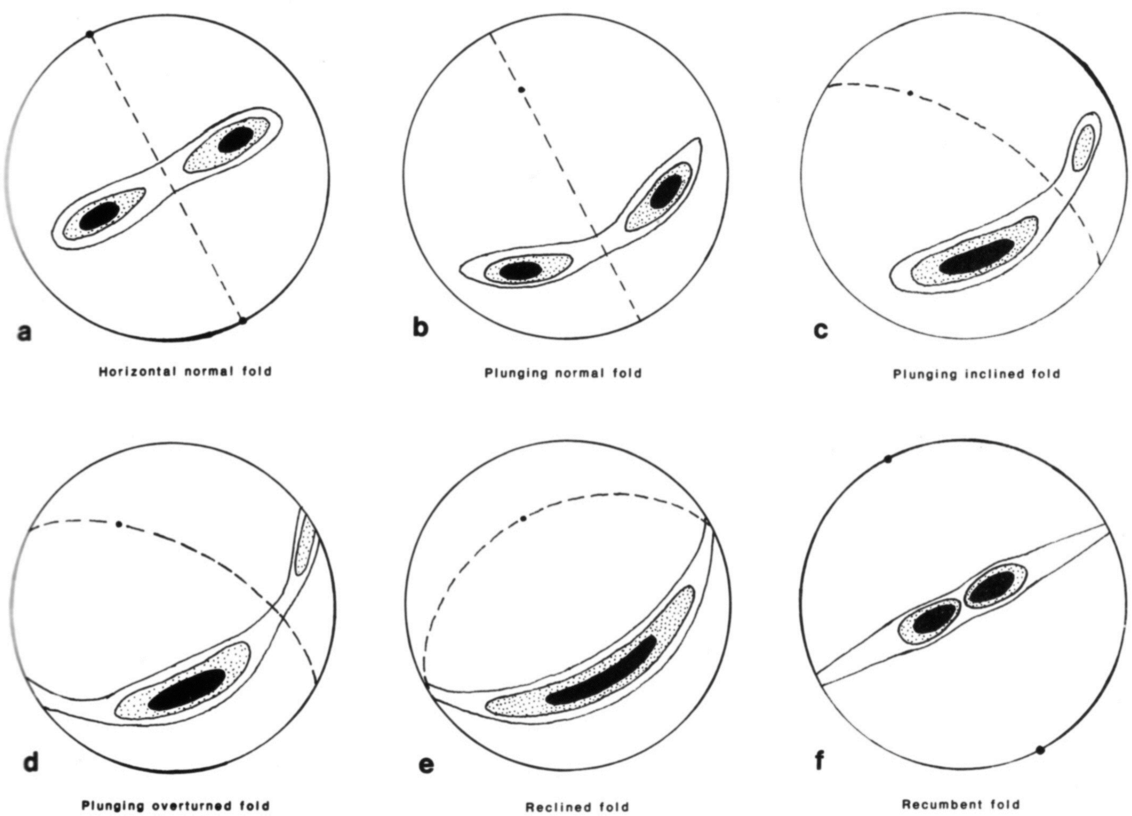
Figure 6-16. Procedure for unfolding and folding a plunging fold and determining the orientation of a prefolding lineation.

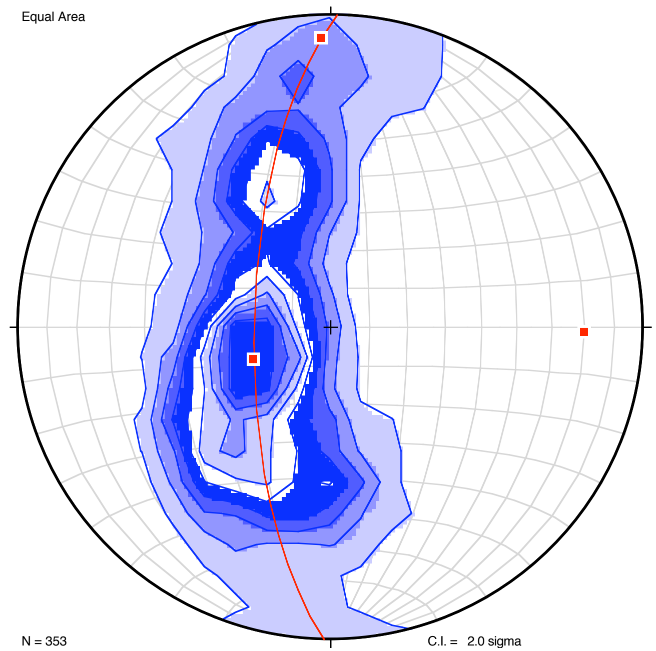


Fold geometries and the stereographic projections of the folded surface

Figure 8-18. Determining attitude of fold-axial surface from a π-diagram.







FOLDED LINEATIONS MAY BE USEFUL HERE TO DETERMINE FOLD MECHANISMS

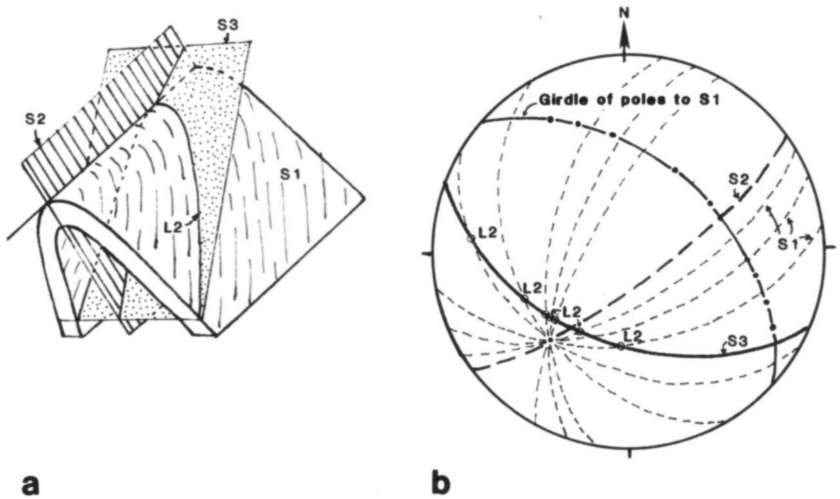


Figure 8-26. Intersection lineation produced by a later planar foliation (S_3) cutting an earlier folded foliation (S_1). (Adapted from Turner and Weiss, 1963.)

