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Title of article Oblique Extensional Tectonics in the Malawi Rift, Africa

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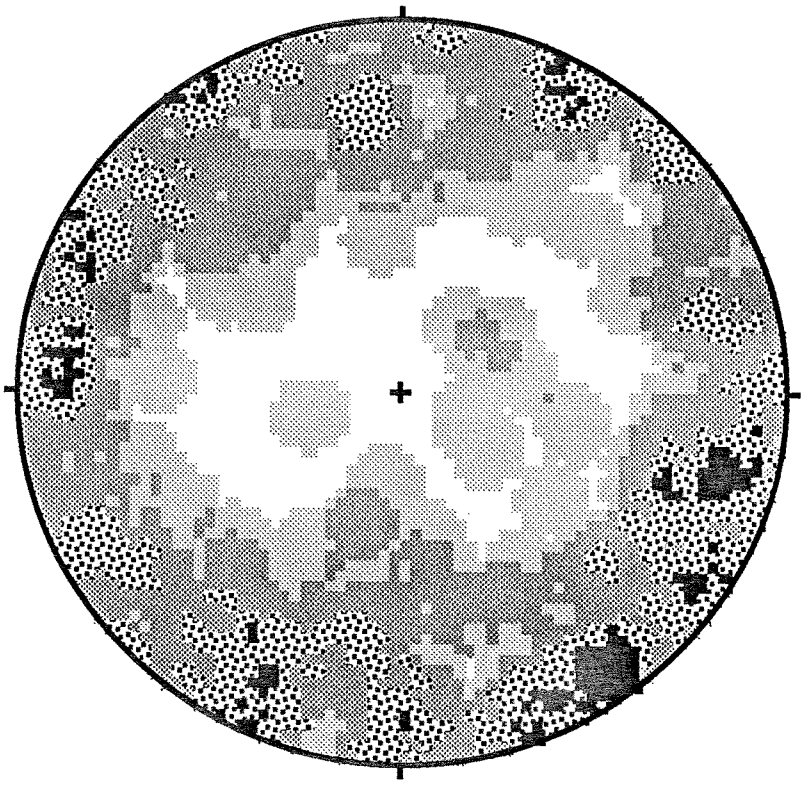
see Bulletin v. 104, p. 1015 - 1023

Contents

34 pg.

Contoured poles to all measured faults — program "Stereo"



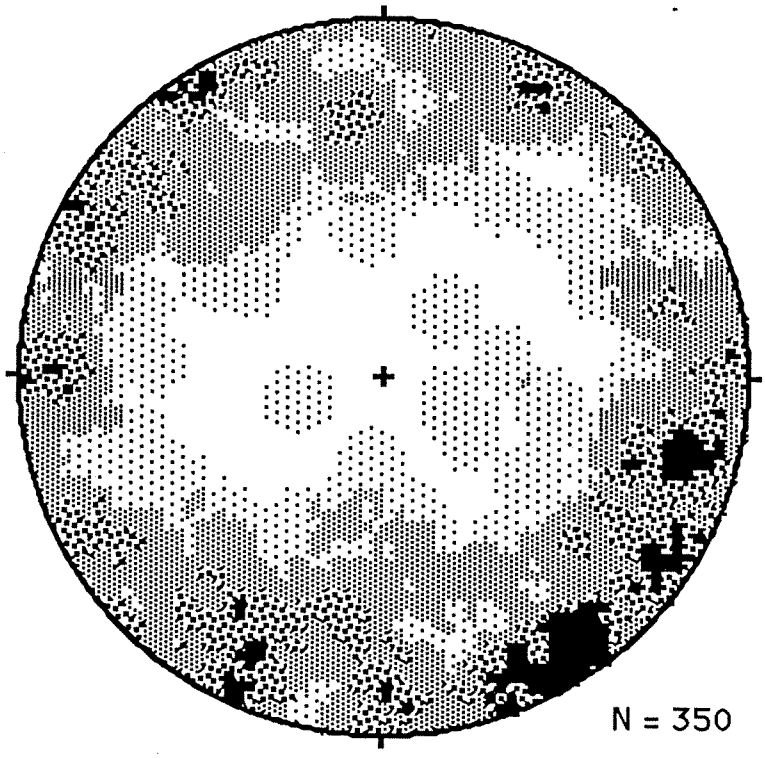
Data	Schmidt Equal Area Projection	Statistics
malawiall 0.3-1.3% 1.3-2.4% 2.4-3.4% 3.4-4.4% N = 383		

EXPLANATION

malawi

- 0.3–1.3%
- 1.3–2.4%
- 2.4–3.5%
- 3.5–4.6%

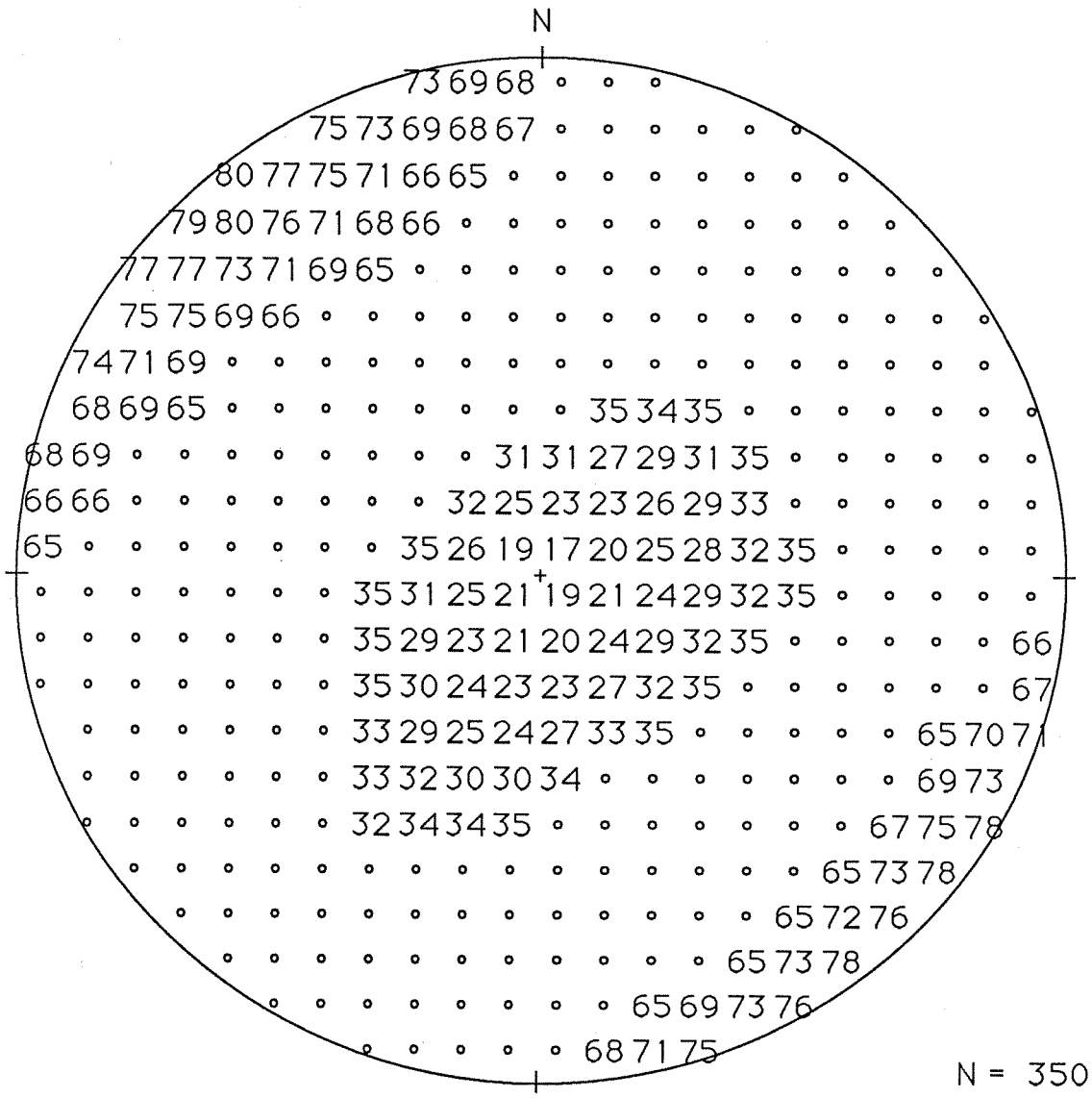
Schmidt Equal Area Projection



N = 350

Contoured poles to faults with striations + sense determined - program "sfereo"

Right dihedra solution for the 350 striation measures with sense determined - All of Malawi.



Supplementary data 92, for: Oblique extensional tectonics in the Malawi Rift, Africa

Christopher C. Sorlien, May 8, 1992 and July 27, 1992

The data used in "Oblique extensional tectonics in the Malawi Rift, Africa" follows. Measurements were made in March 1985 and analyzed manually that year using the right dihedra method of Angelier and Mechler (1977). The data were reanalyzed using the same method and a computer program in 1990 and 1991. The computed results are slightly different than the previous results for several reasons. The data analyzed by hand were weighted by confidence of the measurement, while all measurements for which sense was determined were weighted equally in the computed solution. Stations with many measurements were broken into two parts in the hand analysis by location within a station, while they were combined in the computed solution. The computed results were compared with the hand analysis; when computed results were somewhat ambiguous the quality of the individual measurements was taken into account in choosing the extension direction for figure 2.

The following measurements were made by Pierre-Yves Chenet and Luc Meffre of the Institute Francaise du Petrol, and Jean Chorowicz and Sorlien. Measurements are often rounded to the nearest 5° before correction for magnetic deviation, which is valid since fault surfaces are not perfectly planar; however, these measurements should not be analyzed assuming more precision than 3 degrees. Measurements were made with the compass set on zero and then the magnetic deviation was added in later. The following measurements are corrected for magnetic deviation. Measurements are in this order: strike, dip direction, dip, pitch direction, pitch, and sense. r=reverse; n=normal; d=dextral; s=sinistral. If the striations are questionable I will add p=(?) or p=?. If they were particularly good and that was noted, then I will add p=!. No comment generally means that the striations are not questionable but are not spectacular either. The confidence of the sense determination is given in the following order from bad to good where noted. s=?; (?); app. (for apparent); prob (for probably); and sure or clear. For each station with more than 3 measurements, I will give my own qualitative judgement of the quality of the right dihedra solution from poor to excellent. This is not related to the confidence of individual measurements.

The stations were located onto geologic maps in the field, and latitude and longitude was later measured from these 1:100,000 and 1:250,000 scale maps; precision in most cases is 100 to a couple hundred meters. Most locations are on or near dirt or paved roads. Malawi is a tropical country with thick residual soils; there were almost no outcrops over a wide area of north central Malawi. A future study may want to concentrate on where

streams cross faults, and use a boat along the coast of Lake Malawi. Water erosion may keep up with weathering along escarpments.

Stations a and b-not used in figure 2, only 2 measurements each station.
83,"n",90,"e",0,"d"-prob
38,"nw",86,"ne",65,"n"s=?
90,"s",86,"e",75,"n"
83,"n",60,"e",55,"r"s=(?)
121,"ne",90 no striations
98,"s",85 no striations

station 1, inversion quality=fair
01,"w",88,"s",75,"n", p=?,s=?
66,"n",87,"e",84,"n" conjugate to previous, p=?,s=?
39,"se",83,"ne",58,"d",p=!
45,"nw",73,"ne",50,"d",p=!
01,"e",82,"n",10,"d", s=sure

station 2, inversion quality=very good
146,"ne",70,"se",83,"n" s=clear
102,"s",80,"e",55,"n" large fault 30 cm crushed zone, s=prob
42,"se",56,"sw",74,"n"
67,"s",76,"e",40,"n"
42,"se",70,"w",45,"n" p=?
42,"se",66,"ne",90,"n"
52,"se",80,"sw",37,"n"
42,"se",68,"sw",55,"n"
36,"se",62,"sw",70,"n"

station 3, no inversion
157,"e", 85,"n",7,"d" p=!, somewhat mineralized, s=?

station 4, no inversion
12,"e", 70,"n",40,"n" s=?

station 5, inversion quality fair-good
91,"n",80,"e",80,"n" open fault, p=?, s=(?)
56,"n",47,"w",78,"n" big fault, p=!

87,"n",85,"w",80,"n" s=?
101,"n",60,"w",10,"s"
111,"ne",70,"se",8,"s" s=prob
08,"w",36,"n",83,"n"
71,"n",80,"w",80,"n" p=?
33,"se",70,"ne",64,"n" s=clear
101,"s",60,"w",20,"s" s=sure
36,"se",70,"ne",67,"n" s=sure
36,"se",72,"ne",50,"n" s=prob
85,"s",65,"w",50,"n"
136,"ne",85,"nw",80,"n" p=mullions
106,"ne",75,"se",72,"n" p=? (mullions?)
111,"ne",87,"se",5,"s" p=(?) s=prob
93,"n",85,"w",75,"n" p=?
67,"n",80,"e",78,"n" p=?
99,"n",70,"e",71,"n" p=?
41,"nw",80,"sw",70 no sense determination
01,"e",75 no striations
91,"n",80 no striations

station 6, inversion quality=fair (WNW extension only slightly better than NNW)
109,"n",90,"e",85,"s" p=?, s=prob
94,"n",90,"e",90,"s" p=? s=prob
154,"e",82,"s",25,"d" older striations, s=clear
154,"e",82,"n",80,"n" same fault, younger striations
141,"ne",90,"nw",60,"s" p=?, s=prob
95,"n",90,"w",65,"s" p=?
83,"n",75,"w",83,"n" s=clear
82,"n",85,"w",86,"n" s=clear
74,"n",83,"w",80,"n" p=(?)
94,"n",80,"w",80,"n" s=clear
128,"ne",76,"se",84,"n" s=clear
22,"nw",75,"ne",30,"n" p=?

station 7, inversion quality very good
177,"e",85,"s",56,"n" s=clear
152,"e",80,"s",62,"n" s=clear
132,"ne",68,"se",90,"n" s=clear
122,"ne",80,"nw",80,"n" s=clear
17,"w",75,"n",65,"n" s=clear
172,"w",80,"n",60,"n" s=clear
119,"ne",70,"nw",70,"n" p=!

117,"ne",66,"nw",52,"s"
132,"ne",80,"nw",52,"n"
02,"w",82,"n",63,"n"
20,"e",85,"n",68 no sense
147,"e",75,"s",90 no sense
84,"s",80,"e",80 p=? no sense
12,"w",80,"s",32 no sense

station 8, inversion not used in fig 2 (less than 4 measurements)
42,"se",85,"sw",60,"n" s=clear
52,"se",70,"ne",65,"n"
144,"e",76,"n",25,"n" s=clear

station 9, inversion quality=excellent. 7 measurements did not have sense determination. Inversion was done both without them(N=18) and with them assumed normal (N=25). The azimuth of the least principal stress axis is the same either way. In figure 4, measurements for which sense was not determined are shown as normal.
50,"nw",84,"ne",64,"n"
21,"w",70,"s",15,"d" s=prob
165,"w",80,"s",5,"d" s=prob
131,"ne",90,"se",30,"s" p=!, s=prob
35,"nw",65,"ne",78,"n" s=sure
30,"nw",80,"ne",73,"n" s=sure
27,"nw",64,"ne",75,"n" s=sure
45,"nw",59,"ne",72,"n" s=prob
21,"nw",80,"ne",60,"n" s=sure
25,"nw",65,"ne",52,"n" s=sure
13,"w",68,"n",80,"n" s=sure
145,"ne",70,"se",30,"n" s=clear
170,"w",70,"n",82,"n" s=clear
175,"w",78,"n",80,"n" s=sure
118,"ne",85,"nw",72,"n" s=clear
130,"ne",55,"se",80,"s"
165,"e",90,"s",90,"d" pitch=+/- 5°
171,"e",88,"s",84,"n" s=clear
sense was not determined for the following measurements; assumed normal
21,"w",70,"s",60
95,"n",80,"e",45
155,"e",65,"s",80 p=?
160,"e",75,"s",30 p=!
150,"sw",78,"nw",78 p=!

