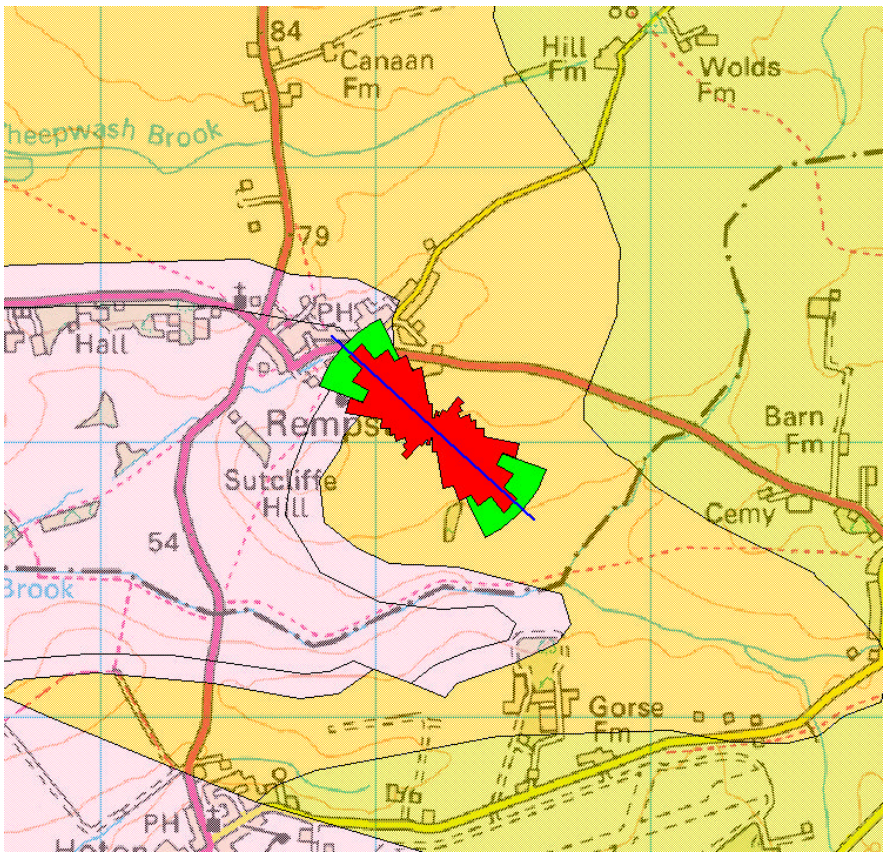
British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

ArcView GIS Front-end to the BGS Rock Stress Database

Sustainable Energy & Geophysical Surveys

Internal Report IR/02/041



BRITISH GEOLOGICAL SURVEY

INTERNAL REPORT IR/02/041

ArcView GIS Front-end to the BGS Rock Stress Database

R J Cuss

Key words

Geographic Information System (GIS); Arc View; Rock Stress; Borehole Breakout.

Front cover

Stress direction for the borehole at Rempstone, Nottinghamshire.

Bibliographical reference

CUSS, R.J. 2002. ArcView GIS Front-end to the BGS Rock Stress Database. *British Geological Survey Internal Report*, IR/02/041. 20pp.

Keyworth, Nottingham British Geological Survey 2002

BRITISH GEOLOGICAL SURVEY

The full range of Survey publications is available from the BGS Sales Desks at Nottingham and Edinburgh; see contact details below or shop online at www.thebgs.co.uk

The London Information Office maintains a reference collection of BGS publications including maps for consultation.

The Survey publishes an annual catalogue of its maps and other publications; this catalogue is available from any of the BGS Sales Desks.

The British Geological Survey carries out the geological survey of Great Britain and Northern Ireland (the latter as an agency service for the government of Northern Ireland), and of the surrounding continental shelf, as well as its basic research projects. It also undertakes programmes of British technical aid in geology in developing countries as arranged by the Department for International Development and other agencies.

The British Geological Survey is a component body of the Natural Environment Research Council.

Keyworth, Nottingham NG12 5GG

☎ 0115-936 3241 Fax 0115-936 3488
e-mail: sales@bgs.ac.uk
www.bgs.ac.uk
Shop online at: www.thebgs.co.uk

Murchison House, West Mains Road, Edinburgh EH9 3LA

☎ 0131-667 1000 Fax 0131-668 2683
e-mail: scotsales@bgs.ac.uk

London Information Office at the Natural History Museum (Earth Galleries), Exhibition Road, South Kensington, London SW7 2DE

☎ 020-7589 4090 Fax 020-7584 8270
☎ 020-7942 5344/45 email: bgslondon@bgs.ac.uk

Forde House, Park Five Business Centre, Harrier Way, Sowton, Exeter, Devon EX2 7HU

☎ 01392-445271 Fax 01392-445371

Geological Survey of Northern Ireland, 20 College Gardens, Belfast BT9 6BS

☎ 028-9066 6595 Fax 028-9066 2835

Maclean Building, Crowmarsh Gifford, Wallingford, Oxfordshire OX10 8BB

☎ 01491-838800 Fax 01491-692345

Parent Body

Natural Environment Research Council, Polaris House, North Star Avenue, Swindon, Wiltshire SN2 1EU

☎ 01793-411500 Fax 01793-411501
www.nerc.ac.uk

Foreword

This report is one of a series produced for the Reservoir Characterisation project, which is a core project of the British Geological Survey. This report explains the operation of the Rock Stress GIS, which delivers a front end to the BGS Rock Stress database. These data derive from borehole breakout measurements within boreholes and describe the local stress field.