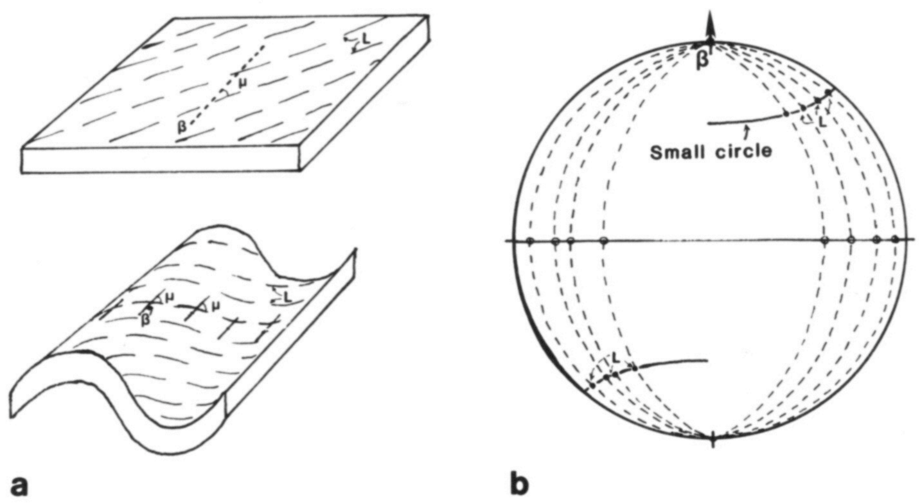


Figure 8-27. Flexural-slip folding of a preexisting lineation. Lineation points lie on a small circle centered on the fold axis. Lineation that was perpendicular to the fold axis (open circles on equal-area plot) lies on a great circle after folding. (Adapted from Ramsay, 1967.)

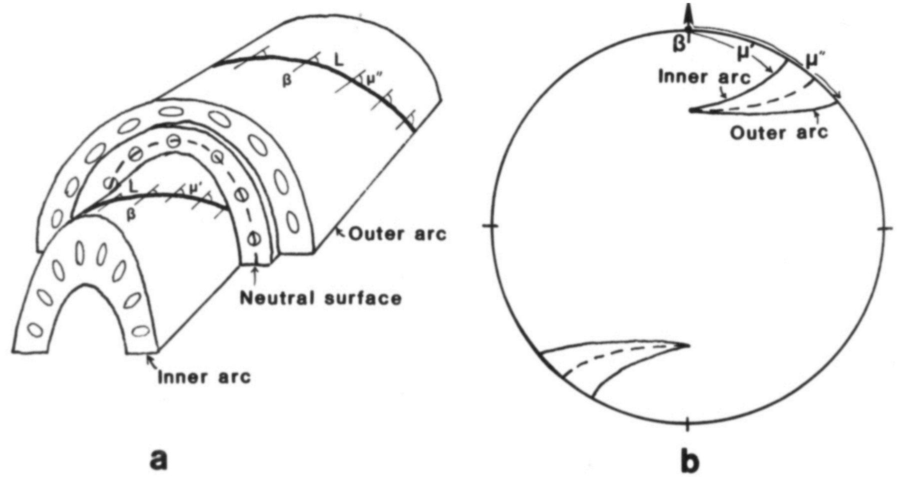


Figure 8-28. Effect of buckling of individual layers during flexural-slip folding. The small-circle arc pattern of lineations is modified in the outer and inner arcs of the fold. (Adapted from Ramsay, 1967.)

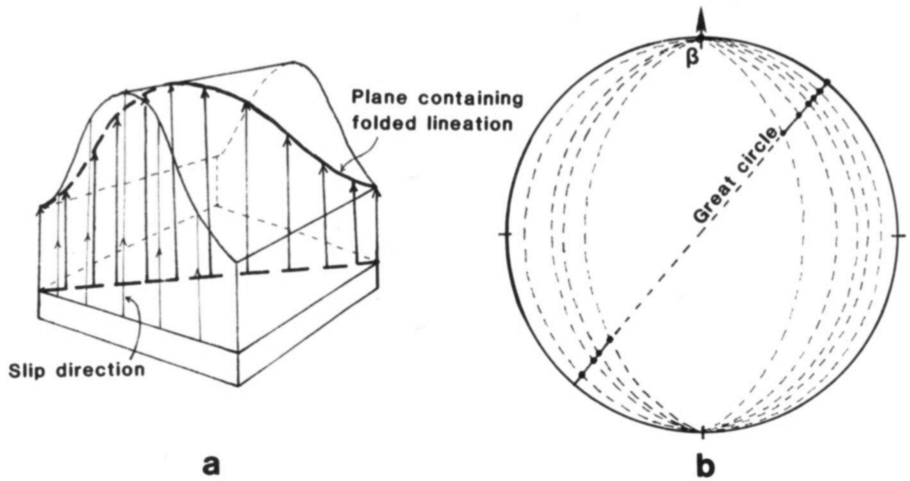


Figure 8-29. Passive folding of a lineation. Lineation points lie on a great circle oblique to the fold axis. (Adapted from Ramsay, 1967.)