110,"s",85,"e",30 p=!
119,"sw",82,"se",32

station 10, less than 4 measurements with sense determined
165,"e",60,"s",85,"n" s=prob
10,"w",62,"s",85,"n" s=clear
102,"n",56,"e",65,"n" s=clear
faults striking 41 and 32 (dip not measured) offset a quartz vein left laterally)

station 11, no striations so no inversion
the following have normal separations
165,"e",75
5,"e",75
25,"se",80
10,"e",70
15,"e",80
10,"e",80 normal sinistral separation
5,"e",80 normal sinistral separation
110,"s",60
13 measurements of extension fractures (open fractures) striking between 20 and 25 degrees, and 5 measures striking between 7 and 22 degrees.

station 12, inversion quality excellent
02,"w",60,"n",45,"n" p=!
12,"w",80,"n",72,"n" s=prob
16,"w",80,"n",70,"n" s=sure by 70 cm separation
167,"w",65,"n",40,"n" s=sure by 3 cm separation
167,"w",71,"n",30,"n" s=sure by separation
152,"w",75,"n",50,"n" s=sure by 50 cm separation
02,"w",75,"n",42,"n" s=sure by 40 cm separation
07,"w",60,"n",52,"n" s=clear
82,"n",40,"e",45,"s" s=?
22,"nw",57,"e",35,"n" s=clear by 10 cm separation
37,"nw",75,"sw",45,"n" s=app
40,"nw",90,"ne",25,"s" s=app
22,"se",83,"ne",30,"d" conjugate with next measure, s=prob
177,"w",80,"n",27,"n" s=clear
92,"s",55,"w",55,"s"
32,"nw",85,"ne",60,"d" s=clear by 1 cm separation
27,"nw",90,"ne",72,"d" s=clear
142,"ne",70,"se",15,"n" 2 sets striations, p=?, ? older

142,"ne",70,"se",80,"n" ? younger
02,"w",74,"n",40,"n" s=clear
117,"ne",68,"w",60,"n" s=sure
127,"ne",68,"nw",75,"n" s=sure
132,"ne",55,"se",55,"n"
147,"w",84,"n",70,"n" 2 sets striations, younger
147,"w",84,"se",0,"d" same fault, older
137,"w",85,"s",80,"n" 2 sets striations, younger
137,"w",85,"s",25,"n" same fault, older
107,"n",30 no striations, reverse separation
152,"w",20 no striations

station 13, inversion solution fair, WSW or WNW extension possible, WNW used accounting for confidence of measurements.
97,"s",80,"w",40,"s" s=prob
152,"e",55,"s",50,"n" s=clear
147,"e",80,"s",60,"n" p=? s=prob
102,"n",40,"w",75,"n" s=sure
17,"nw",80,"sw",70,"n" conjugate with the following measure, s=clear
117,"sw",86,"nw",65,"n" s=clear
82,"s",35,"w",14,"d" azimuth of striation converted to pitch on equal area net, s=app
42,"nw",90,"ne",80,"s" s=prob
42,"nw",55,"sw",86,"n" s=sure
37,"nw",60,"sw",85,"n" s=clear
67,"n",72,"e",0,"s" s=app
72,"n",80,"e",80,"r" s=sure
72,"s",85,"e",72,"n" s=sure
67,"n",80,"w",70,"n" s=app
47,"n",74,"ne",90,"n" s=app
122,"sw",85,"se",55,"d" s=prob
37,"nw",75,"sw",45,"n" s=prob
sense not determined for the following
22,"nw",60,"sw",30
117,"ne",70,"nw",6
122,"sw",66,"se",7

station 14, inversion quality is poor, not used in figure 2 for that reason. Extension between west and northwest is favored, and the manual solution of 1985 favors NW extension.
81,"s",65,"e",40,"s" s=clear
41,"nw",78,"ne",42,"s" p=?, s=prob by separation
61,"n",90,"e",40,"s" s=prob by separation

138,"ne",50,"nw",68,"d" s=clear by 5 cm separation
166,"e",20,"n",25,"s" p=?, s by separation on parallel fault 10 cm away
51,"nw",82,"e",65,"n" s=app
16,"w",78,"n",0,"d" s=app
71,"s",82,"e",5,"s" s=prob
51,"nw",78,"e",55,"n" p=(?)
46,"se",78,"sw",25,"n" p=!, s=clear by 3 cm separation
56,"s",84,"w",10,"s" s=clear by separation
51,"se",70,"ne",65,"n" p=(?), s=clear by 20 cm separation

station 15, inversion solution fair, it is uncertain whether first 10 measurement were on in-place outcrop
49,"se",75,"ne",75,"n" s=app
74,"s",50,"e",90,"n"
66,"s",50,"e",90,"n" s=sure
31,"se",46,"ne",60,"n" s=sure
51,"se",50,"ne",30,"n" s=prob
36,"nw",40,"ne",45,"n"
36,"se",38,"ne",50,"n" s=sure
16,"e",75,"ne",45,"n" s=prob
76,"n",42,"e",90,"n" s=app
16,"e",60,"n",5,"d" s=prob
06,"e",75,"n",57,"d" p=!, s=sure
01,"e",80,"n",55,"d" s=sure
146,"e",87,"n",40,"s" s=sure
121,"ne",60,"se",65,"n" s=(?)
14,"w",65,"n",40,"r" s=sure
91,"n",50,"e",70,"n" s=prob
176,"e",83,"n",60,"r" s=sure
156,"e",80,"n",85,"n" p=(?), s=prob
146,"sw",24,"se",62 no sense, azimuth striation converted to pitch assuming normal (not used in inversion).

station 16, no inversion since only 2 measures
101,"s",80,"w",10,"s" s=sure
31,"nw",84,"s",52,"n" p=(?), s=sure

station 17, no inversion since only 2 measures
80,"n",85,"e",45,"s" p=!, s=prob
37,"se",54,"sw",70,"n" s=sure

station 18, fair to good since extension not tightly constrained
01,"w",65,"n",30,"n" s=sure by 2 cm separation

16,"w",58,"s",60,"n" s=sure
16,"w",55,"ne",90,"n" s=sure
161,"w",62,"n",5,"d" s=sure
166,"e",90,"s",40,"d" s=sure
The following measure at first did not have sense determined, and then we went back to it and it was s=prob normal dextral. I missed this notation, and did not use this measurement in the inversion, but it could be used. It is compatible with NW extension, but does not constrain the solution further.
166,"w",75,"n",36,"d" s=prob

station 19, inversion quality fair-good since many slip directions are subparallel and therefore do not tightly constrain the extension direction
107,"s",50,"e",25,"s"
87,"s",60,"e",35,"s"
67,"s",60,"e",25,"s"
82,"s",55,"e",20,"s"
57,"s",76,"e",10,"s"
97,"s",50,"e",15,"s"
84,"s",70,"e",4,"s" s=sure
167,"e",67,"s",0,"s" s=prob
72,"s",73,"e",0,"s" s=sure, 2 sets striations, older
72,"s",73,"w",20,"s" s=prob, younger
92,"s",85,"w",8,"s"
82,"s",65,"e",0,"s" 2 sets striations, relative age not determined
82,"s",65,"w",30,"s" same fault, s=prob
82"s",60,"e",15,"s" s=clear
57,"se",88,"ne",0,"s"
The following two measurements were used and are conjugate, but are suspect because the striations are in clay and may have been formed during road construction or by a loose block sliding under gravity
177,"w",82,"s",55,"n" p=?
107,"s",60,"w",85,"n" p=?
127,"ne",90+/-10 no striations,5 cm dextral offset of subvertical quartz vein

station 20, inversion quality fair-good (few measures)
02,"e",80,"s",8,"n" p=?, s=?
52,"n",75,"sw",80,"n" p=?
177,"e",72,"n",50,"d" p=!, s=prob
82,"s",58,"w",75,"n" p=!, s=prob

station 21, 1 measure, no inversion

113,"ne",80,"se",80,"n" s=app

station 22, 1 measure, no inversion
103,"n",90,"s",25,"s" s=app

station 23, inversion quality good- quality excellent if 3 measures associated with NW extension removed.
99,"n",60,"e",30,"s"
114,"s",88,"e",40,"s" p=!
94,"n",67,"e",30,"d" s=app
54,"n",80,"e",40,"n"
54,"nw",90,"ne",40,"s" s=?
94,"n",58,"e",30,"d" s=prob
124,"ne",80,"se",55,"n"
109,"n",76,"e",10,"d" s=sure
104,"n",60,"e",40,"d"
109,"n",76,"e",35,"d" s=sure
64,"s",84,"e",45,"d" s=prob
54,"nw",78,"ne",40,"n" s=prob
69,"n",80,"e",55,"d" s=prob
60,"nw",77,"e",54,"d"
114,"ne",67,"e",50,"n" s=sure
74,"n",84,"e",50,"n"
74,"s",86,"e",45 no sense

station 24, not used in figure 2 since only 3 measures
04,"e",55,"s",40,"n" s=clear
39,"se",55,"sw",50,"n" s=clear
179,"e",73,"s",65,"n"

station 25, inversion quality fair-good (extension only at 82%).
24,"e",82,"s",40,"d" s=prob
14,"w",77,"n",0,"d" s=prob
119,"sw",72,"se",65,"n" s=prob
114,"s",76,"e",80,"n" p=?,s=app
30,"nw",74,"ne",10,"d" s=sure
66,"nw",50,"ne",83,"n" s=?(mullions), s=app
164,"w",80,"n",20,"s" s=app
104,"s",65,"e",30,"n" s=sure
129,"ne",68,"se",20,"s" s=app
84,"s",48,"w",80,"n"
174,"e",70,"s",30,"d" s=app
119,"ne",75,"se",63,"d" p=!,s=app

24,"se",74,"sw",65,"n" p=!, s=sure
106,"s",72,"e",10,"d" p=!, s=clear
124,"ne",90,"se",16,"d"
174,"e",85,"s",5,"s" s=app
119,"sw",85,"se",30,"s" s=?
19,"se",85,"sw",10 p=?, no sense

station 26, inversion quality fair, not used in figure 2 due to fair quality and few measures. Also, I made a mistake on 1 fault in 1985 and had NW extension with 1 additional incompatible fault in the hand solution. Not using this station favoring NE-extension in this paper is balanced by not using station 14, which favors NW extension.
09,"e",88,"s",10,"s"
29,"nw",78,"sw",72,"n"
139,"sw",78,"se",77,"n" s=app
154,"w",88,"se",75,"n" s=sure
19,"e",86,"s",76,"n" p=!, s=sure
89,"s",73,"e",83,"n" s=prob

station 27, inversion quality good, large diameter inversion=more grid points results in ESE extension instead of SE.
31,"nw",60,"sw",75,"n" s=sure, 2 m separation
131,"sw",20,"se",5,"n" converted from azimuth 133 to pitch se 5
11,"w",38,"n",58,"n" s=sure
34,"nw",22,"ne",83,"n" converted from azimuth 131 to pitch NE 83
71,"n",74,"w",70,"n" s=sure
171,"w",26,"n",60,"n" s=sure
34,"se",83,"sw",70,"n" large fault, p= (?)
11,"e",80,"n",80,"n"
26,"e",82,"n",70,"n"
31,"e",86,"n",45,"n"
31,"nw",84,"sw",70,"n" p=!
61,"n",55,"sw",58,"n"
36,"nw",78,"sw",80,"n"
156,"w",55,"s",90,"n"
136,"sw",55,"nw",75,"n"
26,"e",80,"s",68,"n"
36,"nw",58,"sw",75,"n"
66,"se",86,"sw",70,"n"
18,"w",68,"n",80,"n"
116,"ne",90,"se",25,"s" p=(?)
86,"n",8 Karroo bedding

station 28, inversion quality good but direction not tightly constrained
136,"w",85,"nw",48,"n"
121,"sw",50,"nw",72,"n"
151,"e",70,"se",90,"n"
91,"s",45,"w",49,"n" striation azimuth 45 converted to pitch west 49
111,"n",55,"w",75,"n" p=?, s=sure by 2.5 m separation
81,"s",70,"e",80 p=?, no sense determined

station 29, inversion quality excellent
111,"n",56,"nw",50,"n" s=sure
36,"nw",62,"ne",75,"n" p=!, s=prob
46,"nw",80,"ne",90,"n"
56,"nw",86,"ne",75,"n"
106,"n",52,"nw",47,"n"
61,"nw",75,"ne",75,"n"
61,"s",55,"w",82,"n"
54,"se",45,"ne",71,"n" p=!, s=clear
111,"n",35,"w",33,"n" s=sure, converted from azimuth 141 to pitch W33
91,"n",70,"w",80,"n" p=(?)
46,"nw",56,"ne",76,"n" s=sure
11,"w",80,"n",73,"n" s=sure
58,"nw",72,"ne",76,"n"
66,"s",66,"ne",37,"n"
94,"n",33,"e",88,"n" p=!, converted from azimuth 06 to pitch E88
81,"n",31,"e",85,"n"
136,"sw",84,"se",30,"s" s=clear, two sets striations, older
136,"sw",84,"nw",35,"d" s=clear, same fault, younger
111,"n",84,"w",30,"s" s=app
126,"sw",80,"se",27,"s" s=prob, two sets striations, older
126,"sw",80,"nw",45,"d" s=prob, same fault, younger
26,"nw",82,"sw",20,"d" s=?
21,"se",70,"n",45 no sense determined

station 30, not in figure 2 since only 2 measures
38,"nw",90,"ne",50,"d"
56,"nw",65,"sw",5,"d" s=sure

station 31, inversion quality good
90,"n",70,"w",55,"n" p=?, s=sure by 20 cm separation
80,"n",86,"w",65,"n" p=?, s=sure by 5 cm separation
10,"w",77,"s",45,"n" p=(?), s=app
30,"se",78,"n",30,"n" p=?, s=app
120,"n",40,"nw",32,"n" azimuth 145 converted to pitch NW32

100,"n",20,"w",65,"n" azimuth 165 converted to pitch W65
105,"n",30,"w",35,"n" azimuth 135 converted to pitch W35
25,"e",70,"s",75,"n" s=prob
135,"ne",72,"se",90,"n" p=!, s=sure
125,"ne",57,"nw",65,"n" p=!, s=sure
95,"n",49,"w",60,"n" p=!, s=sure
75,"n",54,"e",90,"n" p=!, s=sure
50,"nw",86,"ne",50,"d" p=?, s=app
55,"se",87,"ne",80,"n" p=(?), s=sure
85,"n",73,"e",85,"n" p=!, two sets striations, younger
85,"n",73,"w",10,"s" p=(?), same faults, older
15,"w",68,"n",73,"n" p=!, s=sure

station 32, not in figure 2 since only 3 measurements
60,"nw",80,"sw",45,"n"
45,"nw",62,"sw",50,"n" p=?, s=app
50,"nw",80,"sw",80,"n"

station 33, inversion quality very good
111,"s",65,"w",45,"d" s=app
06,"e",80,"s",75,"n" s=sure, 2 sets striations, no relative age
06,"e",80,"n",80,"n" s=sure, same fault
116,"s",72,"se",45,"n" p=!, s=app
116,"n",80,"w",65,"n" p=!, s=sure
116,"n",62,"w",60,"n" p=!, s=sure
126,"ne",67,"w",85,"n"
9,"w",77,"ne",40,"n"
46,"s",50,"sw",35,"d" s=app
161,"w",70,"s",36,"r" s=sure
116,"s",82,"nw",66,"n" p=!, s=app
26,"nw",64,"n",80,"n" p=(?)
121,"sw",75,"se",15,"s" p=(?)

station 34, inversion quality very good, measurements in different outcrops a couple km apart (will give detail when I do locations later).
111,"n",82,"e",0,"s" s=sure
01,"e",72,"s",82,"n" s=sure
101,"n",65,"w",80,"n" p=!, s=sure
58,"se",53,"ne",48,"n" s=app
54,"se",63,"ne",55,"n" s=app
56,"nw",90,"ne",62,"d"
01,"w",88,"n",5,"d" p=!, s=app
26,"nw",90,"ne",12,"d" s=app