Acknowledgements

The BGS Rock Stress database was set up by Robin Brereton and is under the management of Chris Royles. I acknowledge the input of Chris, who ensured that the series of databases conformed to current BGS policy. Steve Rogers initiated the ArcView application and Bruce Napier supplied solutions to some of the script writing. I acknowledge the input of Chris Evans, Andy Kingdon and Helen Reeves who offered advice on what this application should achieve. Helen was also instrumental in the testing phase.

Contents

FIGURES

TABLES

Summary

This report describes the Geographic Information System (GIS) developed as a front-end to the BGS Rock Stress database. The Rock Stress data are derived from borehole breakout measurements within boreholes and describe the local stress field. The GIS covers the entire onshore and offshore UK, with 350 borehole records of rock stress. Data are included for pre-prepared rose diagram display and as ‘raw’ stress magnitude and direction data for vector display. The GIS has been modified to include three dialog tools that allow the user to select data on a number of criteria. These include; plotting as roses, plotting as vectors, selection on borehole method, selection on depth ranges, select for particular chronostratigraphy etc. The Rock Stress GIS incorporates a variety of layers that mainly are derived from the BGS GDI data set.

1 Introduction

During the 1980's a large number of boreholes, both onshore and offshore, were used to calculate the orientation of the *in situ* stress field. This is performed by one of a number of methods that all attempt to detect variation in the shape of a borehole. As a result of the stress field acting in a particular direction, a borehole will become elliptical in shape with breakouts forming in the direction of the long axis, as shown in figure 1. This ellipticity is detected by either measuring the shape of the hole with the caliper/televiewer tool or by determining anisotropy in the resistivity around the borehole using a dipmeter of FMI type tool. The cracks that form in the borehole wall perpendicular to the principal stress direction result in the lowering of the formation resistivity, which can be easily measured. The caliper method directly measures the geometry of the bore. Table 1 summarises the methods used for determining the direction of borehole breakout.

The normal method of presenting breakout is as rose diagrams showing the number of data points in particular orientations (representing stress direction and not stress magnitude). This can also be expressed as a vector mean orientation with an associated confidence limit or error band.

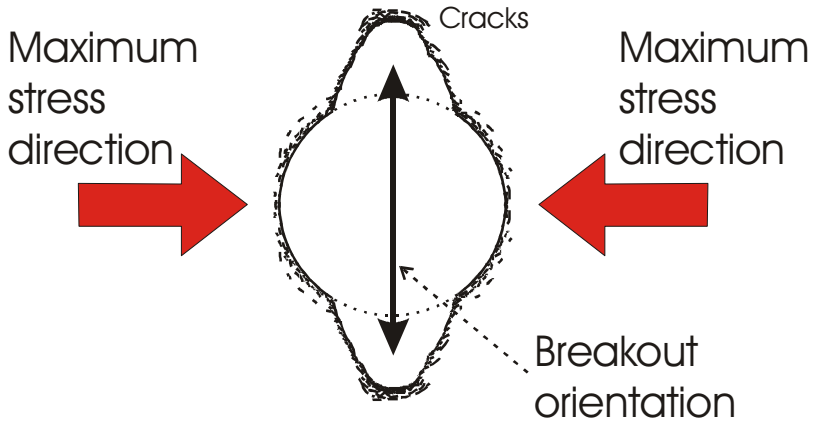


Figure 1: Borehole breakout and *in situ* stress. The bore elongates in the direction of minimum horizontal stress (perpendicular to the maximum horizontal stress direction) for a vertical borehole.

Method	Log type	Technique
ECW	Caliper	Eccentricity of caliper measurements
ECWR	Dipmeter	Eccentricity of resistivity measurements from the dipmeter pads
GRWD	Caliper	Rate of change of caliper measurements
GRWR	Resistivity	Rate of change of resistivity measurements

Table 1: Techniques used for the assessment of borehole breakout

The Rock Stress data were compiled into a series of Oracle tables (BGS_RS_BH_BREAKOUT_*). In all there are approximately 350 borehole records within oracle. These data are stored both as the raw data for calculating the rose diagrams and also pre-calculated roses with the data stored as frequency and orientation in 10 degree intervals. The data record the location of the wells, method used, depth of data, chronostratigraphy, mean azimuth of stress and standard deviation of vector mean direction.

In the past, a Fortran program *Breakimg* was used to produce rose diagram maps of the breakout either for a small region or even the whole of the UK. The aim of the ArcView application was to produce a user-friendlier front end to the Oracle databases to allow individual and regional queries of data to be made. The GIS environment also allows queries against other spatial data sets.

This report describes how to use the Geographic Information System (GIS) that has been developed as a front end to the BGS Rock Stress database. The GIS employs ESRI ArcView software and its functionality has been extended using the customisation options available with this package. New dialogs have been added and these are linked to routines written in the Avenue programming language. The user should refer to the ESRI documentation and online help for details of how to use the standard ArcView features. The aim of this manual is to describe the features that are specific to the Rock Stress GIS.

