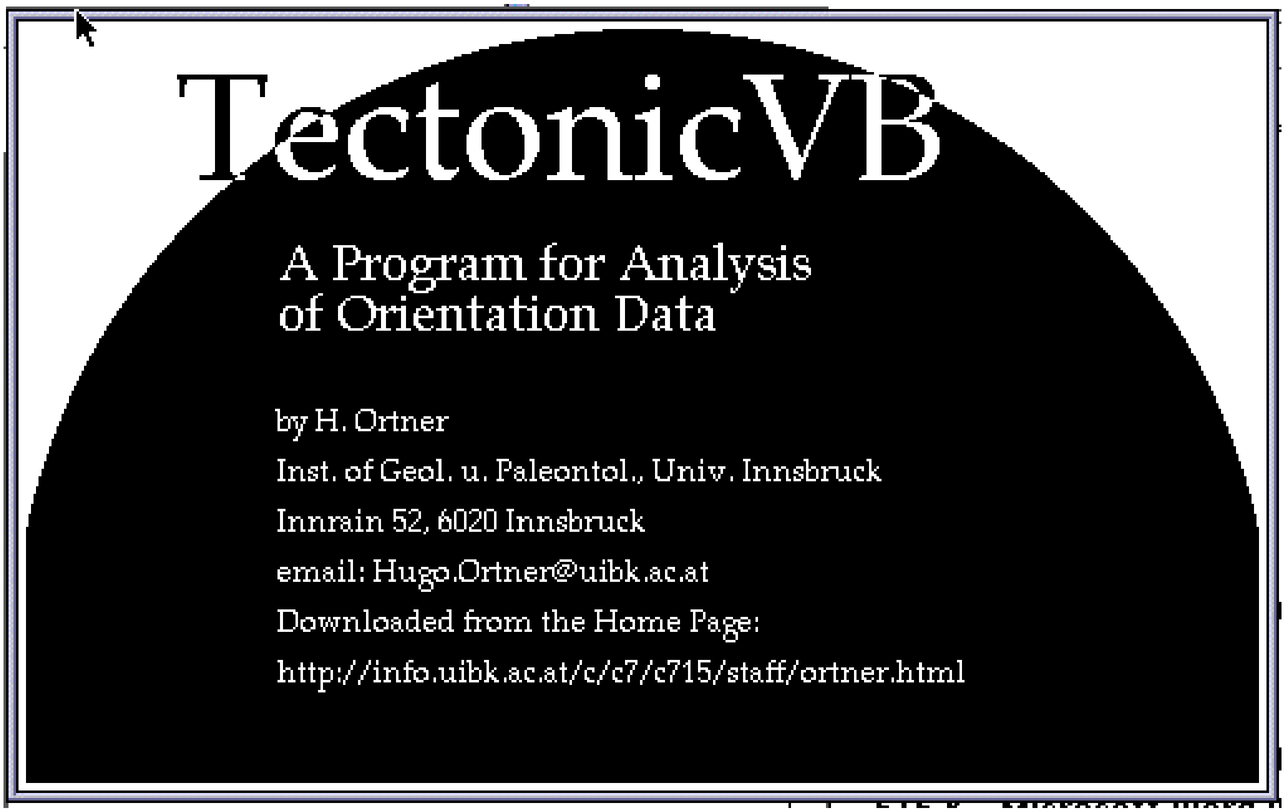


The Program TektonicVB

Introduction

TektonicVB 1.3 was written to provide a tool for fast and effective handling of orientation data like planes, lines and faults. It is the successor of **TektonikQB** , a Quickbasic program, and i s now written in VIP-Basic. It runs on all Macs; a 68K version (will be provided on request) if you use an older 68K Mac (e.g. a Performa). The program uses 1500 to 2000 K of memory space and 1300 K of disk space.

The academic version of the program is provided without charge. You may distribute this program to other non-commercial users. The software is provided without any warranty.

All planes or lines data must be converted to the azimuth,dip format. Graphics produced by the program are automatically copied into the clipboard and can be pasted into any text-editing or drawing-program (Freehand, Adobe Illustrator, MacDraw, RagTime, MacWrite, Word...).

Pictures generated in other programs can be pasted into TektonikVB via the clipboard. (Option **`Paste`** in the Menu File). This command can as well be used, when the current graphic is no longer visible on the screen, e.g. after the screen saver was active, or after another program was used. The maximum amount of data to be handled is 500 for plotting of faults, great circles, poles to planes, lines and most of the statistical calculations. The contouring routine and the Bingham statistics routine can be used with unlimited amounts of data.

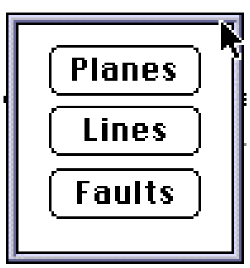
If you generate a picture, any old picture will be erased from the screen and clipboard, except you have chosen **Overlay Plot** from the **Plot** Menu before plotting the new picture.

The Menus

The **File** Menu

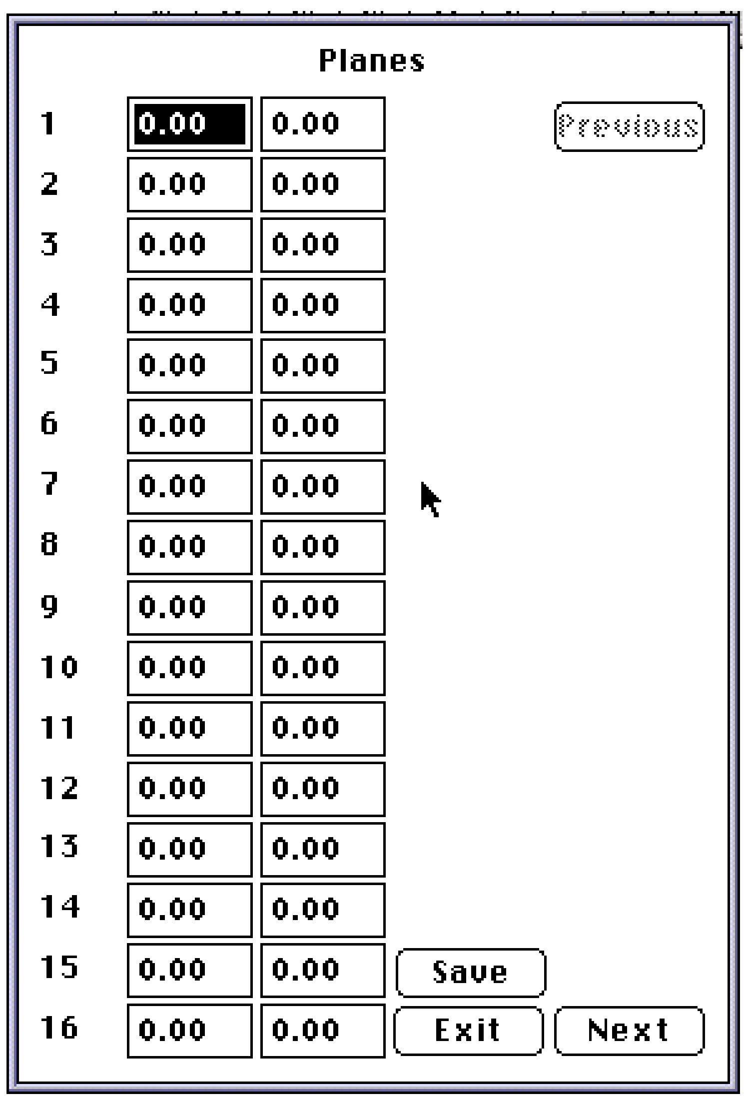
New Datafile

With the command **New datafile** , the user can write new files for input into the program. In the first dialog box you have to indicate, whether the data you want to write are planes, lines or faults (**Planes** can be selected by pressing the return key):