61,"se",84,"sw",70,"r" s=prob
74,"s",73,"e",73,"n" p=!, s=sure
56,"se",82,"sw",25,"s" s=app
141,"sw",85,"se",40,"d"
166,"e",80,"s",38,"d" s=sure
21,"w",15,"s",17,"d" clear by separation, azimuth 36 converted to pitch S17

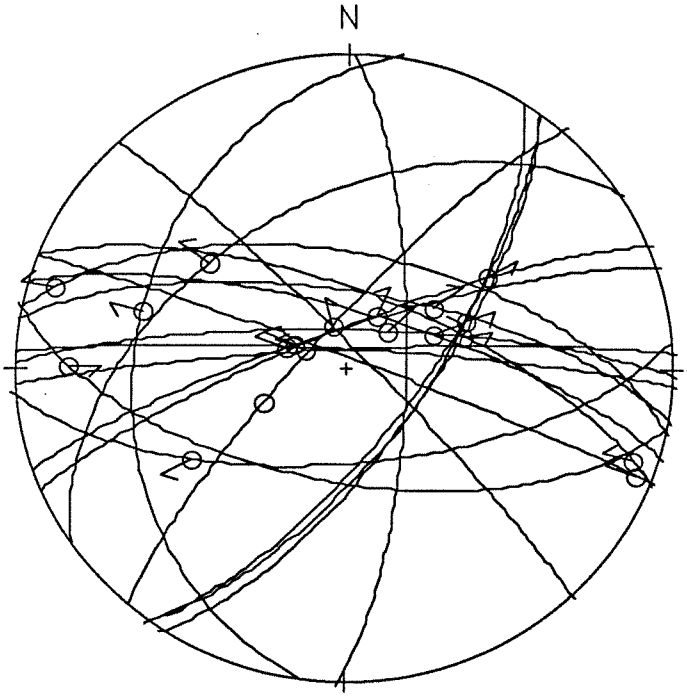
station 35, solution quality very good
34,"nw",79,"sw",15,"d" s=prob
29,"e",72,"n",55,"n" p=?, s=app
64,"n",90,"e",52,"s"
139,"ne",53,"se",52,"n"
94,"n",55,"w",45,"n" p=!

station 36, inversion quality good
154,"e",80,"s",75,"n" p=!, s=sure
114,"ne",64,"nw",70,"n" s=prob
89,"n",70,"w",70,"n"
59,"n",78,"w",80,"n" p=?, s=app
54,"se",50,"ne",10,"d" s=app
64,"n",78,"w",72,"n" s=app
59,"nw",50,"ne",90,"n" p=(?), s=sure
79,"n",48,"e",35,"d" p=!, s=sure
149,"w",72,"n",40,"d" p=?, s=app
149,"w",60,"n",75,"n" p=?
54,"nw",77,"sw",5,"s" s=prob
164,"w",72,"n",80,"n" p=!
164,"w",66,"n",65,"n" p=!
64,"n",65,"e",80,"n" p=!

mwextra: single isolated measurements not given station numbers. All but the first one were used in the whole Malawi (N=350) inversion and figure 5.
129,"sw",73,"se",5,"s" p=?, s=prob
74,"n",53,"w",80,"n"
129,"ne",80,"se",90,"n"
114,"s",77,"w",30,"s" s=app
09,"w",84,"n",80,"n"

Station 1; 15° 20.69' S, 35° 14.28' E along dirt road.
Station 2; 15° 57.36' S, 34° 54.32' E in bend of main paved road.
Station 3; 15° 6.47' S, 35° 22.46' E single measure on dirt road.
Station 4; 15° 2.76' S, 35° 24.41' E on road at low but distinct Makongwa scarp
Station 5a; 15° 10.60' S; 35° 17.40 E big roadcut near Kasupe, main road
Station 5b; 15° 10.52' S; 35° 19.26' E main road
Station 6; 14° 26.07' S, 35° 21.49 E on road measuring up and SE from fault.
Station 7; 14° 25.59' S; 34° 33' E where paved road crosses distinct scarp
Station 8a measures 1 and 2; 14° 42.83' S, 34° 47.06' odometer=121.4 km
Station 8b measure 3; 14° 44.99' S, 34° 47.84 E-8a and 8b both where streams cut distinct low scarp west of paved road. odometer=126-"T" intersection at Bilila=136.0
Station 9; 13° 13.27' S, 34° 18.46' E, measures are close to base of distinct west facing scarp where main road crosses it (road cut)- more measures could be made further away from base of scarp.
Station 10; 12° 58.24' S, 34° 13.05' E on dirt road about 300 m SE of pond
Station 11; 12° 57.01' S, 34° 16.08' E same dirt road as 10.
Station 12; 15° 57.88' S, 34° 54.07' E on main road- starts 1.3 km km south of station 2 and proceeds 1.4 km further south along road.
Station 13; 16° 1.99' S, 34° 51.34' E- on main road, starts at base of escarpment about 50 m above a barrier in road- proceeds a few hundred m uphill (to N).
Station 14; 16° 18.47' S, 35° 3.84' E-Chakanza-Muono Fault-in open area north of dirt road.
Station 15; 16° 5.90' S, 34° 39.91 ' E, measures 1-10 on small outcrop along road just before base of Mwanza scarp, 11-19 in stream bed a few m above where road crosses stream near the base of the scarp.
Station 16; 15° 52.67' S, 34° 24.02' E- measure 1 up a stream, measure 2 on cut of dirt road.
Station 17; 15° 37.59' S, 34° 34.29' E-hard rock outcrop on main(dirt) road 5 km east of Mwanza.
Station 18; 15° 2.84' S, 34° 48.48' E- in stream at Sikulamowa Fault just south of road.
Station 19; 14° 52.08' S, 34° 44.54' E, on main road 16.5 km east of Ntcheu Mobil station-roadcut with especially clear striations.
Station 20; 14° 47.30' S, 34° 35.64' E roadcut on main road.
Stations 21 and 22-single measures on Lillongwe-Salima road-by odometer Station 21 is at 744.5 or 6.5 km east of Mvera; 746.6 is railroad, 758.9 is Chitala Road, 760.7 is railroad, Station 22 is at a scarp at 763.2 km, 772.5 is a main intersection-Salima-Lillongwe Nkhotakhota.

Station 23; 13° 25.09' S, 34° 15.0' E, odometer=819.2 km=46.7 km north of intersection-good striations on roadcut-other roadcuts available to north, but no mapped faults here.
Station 24; 11° 46.12' S, 34° 11.93' E-at 205.4 km, Chinteche at 198.0, river at 205.9-at small quarry-quartzite-this is the middle of a large area of deep weathering-few outcrops and no striations in this region
Station 25; 11° 36.55' S, 34° 18.25' E, measures 1-5 about 500 m south of Nkhata Bay on dirt road, measures 6-18 reached by boat about 1 km to the south-quartzite outcrop.
Station 26; 11° 01.73' S, 33° 54.30' E, roadcut east of bridge on N side river.
Station 27; did not have a copy of the map on which we originally located stations 27, 28, and 34, and the new paved road is not on the geologic map. Station 27=10° 43' S, 34° 9' E roadcut on main new road 7.8 km above the Chiweta intersection.
Station 28; 10° 32.2' S, 34° 12.5' E- roadcut 8.7 km north of intersection with Livingstonia Road.
Station 29; 10° 35.66' S, 34° 08.57' E, location in middle of switchbacks on escarpment- measured from switchback 1 (top) through switchback 11
Station 30; measure 1 on coast 10° 25.80' S, 34° 15.37' E. Measure 2 is in a quarry about 1 km to SE.
Station 31; 4 locations along dirt road measure 1 and 2, odometer=960.3 km, bridge=960.7, measures 3-12=961.7 km, 13-15=962.4 km, narrowest point in valley = 963.1, measure 16=963.5 Zaninge grocery=964.0, bridge=965.5
1,2=9° 57.21' S, 33° 47.83 E; 3-12=9° 56.55' S, 33° 47.41' E; 13-15=9° 56.08' S, 33° 47.24' E; 16=9° 55.84' S, 33° 46.78' E
Station 32; 9° 54.84' S, 33° 41.12' E, at high point in road and 983.0 km
Station 33; 9° 43.89' S, 33° 53.11' E, road to Tanzania, measures 1-3 at 063.1 km, measures 4-12 at 64.5 km (lat-long)(heading SW), Kaporo intersection and 90° bend in road at 067.8 km, immigration control at 070.8 km
Station 34 is at several outcrops along 6 km of new road along the South Rukuru river-travelling to south:
Measures 1-3 at 223.7 km; 4-5 at 224.8; bridge over river at 225.1; 6-11 at 227.3; 12-14 at 229.5 km, intersection Muhuju-Karonga-Mzuzu at 244.0
Station 35; 1-3 at 11° 0.88' S, 33° 59.65' E; 4 and 5 in stream at 11° 0.35' S, 34° 01.75' E.-along dirt road to Mpompa
Station 36; 12° 28.43' S, 33° 31.44' E, about 1 km south of intersection with Mabulabo Road on the main paved road- at a roadcut of weathered rock at base of escarpment.



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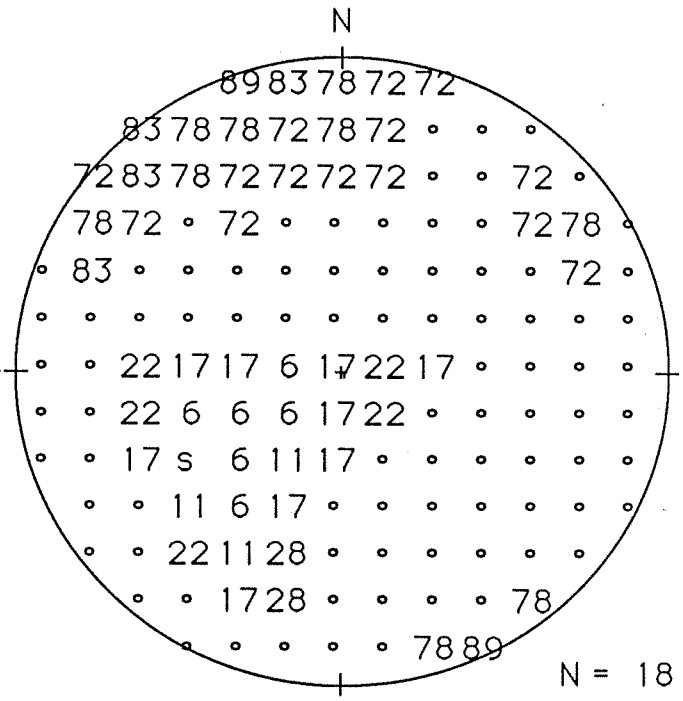

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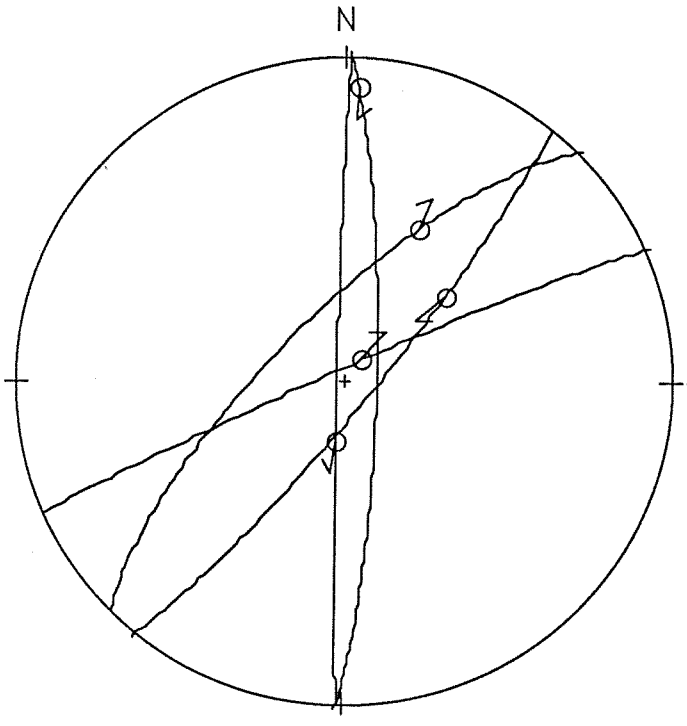

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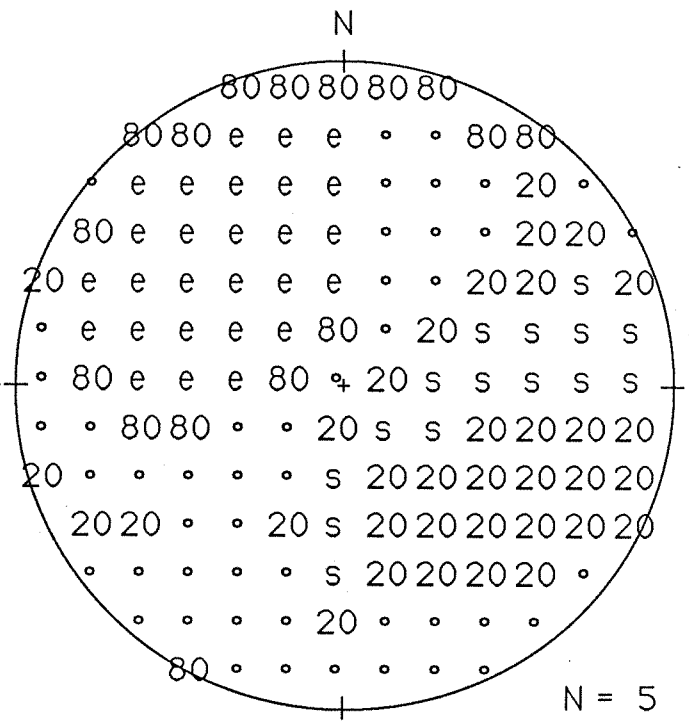

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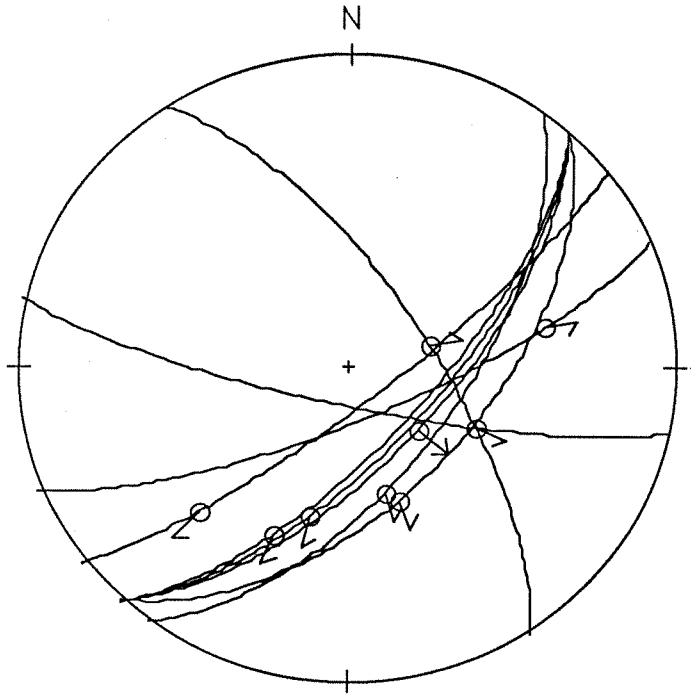

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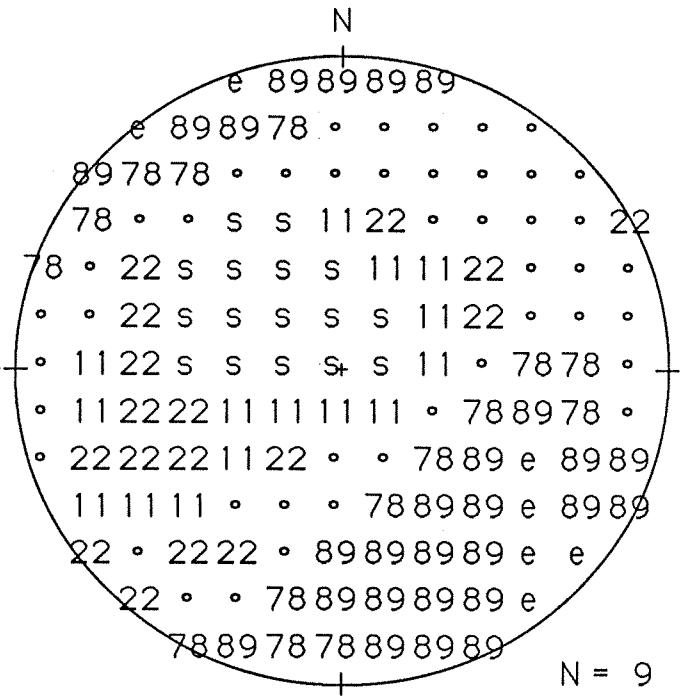