2 Setting up the GIS

The Rock Stress GIS has been developed as an ArcView project (.apr file) and ideally runs on Version 3.2a, although it does work with version 3.1. At present, the customisations are not compatible with ArcGIS 8.1, as this uses Visual Basic as the programming language rather than Avenue. There are no specific additional hardware requirements for running the GIS. Some of the tools (e.g. regional stress queries over large areas) may be slow if run on a system with limited processing power, for instance a country-wide query of the stress vector data within the Jurassic takes 145 seconds to complete on a 1GHz Athlon PC and a summation of all the breakout rose data takes 70 seconds on the same machine. The GIS customisations have been created with a screen resolution of 1024 x 768 or greater. The dialogue window may become too obstructive when using screen resolutions below this limit.

2.1 LOCATION OF THE ROCK STRESS GIS

The Rock Stress ArcView project can be found on the corporate V: drive (programmes on kwnts9):

V:\LR\SEGS\Rock StressGIS\RockStress_v1.apr

or

\\kwnts9\programmes\ LR\SEGS\Rock StressGIS\RockStress_v1.apr

This project can be opened directly within ArcView by selecting the ‘Open an existing project’ option when the programme is started up, or from the ‘Open Project’ option in the File menu when the program is running. Double clicking on either the file icon or a shortcut to the file can also open the project.

If the project does not load satisfactorily, ArcView will prompt for missing components. If these are program extensions, consult SNS to check that the required extensions are properly loaded. If ArcView cannot trace particular components of the GIS (shapefiles, grids etc.) consult Robert Cuss (rjcu@bgs.ac.uk).

When the project has loaded, an ArcView 'View' should be displayed, with the Table of Contents (TOC) down the left hand side and a map display to the right (Figure 2). The 'Project Window', which allows access to all the different components of the GIS, should also be visible.

2.2 SETTING UP A WORKING DIRECTORY

An important first step when using the Rock Stress GIS is to set up the working directory. ArcView will have defined a default value (using the $HOME environment variable) but it is strongly recommended that a separate project-specific working directory be created. This is because the customised functions can generate temporary files in the working directory and it is best to keep these in a separate area to avoid accidental deletion by other processes and facilitate 'housekeeping'. The working directory needs to be created outside ArcView and then identified using either the 'Properties' dialog called from the Project menu (when the project window is active) or the 'Set Working Directory' dialog called from the File menu (when a view is active).

2.3 CREATING A "WORKING COPY" OF THE ROCK STRESS GIS

It is recommended that, when the Rock Stress GIS has been established on the user's system, a 'reference copy' of the project (.apr) file be saved on the user's local hard drive. All users at BGS have read access only to the Rock Stress GIS, thus if a user wishes to add/remove data from the project it will be necessary to save the project onto his/her file space. It is good practice to make backups of other project files periodically as they evolve.