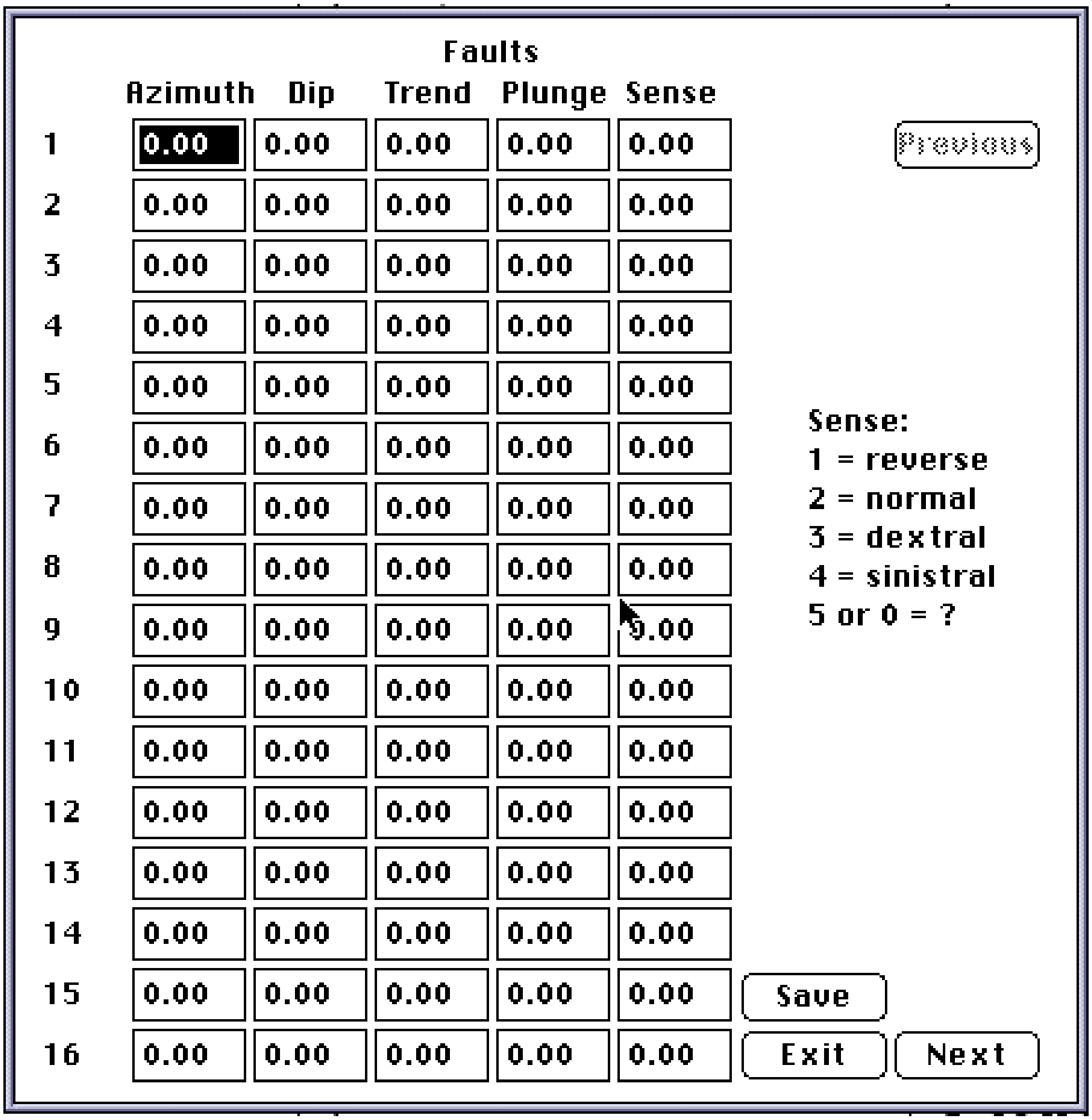
Upon selection of **Planes** or **Lines** a data edit window appears (right):

Write your data into the edit fields and move from one field to the next with the tabulator key (or with the mouse). If you have more than 16 data then move with the Next button to the next 16 data. Don´t forget to save the data: Click the **Sa-**



ve button, and the standard Macintosh save dialog box appears. Click **Exit** or press the return key for leaving the data edit window.

The data edit window for faults looks similar, but it has more columns:



Azimuth and Dip of the fault plane, Trend and Plunge of the lineation and a number that indicates the movement sense on the fault: 1: reverse, 2: normal, 3: dextral, 4: sinistral, 5 or 0: unknown.

The buttons work the same way like in the Planes data edit window (see above).

If anyone would like to edit data with a text editor, this is the data format:

for Lines or Planes:

12,56

340,11

are written in the form azimuth,dip. All data are separated by a comma, the end of the line is a return. At the end of the file, the cursor should be left at the end of the last line, so that no blank line forms the end of the file.

The lines in files with fault data consist of:

a number that indicates the movement sense on the fault: 1: reverse, 2: normal, 3: dextral, 4: sinistral, 5: un known then the fault plane and the lineation on the plane, e.g.:

1,23,45,23,45

2,340,60,335,56

4,120,89,30,1

Again, all datums are separated by a comma.

Bugwarning: When selecting **New Datafile**, sometimes the alert "Too many data!" is displayed on the screen. Just ignore the alert and try again. In some cases, the data input dialogs are displayed without zeros in the data field. In this case, click on exit, select **Open Datafile**, open any datafile and exit the dialog. Afterwards the **New Datafile** command should work properly.

Open Datafile...

This command opens plane-, line- or fault-files for editing in the input dialog windows. Do not forget to save your changes by clicking the **Save** button.

Show data

Show Data prints data files on the screen, so that they can be printed or exported to a graphics utility. The program recognizes the data type of files produced by **TectonicVB** . (If you want to plot a file produced by the Invers or NDA - routines (see later), click **Cancel** in the first dialog box. Another dialog will appear, that facilitates plotting of these files.)

Correct Data

Most field measurements of fault data with the Clar compass are not exact, the lineation does not lie on the fault plane exactly. To avoid calculation errors, the lineations are brought onto the fault plane. The lineation and the pole of the fault plane define a plane, that intersects with the fault plane. The intersection lineation is taken as the corrected lineation. The ending ".cor" is added to the file name during the operation.

Rename File

Changes the name o f a file.

Clear File

Erases a file.

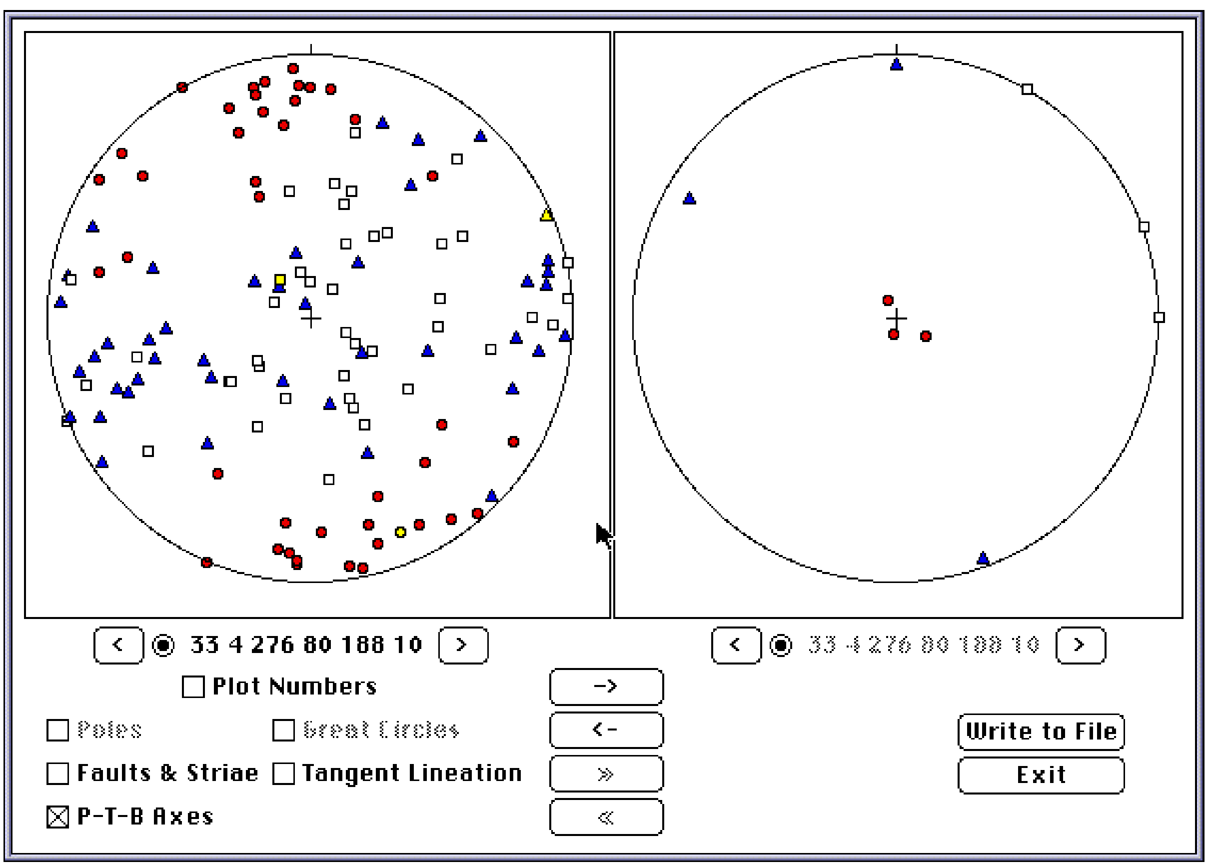
Import File

This command imports and converts plane and line files created in **Stereoplot** or **StereoNet** and DataBase files created in **FaultKin**. In all other text files, spaces or tabulators, that separate data are replaced by commas.

