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PLOTSYS

A MAP PLOTTING SYSTEM FOR THE VAX 8700

VERSION 3.2

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APPLICATIONS SECTION

GEOPHYSICS DIVISION

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TABLE OF CONTENTS

1.0 INTRODUCTION	1
2.0 PLOTSYS CONCEPTS	2
3.0 ACCESSING PLOTSYS	3
4.0 CREATING A GRID	4
4.1 Required Information	4
4.2 Grid Interpolation Methods	4
4.3 Input Data File Format	6
4.4 Grid File Format	6
4.5 Grid Folder	6
4.6 Sample Griding Session	6
5.0 GRID ENHANCEMENT	11
5.1 Horizontal Gradient Magnitude	11
5.2 Horizontal Gradient Direction	11
5.3 Vertical Gradient Magnitude	11
5.4 Shaded Relief	12
5.5 Laplacian Filter	12
5.6 Smoothing using an Averaging Filter	12
5.7 Smoothing using a Median Filter	12
6.0 DISPLAYING A MAP	13
6.1 Feature menu	14
6.2 Colour-Shaded or Line Contours	15
6.2.1 Automatic Constant Interval Contour Levels	15
6.2.2 Manually Set Contour Levels	15
6.2.3 Histogram Equalization	16
6.2.4 Specific Intervals from a Contour Level File	16
6.2.5 Histogram of Data Distribution	16
6.2.6 Colour Schemes for Colour-Shaded Contours	16
6.2.7 Line Contour Annotation and Line Colours	17
6.3 Data Positions	18
6.4 Map Shape	18
6.5 Map Base	19
6.6 Geographic Features	19
6.7 Map Notes	19
6.8 User Supplied Geographic Features	20
6.9 Double Exposure Map	20
6.10 Geographical Names	20
6.11 Data Units and Map Title	21
6.12 Map Scale	21
6.13 Display Devices	21
6.14 RDB File	22
6.15 Interactively Changing Colour-Shaded Contour Colours	23
6.16 Sample Display Session	26
7.0 PLOTTING A RDB FILE	34
8.0 CHANGING THE DEFAULT DIRECTORY	34
9.0 ISSUING A DCL COMMAND	34

APPENDIX A	Standard Geophysics Grid Format	35
APPENDIX B	Grid File Folder	36
APPENDIX C	Colour Scheme File Format	37
APPENDIX D	UNIRAS Default Colour Scale	38
APPENDIX E	User Supplied Geographic Features File Format	39
APPENDIX F	Sample Map produced by PLOTSYS	41
APPENDIX G	Gravity Data Base Retrievals	42

1.0 INTRODUCTION

PLOTSYS is a suite of interactive FORTRAN programs that will produce almost map quality output plots of geographically distributed data. The system consists of four main programs, each of these programs is dedicated to one aspect of producing a map. The graphics are produced using the UNIRAS graphics library.

The current version of PLOTSYS is interfaced with the G.S.C.'s Gravity Data Base and the first program is dedicated to retrieving data from the Gravity Data Base currently located on the CYBER computer. The second, is assigned to producing a regularly distributed grid from the irregularly spaced input data. The third program is committed to enhancing grids by applying filters or transformations to the input grid. The fourth program is for displaying a plot on a graphics terminal and/or producing an output plot on a hard copy device, either from a gridded data set or from the irregularly spaced data.

The grid files produced by PLOTSYS are compatible with the Standard Geophysics Grid Format used by within the Geological Survey of Canada. Therefore, the software used to grid and display the data sets are interchangeable.

The plot produced can have one or more of the following features;

- a base map displaying the latitude/longitude lines and/or the geographical features.
- a colour-shaded contour map with or without line contours.
- a line contour map.
- a data position map with or without the data values.
- map notes displayed beside or below the map.

2.0 PLOTSYS CONCEPTS

If you wish to display line or colour-shaded contours, you will have to supply the plotting program with a grid created your irregularly spaced data. When this grid has been created, it then can be enhanced by applying filters and transformations to the grid. Once the grid enhancements, if any, have been applied, the grid can then be displayed.

If data positions or a base map are the only elements to be displayed, a grid does not have to be created. The display program allows you to display as much information as you wish at one time.

PLOTSYS keeps a record of your gridding and/or map display job specifications in files call FOLDERS. These folders contain all the information that you had entered to create the job. These files folders are used by the system when the job is requested to be executed in a batch queue or if a user wishes to recreate a map display.

These folders can also be used by the user to keep track of a grid's or map's specifications.

3.0 ACCESSING PLOTSYS

The programs that are used by PLOTSYS can only be accessed through the PLOTSYS command procedure. To begin execution of the PLOTSYS command procedure, enter the command `@GSC$GRAVITY:[ASSOB.PLOTSYS32]PLOTSYSTEM`. Since this string is lengthy, it is recommended to place the following symbol assignment into your LOGIN.COM file. The symbol assignment is

```
PLOTSYS := "@GSC$GRAVITY:[ASSOB.PLOTSYS32]PLOTSYSTEM".
```

After making the above assignment, execute the PLOTSYS command procedure by entering the command `PLOTSYS`.

Once the procedure is invoked, you will be asked if you wish to change the default directory. To change the directory enter the name of the new directory using the proper VAX/VMS syntax. If you wish to keep the current directory as the default, just press the RETURN key.