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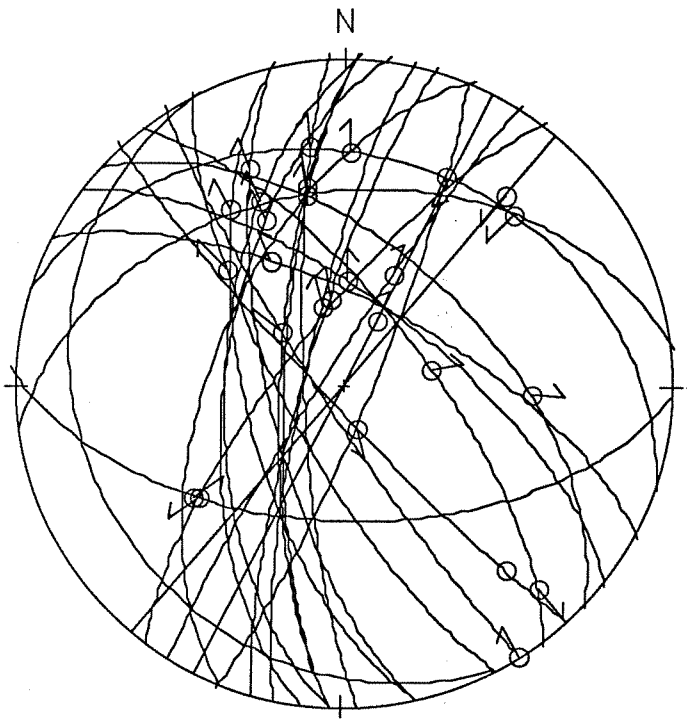

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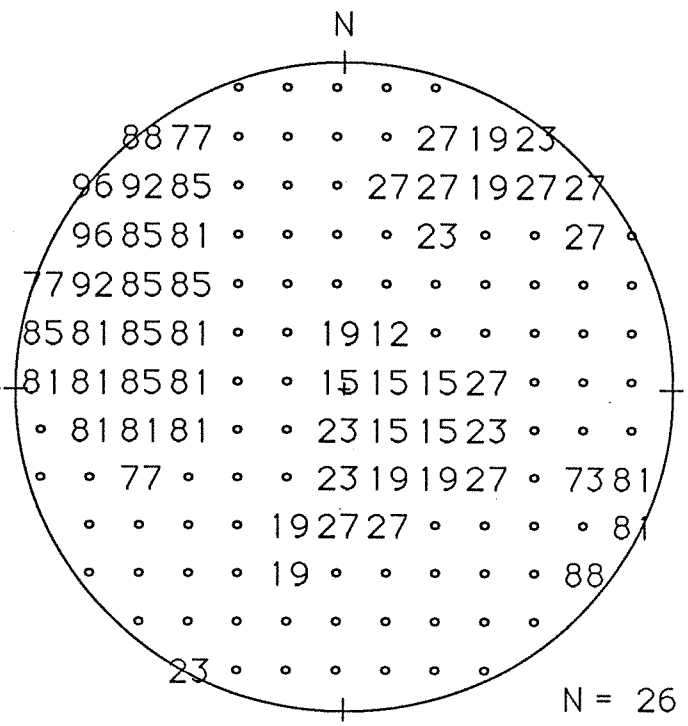

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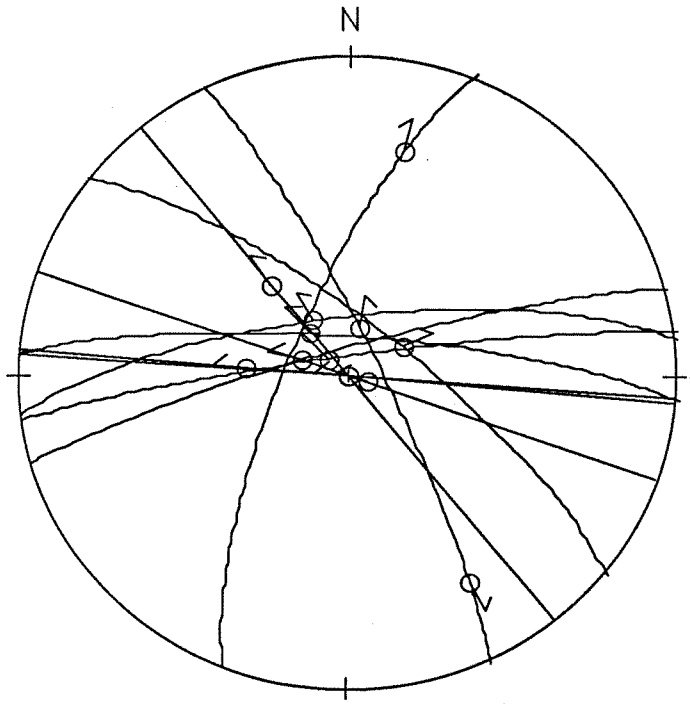

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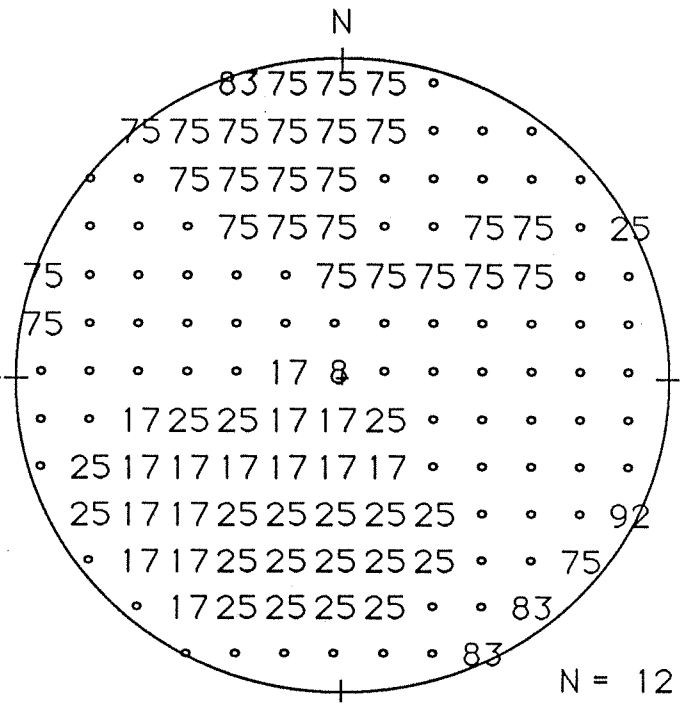

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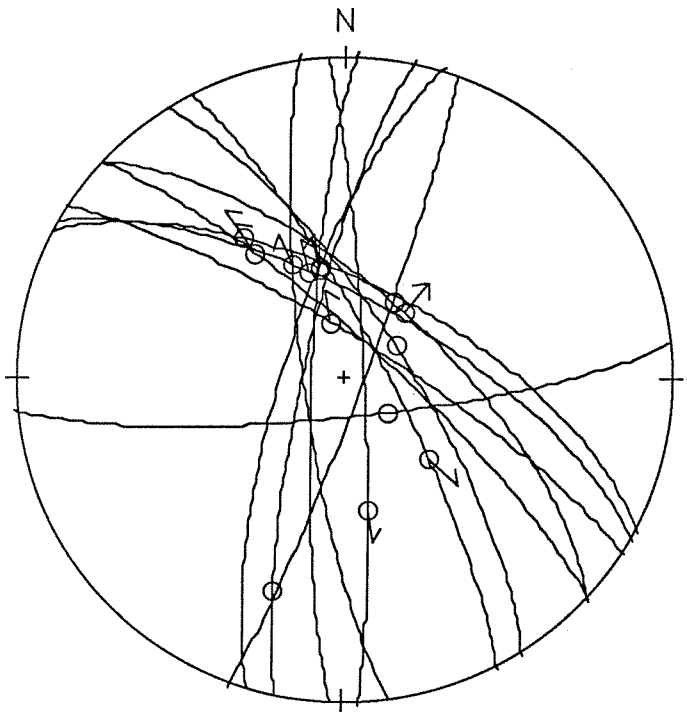

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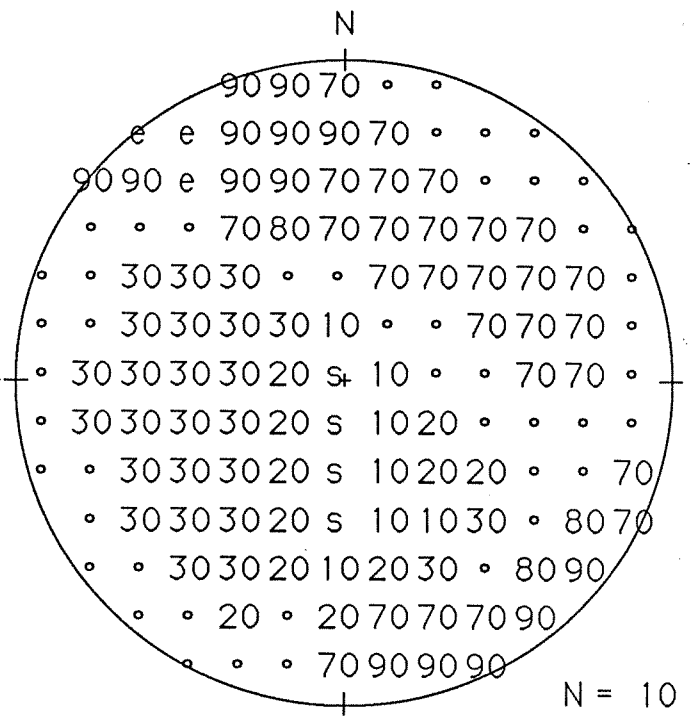

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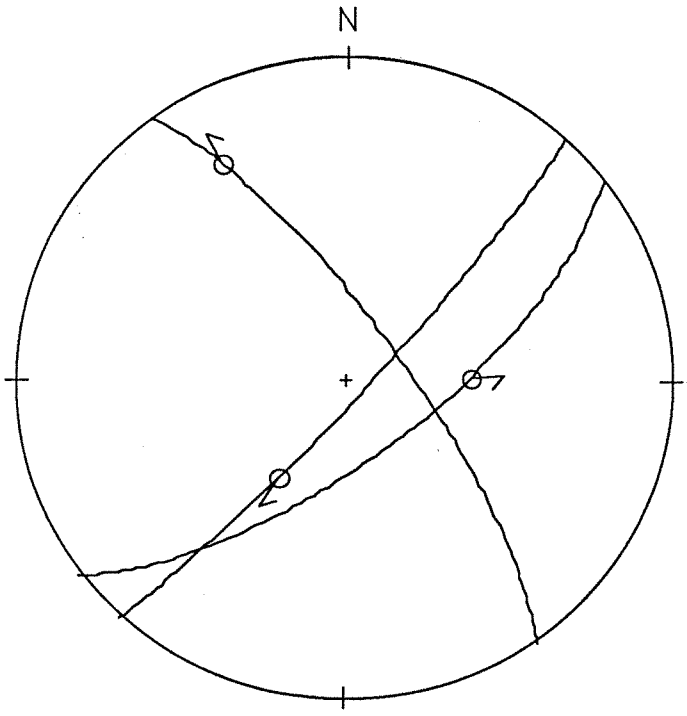

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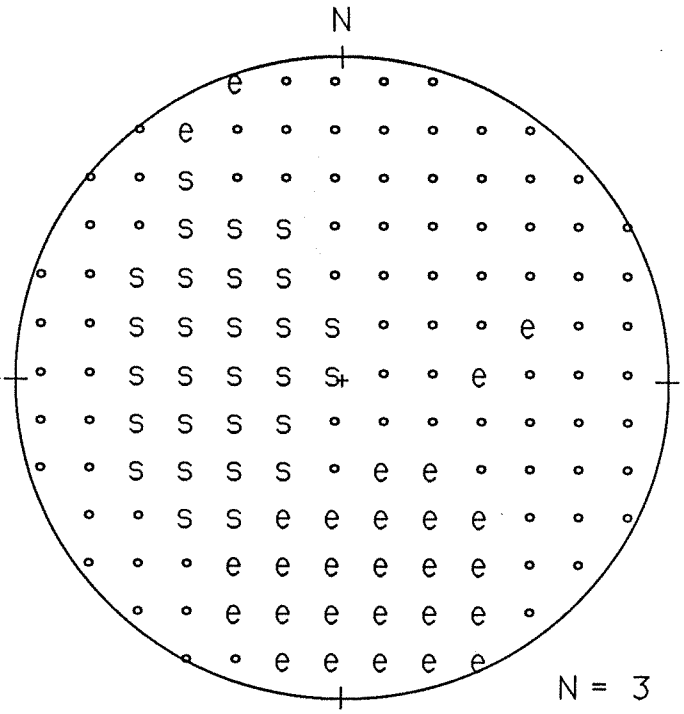

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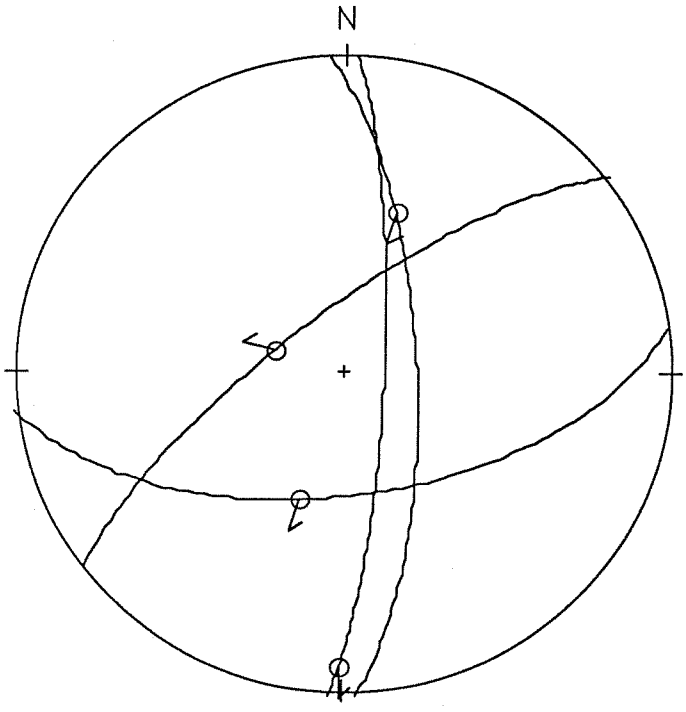

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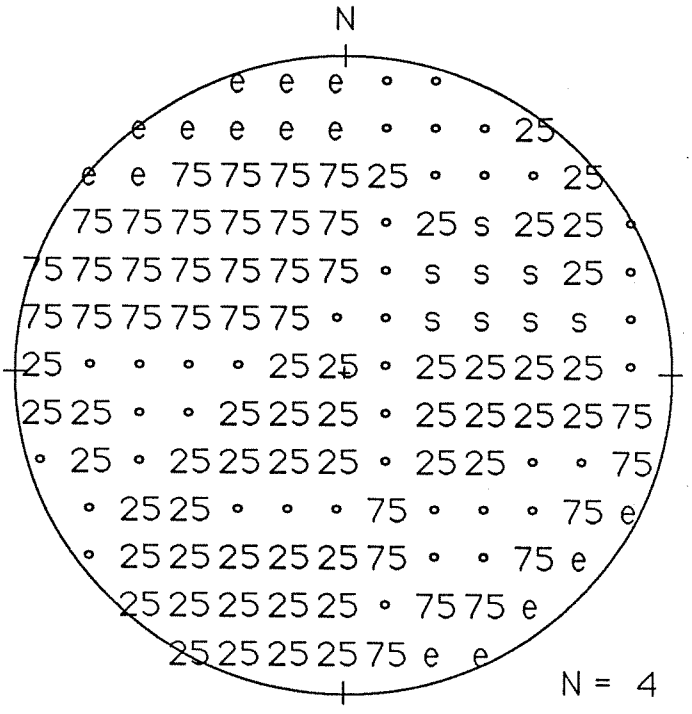