Sort Data

P-T-B-Axes, faults, planes or lines data can be sorted on basis of graphic separation. Open a file and a window like the window above will appear. Move around in the data set by clicking the **>** or **<** buttons or by se lecting the data by mouse-click. Selected data will be marked red (or yellow in case of P-B-T-axis- plots; see above) and can be transferred to the right stereonet by clicking the **->** button. Selected data in the right stereonet can be transferred to the left side by clicking the **<-** button. Clicking the **«** or the **»** button will put all data from the right to the left side, or from the left to the right side, respectively.

Data in the right stereonet can be saved to disk by pressing the button **Write to File**.



Depending on the type of data file you opened, the data can be plotted in several ways. Line data will always be plotted as lines. Planes can be plotted as great circles or as poles to planes. Switch between the different types of plots by clicking the check boxes **Great Circles** or **Poles** (Great Circles cannot be selected by mouse click!). Faults can be plotted as **Faults & Striae** or as **Tangent Lineations** by selecting these check boxes. If you opened a P-T-B-axis file, you have the possibility to switch between P-T-B-axes , Faults & Striae or Tangent Lineations during the process of sorting your data.

Line numbers can be added to the plot by selecting the check box **Plot Numbers**.

Open Picture

Opens a picture file in PICT format.

Save Picture

Saves the current screen content in a PICT file.

Print

Sends the current content of the screen to the current printer. The dialog windows that will appear depend on your printer driver. The quality of the print output is not very good, unless you reduce its size. I suggest exporting of the graphics to a graphics program and print it from there. Moreover, it is easier to combine different plots and modify them.

Paste

Brings the content of the clipboard to the screen.

Quit

Select **Quit** to exit the program.

Info

Gives some info on the author.

The **Text** Menu

The options of the **Text** menu are used to select the textfont, size and style of the text used for labelling of the diagrams.

The option **Titel** can be selected to label the diagrams. If **Titel** is active, a checkmark appears beside the word **Titel** in the menu. When plotting diagrams, while

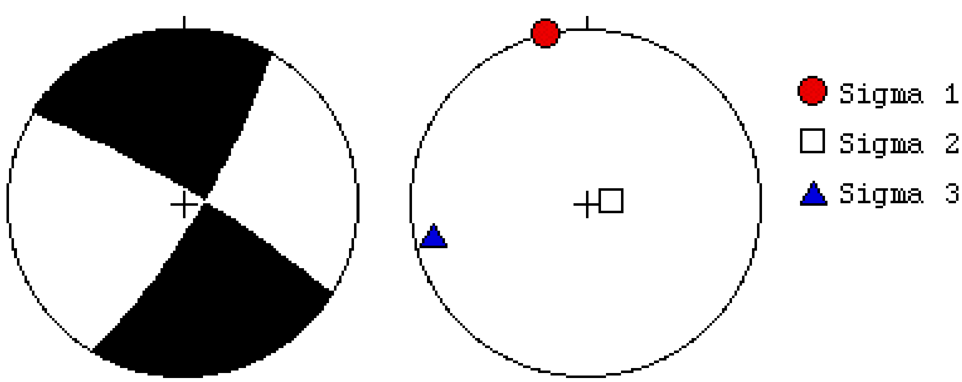
Titel is active, the file name, number of data and type of data will be plotted around the graph. If you are contouring data, some contouring information (Maximum density, position of maximum density, density at contour intervalls) will be plotted. The results of Bingham statistics, Fisher Statistics and labels with the declaration of symbols (Options Sigma1,2,3 and Plot P-,T-Axes) will always be plotted.

Plot Numbers

If **Plot Numbers** is checked, a checkmark appears beside the menu item. When you plot great circles, poles, lines, faults (Angelier or Höppener), P-,T-Axes or the Mohr Circle, while "numbers" is active, the line numbers of the data will be plotted next to the point or great circle.

The **Plot** Menu

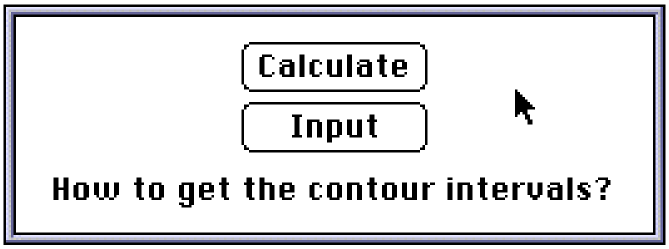
The commands **Great Circles** , **Poles** , **Lines** , **Faults & Striae**, **Tangent Lineation** , **Plot P-T-Axes** and **Sigma1/2/3** all work in the same way. You just have to open a adequate file with data for the plot. Great Circle and Poles plot planes, Lines plots lines, all from files of the type „azimuth,dip". Faults & Striae and Tangent Lineation use fault files (see Option New Datafile). **Faults & Striae** plots great circles and lineations with arrows, that indicate the sense of movement. **Tangent Lineation** plots tangent lineation diagrams, with the pole of the plane and an arrow, that indicates the sense of movement of the upper block. Plot P-T-Axes plots the kinematic axes from a file, that contains these axes (see Option P-T-Axes of the Menu Calculate). **Sigma1/2/3** plots symbols for the main stress axes into a Schmidt net. The orientation of the axes is read from a file with the results of paleostress calculations (see Option Invers and NDA from the menu Calculate). The option **fault plane solution** does the same thing, but plots the compressive and distensive dihedra according to the orientation of the main stress axes:



The left diagram illustrates the fault plane solution, the right diagram the orientation of the main stress axes.

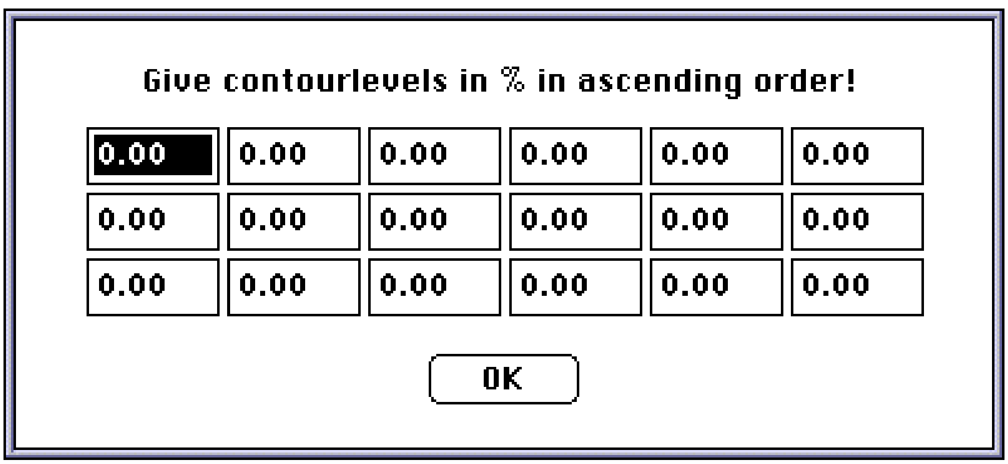
Contour (Gauss) and **Contour (Kaalsbeck)**

In TektonicVB, planes or lines can be contoured in a Kaalsbeck net (Pecher 1989) or using a Gaussian distribution function (Robin and Jowett 1986). The latter produces smoother contours. After the counting is performed, a dialog box asks if the contour intervals should be calculated by the program or typed by the user:



On **Calculate** , the Contour Intervals are calculated automatically. The Lowest contour will always be 1, the following contour s are in equal steps up to the maximum contoured value. The contour levels, maximum counted value and the position of the maximum is displayed if **Titel** is active.