FAULTS AND LINEATIONS
STRESS INVERSION FROM FAULT AND SLICKENSIDE MEASUREMENTS

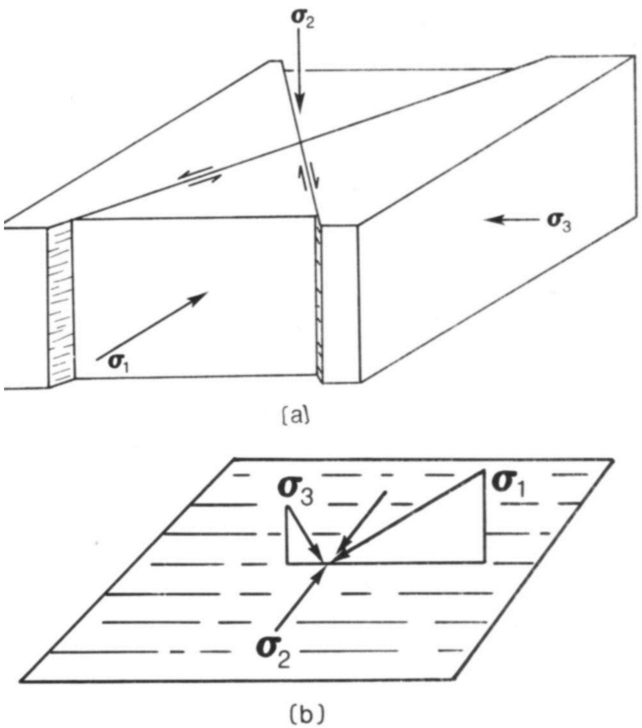


Figure 12-15. Ideal orientations of fault planes with respect to principal stresses. (a) Block diagram showing the orientation of principal stresses with respect to two conjugate strike-slip faults; (b) diagram showing principal stresses with respect to slip lineations on a single fault plane.

"Andersonian faulting", Mohr-Colomb fracture "law"

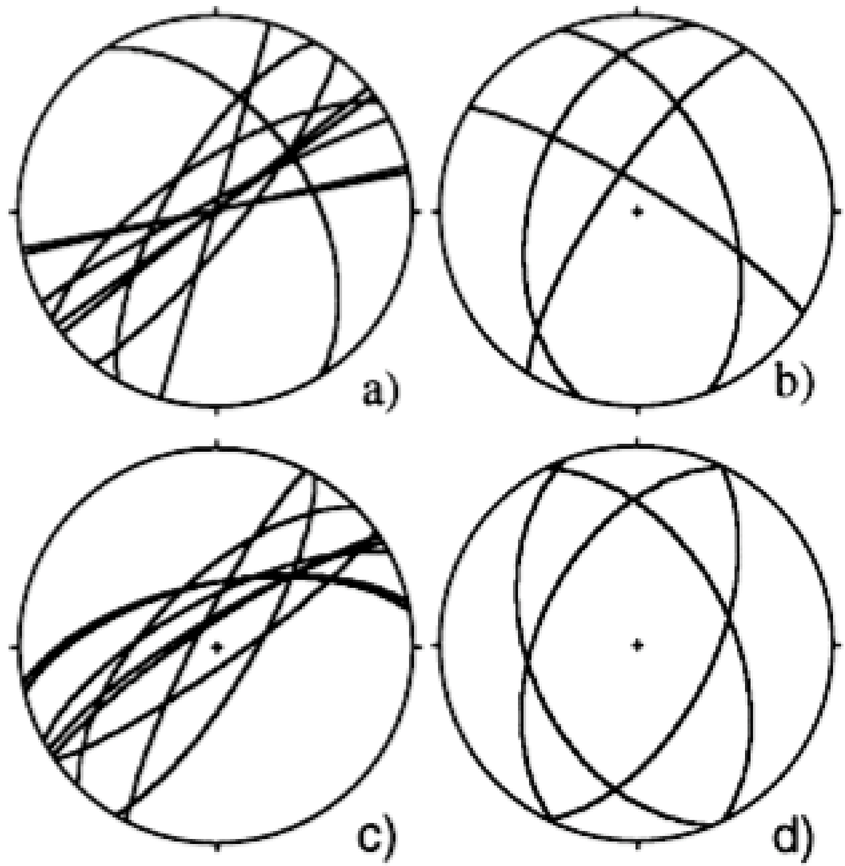


Fig. 11. Stereographic (Schmidt-net) representations of synsedimentary intrabasinal faults in the study area. (a) Present orientations of oblique faults that cut the basal unconformity. $n = 10$. (b) Present orientation of main faults of the Selsvatn fault system. (c) Faults in (a) unfolded and back-roatated with bedding. $n = 10$. (d) Data in (b) unfolded and back-rotated. The synsedimentary orientations of the four main faults reveal that the Selsvatn fault system originated as an orthorhombic fault system characterized by positive elongation in east–west and north–south directions. See discussion in text.

Orthorhombic faults!

STRESS AXES LOCATED WITH THE ASSUMPTION OF PERFECT MOHR-COLOMB FRACTURING

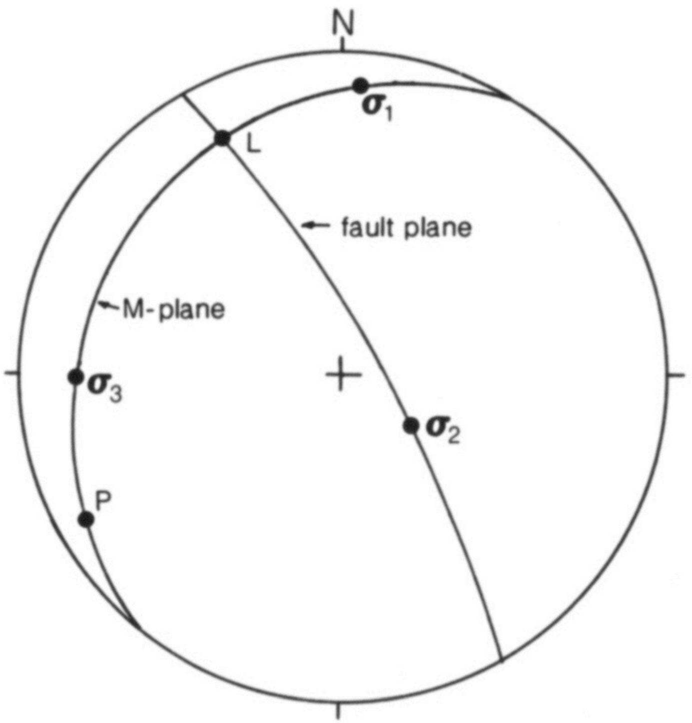


Figure 12-17. Equal-area plot showing estimation of principal stresses from a single set of slip lineations.