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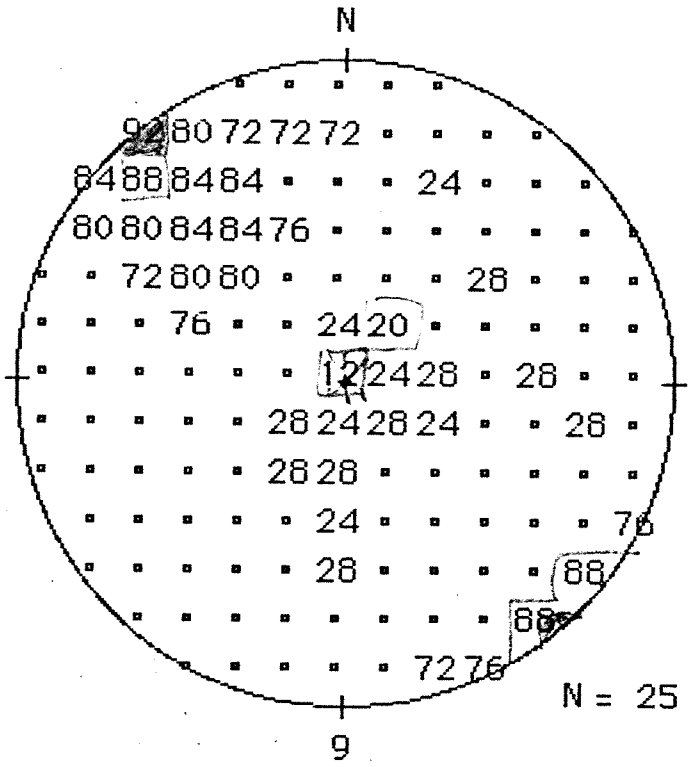
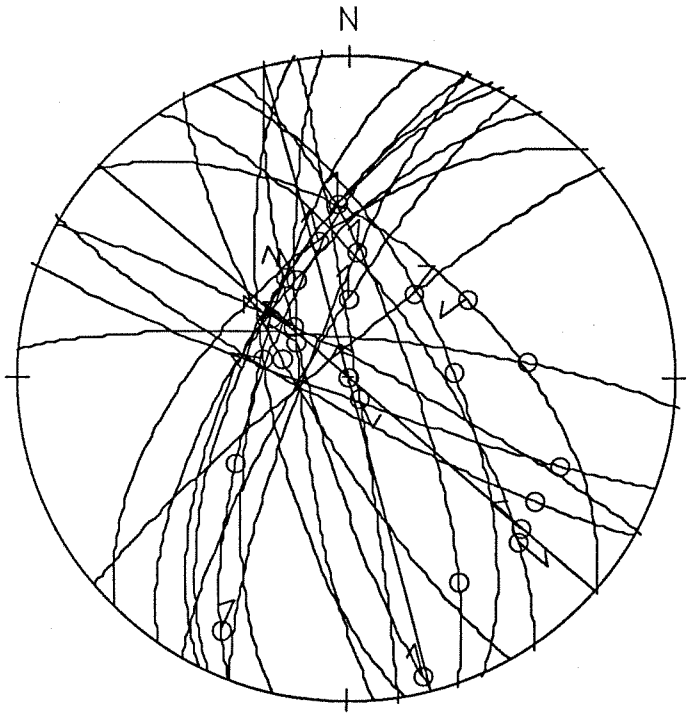
7 faults for which sense was not determined assumed to be normal





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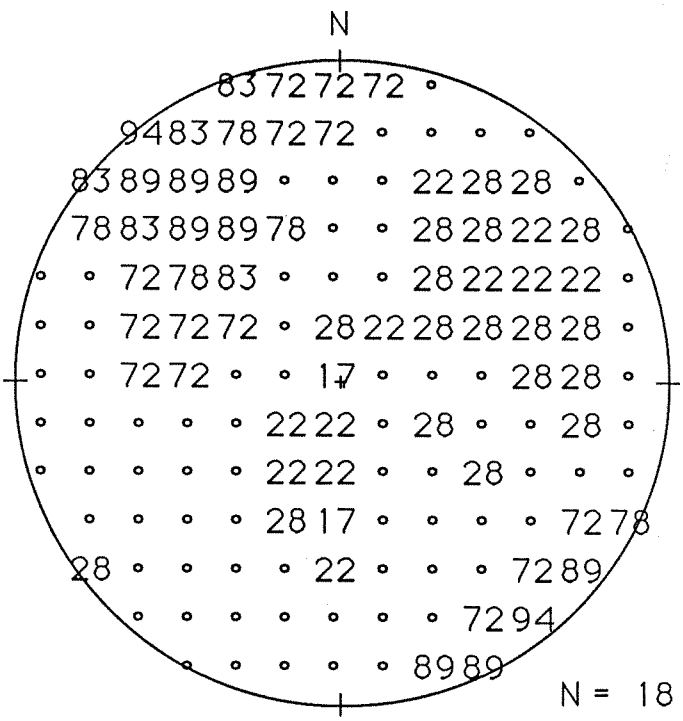

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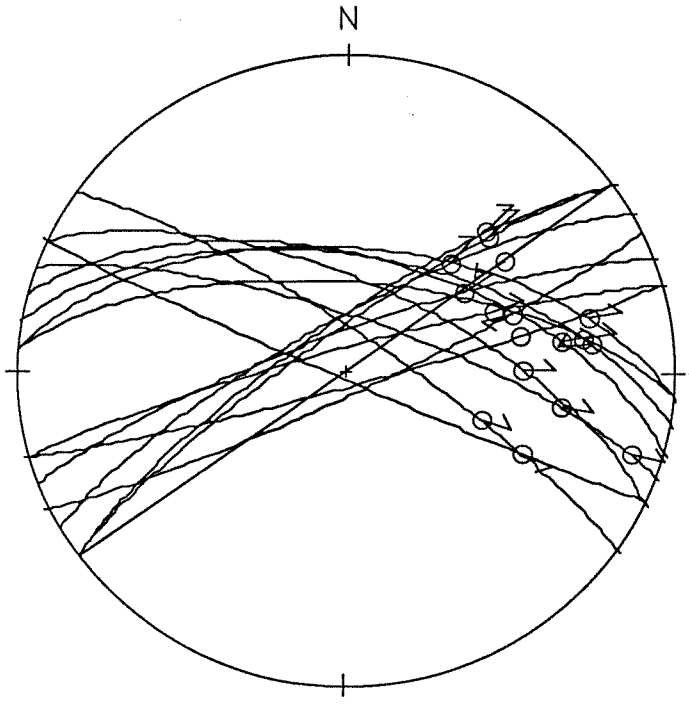

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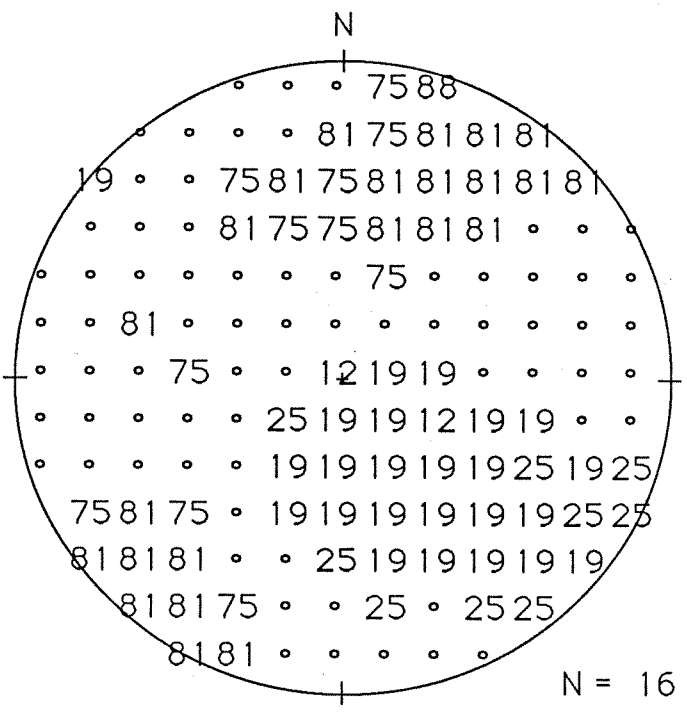

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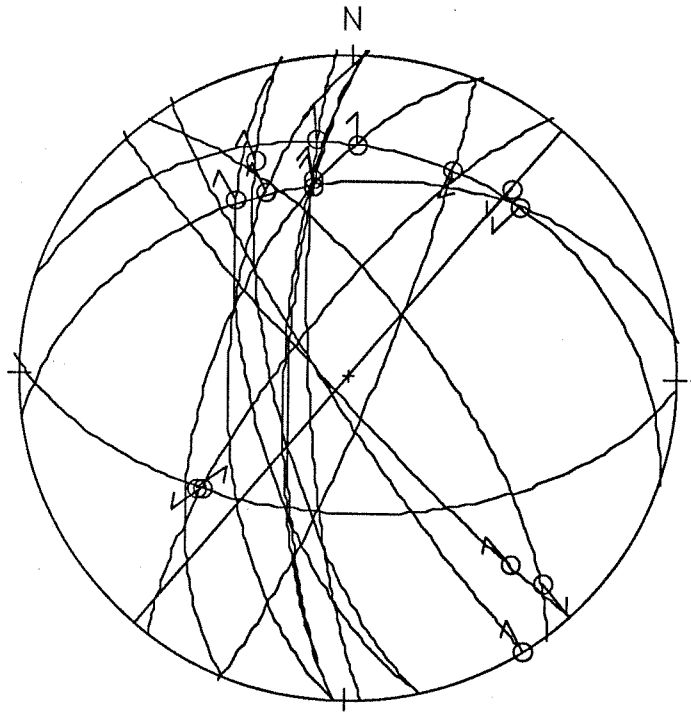

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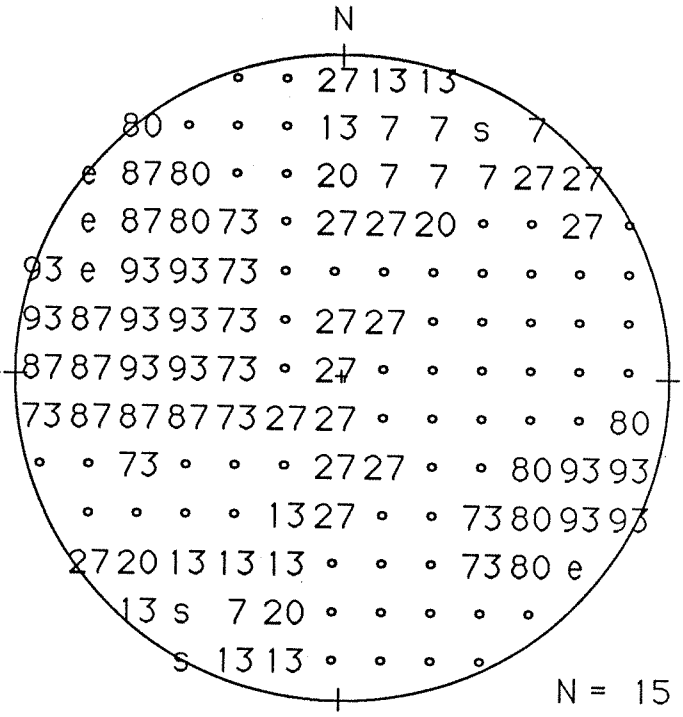

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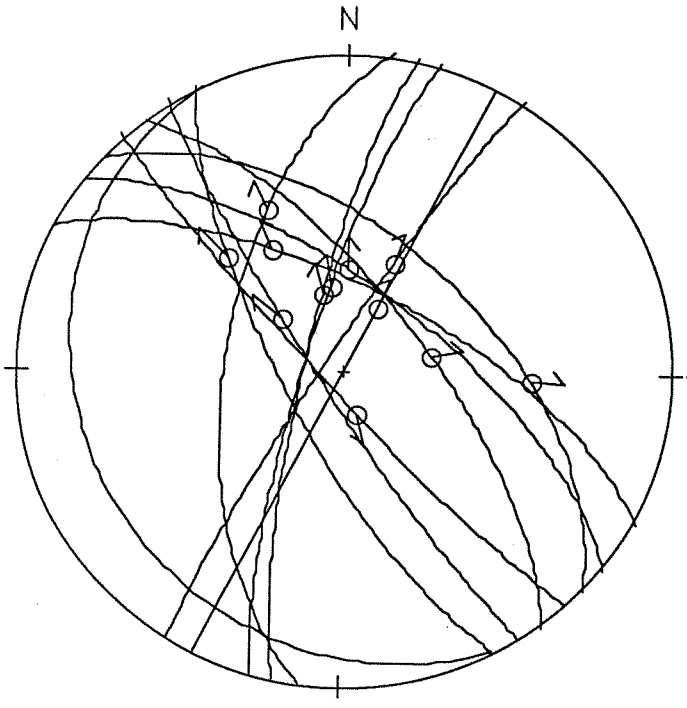

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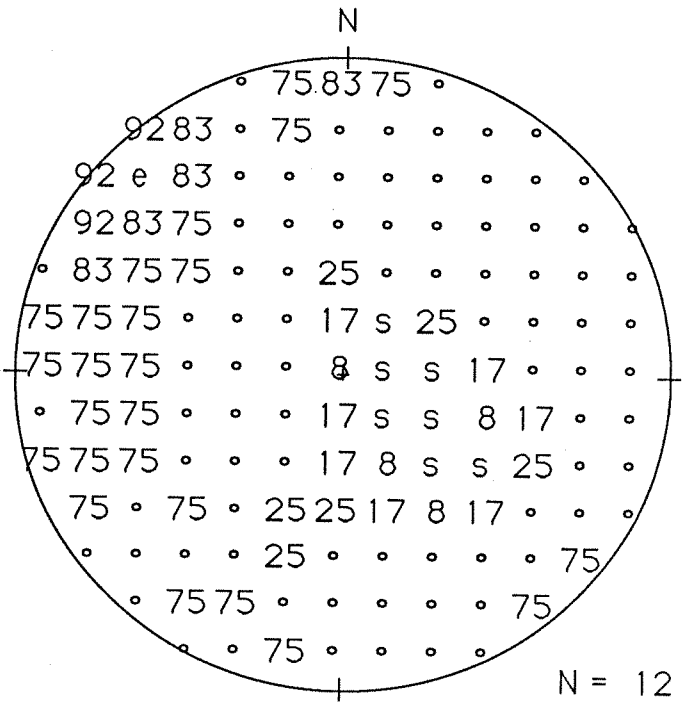

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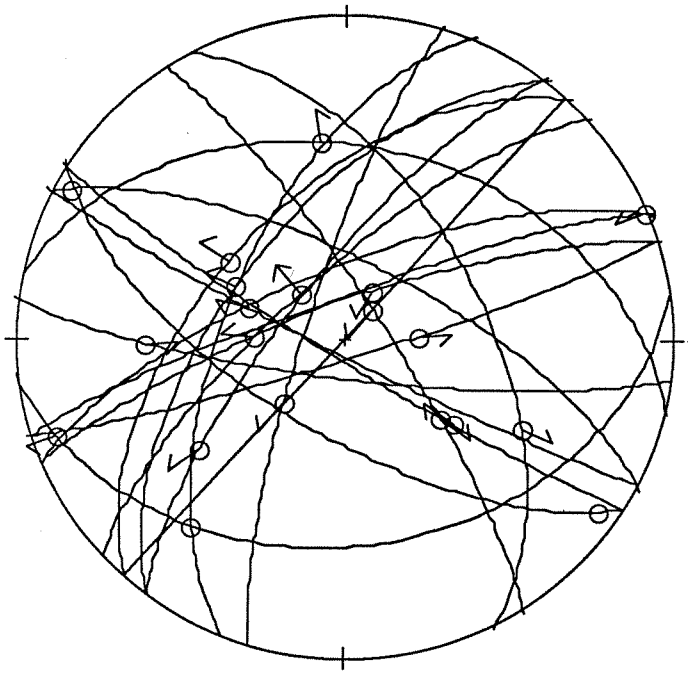