On **Input**, the user is asked to type the contourlevels into the edit fields of the following dialog window:

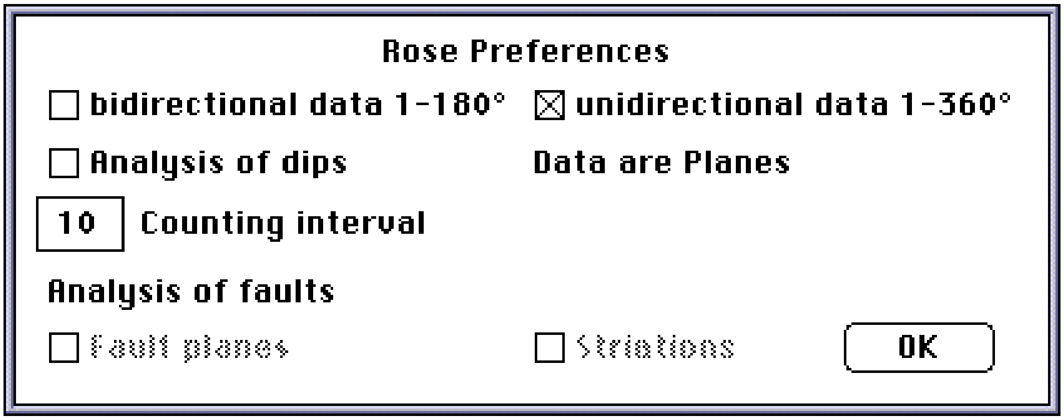


Click **OK** when finished. The diagram is plotted onto the screen.

Rose

Rose diagrams can be plotted for planes, lines or faults. After opening a file, specify the settings for plotting.

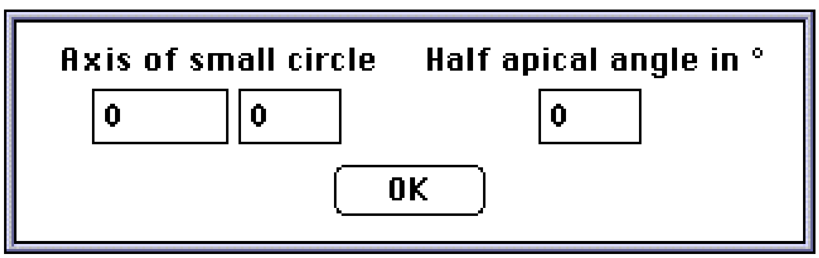
In the dialog window, you have to tell the program if the data are unidirectional (resulting in analysis of the data from 0-360°, e.g. current directions), or bidirectional (resulting in analysis of the data from 0-180° and a bilateral symmetrical diagram, e.g. joints). Dips can be analysed by selecting the check box **Analysis of Dips** . The counting interval is preset at 10°, but if you wish you can change that interval. If data are faults, the check boxes **Fault planes** and **Striations** will be active, and you can select which of the two you want to analyse.



The number at the right side of the diagram tells you the size of the largest rose petal. It is always aquivalent to the net diameter.

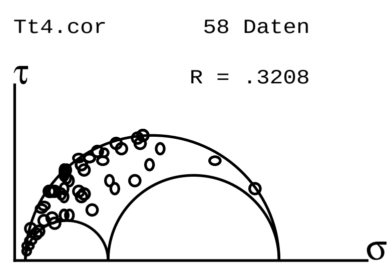
Set Small Circle

This option allows to plot a small circle. Specify the orientation of the axis of the small circle and the half apical angle of the cone (opening angle of the small circle).

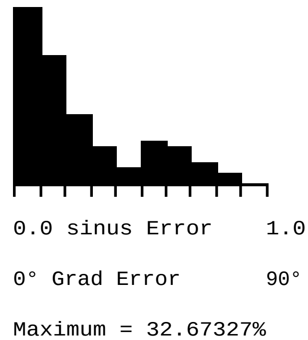


Mohr Circle

Mohr Circle plots dimensionless Mohr circles from the results of paleostress calculations (see Option **Invers** from the menu **Calculate**). Open a file with results from paleostress calculations (produced **Invers** or **NDA**). The dimensionless Mohr circle is used to assess the quality of results of paleostress calculations.



Fluctuation Histogram



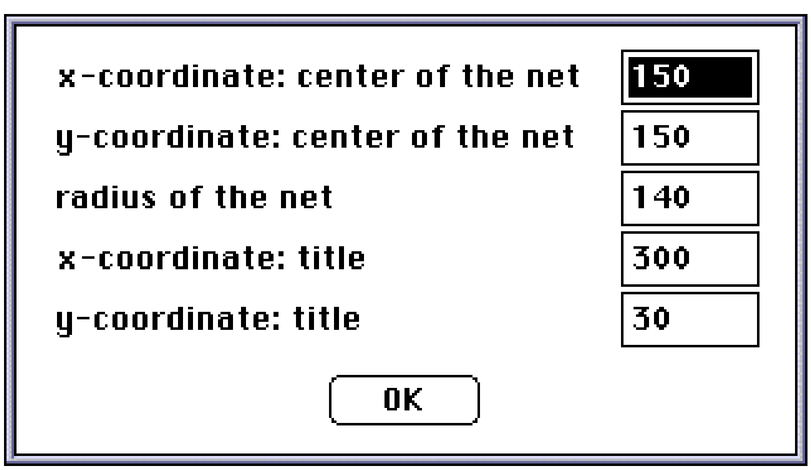
Open a file with results from paleostress calculations (produced **Invers** or **NDA**). In a fluctuation histogram, the distribution of the deviations of the calculated from the measured lineations is plotted. On the horizontal axis, the sinus of the errors is plotted, on the vertical axis the frequency of the classes. The maxim um is always scaled to the same height. The maximum percentage is given at the bottom of the plot. The fluctuation histogram is used to assess the quality of results of paleostress calculations. Ideally, the distribution of errors forms a steep Gaussian distribution with the maximum at the left side. The presence of a second maximum could be a indication of a heterogenous data set.

Overlay Plot

If you want to place two plots (e.g. poles of planes and a Bingham statistic) in the plot window, you have have to select **Overlay plot** before you do the second plot. The second plot will be added to the first one.

Preferences

In the **preferences** dialog window, you can control the position and size of your plots. All plots can be scaled to different sizes by the field **Radius of the net**. The position of the plot in the plot window can be controlled by the x- and y-coordinate of the net. The **x-coordinate: center of the net** is measured from the left margin of the plot window to the center of the Schmidt net, the **y-coordinate: center of the net** is measured from the top of the window. The **x-** and **y-coordinates: title** are measured in the same way and determine the position of additional text, e.g. information on contouring results, if **Title** is checked. The results of Fisher- and Bingham Analysis, and additional labels, if the main stress axes or the P-, T- and B-axes are always plotted (Options **Sigma1,2,3** and **Plot P-,T-Axes**).



Locate Point

Gets the position of the cursor in the current plot on mouseclick. The results give the orientation of lines. To end click in the **END** field in the upper left corner of the plot window.

The **Symbols** Menu

In the symbols menu, you can choose the symbols for representation of lines or poles in the Schmidt net. Also the representation of lines in the Faults & Striae or Tangent Lineation plots is changed.

The selection of different fill colors affects filled symbols (**Filled Circle**, **Filled Square** , **Filled Triangle**) and the fill color of the compressive dihedra in **Fault Plane Solutions** and **Fluctuation Histograms** .