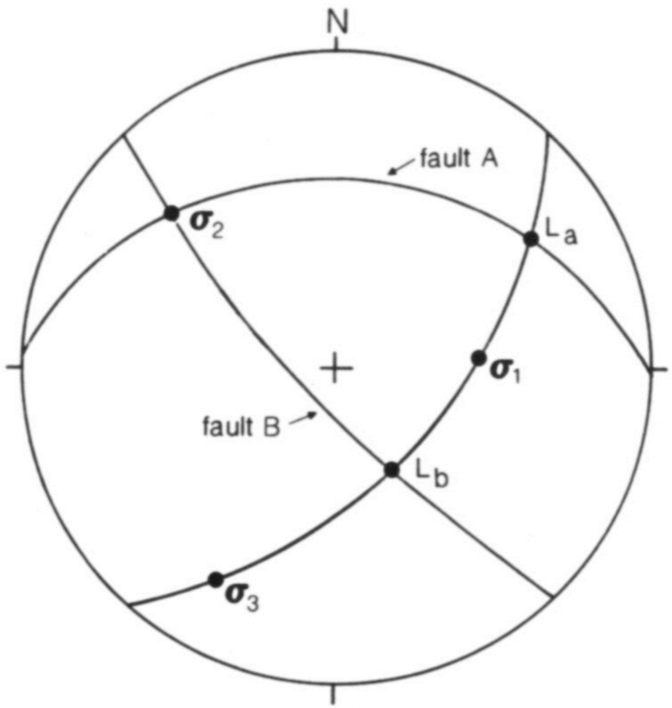


Figure 12-16. Equal-area plot showing estimation of principal stresses from data on two faults of a conjugate system. L_a and L_b are slip-lineation attitudes.

STRESS AXES LOCATED WITH THE ASSUMPTION OF PERFECT MOHR-COLOMB FRACTURING

Angle between fault & σ1 is 30'
Fault contains σ2 at 90' to L

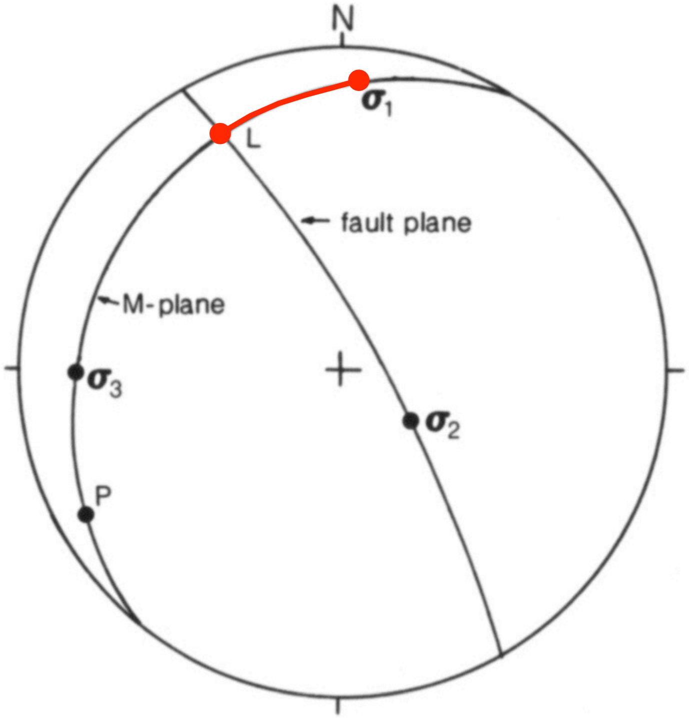


Figure 12-17. Equal-area plot showing estimation of principal stresses from a single set of slip lineations.

σ1 bisects acute angle between fault 1 and 2
Fault 1 and 2 intersect at σ2

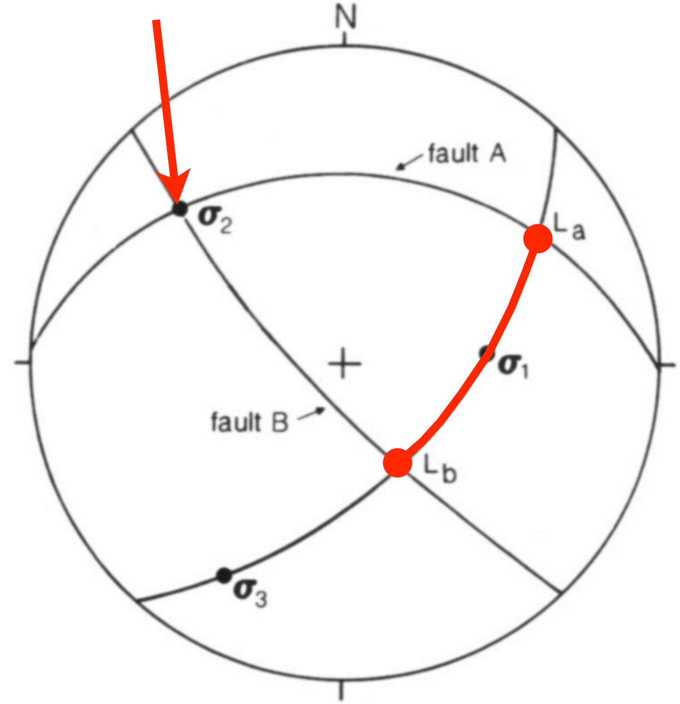


Figure 12-16. Equal-area plot showing estimation of principal stresses from data on two faults of a conjugate system. L_a and L_b are slip-lineation attitudes.