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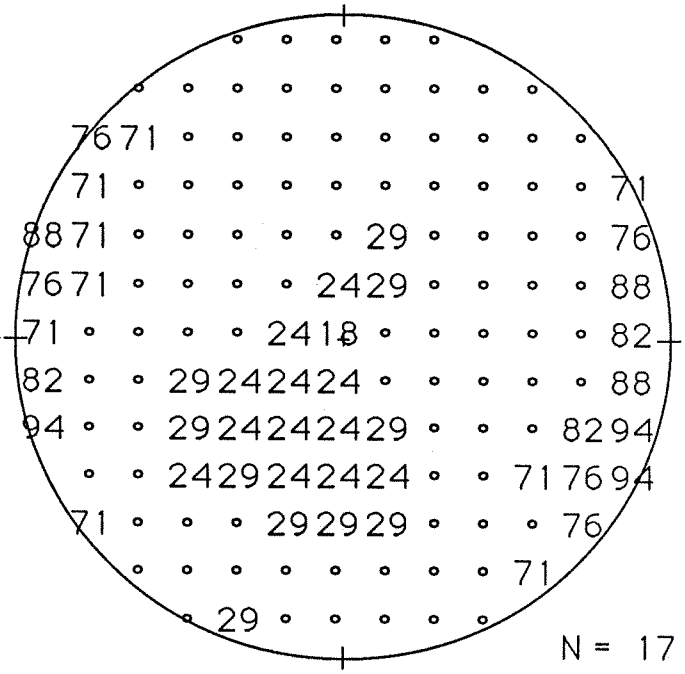

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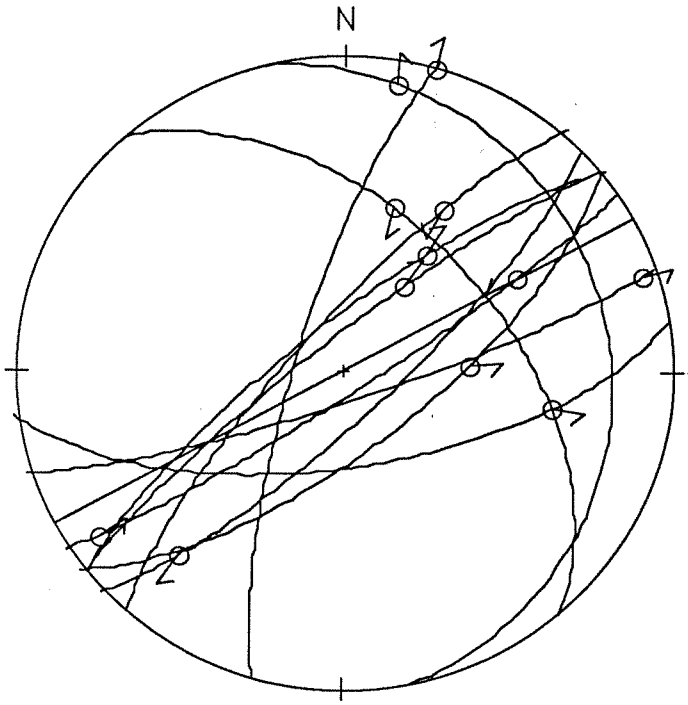

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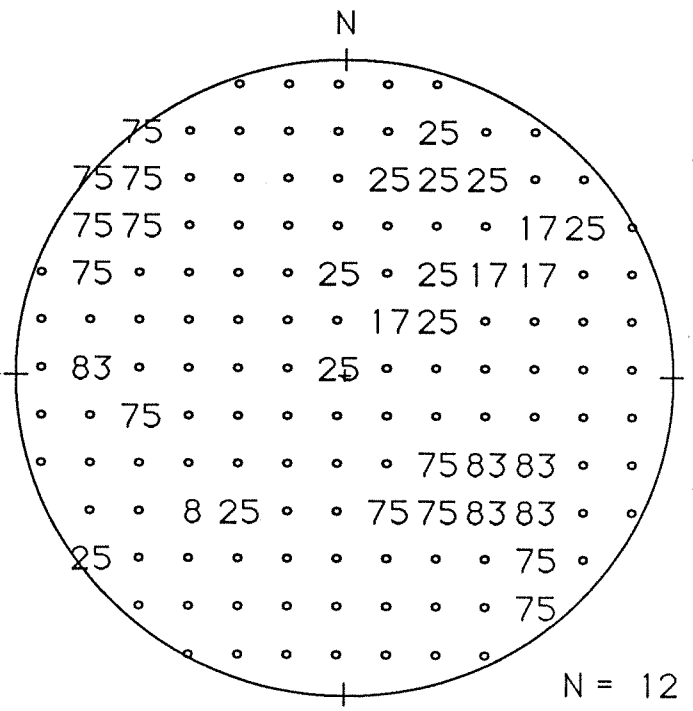

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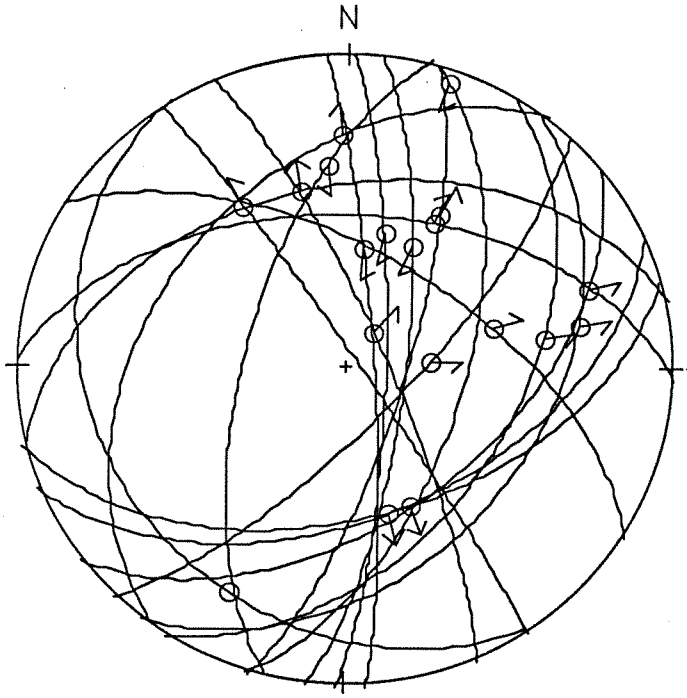
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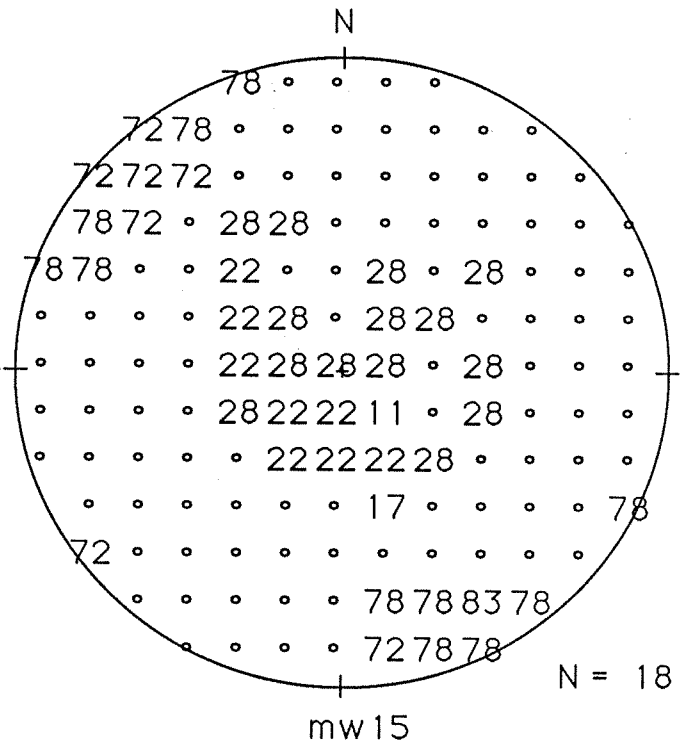
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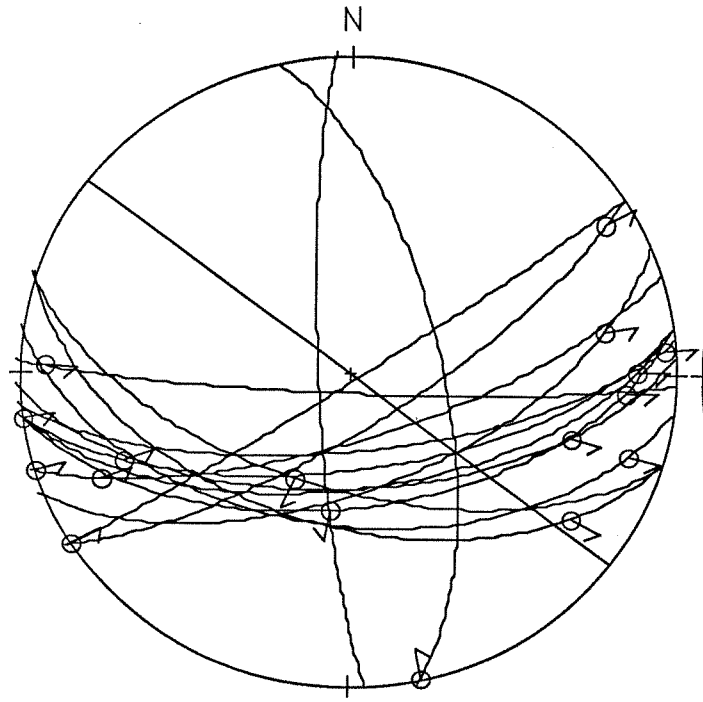

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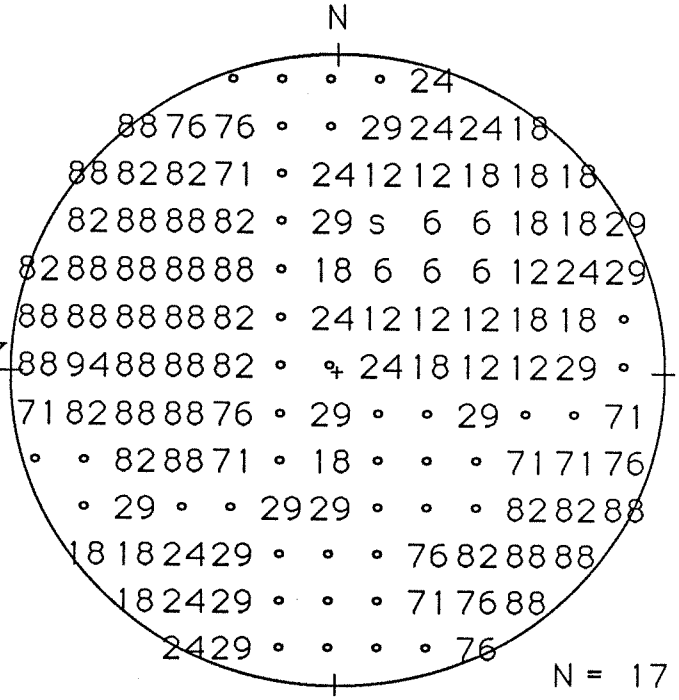

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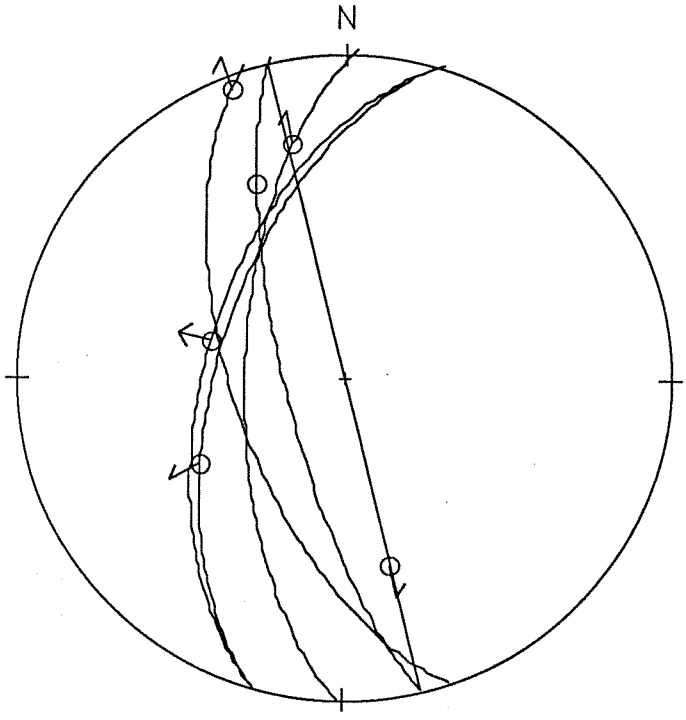

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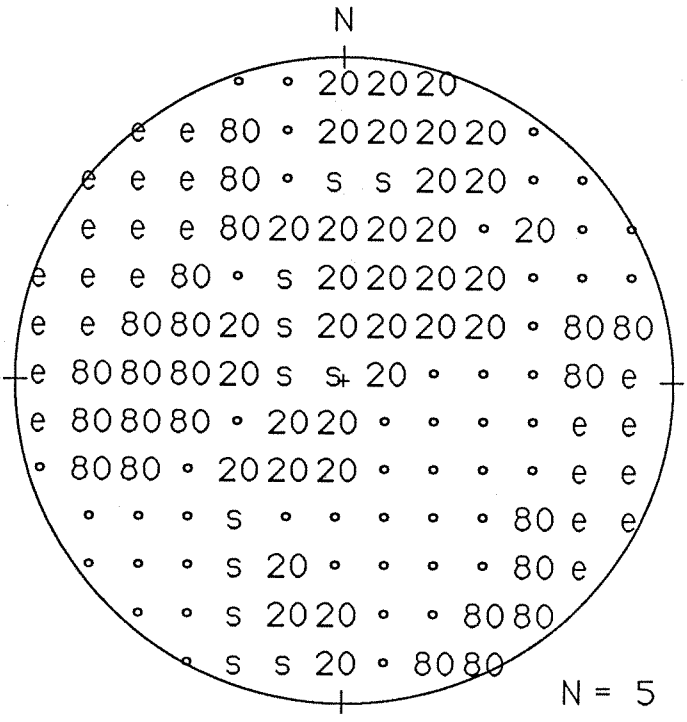

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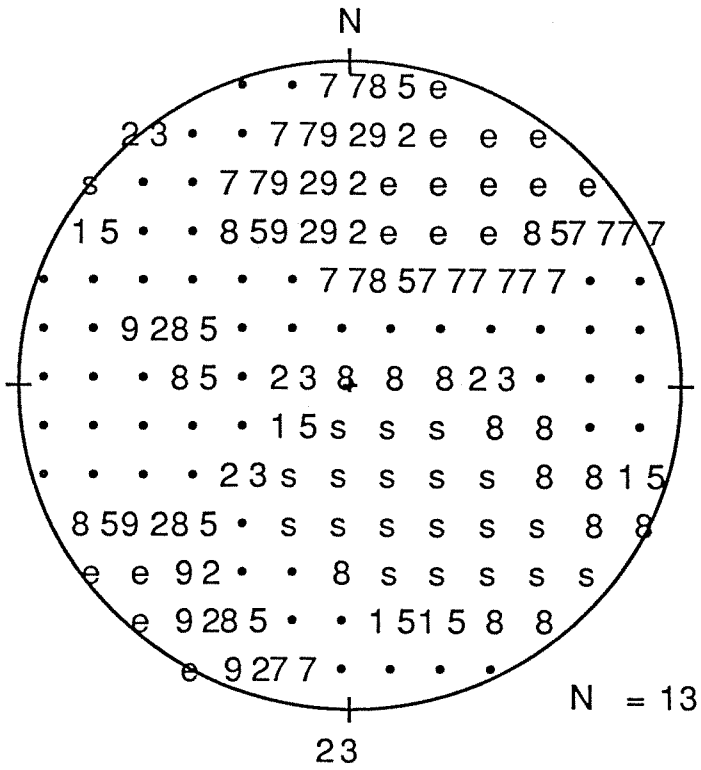