The **Calculate** Menu

Invers

This routine implements the direct inversion method of Angelier and Goguel 1979 as programmed by Sperner, Ratschbacher and Ott 1993. Open a file with fault data, and the program will calculate the reduced stress tensor by a least squares minimisation of the angles between the calculated directions of maximum shear stress acting along the fault planes and and the measured striae. The results will be written into a file with the extension ".inv".

```
Dolomitkeil.cor.inv

 Sigma1    334 / 3
 Sigma2    65 / 9
 Sigma3    223 / 80
 R= 0.4807
           310 / 5          350 / 4          11       *        ( 89 )
 +         310 / 23         309 / 23         0                 ( 50 )
 -         45 / 42          322 / 6          32       nev      ( 73 )
 +         133 / 40         120 / 39         32                ( 33 )
           102 / 20         139 / 16         4        *        ( 59 )
 +         100 / 45         159 / 27         11                ( 28 )
 +         135 / 55         191 / 39         15                ( 26 )
 +         320 / 40         302 / 39         15                ( 21 )
 +         130 / 25         164 / 21         5                 ( 38 )
 +         120 / 70         192 / 40         1                 ( 33 )
 +         144 / 40         180 / 34         15                ( 15 )
           135 / 85         196 / 80         20       *        ( 81 )
 F= 9.83333         nev: 1
 N= 12
```

Above you see an example of a file with the results of the paleostress calculation (Displayed in TectonicVB with **Show Data**). The file contains:

1. The orientations of the three main stress axes

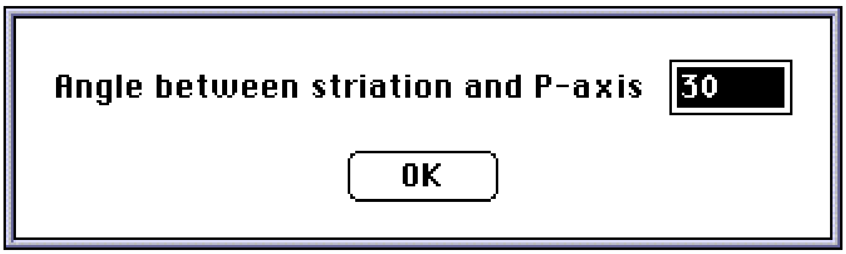
2. The R-ratio ($R = (\sigma_2 - \sigma_3)/(\sigma_1 - \sigma_3)$)

3. A table of the fault data (the movement sense is converted to "+" for reverse movements and "-" for normal movements). The fourth column contains the angle between the measured striae and the and the orientation of the maesured shear stress for the particular fault. In the fifth column, all data with a shear sense contradicting the calculated stress field are marked with "nev" and all data without shear sense are marked with an asterisk. The last column shows the angle between the stress vector and the fault plane.

4. The value F is the average angle between the measured striae and the and the orientation of the maesured shear stress for all faults. Nev gives the number of fault planes with wrong shear sense.

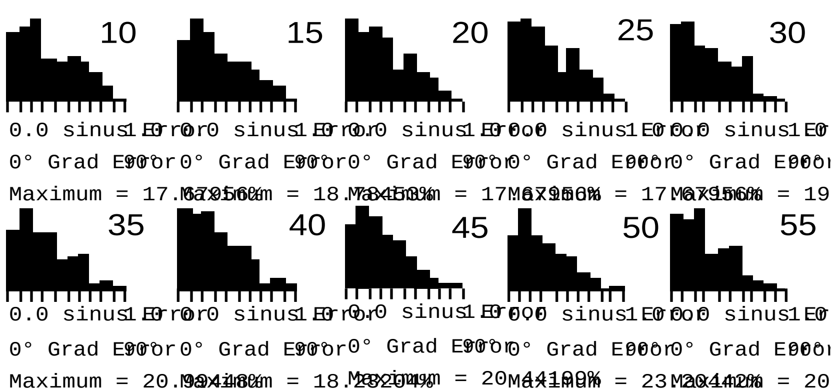
7. N is the number of data.

NDA



The Numerical Dynamic Analysis originally was designed to calculate the paleostress tensor from calcite twins (Spang 1972). The method was adapted for use with fault planes by Sperner 1993 (pers. comm.). Open a file with fault data, and the program will ask you for the angle between the the pressure axis and the fault plane (friction angle):

The results depend highly on the selection of the correct angle. The angle can either be observed in the field if you find conjugated shear fractures or faults, or calculated during calculation of the P-T-Axes (see there), or you calculate the results for a series of different angels and check the results with the fluctuation histogram (see diagram below): In this case, the calculation with 40° yields the best results (see also **`Fluctuation Histogram`**).



The results of the calculation are stored in a file with the extension ".n##". ## is the friction angle you used. The file contains the same components as the files produced with **`Invers`** (see there).

P-T-Axes

This option allows you, to calculate the kinematic axes of a fault data set. Open a file with fault data. A dialog field appears, where you can set the friction angle (angle between compression axis and fault plane; 30° will be a good value; select **= Theta - OK**) or ask the program to search for it (select **Find best Theta**):

If you choose the friction angle the program will calculate the kinematic axes and store the results in a file, that contains: a number that classifies the sense of movement:

1 = R = reverse

2 = N = normal

3 = D = dextral

4 = S = sinistral

5 = SN = sinistral normal

6 = SR = sinistral reverse

7 = DN = dextral normal

8 = DR = dextral reverse,

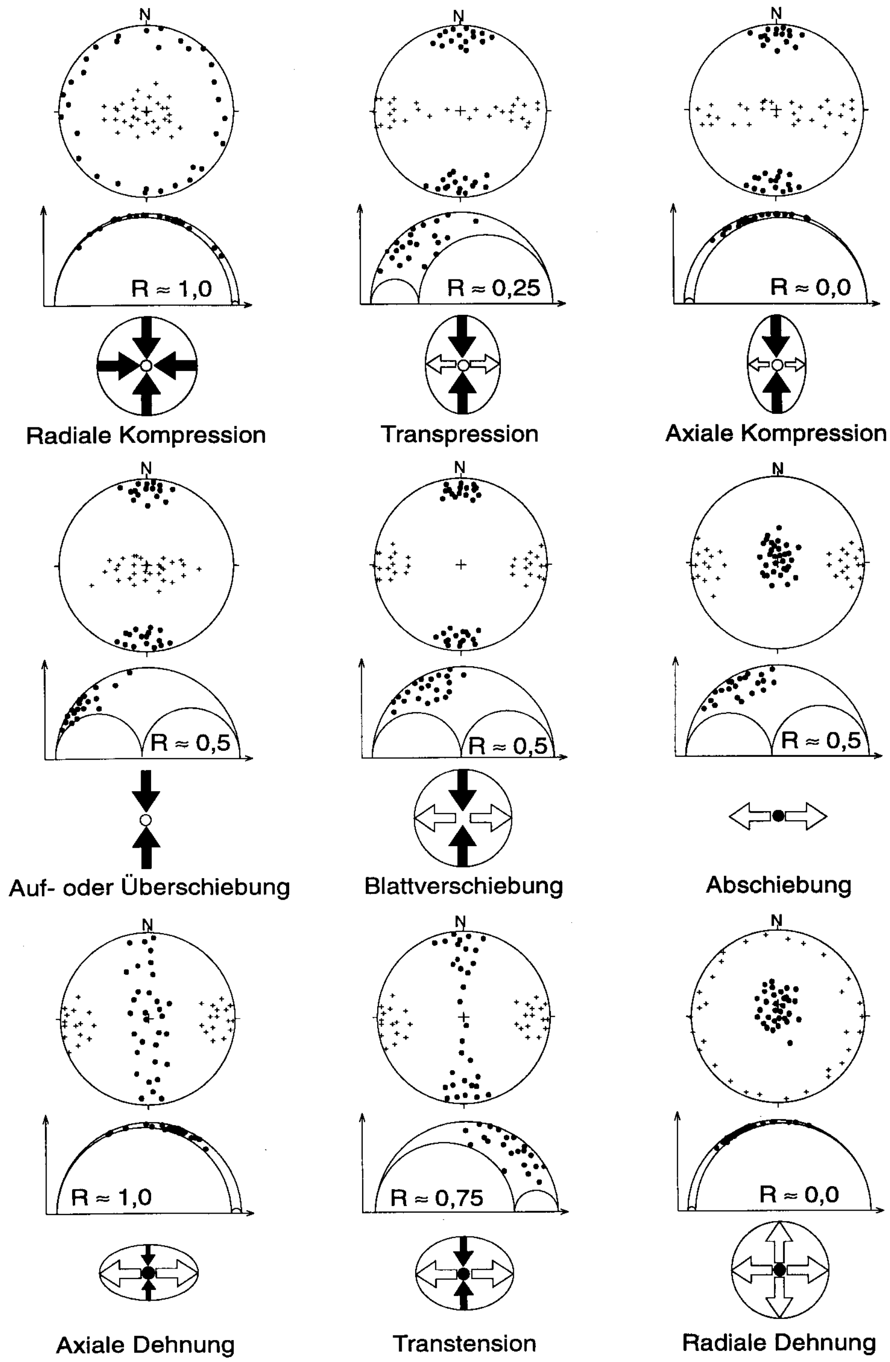
the fault plane, the lineation, the B-axis, the P-axis, the T-axis and the pitch of the lineation in the fault plane.