SLIP-LINEAR PLOT

are particularly useful for ananalyses of large fault-slip lineation data sets.

Slip-lines points away from σ_1 towards σ_3 and with low concentration around σ_2

slip-linear plot

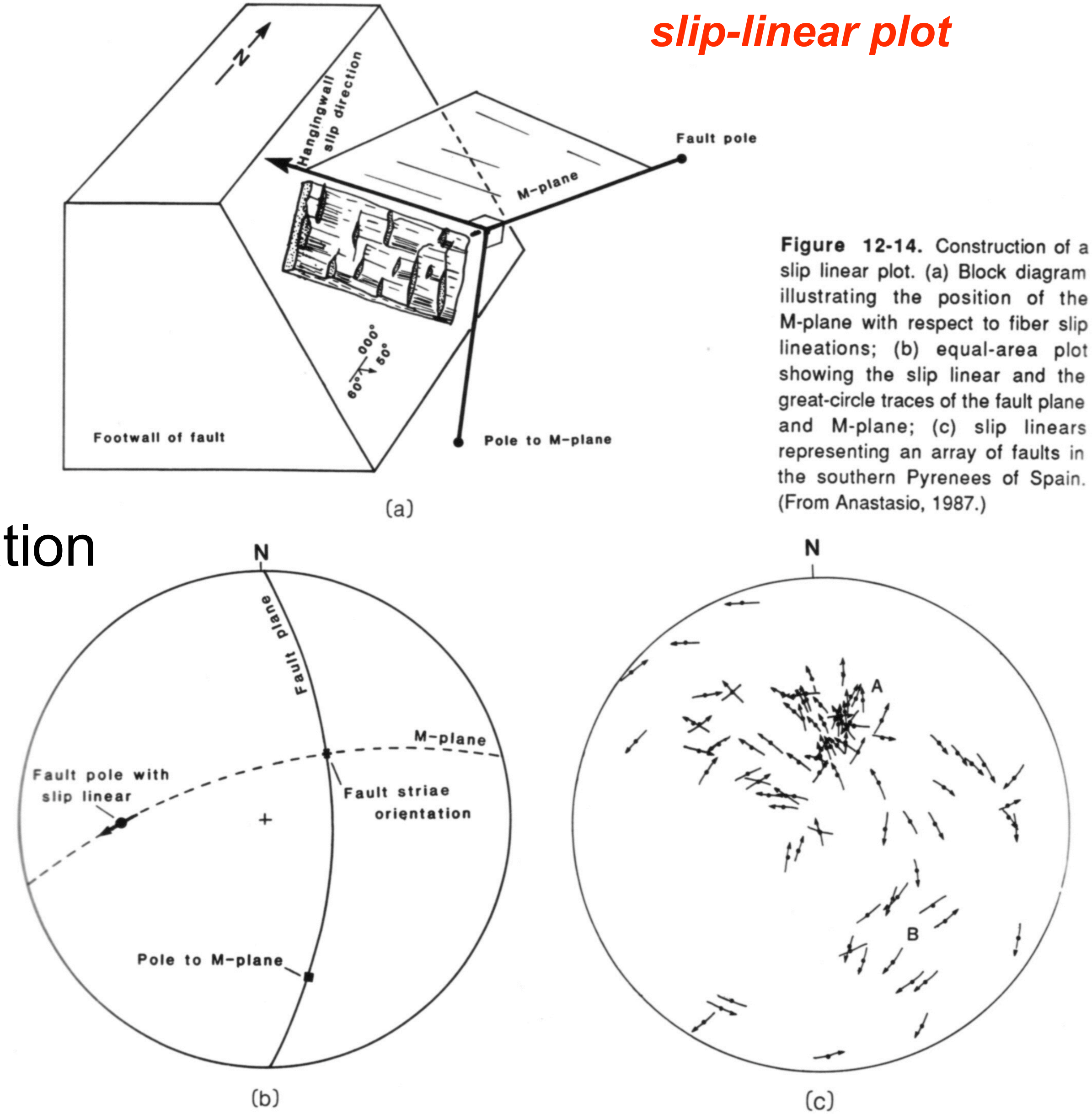
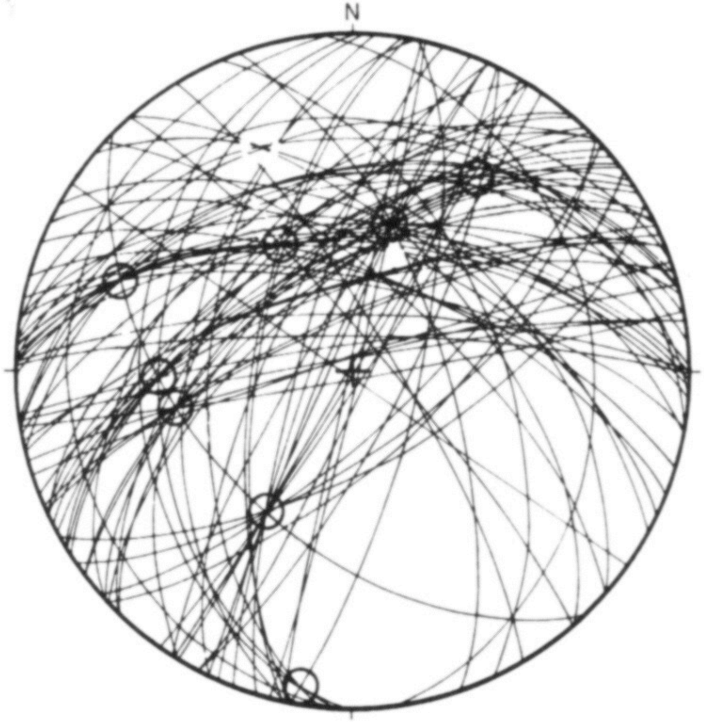
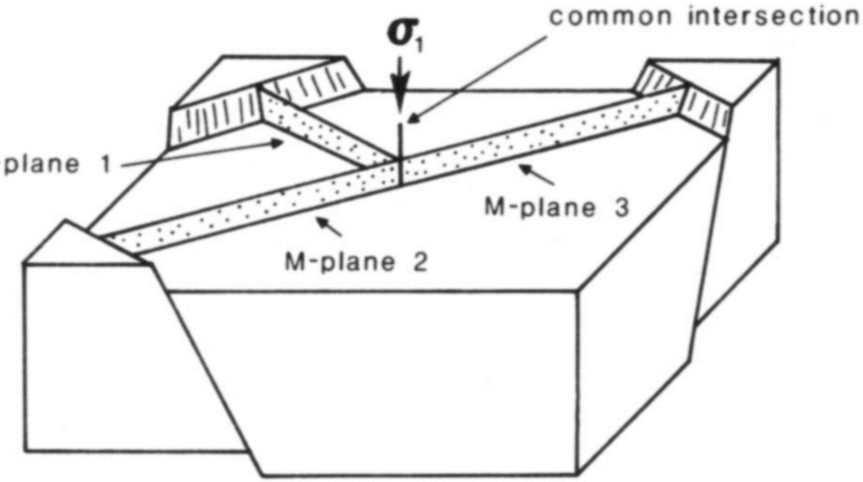