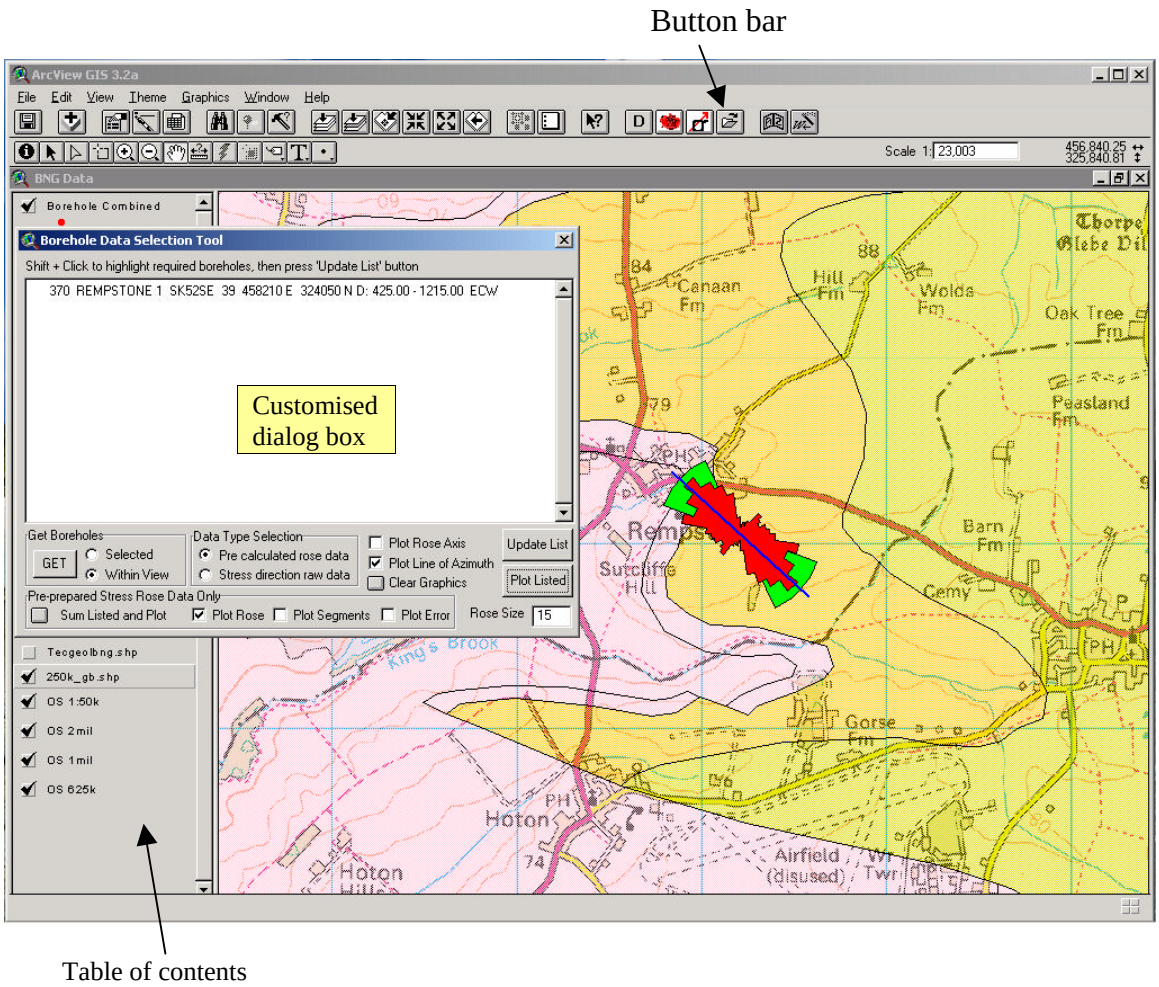


Figure 2: The Rock Stress GIS

3 Available GIS components

The sections below and Appendices 1-3 provide information on the layers that have been generated and included in the Rock Stress GIS. The datasets can be divided into three broad categories:

1. Borehole layers and tables
2. Geological layers
3. Ordnance survey layers

3.1 BOREHOLE LAYERS AND TABLES

There are 2 borehole themes within the table of contents. The Borehole Combined theme displays locations of data for stress rose data as numbers of measurements recorded for 10° increments. The Stress Combined theme displays 'raw' stress data as magnitude and direction. Both of these themes have corresponding table entries, as does the original Oracle tables that have been inputted into the Rock Stress GIS. The link between Oracle and ArcView is not active, as the relevant data tables in Oracle are rarely updated and the 'live link' to Oracle raises performance issues. The Oracle data tables were combined to make the Borehole and Stress Combined tables to speed data processing.

3.2 GEOLOGICAL LAYERS

These data layers are derived from the BGS Geoscience Data Index (GDI). Surface geology is provided at three scales; tectonic geology at 1:1,000,000 scale, solid & drift geology at 1:625,000 scale, and solid & fault geology at 1:250,000 scale.

3.3 ORDNANCE SURVEY AND OTHER LAYERS

Ordnance survey maps are provided at 1:50,000 Landranger series, 1:625,000, 1:1,000,000, and 1:2,000,000 scales. A coastline at 1:250,000 scale is also provided.

3.4 RESTRICTION OF DATA USAGE

All data held within the Rock Stress GIS is available for usage by BGS staff on individual projects. Scale is an important issue to consider when using any of the data sets within the Rock Stress GIS. Care should be taken when using data at inappropriate scales. The geological layers also require careful consideration. These layers represent the surface geology and may not reflect the lithology that the stress data were recorded within at depth.

4 GIS customisations

There are three added dialog boxes to the Rock Stress GIS that allow the user to select data to be plotted. The Borehole Data Selection Tool (section 4.1) displays available data and allows the user to interactively refine their search criteria. The Borehole Stress Plot dialog tool (section 4.2) allows the user to select data given certain criteria, such as depth and/or lithology. The final customised tool allows the user to load and plot pre-prepared rose data (section 4.3).

4.1 THE BOREHOLE DATA SELECTION TOOL DIALOG

Rock Stress data can be picked using the Borehole Data Selection Tool, which is activated pressing the  button on the button bar (figure 1). This icon opens up the Borehole Data Selection Tool dialog (as shown in figure 3).

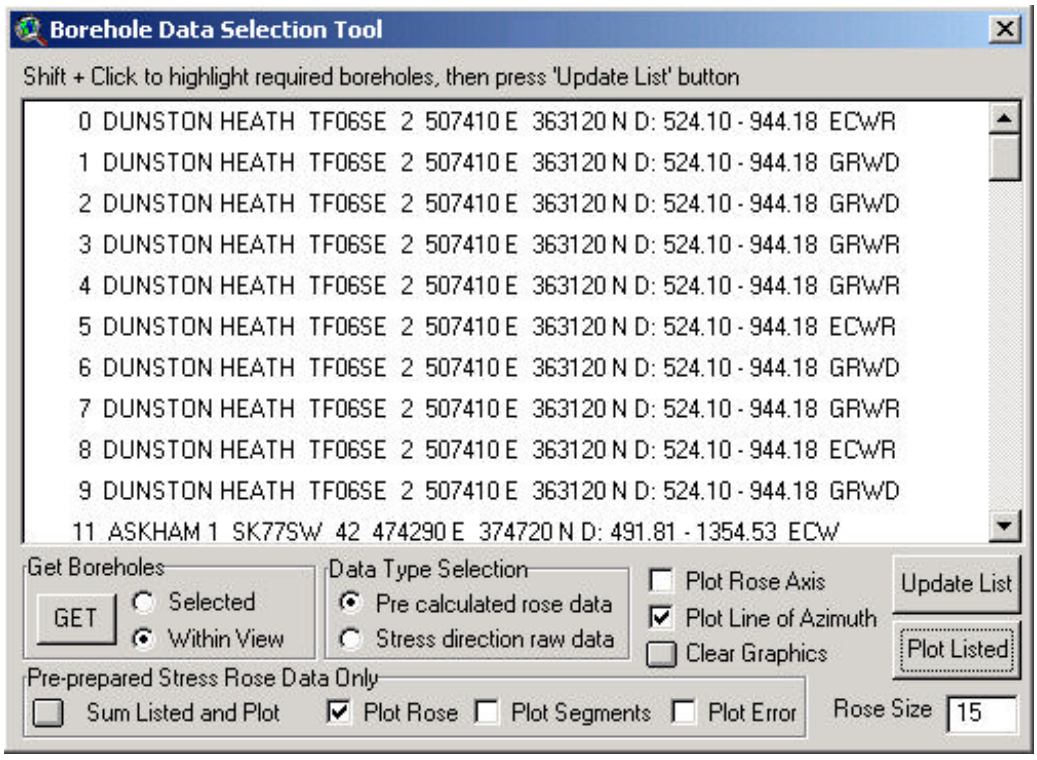
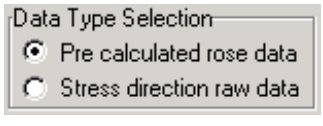