Example of a file:

```
8 , 310 , 23 , 309 , 23 , 39 , 0 , 129 , 7 , 306 , 82 , 89
5 , 45 , 42  322 , 6 , 57 , 41 , 299 , 27 , 187 , 36 , 9
8 , 133 , 40 , 120 , 39 , 215 , 6 , 124 , 9 , 339 , 78 , 80
6 , 100 , 45 , 159 , 27 , 49 , 32 , 141 , 2 , 235 , 57 ,-40
6 , 135 , 55 , 191 , 39 , 70 , 31 , 170 , 14 , 281 , 54 ,-50
8 , 320 , 40 , 302 , 39 , 39 , 8 , 307 , 9 , 172 , 77 , 76
```

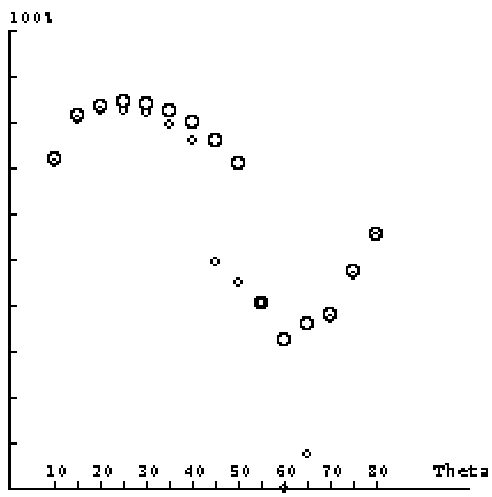
The file has the extension ".t##", where ## is the friction angle.

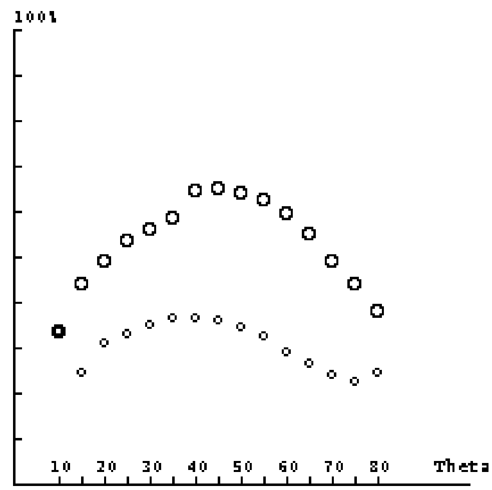
The distribution of the P- and T-axes can be used to classify the type of deformation.



Different distributions of the kinematic axes associated with different types of deformation. For deformations with R ~ 0.5, all kinematic axes form clusters. For R - values near zero, P- and B- axes show a great circle distribution, for R- values near one T- and B- axes are aligned along a great circle. (Meschede 1994)

If you decide to let the program search for the friction angle and select **`Find best Theta`** , the P- and T-axes for all friction angles between 10° and 80° and their alignment according to R% (see Option R% and center of gravity) will be calculated. You get a crossplot with R% of the P-axes (larger circles) and R% of the T-axes (smaller circles) on the vertical axis, and the Friction angles on the horizontal axis (see above):



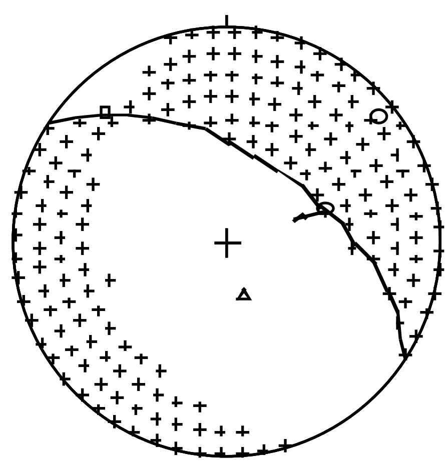


Best Theta for Dolomitkeil.cor = 25
R% (P): 84.0546;R% (T): 82.3085

Best Theta for Werlberg.cor = 45
R% (P): 64.7402;R% (T): 35.884

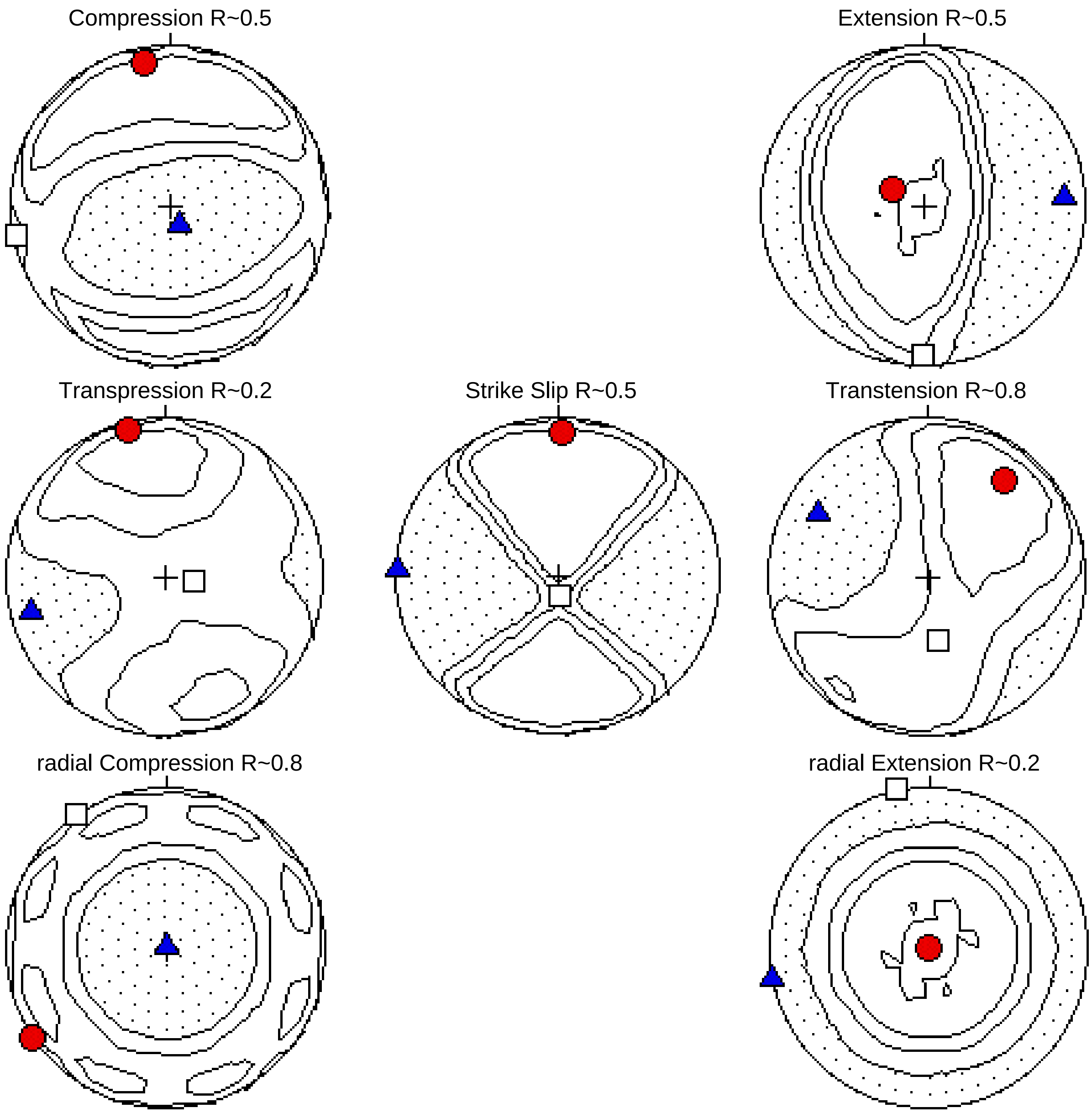
The program adds R% of the P- and T-axes and finds a maximum value, w hich is considered to correspond to be the bestfit friction angle in many cases. If deformation is transpressive and T-axes show a great circle distribution, it is better to take the maximum value of R% of the P-axes for the best-fit friction angle (right diagram). Similarly, take R% of the T-axes for transtensive data sets. Read the maximum values from the diagram, select **`P-T-Axes`** and type the desired friction angle, then select **`= Theta - OK`** (compare Michel 1993).