The PLOTSYS main menu will now be displayed (Figure 1). The following sections describe the menu items in detail.

```
$ PLOTSYS

WELCOME TO THE GEOPHYSICS DATA BASE/APPLICATIONS GROUP PLOT SYSTEM

The default directory is set to : [PLOTSYS.DEMO]

To change the default enter a new directory, else enter <cr>
Enter directory or <cr>: <cr>

The directory is set to : [PLOTSYS.DEMO]

PLOTSYS MAIN MENU

A - RETRIEVE DATA FROM THE GRAVITY ANOMALY DATA BASE
B - CREATE A GRID FROM A RANDOM DATA SET
C - GRID ENHANCEMENT
D - DISPLAY A MAP
E - PLOT A RDB FILE
F - CHANGE DEFAULT DIRECTORY
G - ISSUE A DCL COMMAND
X - EXIT SYSTEM

Enter A-F or X:
```

Figure 1
PLOTSYS main menu.

4.0 CREATING A GRID

A grid is necessary if colour-shaded or line contours are to be displayed. A grid can be created from any binary or coded file that contains one geographical location and data value per record. The order of the latitude, longitude and data value is not important, because you will be able to specify this on input. The only restriction on the file format is that the latitude, longitude and data value, in any order, must be the first three values in the record. The record may contain other values but only the first three values are used. The latitude and longitude values must be in decimal degrees with north being positive. The longitude can be either negative or positive west.

The program is mainly menu driven. Where input is required, such as a file name, the user will be prompted. After most user input, the information is redisplayed and the user can then make changes, if required. After all the required parameters have been entered, the user has the choice of how the program should be executed, either interactively or in batch mode. If the user chooses to run the program interactively, the user's terminal will be tied up until the gridding has completed. If batch mode is chosen then the gridding can be performed either as a background job using the batch queue `SY$BATCH` or as an overnight job using the batch queue `NIGHT`.

4.1 Required Information

The following list contains the minimum information that is required to grid an irregularly spaced data set.

Input irregularly spaced data file name.

The format of the file, whether it is coded or binary.

The order of the variables in the record of the file.

The map projection, central meridian and, if required, the parallels.

The type of interpolation to be used.

The grid spacing, in metres.

The search radius, in metres, used while gridding.

4.2 Grid Interpolation Methods

There are four grid interpolation methods available these are: UNIRAS GINTPF weighted average, UNIRAS GINTPF double linear, UNIRAS GINTP1 weighted average using binned data and Brigg's minimum curvature. Each method is discussed below.

The method used is chosen from the grid interpolation method menu (Figure 2). You choose the method by entering the letter that corresponds to it.

```
The following gridding methods are available
1 -- UNIRAS GINTPF - Weighted average interpolation.
2 -- UNIRAS GINTPF - Double linear interpolation.
3 -- UNIRAS GINTP1 - Data points are sorted into grids before
                    linear interpolation is performed.
4 -- Briggs       - Minimum curvature using Briggs method.

Enter you choice (1-7).
*
```

Figure 2
Grid interpolation method menu.

The UNIRAS GINTPF weighted average interpolation method uses the closest data point to the grid node from each quadrant that is within the search radius. If there are not any data points within the search radius the grid point is set to the undefined value. If a data point is located in one or more quadrants, then weighted average interpolation is performed. The maximum number of grid nodes that can be interpolated is set to 3,000,000.

The UNIRAS GINTPF double linear interpolation method uses the closest data point to the grid node from each of the four quadrants. If no data points are found within the search radius, then the grid node is set to the undefined value. If one data point is found in each of the four quadrants, then double linear interpolation is performed. Double linear interpolation involves computing the four values at intercepts along the X and Y axes that pass through the grid node, then calculating the two values at the grid node by interpolation along the X and Y axes. These two values are then averaged to give the grid node's final value. The maximum number of grid nodes that can be interpolated is set to 3,000,000.

The UNIRAS GINTP1 weighted average with binned data method first sorts the data points into bins that are centred on the grid node locations. If a data point falls into a bin, then that grid node is set to the data point's value. If more than one data point falls into the bin, then the average value of the data points is used as the grid node value. The remaining undefined grid nodes are defined by searching for the closest neighbouring defined grid node in the four quadrants. Weighted averaging interpolation is then used. If there are not any defined grid nodes within the search radius, the grid node is set to the undefined value. The maximum number of grid nodes that can be interpolated is set to 3,000,000.

The Brigg's minimum curvature method first breaks the grid area into blocks, which contain no more than 5000 grid nodes. For each block, a temporary file containing the input data points is created and an initial grid is interpolated, using one-dimensional interpolation. A smooth grid is produced by iteratively solving a set of difference equations, which minimize the total 2nd horizontal derivative and attempt to honour the input data. Continuity between blocks is maintained by initializing the next block with interpolated values from a coarser regional surface and with a given amount of overlap from preceding blocks. The maximum number of grid nodes that can be interpolated is set to 1,300,000.

4.3 Input Data File Format

The input data file can either be a coded or binary file. The first three variables of every record must be the latitude (positive north), the longitude and the value to be gridded. These variables are all real numbers and may be arranged in any order.

4.4 Grid File Format

The grid file produced is a binary file and consists of two parts. The first part is the grid header. The grid header contains information about the grid. It includes such things as a title, the grid units, the geographic location of the grid and the map projection used. The second part contains the data values at the grid nodes.