Figure 3: The Borehole Data Selection Tool dialog window

4.1.1 Available data sets, data selection and refining your search



Two types of data are available for display. Pre-calculated stress direction rose data are available for plotting in rose format. Original 'raw' stress direction data are available for plotting as stress magnitude and direction vectors.

There are approximately 1000 records of pre-calculated rose data for 350 boreholes within the UK. For most bores, there are roses calculated for the different borehole methods. Rose data are usually summed for the entire depth of the bore.

There are approximately 165,000 records of stress magnitude and direction for 350 boreholes within the 'raw' dataset. These data are predominately recorded over short intervals and allow checks to be made for stress variations at depth along the borehole length. Most boreholes have approximately 500 records each.

Data can be added to the Borehole Data Selection Tool dialog window either for all pre-selected records or for all records that are displayed within the Rock Stress GIS view. Simply select which data set is required and press 'GET', this will fill the data window within the Borehole Data Selection Tool dialog with the requested data. Data supplied within this window includes:

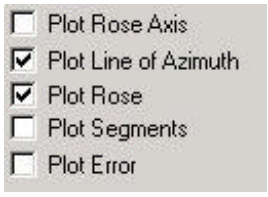
- A unique ID number (related to the record number in the Arc View database)
- Borehole name
- Borehole ID
- Easting (BNG m)
- Northing (BNG m)
- Depth range (m)
- Borehole method

The data search can be further refined from the information supplied in the Borehole Data Selection Tool dialog window. Simply highlight the required records using your mouse and press the 'Update List' button. This will remove all non-highlighted records from the dialog window. Pressing shift and clicking on required records can achieve selections of multiple bores.

Once you are happy with your selection, the 'Plot Listed' button will display the required bores. All bores displayed in dialog box will be plotted.

4.1.2 Rose and vector plotting options

Figure 4 shows the different options available when plotting rose and stress vector data. There are five main options available in the Borehole Data Selection Tool dialog (as shown in figure 4 and to the right). Four of the five main display options are shown in figure 4a. Each of the five options are available by clicking in the appropriate box, this will display a tick if that feature is to be plotted.



Plot Rose Axis – This option displays the rose axis centred on the location of the record, as shown in figure 4a-b. When data points are closely spaced the rose axis from different records may overlap. This option allows just the rose to be plotted (as shown in figure 4c).

Plot Line of Azimuth – This option will plot a blue line in the direction of the pre-determined vector mean, as shown in figures 4a-b. If the 'Sum Listed and Plot' option has been selected (see below), the Plot Line of Azimuth option plots the vector mean as a red line and the vector mode of direction as a blue line. The vector mode represents the direction of the rose segment with the highest count. As can be seen in figure 4c, the difference between the vector mean and mode is not usually significant in well ordered data. However, in records with more than one trend of direction, the difference between the vector mean and mode can be very significant, even up to 90°.

Plot Rose – This option will determine whether the rose data is plotted or not. If this option is turned off it will allow the plotting of just the line of azimuth.

Plot Segments – Figure 4b shows a rose plotted with the individual segments displayed, compared with figure 4a which does not have the segments plotted.

Plot Error – Each record has a line of azimuth and associated error in this value. This option allows an error of direction to be plotted, as shown in green in figure 4a.