Dihedra



compressional dieder (crosses) for a fault datum.

This Option implements the right dihedra method of Angelier and Goguel 1977. Open a file with fault data. The program will calculate all compressive dihedra and store them in an array. Every dieder consists of an array of lines on a grid, that represent all possible orientations of the compressive axis. The lines are automatically contoured to see the approximate positions of the main stress axes. The 0.5% density contour can be used to classify the type of deformation. The exact positions of the main stress axes automatically calculated by a Bingham analysis of the Dihedra array.



Different shapes of the 0.5% contour line of the superposed compressive dihedra are characteristic for different types of deformation. The positions of the main stress axes were determined by the eigenvectors of the lines array.

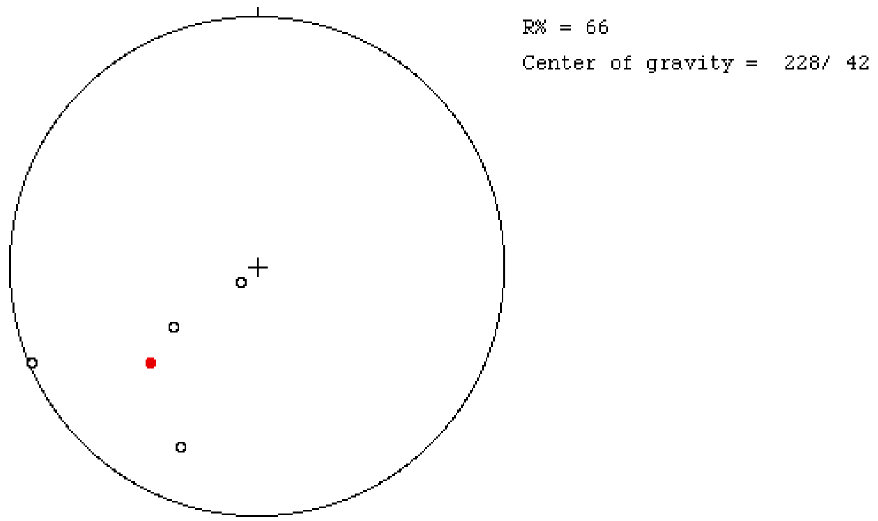
R% and Center of Gravity

R% describes the distribution of data in space in numbers between 0% and 100% (Wallbrecher 1986). Randomly distributed data will yield low values near 0%, while clusters will yield high values, near 100%. The center of gravity is equivalent to the mean vector. To calculate the values, select **R% and Center of Gravity** and open a file, and the mean vector and the results will be plotted on the screen (see graphic at bottom of page). If you select P,B,T-Axes, R% and the center of gravity will be calculated for the all kinematic axes from a file with P-T-B-axes (see option P-,B,-T-Axes). After pressing a key, the symbols for the main stress axes will plotted at the positions of the mean vectors for every kinematic axis.

$$|\vec{R}| = \sqrt{\left(\sum x_i\right)^2 + \left(\sum y_i\right)^2 + \left(\sum z_i\right)^2}$$ *length of the vector sum*

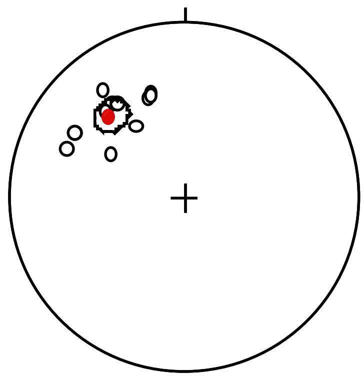
$$\vec{S} = \frac{\vec{R}}{|\vec{R}|}$$ *center of gravity*

$$R\% = \frac{2|\vec{R}| - n}{n} * 100$$ *R%*



Fisher Statistics

Calculates the mean vector, its mean length and the cone of confidence at a level 95% for a Fisher distribution of vector data. The routine plots the mean vector and the confidence cone. Open a file with lines or planes. The poles of planes will be treated like vectors.



Level of confidence: 5%

Half apical angle: 7°

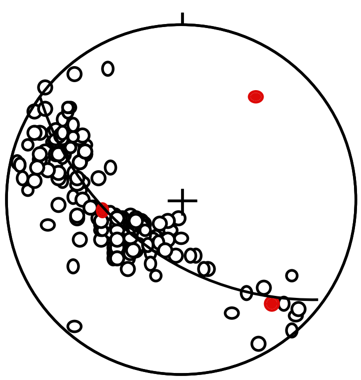
R = 0.990419

k = 28.2426

Mean vector: 318 / 38

Bingham Statistics

Determines the eigenvectors and eigenvalues for lines or planes. The Eigenvect ors are both plotted in a Schmidt net and printed together with the corresponding eigenvalues at the right side of the Schmidt net. A great circle is plotted through the two larger eigenvectors. Thids great circle corresponds to the best fit plane in a array of lines. The smallest eigenvalue is the cylindrical fold axis if the data are poles if planes. The eigenvector with the greatest eigenvalue is equivalent to the mean vector of the data. TektonicVB gives some additional statistical data (Wallbrecher 1986). The "alignment along great circle" (=arctan(ln(λ_2/λ_1)/ln(λ_3/λ_2)) describes, how the data are arranged along a great circle. Data distributions like clusters yield values near 0%, great circle distributions have values near 100%. If the "alignment along great circle" is larger than 50%, the "circular aperture" (β=2*arcsin($\sqrt{(2^* \lambda_2)}$); 0°<β<180°) is printed. It describes the size of the section of the great circle with homogenously distributed data. If the "alignment



Eigenvalues		Eigenvectors
1 .	0.02	36/28
2 .	0.23	139/23
3 .	0.75	262/53

	1	

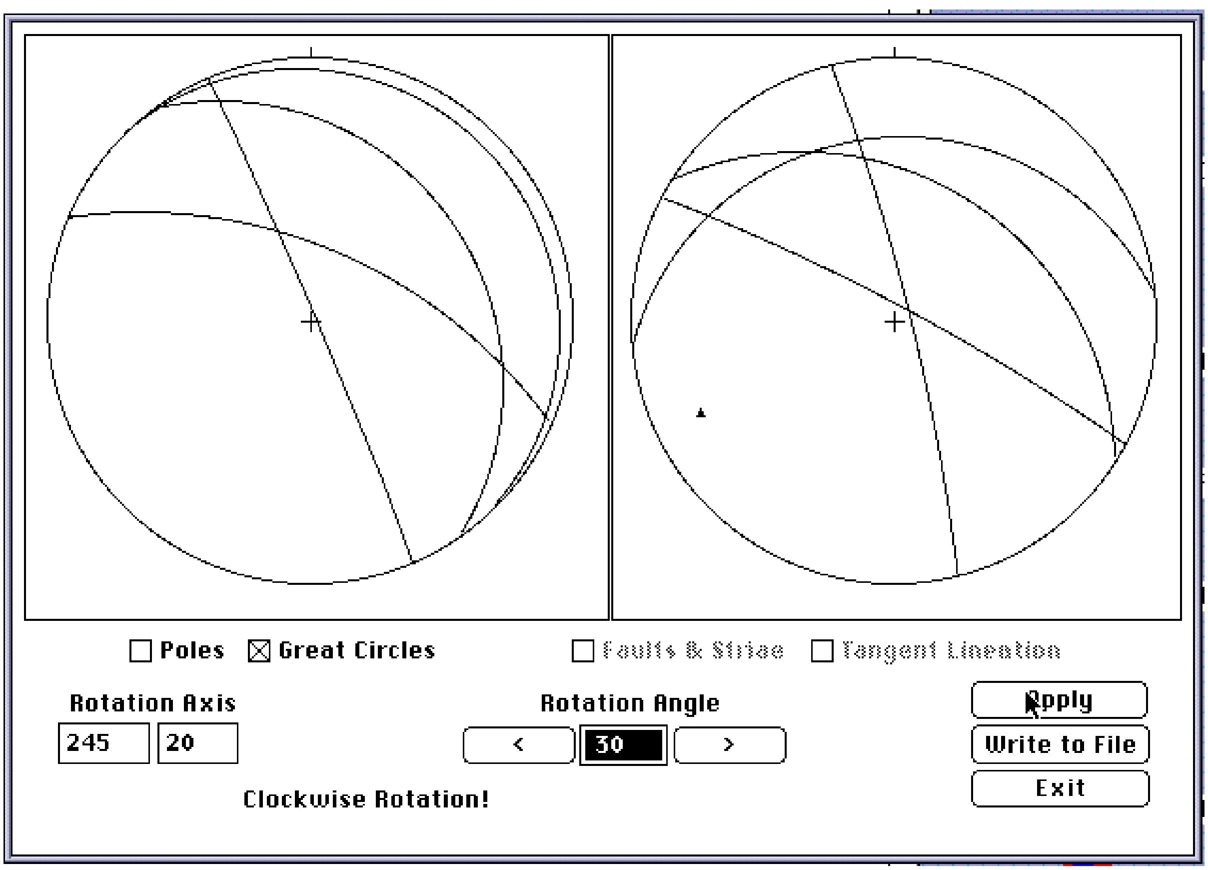
Alignment along great circle= 71

Circular aperture= 85°

along great circle" is smaller than 50%, the "alignment along small circle" (=λ_1/λ_2 *100) is printed, that becomes 100%, if the data form clusters or small circles and 0% if the data are distributed along great circles.