The grid node values are stored in column order with one column per record. The columns are stored from the south to the north. The rows are stored from the west to the east.

This grid format is compatible with the Standard Geophysics Grid Format. Therefore, a grid produced by other software using the standard grid format may be displayed using PLOTSYS or a grid produced by PLOTSYS may be displayed using other software using this format.

A detailed description of the grid file format is given in Appendix A.

4.5 Grid Folder

The grid folder is a file that contains all the information on how the grid was produced and which data files were used. This file can be used by the display program to set some of the defaults in that program. An example of a grid folder is in Appendix B.

4.6 Sample Gridding Session

In the following example, the irregularly spaced data file VISLANDBOUGUER.DATA, which is an ASCII formatted (coded) file with the data organized as latitude (positive north), longitude (negative west), Bouguer gravity value (undefined point equal to 9999.0), is gridded to a 2000 metre grid on a Lambert conformal projection. The central meridian used is the centre of the map and the parallels are set to one sixth of the vertical distance from the north and the south. The search radius used is 10000 metres. This allows interpolation to be performed over 5 grid nodes.

The grid is given the title VANCOUVER ISLAND - BOUGUER GRAVITY and has the data unit of Milligals. This text may be used as the default titles and units when the grid is displayed.

\$ PLOTSYS

WELCOME TO THE GEOPHYSICS DATA BASE/APPLICATIONS GROUP PLOT SYSTEM

The default directory is set to : [PLOTSYS]

To change the default enter a new directory, else enter <cr>

Enter directory or <cr>: [PLOTSYS.DEMO]

GSC\$GRAVITY:[PLOTSYS.DEMO]

The directory is set to : [PLOTSYS.DEMO]

PLOTSYS MAIN MENU

- A - RETRIEVE DATA FROM THE GRAVITY ANOMALY DATA BASE
- B - CREATE A GRID FROM A RANDOM DATA SET
- C - GRID ENHANCEMENT
- D - DISPLAY A MAP
- E - PLOT A RDB FILE
- F - CHANGE DEFAULT DIRECTORY
- G - ISSUE A DCL COMMAND
- X - EXIT SYSTEM

Enter A-F or X:*

Enter PLOTSYS file folder name: [VISLANDBOUGUER]

WELCOME TO THE
GEOPHYSICAL DATA GRIDING PROGRAM

CREATED BY
APPLICATIONS SECTION
GEOPHYSICS DIVISION
GEOLOGICAL SURVEY OF CANADA

<cr>

What is the input data file name?

>[VISLANDBOUGUER.DATA]

Is the file in coded format (Y/N)?

>*

What is the order of your input data ?

- A - LATITUDE, LONGITUDE, Z VALUE
- B - LONGITUDE, LATITUDE, Z VALUE
- C - Z VALUE, LATITUDE, LONGITUDE
- D - Z VALUE, LONGITUDE, LATITUDE
- E - LATITUDE, Z VALUE, LONGITUDE
- F - LONGITUDE, Z VALUE, LATITUDE

Enter A - F

>*

Is the longitude positive west? (Y/N)

>*

Do you wish to scan the input data? (Y/N)

>*

READING INPUT RECORD : 1000

There were 28473 data values read from file :[PLOTSYS.DEMO]VISLANDBOUGUER.DATA

Latitude minimum : N 47 0.00
Latitude maximum : N 52 59.96

Longitude minimum : W 121 0.00
Longitude maximum : W 130 59.99

Data minimum : -0.2071720E+03
Data maximum : 0.9999000E+04

Do you wish to set the data value limits? (Y/N)

>Y
The input data minimum is : -0.2071720E+03
The input data minimum limit is : -0.1000000E+21

Enter lowest allowable value or <RETURN> for no change

>RETURN
The input data maximum is : 0.9999000E+04
The input data maximum limit is : 0.1000000E+21

Enter highest allowable value or <RETURN> for no change

>9000
The data has a minimum value of : -0.2071720E+03
and a maximum value of : 0.9999000E+04

The data limits that you have set are
data minimum limit : -0.1000000E+21
data maximum limit : 0.9000000E+04

Are these O.K.? (Y/N)

>Y
The input data values geographical limits are
Latitude minimum : N 47 0.00
Latitude maximum : N 52 59.96

Longitude minimum : W 121 0.00
Longitude maximum : W 130 59.99

Please enter the grid boundaries
The format is : N 49 52.546

Enter south latitude

>N48

Enter north latitude

>N52

Enter east longitude

>W121 30.0

Enter west longitude

>W130 30.0

The input data values geographical limits are

Latitude minimum : N 47 0.00
Latitude maximum : N 52 59.96

Longitude minimum : W 121 0.00
Longitude maximum : W 130 59.99

The grid geographical limits will be

Latitude minimum : N 48 0.00
Latitude maximum : N 52 0.00

Longitude minimum : W 121 30.00
Longitude maximum : W 130 30.00

Are these O.K.? (Y/N)

>Y

What type of projection do you wish to use?