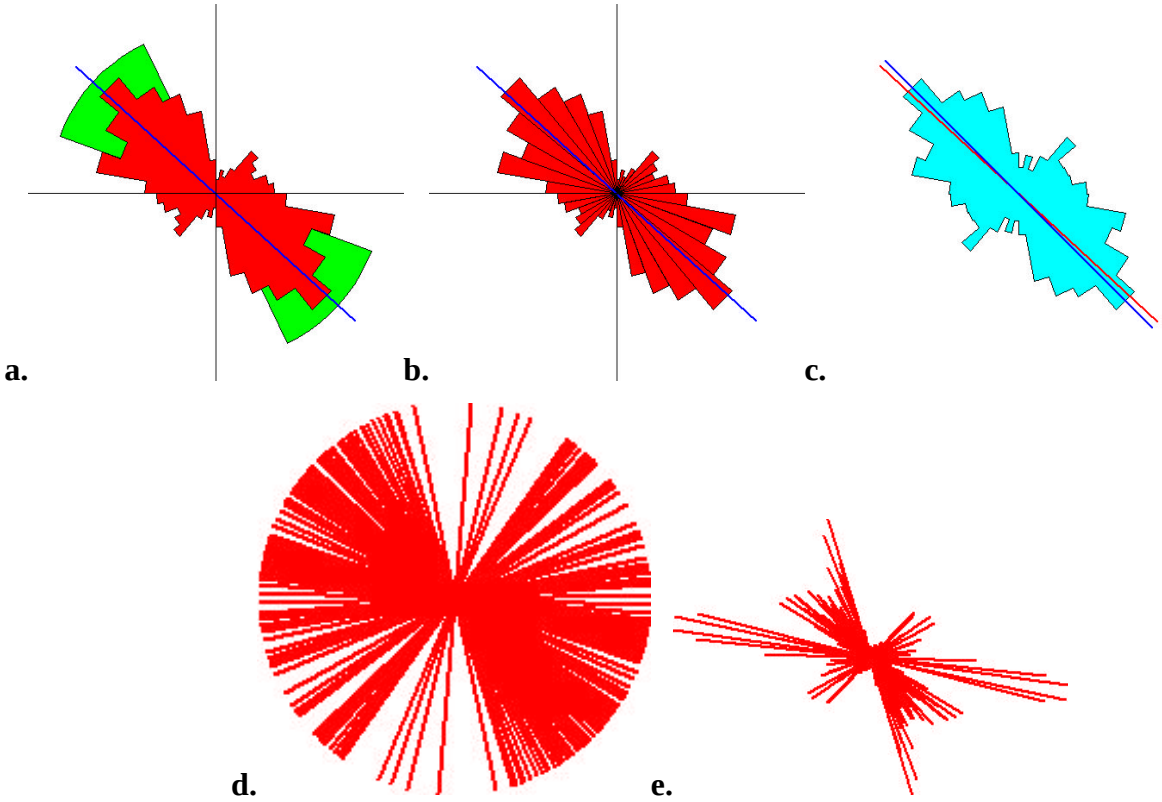


Figure 4: The rose and vector plotting options. a). Rose diagram with axis (black lines), line of azimuth (blue line), error of azimuth (green wedge) and rose data (red wedge). b). Rose diagrams showing segments for each 10° increment. c). Rose of summed data from multiple records (light blue rose) with vector mean direction (red line) and vector mode direction (blue line). d). Vector display without proportional vector length. e). Vector display with proportion vector length determined by estimated stress magnitude.

Note: Only proportional sized vector display (as shown in figure 3e as opposed to figure 3d) is available from the Borehole Data Selection Tool dialog window. Only the Plot Rose Axis option is available for vector plotting.

The 'Sum Listed and Plot' button will create a composite rose diagram of the bores selected from the Borehole Data Selection Tool dialog window. This will plot a blue rose diagram (as shown in figure 3c) located at the centre of the data selected.

The 'Rose Size' data entry option allow the size of the rose or vector plot to be altered. The

number entered is a size relative to the width or height (whichever is shorter) of the displayed view. An entry of 15 will plot a rose 1/15th of the smaller axis of view window. Note: if no number is entered the default of 15 is used.

The 'Clear Graphics' button can be used to clear all graphics from the view window.

4.2 THE BOREHOLE STRESS PLOT DIALOG

Rock stress vector data can also be selected using the Borehole Stress Plot dialog tool, which is activated pressing the  button on the button bar (figure 1). This icon opens up the Borehole Stress Plot dialog (as shown in figure 5).

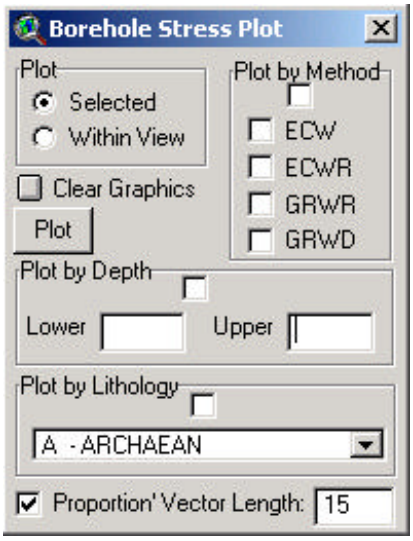


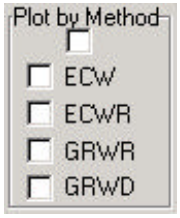
Figure 5: The Borehole Stress Plot dialog window.

The Borehole Stress Plot dialog tool allows the user to display vector-based data selected using a number of different criteria, such as depth range, lithology and method. Note: due to the search of 165,000 data records, using the Borehole Stress Plot dialog window can be slow.

Data can be plotted for either pre-selected data or from all data that lie within the viewed map area. Select whichever is required and the 'Plot' button can be pressed to display the vector data required. Data can be display as either 

proportional vector length determined by estimated stress magnitude (as shown in figure 4e) or as constant vector length (as shown in figure 4d). The number entered is a size relative to the width or height (whichever is shorter) of the displayed view. An entry of 15 will plot a rose 1/15th of the smaller axis of view window. Note: if no number is entered the default of 15 is used.

4.2.1 Plot by Method option

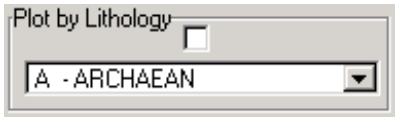


To activate the plot by method option, click the check box below the 'Plot by Method' label. When activated a tick will be displayed. This allows any combination of borehole methods to be selected by clicking in the corresponding boxes. The methods available are displayed in table 1.