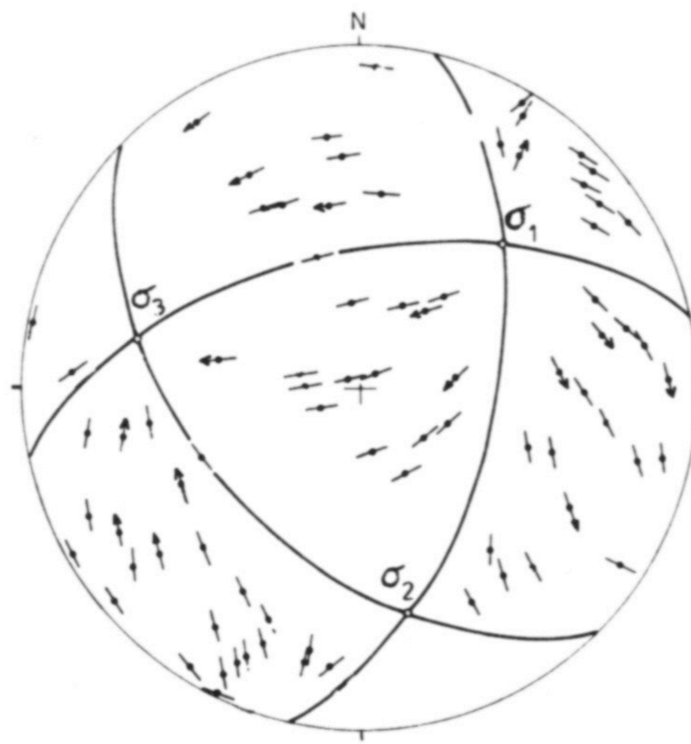
Figure 12-14. Construction of a slip linear plot. (a) Block diagram illustrating the position of the M-plane with respect to fiber slip lineations; (b) equal-area plot showing the slip linear and the great-circle traces of the fault plane and M-plane; (c) slip linears representing an array of faults in the southern Pyrenees of Spain. (From Anastasio, 1987.)



(a)

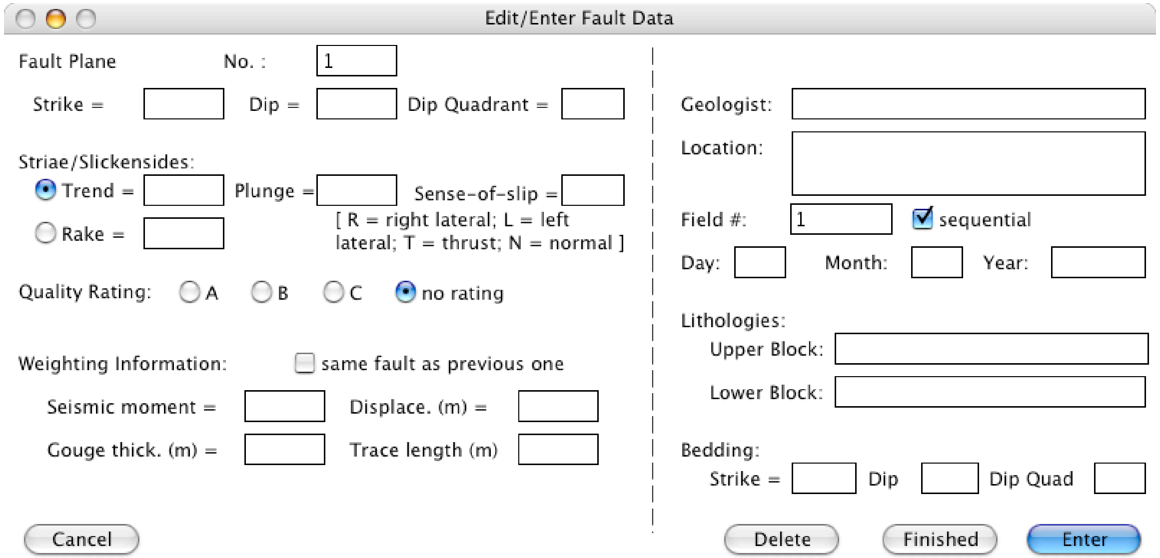


(b)