- 1 -- Universal Transverse Mercator (UTM)
- 2 -- Modified Mercator (MER)
- 3 -- Lambert Conformal Projection (LCP)
- 4 -- Polyconic (PLY)
- 5 -- Polar Stereographic (POL)
- 6 -- Mercator (MRC)
- 7 -- Van der Grinten (VAN)

Enter 1-7

>3

Do you want a default CM, half way between longitude limits

>Y

Do you want the parallels to be set automatically? (Y/N)

>Y

The grid projection specifications are

Projection : Lambert Conformal Projection (LCP)
Central meridian : W 126 0.000
South parallel : N 48 40.000
North parallel : N 51 20.000

Is this O.K.? (Y/N)

>Y

The following gridding methods are available

- 1 -- UNIRAS GINTPF - Weighted average interpolation.
- 2 -- UNIRAS GINTPF - Double linear interpolation.
- 3 -- UNIRAS GINTP1 - Data points are sorted into grids before
linear interpolation is performed.
- 4 -- Briggs - Minimum curvature using Briggs method.

Enter your choice (1-7).

>3

Enter the grid cell size in metres.

>2000

The number of grid cells in the X direction is : 355
The number of grid cells in the Y direction is : 247

Is this O.K.? (Y/N)

>Y

Enter the search radius in metres.

>10000

Grid smoothing

- 2 -- Only grid fitting is performed
- 1 -- Quadratic interpolation after grid fitting
- 0 -- Smoothing using radius of closest neighbour (default)
- 1 -- Smoothing using radius of 2nd closest neighbour
- 2 -- Smoothing using radius of 3rd closest neighbour
- 3 -- Smoothing using radius of 4th closest neighbour
- 4 -- Smoothing using radius of 5th closest neighbour

Enter the smoothing level or <cr> for default.

><cr>

Enter a header for the grid (80 characters max.).

>VANCOUVER ISLAND - BOUGUER GRAVITY

Enter the data units of the grid (40 characters max.).

>Milligals

The default value for undefined grid points (grid nulls) is : -9999.0
You may change this if you wish.

Enter a value for grid nulls or <cr> for default.

><cr>

Do you wish to run this job interactively? (Y/N)

>*

```
      READING INPUT RECORD :   1000
--- SORTING THE INPUT DATA
--- CHECKING FOR REPLICATES
---   39 REPLICATES WERE REMOVED
--- 27485 POINTS ARE IN THE NEW LIST
I-GOPEN--WELCOME
I-GOPEN--SOP1INF
I-GOPEN--CUSTNAM
I-GOPEN--SOP2INF
I-GINTPF-INTPFPA
I-GINTPF-ZMINMAX
I-GCLOSE-GOODBYE
FORTRAN STOP
```

Enter <cr> to continue: <cr>

The directory is set to : [PLOTSYS.DEMO]

PLOTSYS MAIN MENU

```
A - RETRIEVE DATA FROM THE GRAVITY ANOMALY DATA BASE
B - CREATE A GRID FROM A RANDOM DATA SET
C - GRID ENHANCEMENT
D - DISPLAY A MAP
E - PLOT A RDB FILE
F - CHANGE DEFAULT DIRECTORY
G - ISSUE A DCL COMMAND
X - EXIT SYSTEM
```

Enter A-F or X:*

\$

5.0 GRID ENHANCEMENT

Grid enhancement allows the user to either smooth a grid by filtering or enhance a grid by applying a transformation. The production of enhanced or derivative products is, in many cases, an aid to geophysical interpretation. The following is a list of the currently available filters and transformations, with a brief discussion of their use. New filters and transformation may be added in the future, but their use will be similar to the existing ones.

All of the filters and transformations use a window around a grid node to produce a new value for that grid node. The size of this window is determined by the filter half width value. The filter half width is the number of grid nodes away from the centre grid node that the window extends. For example, if the filter half width is 2 grid nodes then the window will be 5 by 5 grid nodes.

The file name of the grid will be changed automatically to reflect the enhancement performed by adding a suffix to the input grid file name. The header title of the grid may also be changed to reflex the enhancement that has been performed. Also, the data units will automatically be changed if required.

5.1 Horizontal Gradient Magnitude

The horizontal gradient magnitude is calculated by applying a least-squares fit of a plane to the grid nodes within the filter window. The centre grid node of the window is then set to the maximum slope of this plane.

The output horizontal gradient magnitude grid name will be the same as the input grid name suffixed by _HGMAG.

5.2 Horizontal Gradient Direction

The horizontal gradient direction is calculated by applying a least-squares fit of a plane to the grid nodes within the filter window. The centre grid node of the window is then set to the direction of the maximum slope of this plane. North will have a direction of 0 degrees and increase clockwise.

The output horizontal gradient direction grid name will be the same as the input grid name suffixed by _HGDIR.

5.3 Vertical Gradient Magnitude

The vertical gradient magnitude is calculated by upward continuing the portion of the input grid within the filter window to the specified height. The upward continued grid node value is then subtracted from the original grid node value to give the vertical gradient.

The output vertical gradient magnitude grid name will be the input grid name suffixed by _VGRAD.

5.4 Shaded Relief

A shaded relief grid can be created by entering the azimuth and declination of illumination and a vertical exaggeration factor. Shaded relief is a measure of the reflectance of the surface. A high reflectance is when the surface is perpendicular to the illumination direction. A low reflectance is when the surface is parallel or faces away from the illumination direction.

The vertical exaggeration factor is a multiplier for the grid's z values. It allows the grid's z values to be scaled to a magnitude similar to the grid's spacing.