4.2.2 Plot by Depth option

To activate the plot by depth option, click the check box below the 'Plot by Depth label. When activated a tick will be displayed. This allows the user to select depth ranges for plotting. Enter two numerical values into the boxes for the lower and upper depths required. When plotting, the program will average each depth range of stress calculation and if this value falls between the limits entered, will plot that data.

4.2.3 Plot by Lithology option



To activate the plot by lithology option, click the check box below the 'Plot by Lithology' label. When activated a tick will be displayed. This allows a corresponding lithology to be selected from the pull-down menu. Lithologies are chronstratigraphic and the search criteria are restricted to singular lithologies. This can cause problems when stratigraphic units have been subdivided.

The 'Clear Graphics' button can be used to clear all graphics from the view window.

4.3 THE LOAD ROSE DATA DIALOG

New rose data can be loaded into the Rock Stress GIS by pressing the  button on the button bar (figure 1). This initially brings up a standard Windows load window. Navigate to the required file and press 'Open'. This will initiate the Load Rose Data dialog window, as shown in figure 6.

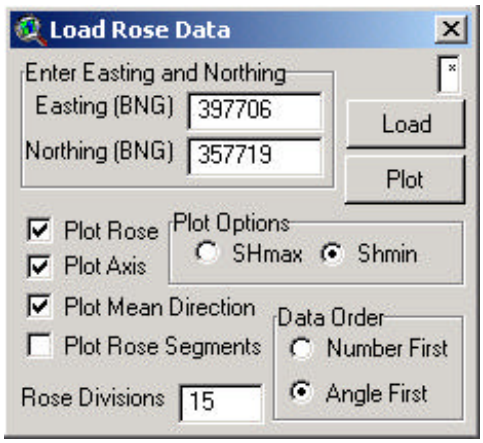
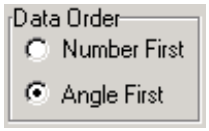


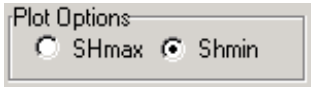
Figure 6: The Load Rose Data dialog window

The Load Rose Data dialog window has a number of functions that are identical to those described for the Borehole Data Selection Tool dialog (section 4.1). These include the rose plotting options (such as Plot Rose, Plot Axis, Plot Mean Direction and Plot Rose Segments, see sections 4.1.2) and the rose divisions (see section 4.1.2).



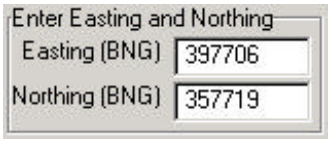
Data are required in a format that gives the degree increment (10° intervals from 5° to 355°) and count within those increments. The data Order selection allows the user to easily switch between data that have been formatted with either the number of counts or angle increment first.

Data can also be easily rotated by 90° by selecting either SHmax or Shmin. Borehole breakout data show the direction of minimum stress (Shmin). If data are to be displayed in the direction of the maximum stress direction (SHmax), then selecting SHmax will rotate the rose data by 90°.



The 'Plot' button will display the rose data at the Easting and Northing entered in the appropriate boxes.

The 'Load' button will allow the user to load a second set of rose data for plotting.



4.3.1 Data format

The Load Rose Data tool has been written to accept data in a similar format to the existing *Breakimg* program. This is a simple two-column text file with directions in 10° increments from 5° to 175° and counts within these bins in the second column, as shown below:

```
  5  10347.38
 15  15545.54
 25  15792.93
      ↓
175  12604.06
```

The Rock Stress GIS can be adapted to accept data in other formats by modifying the RS.LoadAndPlotRoseData Avenue script.

5 Other features

Five additional buttons are available in the button bar (see figure 1), which initiate various functions.

5.1 UPDATE FROM ORACLE 

Selecting the ‘Update from Oracle’ button will update the databases within the Rock Stress GIS from the RS.* tables on Oracle. The live-link from ArcView to Oracle has been isolated for performance purposes, with combined databases in ArcView performing searches significantly quicker.

5.2 DELETE GRAPHICS 

The delete graphics button can be used to delete all graphics present within the active view. If the user wishes to delete only selected graphics, then these need selecting using conventional ArcView tools.

5.3 GAZETTEER 

The Gazetteer tool can be used to quickly locate areas of interest from place names. Simply enter the name of the place of interest (e.g. Keyworth) and a number of matches will be displayed. Selecting the required place will automatically find and zoom into that area.

5.4 WORD REPORT 

A simple automatic Word report generator has been included in the Rock Stress GIS. Selecting this button will generate a report listing:

- Number of boreholes within the designated area
- Number of records per borehole method
- Borehole details, including QS, easting, northing, bore name, top depth, bottom depth, borehole method and azimuth.
- A map corresponding to the active ‘View’

5.5 SELECT OS 

The ‘Select OS’ button can be used to turn on and off the OS map backdrop from the view.