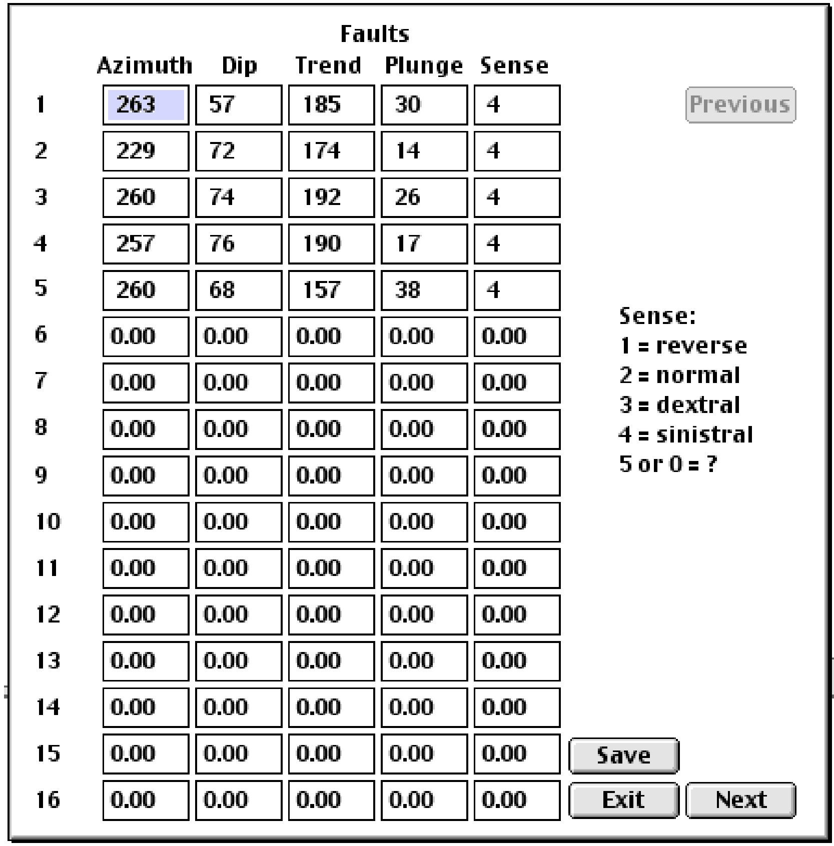


(c)

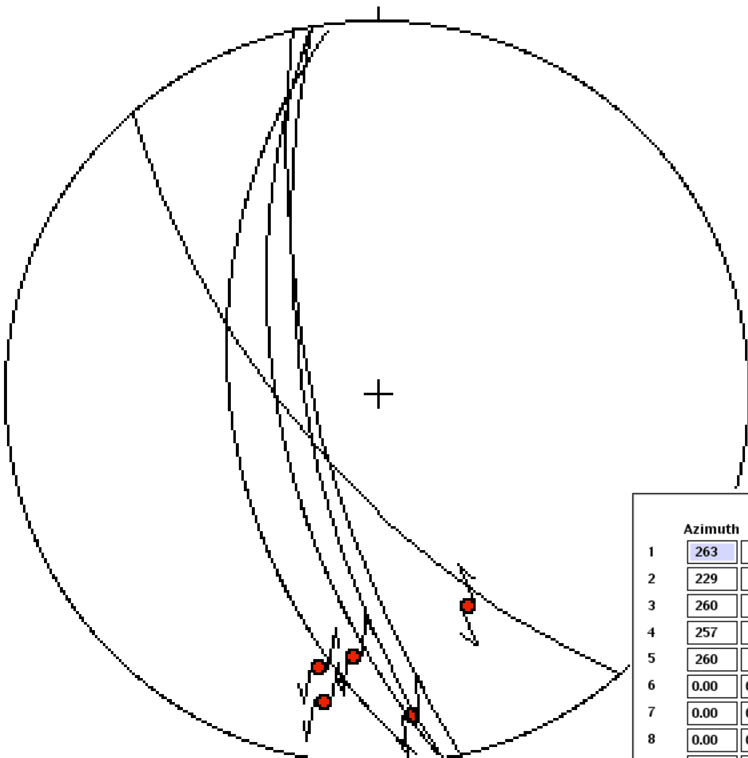
Figure 12-18. M-plane method of calculating principal stresses from a complex fault array. (a) M-plane great-circle traces for members of a complex array. Circles show the common intersection points (from Aleksandrowski, 1985); (b) block diagram showing how the common intersection of three M-planes may be related to a principal stress; (c) slip linear plot for the faults of plot 'a'. Note that the slip linears point toward σ_3 and and away from σ_1 (from Aleksandrowski, 1985).