The output shaded relief grid will be the input grid name suffixed by `_SHADE`.

The shaded relief grid can be combined with colour-shaded contours to produce a double exposure map. Refer to section 6.9.

5.5 Laplacian Filter

The Laplacian filter enhances edges within a grid. This filter is usually used with digital photographs and remotely sensed data. The Laplacian is calculated by multiplying the filter window's centre grid node value by the number of grid nodes within the filter window then subtracting the sum of all the other grid node values excluding the centre grid node value.

The output grid name is the input grid name suffixed by `_LAPLC`.

5.6 Smoothing using an Averaging Filter

The averaging filter replaces the centre grid node by the average value of all the defined grid nodes within the window.

Two window patterns are available for smoothing using averaging. These are the square window and the cross window. The square pattern uses all the grid nodes within the window defined by filter half width, while the cross pattern only uses the grid nodes that are in the vertical and horizontal lines that pass through the centre grid node. The advantage of using the cross pattern is that it will retain vertical and horizontal features better than the square pattern.

The suffixed used with smoothing by averaging is `_SMAVE`.

5.7 Smoothing using a Median Filter

The median filter replaces the centre grid node by the median (middle) value of all the defined grid nodes within the filter window.

Similar to the averaging filter, two filter patterns are available, the square and the cross pattern. Refer to the averaging filter for a discussion of these patterns.

The suffixed used with smoothing by median is `_SMMED`.

6.0 DISPLAYING A MAP

To display a map choose item D from the PLOTSYS main menu. This allows you to create a display of geographical based information. This includes colour-shaded contours, line contours, data positions with or without values and or a map base with or without geographical features. You will be prompted for the PLOTSYS plot file folder name. The name you enter is either the same as the file folder name used to create a grid or a name that is associate with the map you are going to produce.

The plot file folder contains all the information to recreate a previously displayed map. These files are kept so that the users do not have to enter all the map specifications again if they wish to redisplay the map or if they wish to display the map on another output device.

Once this name has been entered, the program searches the default directory for plot file folders that are associated with the name entered. These associated plot file folders will have the same name as the name entered but may have suffixes added to them. If one or more associated plot file folders are found, they will be displayed and you will be asked if you wish to use one of them. If no plot file folders are found that match the name entered, you will be asked if you wish to search another directory. If you wish to search another directory, enter the new directory name using proper DCL syntax. If do not wish to search another directory, you will be asked if you wish to used another file name search pattern. If another plot file folder is to be used, enter a new search pattern including the suffix. If you do not wish to use a new search pattern, the feature menu will then be displayed and a new plot file folder will be created.

If one plot file folder is found, you will be asked if you wish to use it. If more then one file is found, a list of these files will be displayed and you will be asked to choose one from the list by entering the letter that corresponds to the file folder that you want to use. If you do not wish to use any of them, just enter a return and answer no to using a new directory and new file name search pattern. The feature menu will then be displayed.

If you choose to use an existing plot file folder, you will not be able to change any of the parameters. You will only be allowed to choose the output device for displaying the map.

6.1 Feature menu

The main features of the map are chosen from the feature menu (Figure 3). These features are toggled on or off by entering the letter that corresponds to that feature.

Please choose the features you wish to display.

```
A -- COLOUR CONTOURS.....: YES
B -- LINE CONTOURS.....: NO
C -- DATA POSITIONS.....: NO
D -- MAP BASE.....: YES
E -- GEOGRAPHIC FEATURES..(WDB2).....: YES
F -- MAP NOTES.....: NO
G -- USER GEOGRAPHIC FEATURES.....: NO
H -- GEOGRAPHICAL NAMES.....: NO
```

Enter A to H to change, <cr> to continue

>

Figure 3
Display features menu.

Item A chooses whether colour-shaded contours will be displayed (YES) or not (NO).

Item B chooses whether line contours will be displayed. Later in the program you will be able to choose whether contour line annotation will be displayed.

Item C allows data positions to be displayed. If this feature is chosen, you will be asked how you wish to display the data positions later in the program.

Item D allows a map base to be displayed. The map base is the latitude/longitude positions of the corner points or lines joining points with the same latitude or longitude.

Item E allows geographic features to be displayed. The geographic features are from the World Data Base II.

Item F allows a file of map notes to be displayed either beside or below the map.

Item G allows a user supplied file of geographic features to be displayed. The user has control over the line style and colour for the features.

Item H will add the names of cities, towns and some geographical features such as lakes to the map.

6.2 Colour-Shaded or Line Contours

If colour-shaded and/or line contours were chosen from the feature menu, you will be asked to enter a grid file name to be used. If there are grid file names in the default directory that match the file folder name, then a list of these files will be displayed and you will be asked to choose one by entering the letter that is associated with that grid file. If none of the listed grid files are the one you wish to use, enter return and you will be prompted to enter another grid file name.

After a grid file name has been entered, the grid file will be read and its geographic boundaries will be displayed. You may change these boundaries to display only a portion of the grid or create a display that is larger than the grid.

There is a limit to the number of grid nodes that can be used to produce a line contour map. This limit is set to 3,000,000 grid nodes. There is no limit to the number of grid nodes that can be used to produce a colour-shaded contour map.