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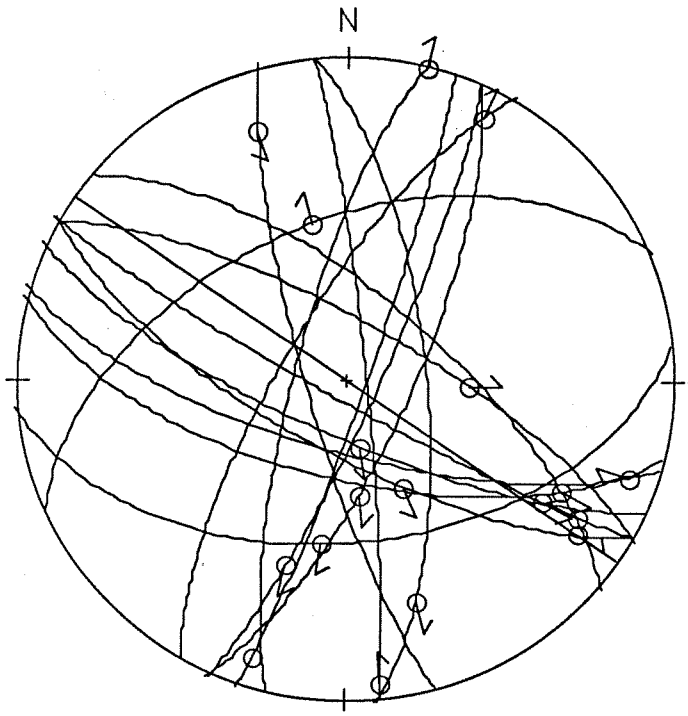

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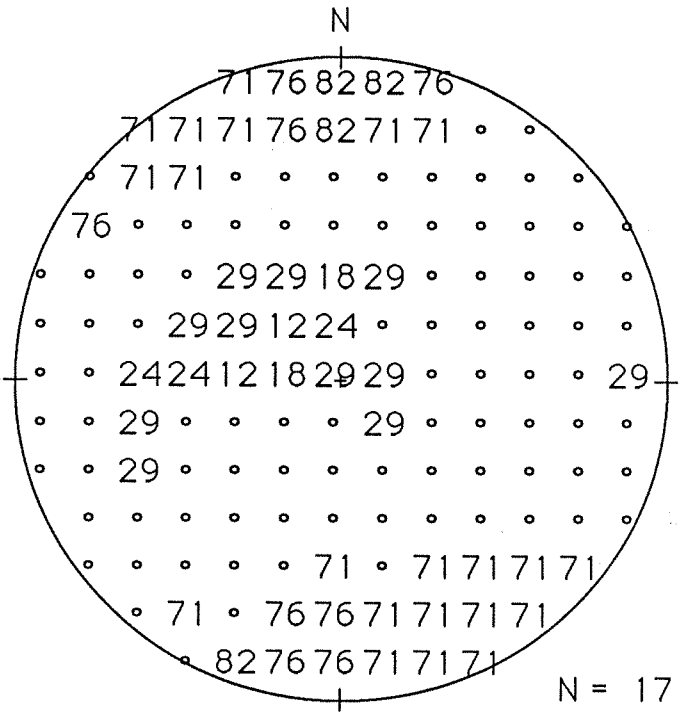

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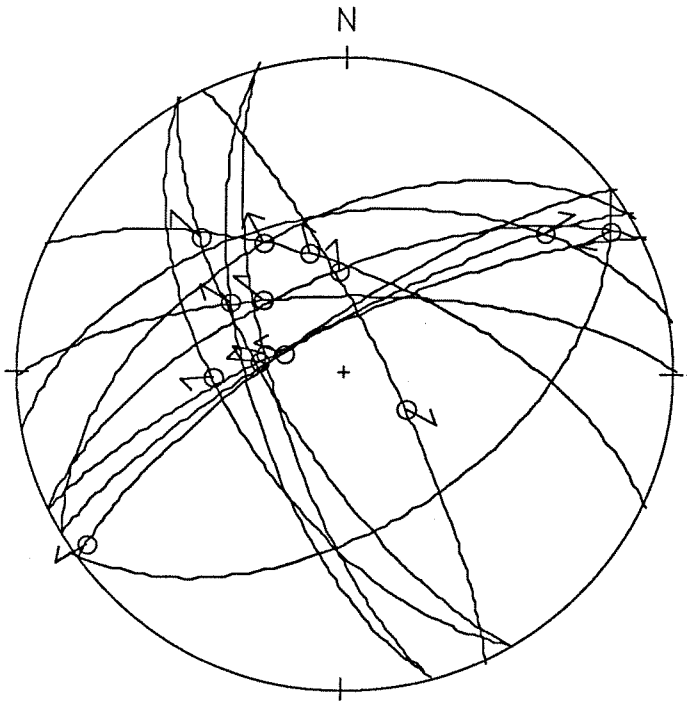

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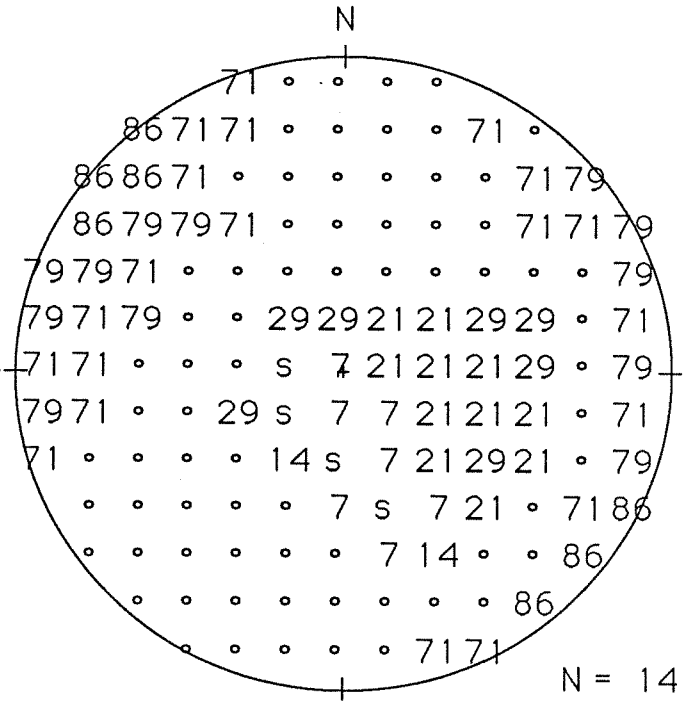

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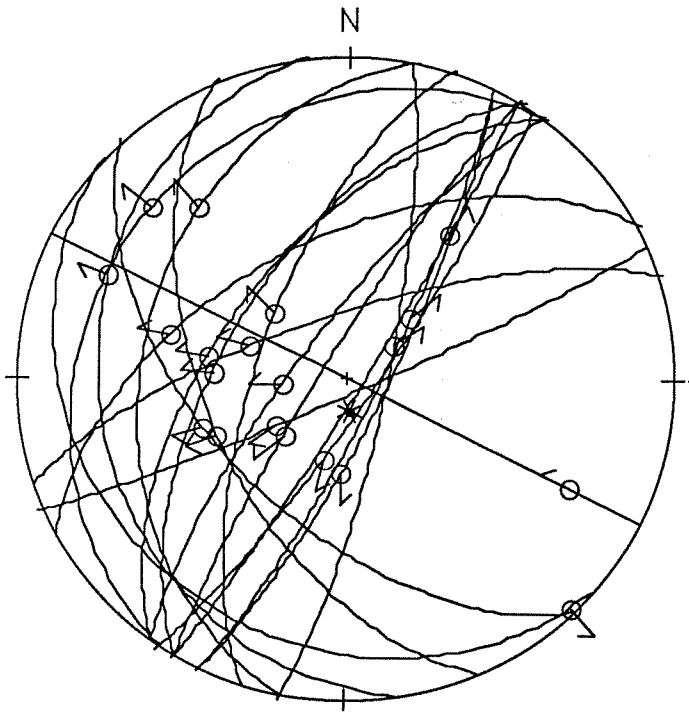

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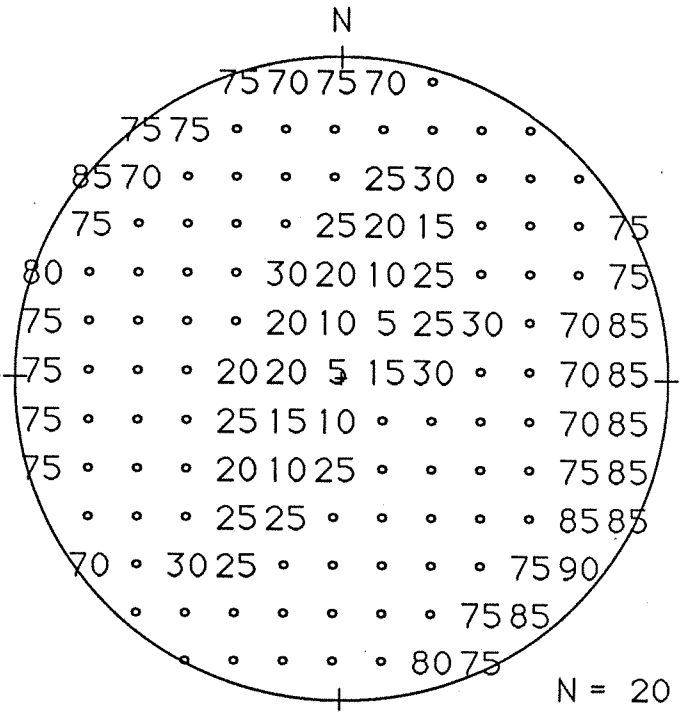

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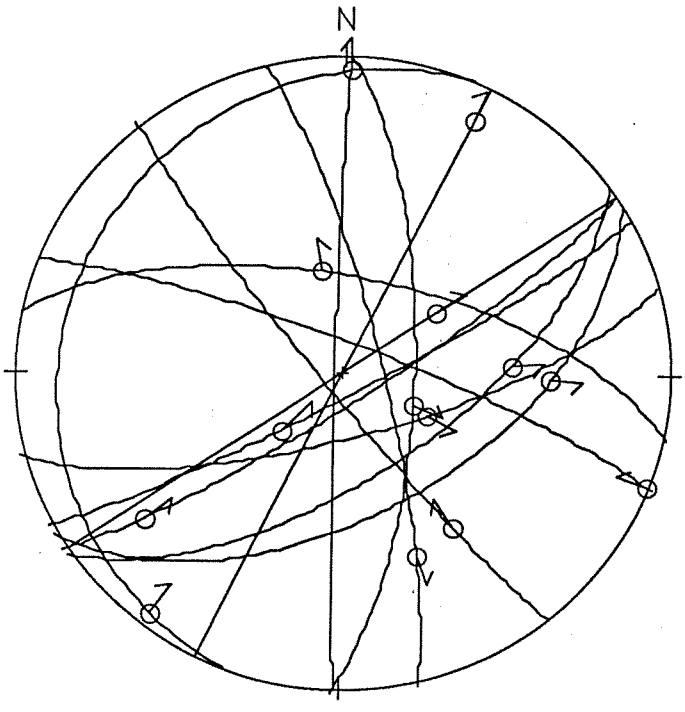

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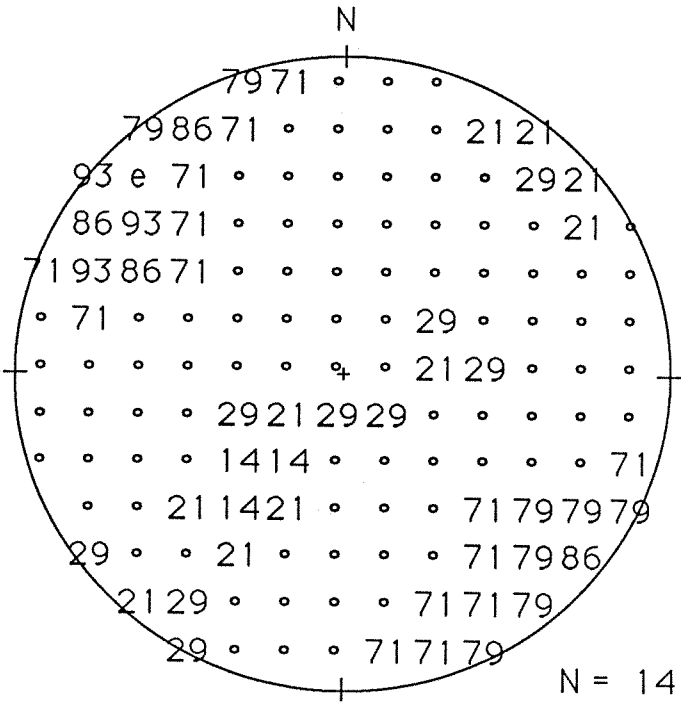

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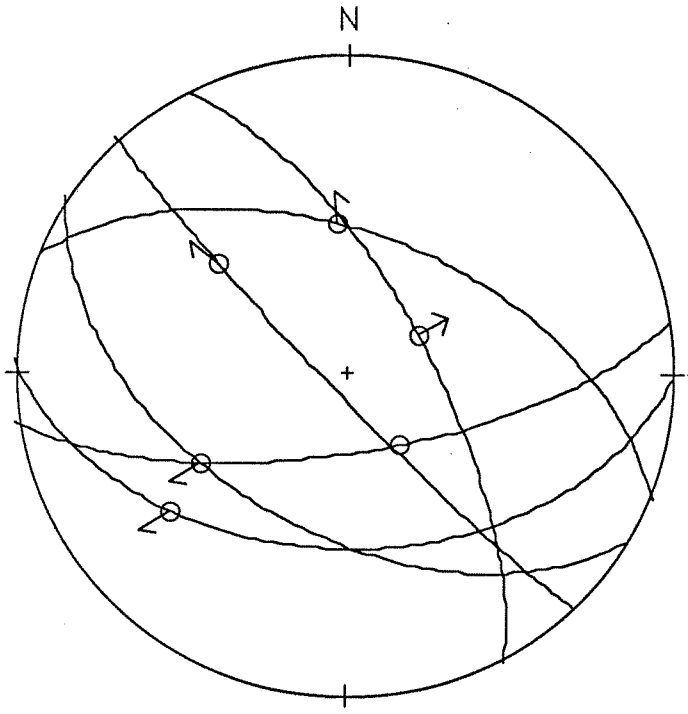

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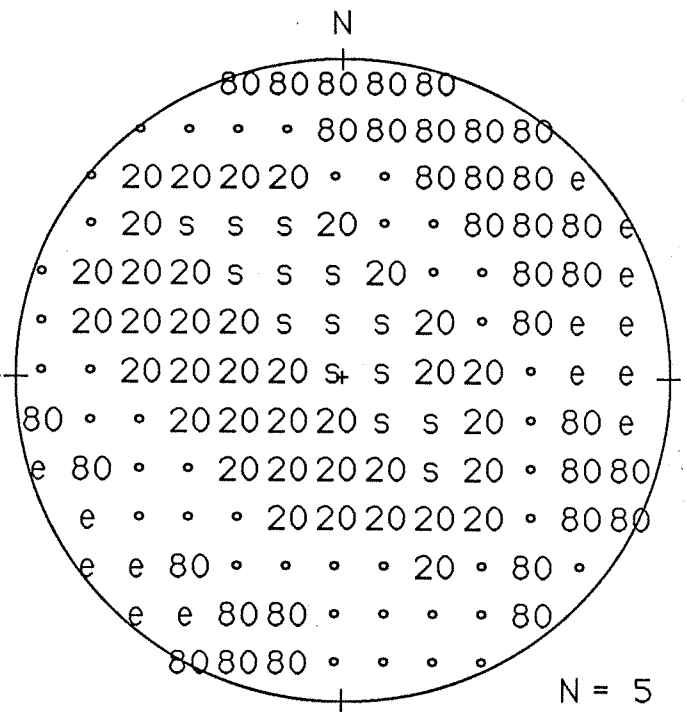