Appendix 1 GIS layers

Theme name	File name	File location	Comments
Borehole Combined	borehole_combined.dbf	\arcview_data	Locations of boreholes with stress rose data
Stress Combined	stress_combined.dbf	\arcview_data	Locations of boreholes with stress magnitude data
Coastline	coastline.shp	\arcview_data	Low resolution British coastline
Coastline 1:250k	250k_coastline.shp	\arcview_data	Higher resolution British coastline (1:250,000 scale)
Faults 1:250k	250k_fault.shp	\arcview_data	GDI Faults (1:250,000 scale)
Fault Ticks 1:250k	250k_fault_tick.shp	\arcview_data	GDI Faults (1:250,000 scale)
National Grid	national_grid.shp	\arcview_data	National Grid squares
Tectonic Geology – Symbol 1:1mil	tecsybng.shp	\arcview_data	Tectonic Geology Symbols (1:1,000,000 scale)
Tectonic Geology – Line 1:1mil	teclinebng.shp	\arcview_data	Tectonic Geology Line work (1:1,000,000 scale)
Tectonic Geology 1:1mil	tecgeolbng.shp	\arcview_data	Tectonic Geology Polygons (1:1,000,000 scale)
Solid Geology 1:625k	625sgeol.shp	q:\gdi\gdidata	GDI Solid Geology (1:625,000 scale)
Drift Geology 1:625k	625dgeol.shp	q:\gdi\gdidata	GDI Drift Geology (1:625,000 scale)
Solid Geology 1:250k	250k_gb.shp	q:\gdi\gdidata	GDI Solid Geology (1:250,000 scale)
OS 1:50k	all_gb.dbf	q:\ordnance survey data\50k colour raster	Ordnance Survey topography map Pathfinder Series (1:50,000 scale)
OS 1:2mil	uk.tif	q:\gdi\sysdata\map_2m	Ordnance Survey topography map (1:2,000,000 scale)
OS 1:1mil	uk.tif	q:\gdi\sysdata\map_1m	Ordnance Survey topography map (1:1,000,000 scale)
OS 1:625k	imgcat2.dbf	q:\gdi\sysdata\map_625	Ordnance Survey topography map (1:25,000 scale)

Appendix 2 GIS tables

Theme name	File name	File location	Comments
Borehole Combined	borehole_combined.dbf	\arcview_data	Locations of boreholes with stress rose data
Stress Combined	stress_combined.dbf	\arcview_data	Locations of boreholes with stress magnitude data
gaze50k.dbf	gaze50k.dbf	\arcview_data	Gazetteer data
RS_BH	rs_bh.dbf	\arcview_data	Rock stress data for borehole name and location
RS_BH_BREAKOUT_BORE_INDEX	rs_bh_breakout_bore_index.dbf	\arcview_data	Rock stress data for borehole index
RS_BH_BREAKOUT_CHRON_CODES	rs_bh_breakout_chron_codes.dbf	\arcview_data	Rock stress data for chronostratigraphy codes
RS_BH_BREAKOUT_MEAN_STRESS	rs_bh_breakout_mean_stress.dbf	\arcview_data	Rock stress data for mean stress and direction
RS_BH_BREAKOUT_ROSE_DIAGRAM	rs_bh_breakout_rose_diagram.dbf	\arcview_data	Rock stress data for pre-prepared stress rose data
RS_BH_BREAKOUT_WORLD_STRESS	rs_bh_breakout_world_stress.dbf	\arcview_data	Rock stress data for world stress map data
RS_BH_LITHOLOGY	rs_bh_lithology	\arcview_data	Lithology data for the relevant boreholes

Appendix 3 Embedded Avenue Scripts

Script name	Script description	Called from
RS.StressVectorPlot	Plots stress vector data dependant on criteria, such as logging method, depth and lithology	RS.StressVectorPlotDiag dialog box
RS.OpenStressVectorPlot	Initialises the RS.StressVectorPlotDiag dialog box	Project – Stress Vector Plot button
RS.Overlay_Grid	Plots OS overlay grid onto the view	
RS.Get	Gets the appropriate data from the Borehole or Stress databases and places in the RS.DataSearchWindow dialog box for further selection	RS.DataSearchWindow dialog box
RS.ClearGraphics	Clears all graphics from the view	Project and all dialog boxes
RS.Start_Up	Initialises Arcview during the loading of the project and displays a Rock Stress GIS splash	Loading of project
RS.UpdateSearch	Removes non-highlighted bores from the RS.DataSearchWindow dialog	RS.DataSearchWindow dialog box
RS.SelectOS	Turns OS map layers on and off	Project – Select OS button
BGS.Gazetteer50k	GDI gazetteer	Project – Gazetteer button
RS.UpdateOracle	Update the Arcview databases from Oracle	Project – Update from Oracle button
RS.LoadAndPlotRoseData	Reads in data from Unix and plot rose in selected location	Project – Load and Plot Rose Data button
RS.StressPlotSumAndPlot	Sums selected borehole rose data and plots new rose	RS.DataSearchWindow dialog box
RS.StressPlot	Calls either RS.StressPlotPreExist or RS.StressPlotVector dependant on whether user wishes to plot preexisting rose data or stress vector data	RS.DataSearchWindow dialog box
RS.StressPlotPreExist	Plots pre-prepared rose data	RS.StressPlot
RS.StressPlotVector	Plots stress vector data	RS.StressPlot
RS.StressReport	Creates automatic report of selected stress data	Project – Report button
RS.StressReportFigureOne	Generation of stress report figure of current view	RS.StressReport
RS.StressReportFigureExport	Exports stress report figure for import into stress report	RS.StressReport
RS.ExportCommaQuoteDelimited	Exports selected stress data for inclusion in stress report	RS.StressReport
RS.StressWindowRefinedSearch	Initialises the RS.DataSearchWindow dialog box	Project – Refined Borehole Finder button