Once the geographical boundaries have been entered, the grid data limits will be displayed and you will have to choose how to set the contour levels. There are four methods of setting the contour levels, these are; automatically using a constant contour interval (this is the default), manually (the user enters the contour levels), histogram equalization and specific intervals from a contour level file.

6.2.1 Automatic Constant Interval Contour Levels

If you choose automatic constant interval contour levels you will be asked to set the minimum and maximum levels to contour. Entering a return for these values will set the minimum and maximum contour levels to the minimum and maximum data values of the grid in the area that is to be displayed.

You will then be asked to enter a contour interval, only 97 contour levels are allowed. After this has been entered, the minimum level, maximum level, contour interval and the number of levels will be displayed and you will be asked if these are acceptable. If they are, enter Y. If they are not acceptable, enter N and the contour level method menu will be redisplayed.

6.2.2 Manually Set Contour Levels

If you choose to set the contour levels manually, you will be able to create contours at any level that you wish. This is done by entering the contour levels in ascending order. While entering the levels, the following commands are available.

- R - Reenter the last contour level.
- E - Edit any level entered.
- B - Erase all contour levels and begin again.
- P - Display the contour levels entered.
- ? - Display the menu of commands.
- <cr> - Stop entering contour levels.

6.2.3 Histogram Equalization

Histogram equalization will set the contour levels so that the number of grid nodes between contour levels will be approximately equal for all intervals. You will be asked to enter the percentage for each level. The minimum percentage is 1% and the maximum is 25%.

6.2.4 Specific Intervals from a Contour Level File

If you choose this option, a list of contour level files will be displayed. The files listed are files in the default directory with the extension ".level" and three standard level files for use with aeromagnetic data. If you do not wish to use one of the listed files and have a contour level file in another directory, entering <cr> at the prompt will allow you to enter the contour level file specification. If you wish not to use a contour level file, then enter a <cr> at the prompt for a contour level file name specification prompt. This will return you to the contour level main menu.

Once a contour level file has been selected, its values will be read and displayed. At this time, you may modify the contour levels by using a multiplier and by adding a constant to each level. The formula used to modify the contour levels is below.

$$\text{NEW LEVEL} = (\text{OLD LEVEL} * \text{MULTIPLIER}) + \text{CONSTANT}$$

6.2.5 Histogram of Data Distribution

Once the contour intervals have been set, a histogram of the data distribution within the contour levels can be displayed. This histogram will help you to refine the choice of the minimum and maximum contour level, as well as the contour interval for your data set.

If you display the histogram, it will be displayed with a linear Y axis. You will have the choice of replotting the histogram with a logarithmic Y axis or exiting the histogram routine. Once the routine has been left, you may continue using the specified contour intervals, or return to the contour interval selection menu.

6.2.6 Colour Schemes for Colour-Shaded Contours

If you choose to display colour-shaded contours, you will have to choose a colour scheme. Figure 4 shows the colour scheme menu. You choose a colour scheme by entering the letter that corresponds to the desired scheme.

There are two types of colour schemes. The first uses the full range of colours from the scale, which changes with the number of contour levels. The second has a fixed colour scale and sets a specific colour at the zero level and for the levels below and above zero. This type of scale is denoted by the word FIXED in its description in the menu.

Item L from the colour scheme menu allows the use of a user defined colour scale. This scale may be created in two ways. One way is to use a graphics display terminal and change the colours interactively, refer to the section **Interactively Changing Colour-Shaded Contour Colours**. The other way of creating a user defined colour scale is to use a text editor. Refer to Appendix C for details of the Colour Scheme file format.

```
A -- UNIRAS DEFAULT (blue-green-red-yellow-white)
B -- UNIRAS 2 (cyan-yellow-magenta)
C -- Grey Scale (black to white)
D -- Grey Scale (white to black)
E -- Topographic Scale (green-yellow-brown)
F -- HLS Scale (blue-cyan-green-yellow-red-magenta)
G -- Standard Gravity Scale, FIXED (yellow at zero)
H -- Standard Gravity Scale, FIXED (blue at zero)
I -- Aeromag Total Field Scale
J -- Aeromag North America Scale
K -- Aeromag Vertical Gradient Scale
L -- User defined colour scale
```

```
Enter the colour scheme to use.
>
```

Figure 4
Colour scheme selection menu.

6.2.7 Line Contour Annotation and Line Colours

If line contours are to be displayed and you chose a constant contour interval, you will be asked for a interval for contour labels. If you do not wish contour labels, enter a zero. When line contours are used with colour-shaded contours, labels are not necessary, but when line contours are used alone annotation is highly recommended. If you chose to use annotation, you will be asked for the contour interval for the labels, this must be a multiple of the contour line interval.

You will be asked for the interval for bold lines. Again this must be a multiple of the contour line spacing. You will then be asked to choose a colour scheme for the contour lines. A menu of colour schemes will be displayed and you choose one by entering the number that corresponds to the desired scheme.

When a non-constant contour interval is chosen, you will be asked if you wish contour line annotation. If you choose to label the contour lines, the contour level will be displayed and you will choose if the line is to be labelled and/or if it is to be a bold line.

You will also be asked for the colour line colour scheme. You may choose any colour from the default colour table (Appendix D), a ready made scheme or set each level to a different colour. If you chose to set a different colour for each level, you will be prompted for the colour for the contour level just after being prompted for labelling and/or bold lines.