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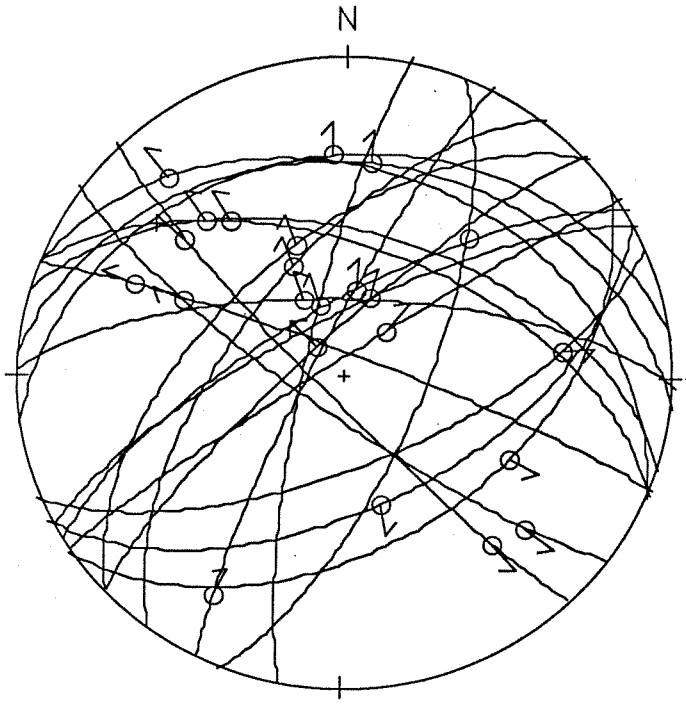

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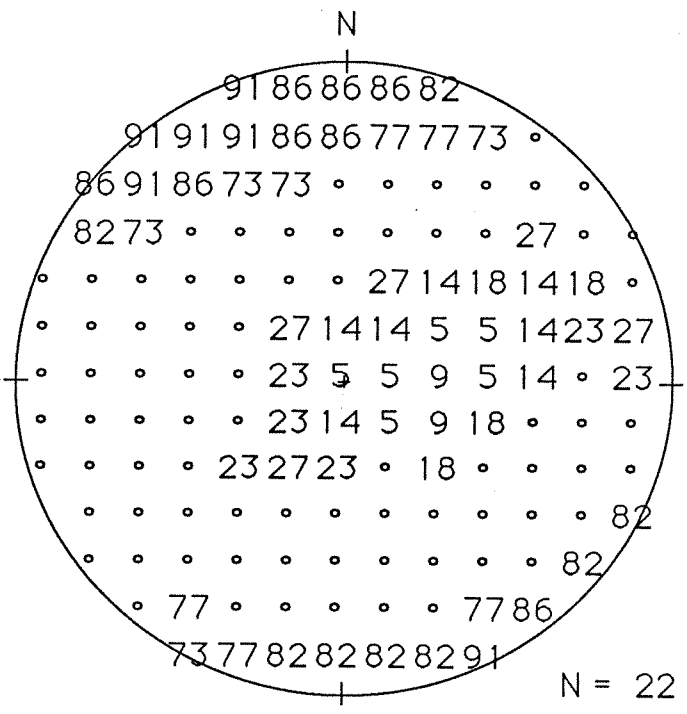

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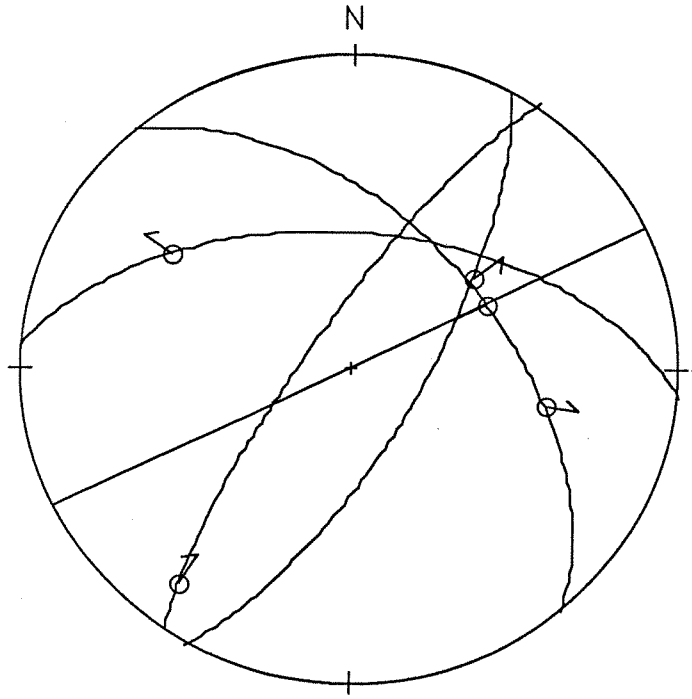

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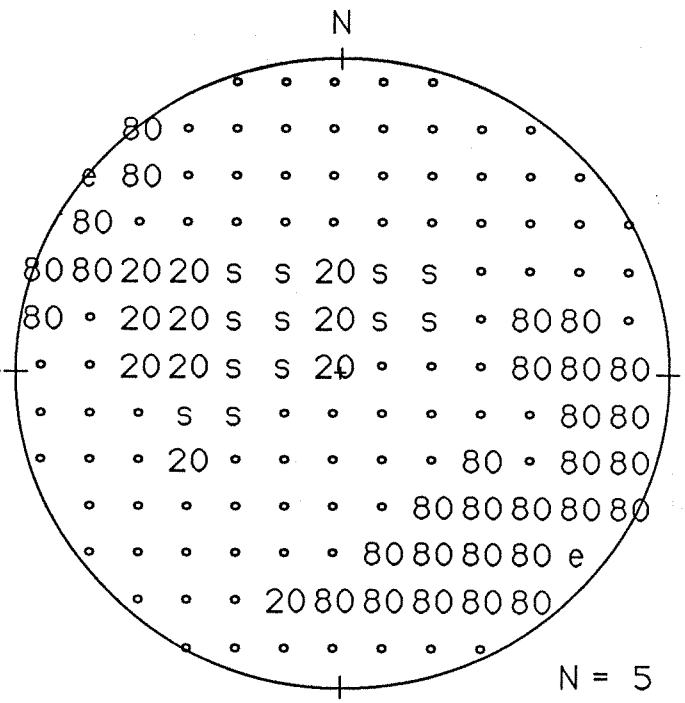

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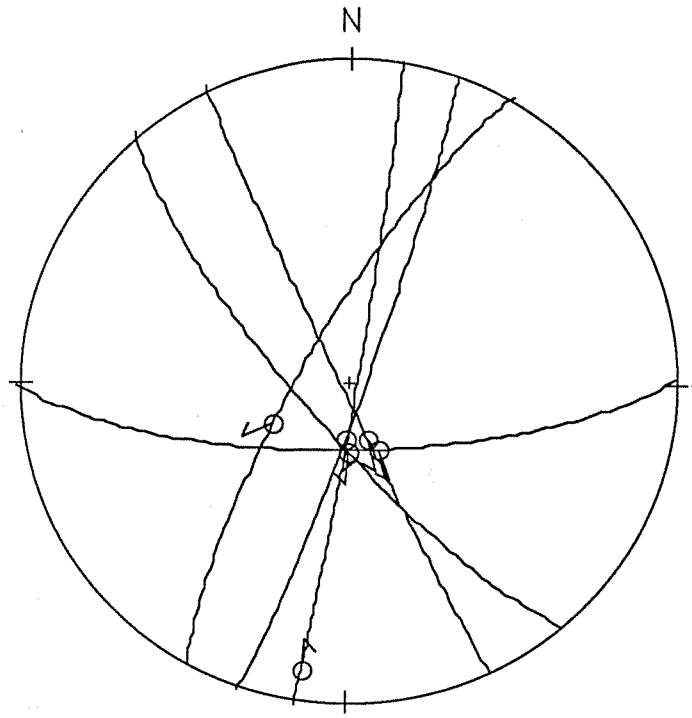

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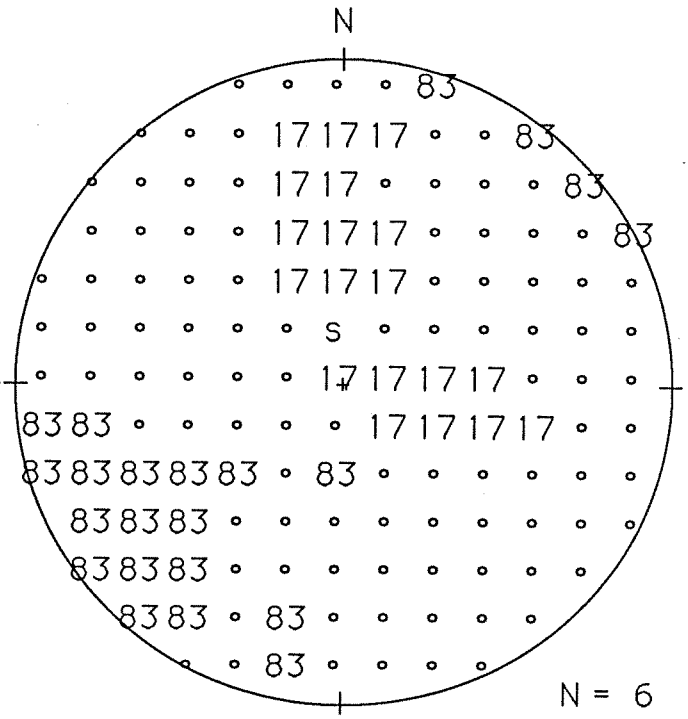

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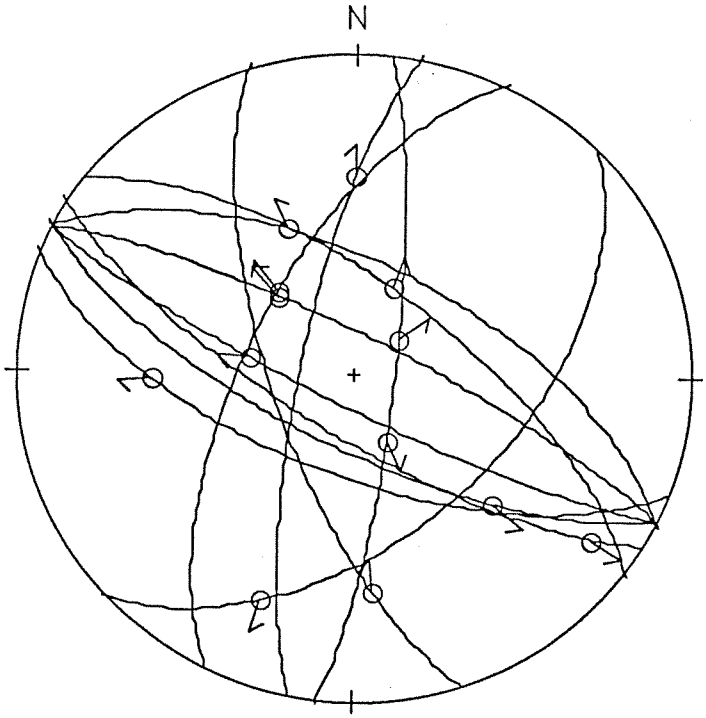

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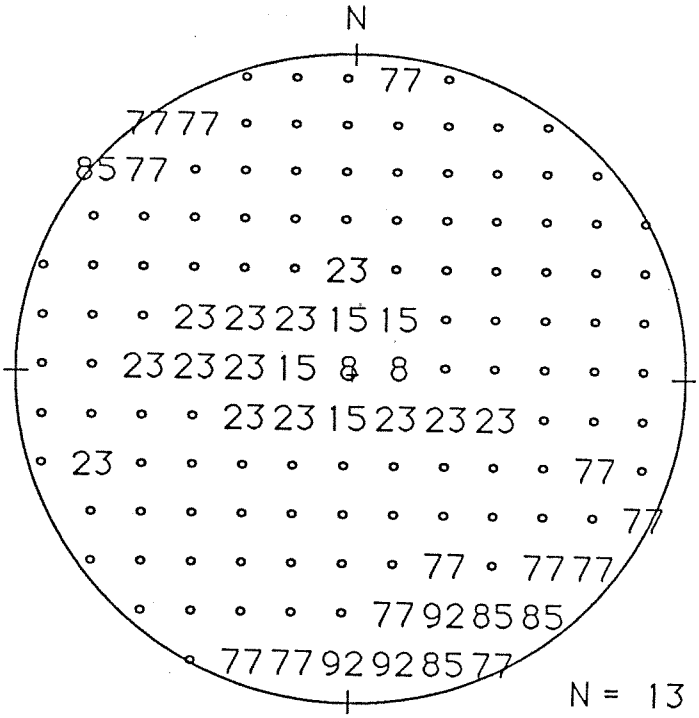

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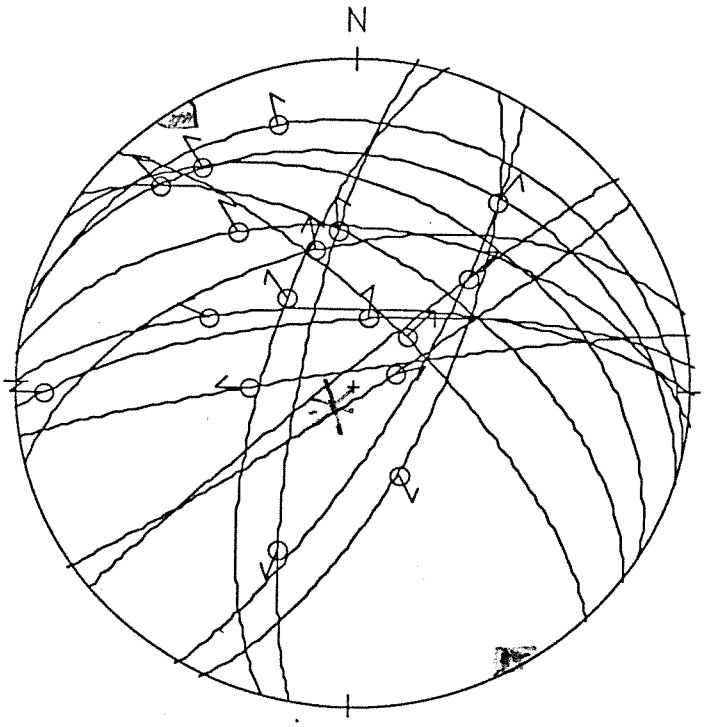

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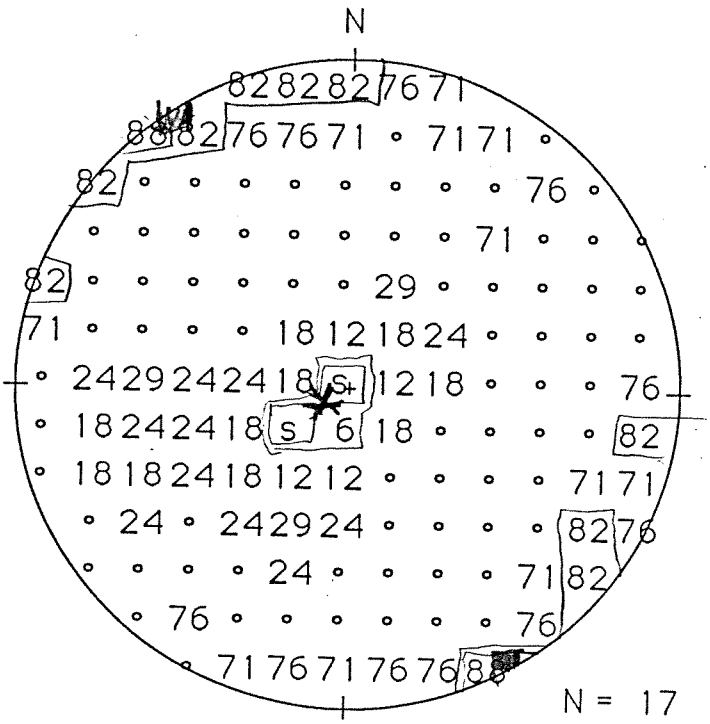

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