VARIOUS WAYS TO RECORD THE MEASUREMENTS IN DIFFERENT PROGRAMS



FAULTS WITH SLICKENSIDE AND RECORDED RELATIVE MOVEMENT FROM ONE STATION



Faults

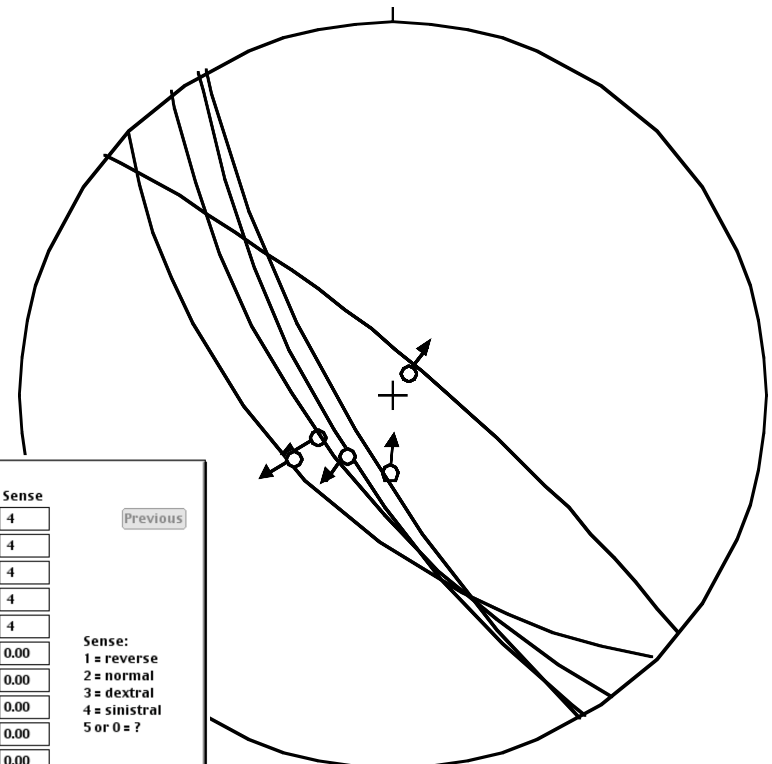
	Azimuth	Dip	Trend	Plunge	Sense
1	263	57	185	30	4
2	229	72	174	14	4
3	260	74	192	26	4
4	257	76	190	17	4
5	260	68	157	38	4
6	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00
11	0.00	0.00	0.00	0.00	0.00
12	0.00	0.00	0.00	0.00	0.00
13	0.00	0.00	0.00	0.00	0.00
14	0.00	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00	0.00
16	0.00	0.00	0.00	0.00	0.00

Previous

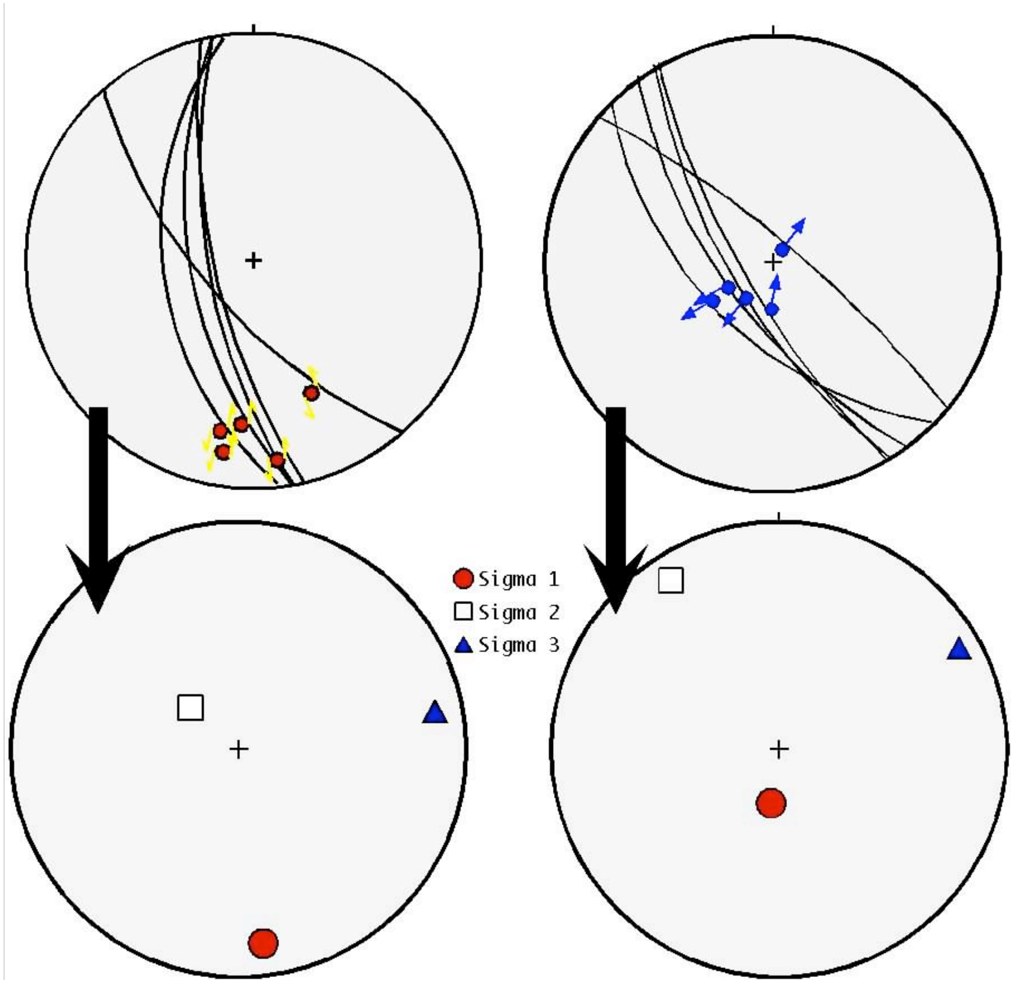
Sense:
1 = reverse
2 = normal
3 = dextral
4 = sinistral
5 or 0 = ?

Save

Exit Next



SAME DATA AS BEFORE, STRESS-AXES INVERSION, RIGHT HAND SIDE ROTATED



Field exercises Tuesday 04/09

Departure from IF w/IF car at 09.00 am

Station 1 at Nærsnes
(large-scale fault between gneisses and sediments)
(ca 2-3 hours)
Station 2 a and b at Fornebo
(small-scale fractures, veins and faults with lineations)
(ca 2-3 hours)

Bring food/clothes/notebook/compass/etc.

Return to Blindern ca 4 pm.

10/09 Report in (presentation of measurements, interpretation and descriptions)