6.3 Data Positions

If data positions are to be displayed, the user will be prompted to enter the name of the file that contains the data. This file can be one of the formats used by the gridding program. You will be asked about its format in a similar manner to the gridding program. Once the file name and format has been entered, you will be asked if you wish to scan the data. If you scan the data, its geographic and data value limits will be displayed and you will have the opportunity to set the data value limits.

Data positions can be displayed either with contours or without contours. If contours are not going to be displayed, then you will be asked to enter the geographical limits for the area to be displayed.

You will be asked to choose a symbol and the size of the symbol to be used to display the data positions. The symbols that are available are a dot, a plus sign, a cross, an asterisk, user supplied symbols or user supplied circles. If you choose to use user supplied symbols, then the file which contains the data positions must also contain a symbol number and symbol colour for each data position. If you choose to use user supplied circles, then the file which contains the data must also contain a circle radius (in millimetres) and a colour for the circle.

The format of the data position file, when containing the symbol number and colour is, the latitude, longitude, data value (in any order) followed by the symbol reference number and symbol colour number (refer to Appendix D). The symbol reference number represents the symbol to be displayed from the UNIRAS RASPAC Text Reference Numbers. The symbol colour number represents the colour number from the UNIRAS default colour scale, see Appendix E for the list of colours. Refer to UNIRAS RASPAC User's Manual, Appendix A, for the symbol reference numbers.

The format of the data position file, when containing the circle radius and colour is, the latitude, longitude, data value (in any order) followed by the circle radius and circle colour number (refer to Appendix D). The circle colour number represents the colour number from the UNIRAS default colour scale, see Appendix E for the list of colours.

When user supplied circles are used, a circle legend may also be displayed. If this option is used, you will be required to enter the circle radius, colour and text for each circle in the legend.

You will also be asked if you wish to display the data value beside the data position. If you choose to display the data value, you will be prompted for the height and angle for the value numbers to be displayed.

6.4 Map Shape

There are 2 map shapes. These are a rectangular map and a map bounded by the map projection's geographic boundaries. The rectangular map will be the smallest rectangle which contains the geographic boundaries of the map projection.

6.5 Map Base

Map bases are reference points that aid in the recognition of locations on the map. Three map bases are available: corner positions marked, corner positions marked and annotated and a map frame with annotation and grid lines.

A map base with corner positions marked will place a cross at the location of the corner points. A corner positions marked and annotated map base will place a cross at the location of a corner point and label the position with its latitude and longitude.

A base map with a map frame with annotation and grid lines will draw a line around the map area and label the corner points. If grid lines are requested, then the grid lines will also be drawn and labelled. Tic marks are available for geographical bounded maps only.

6.6 Geographic Features

If you choose to display geographic features, then the default is to display all coastlines, islands, lakes and rivers, as well as international, state and provincial boundaries. Some of these features can be set so they will not be displayed. The line width used for displaying these features may also be changed. The line width is measured in millimetres. Figure 6 shows the menu that allows you to change these features.

```
You have chosen to display geographical features. Coast
lines, major islands, lakes and double line rivers are
the minimum that will be displayed. In addition to the
above, the following can be displayed,

A -- Additional major islands, lakes and rivers.....: YES
B -- Minor islands, lakes and rivers.....: YES
C -- International Boundaries.....: YES
D -- Internal Boundaries (U.S.A & Canada only).....: YES
E -- Coast line, major islands, rivers line width...: 0.35
F -- Minor islands, lakes and rivers line width....: 0.35
G -- International boundary line width.....: 0.75
H -- Internal boundary line width.....: 0.50

Enter A-H to change, <enter> to continue
>
```

Figure 6
Geographic features menu.

6.7 Map Notes

Map notes will display a text file beside or below the map. The map notes file is a ASCII file, which contains the text that will be displayed. This file can be created by the text editor and should not exceed 40 lines of 80 characters. A line, however, may contain more then 80 characters, if it contains UNIRAS escape characters that are used to display special characters in addition to alphanumeric characters.

UNIRAS Escape Characters

```
< -- Subscript.  
> -- Superscript.  
"  -- Initiate upper case. (used on computers with upper case letters only)  
#  -- Initiate lower case. (used on computers with upper case letters only)  
^  -- Special character.  
_  -- Backspace.  
$  -- Terminate string.
```

The character ^ followed by a number will print the character that corresponds to that number. Refer to UNIRAS RASPAC Appendix A for character numbers. The character ^ followed by an escape character will print the escape character.

The program will prompt you to enter the name of the notes file. If you do not have a notes file or decide not to display the file, just enter return and this feature will not be displayed.

6.8 User Supplied Geographic Features

User supplied geographic features allows the user to display line segments on the plot. The line segments are read into the program from a file supplied by the user. This file can either be a coded text file or a binary file. The file format is similar in both cases. When this feature is chosen, the user will be prompted for the geographic features file name and the form in which the data has been stored.

The user has control over the style, colour and width of the line, for each line segment. This information is stored in the file along with the lines geographical coordinates. The user supplied geographic features file is fully described in Appendix E.

6.9 Double Exposure Map

The double exposure map feature allows a second grid to be superimposed on the colour shaded contours. The second grid is displayed as grey shaded contours. The grid file name and contour intervals are selected in a similar manner as for the colour shaded contours.