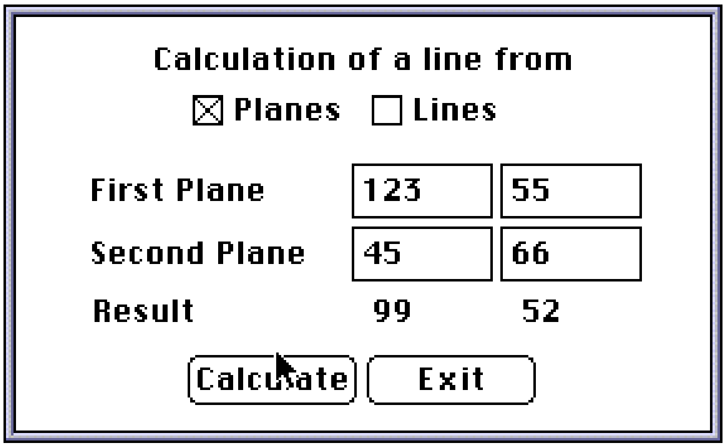
Rotation

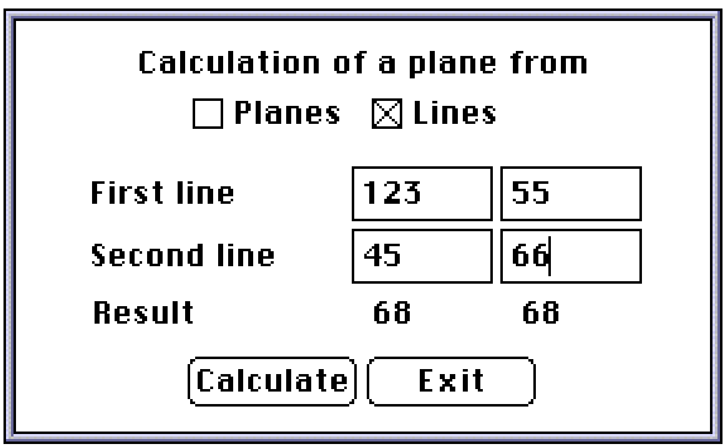
Open a file. Enter Azimuth and Dip of the rotation axis and the rotation angle into the dialog boxes. You can increase or decrease the rotation angle by clicking on the **>** or **<** buttons. The rotation angle is defined as follows: if you look down the rotation axis, data move clockwise with positive rotation angle. To see the result of your rotation, click on **Apply** . The rotated data will be displayed in the stereonet on the right side. To save the rotated data, click on **Write to File**. You can switch between then **Great Circles** and **Poles to Planes** when rotating planes or between **Faults & Striae** and **Tangent Lineation** when rotating faults by selecting the check boxes.



Planes from Lines

Calculates a intersection lineation from two planes or a plane defined by two lines. Switch between the two possibilities by selecting **Planes** or **Lines** . Write your data into the edit fields and click **Calculate** to display the results. Click **Exit** to leave the routine.





Angle between Lines

Calculates the angle between two lines or between two planes. The routine works the same way as Planes from Lines . See there.

A guide for analysis of brittle faults

The following paragraphs suggest a method to analyse brittle fault data.

1. Correct the data to correct measuring errors bring all striations exactly onto the fault p lane. Use **`Correct data`** from the File menu.

2. If the data set is not homogenous (several deformational events), split the data into homogenous subsets. Calculate P-T-B-axes with a theta (friction) angle of 30° and open this P-T-B-axes-file with **`Sort data`** from the File menu. Sort the data in the sort window. This is the crucial step in the analysis!

3. The following step depends on the number of data in your subset and on the spatial distribution of the data. A kinematic analysis of the data can be done by calculating kinematic axes of the fault data set (Marrett & Allmendinger 1990). If the data set consists predominantly of secondary planes (Riedel and anti-Riedel pl anes), the bestfit friction angle (Theta) for the data set can be calculated (**`Find best Theta`** in **`P-T-Axes`**). The average position of the principal axes of the strai n ellips oid can be calculated: select **`R% & center of gravity`** in the menu **`Calculate`** and open the P-T-Axes file. The symbols for the principal axes will be plotted at the location of the center of gravity for each kinematic axis.

On data sets with homogenously distributed data, the right dihedra method (Angelier & Mechler 1977) can be applied. Select **`Dihedra`** from the **`Calculate`** menu and open the fault data file. A new lines file, that contains a lines array for each compressive dieder is written. The orientation o f the stress tensor can be found by contouring these data, the exact positions of the stress axes can be determined by calculation of the Eigenvectors of the data (select **`Bingham Statistics`** in the **`Calculate`** menu). If your data are distributed homogenously i n space and you have 20-30 data in o ne set, you can calculate the orientation and relative sizes of the principal stress axes by direct inversion or NDA . Simply select **`Direct Inversion`** or **`NDA`** from the **`Calculate`** menu and open the fault data set. Evaluate the r esults with the help of the dimensionless **`Mohr Circle`** and/or the **`Fluctuation Histogram`** (comp. Sperner at al. 1993).

References

ANGELIER, J. (1979): Determination of the Mean Principal Directions of Stresses for a Given Fault Popul ation.- Tectonophysics 56, T17 - T26, 5 figs., 2 tabs., Amsterdam

ANGELIER, J. & MECHLER, P. (1977): Sur une methode graphice de recherche des contraintes principales egalement utilisable en tectonique et en seismologie: La methode des diedres droits,. Bull. Soc. Geol. France XIX/7, 1309 - 1318, Paris

MARRETT, R. & ALLMENDINGER, R. W. (1990): Kinematic Analysis of Fault Slip Data.- Jour. Struct. Geol. 12/8, 973 - 986, 15 Figs., 3 Tabs., Oxford

MESCHEDE, M. (1994): Methoden der Strukturgeologie.- 169 S., 148 Abb., Stuttgart (Enke).

MICHEL , G. W. (1993): Modeling fault-slip data sets: a key for approximating stretching ratios?- Zeitschrift der Deutschen Geologischen Gesellschaft 144, 150 - 158, 2 figs., 2 tabs., Hannover.

PECHER, A. (1989): SCHMIDTMAC - a program to display and analyse directional data.- Computers & Geosciences, 15, 1315 - 1326, Oxford.

ROBIN, P.- Y. F. & JOWETT, E. C. (1986): Computerized density contouring and statistical evaluation of orientation data using counting circles and continous weighting functions.- Tectonophysics, 121, 207 - 233, Amsterdam.

SPANG, J.H. (197 2): Numerical Method for Dynamic Analysis of Calcite Twin Lamellae.- Geol. Soc. Am. Bull. 83/1, 467 - 472, 6 figs., 1 tab., Boulder

SPERNER, B., RATSCHBACHER, L. & OTT, R. (1993): Fault Striae Analysis: A Turbo - Pascal Program Package for Graphical Presentation and Reduced Stress Tensor Calculation.- Computers & Geosciences 19/9, 1361 - 1388, 4 figs., 3 tabs., Oxford

WALLBRECHER, E. (1986): Tektonische und Gefügeanalytische Arbeitsweisen. Graphische, Rechnerische und Statistische Verfahren.- 244 S., 220 Abb., Enke, Stuttgart