6.10 Geographical Names

The geographical names option allows text to be added to map. The text is contained in a coded file with one text string per record. The format of the file is latitude, longitude, dot, height, angle and text.

The latitude is positive north and the longitude is positive west. Dot is an integer with a value of 0 if the text is to be centred at the latitude longitude position, -1 if a dot is to be plotted and the text to the left of the dot and 1 if a dot is to be plotted and the text to the right of the dot. Height is the height of the text in millimetres. Angle is an integer that specifies the text angle from horizontal in degrees. Text is the character string to be plotted, it must be inclosed in quotation marks.

6.11 Data Units and Map Title

If contours are to be displayed, then the data units will be assigned from the grid header. If contours are not being displayed, then the data units will be blank. You will have the opportunity to change the data units or blank the field out, so the units will not be displayed on the map.

If colour-shaded contours are being displayed with a colour bar, then the units will be displayed below the colour bar. If line contours only are being displayed or if a colour bar is not being displayed, then the data units will appear above the scale bar and map projection description.

The map title consists of up to 7 lines of 80 character text. The first line of the map title will be the grid title (if contours are displayed), else the line will be blank. The default for lines 3 through 7 are for the Geophysical Data Centre and may be changed by the user.

You will be asked if you wish english titles first. If you answer yes, then the english titles will be before the french titles. Otherwise, the french appears first.

You will be asked if you wish to change any of the text. If you do wish to change the text enter Y. You will then be asked for the line number of the text line that you wish to change. Enter the line number then enter the new text. Repeat this until all required text has been changed. When you are through changing the text and when asked for the line of text to change, either enter 0 or a <cr>. The full text will again be displayed and you will have an opportunity to change it further.

You have the choice of displaying the map title either centred above the map or at the bottom to the right of the map. The map scale bar and projection notes can either be displayed centred below the map or at the bottom right of the map.

6.12 Map Scale

You will be asked to enter a scale for the map. This should be the scale to be used if the map is to be sent to a hard copy device, even if the map is first going to be displayed on a graphics terminal. When the map is displayed on a graphics terminal and the map is larger than the device, the whole map will be rescaled to fit the graphics screen.

6.13 Display Devices

There are two groups of display devices available. These are interactive graphics terminals and hard copy devices. PLOTSYS allows you a choice of several devices of either type, but you must be logged onto a interactive graphics device in order to display the map on it. Figure 7 shows the device selection menu. If you are using a interactive graphics device that on the menu, it may emulate one of the devices on the list.

The following devices are available for displaying your map,

```
DISPLAY TERMINALS
A -- Raster Technologies Model One/80
B -- Raster Technologies Model One/10
C -- DEC Regis Graphics Terminals
D -- Tektronix 41XX Terminals
E -- Tektronix 40XX Terminals
PLOTTERS
F -- Versatec Model CE3436 Electrostatic Plotter
G -- Applicon Ink Jet Plotter
H -- Optronics Film Plotter
I -- Hewlett Packard DraftPro Pen Plotter
```

```
Enter your choice A-I
>
```

Figure 7

Device selection menu.

You make your selection of a device by entering the letter that corresponds to the device that you wish to use. If you choose a interactive graphics device, the map will begin to be displayed immediately. If you choose a hard copy device, you will be asked if you wish to run the job interactively or in batch mode. Two batch queues are available, the SYS\$BATCH queue, which will run as a background job with low priority, or the NIGHT queue, which has a high priority but execution will not begin until after 6 PM.

If you choose a interactive graphics device, once the map has finished plotting you will be asked if you wish to create a hard copy of it. If you wish a hard copy enter Y. The list of hard copy devices will be displayed and you will be able to choose one.

6.14 RDB File

When a hard copy device is selected, a Raster Data Base (RDB) file is created. This file contains an image of the map. From this file, a plot file is created for the hard copy device that you have selected.

You have the option of keeping or deleting this file, once the plot file was been created. You may wish to retain the RDB file, if you wish multiple copies of a plot or if a very high quality plot is necessary and it may require replotting several times. The RDB file should not be retained indefinitely, so that the disk space will be available for another user. If a RDB file has been retained, it can be plotted by using the PLOTSYS main menu item E - PLOT A RDB FILE.

6.15 Interactively Changing Colour-Shaded Contour Colours

The Raster Technologies and Tektronix 4111 graphics terminals have the capability to change the colour-shaded contour colour scale interactively. Once the colour-shaded contour map has been displayed on one of the above terminals, you will be asked if you wish to change the contour colours. If you wish to change the colours, the colour scheme menu will be displayed (refer to Figure 8). Choose the new colour scheme by entering its corresponding letter or choose to interactively change single colours by selecting item M.

```
Choose a colour scheme for the map.

A -- UNIRAS DEFAULT (blue-green-red-yellow-white)
B -- UNIRAS 2 (cyan-yellow-magenta)
C -- Grey Scale (black to white)
D -- Grey Scale (white to black)
E -- Topographic Scale (green-yellow-brown)
F -- HLS Scale (blue-cyan-green-yellow-red-magenta)
G -- Standard Gravity Scale, FIXED (yellow at zero)
H -- Standard Gravity Scale, FIXED (blue at zero)
I -- Aeromag Total Field Scale
J -- Aeromag North America Map Scale
K -- Aeromag Vertical Gradient Scale
L -- User defined colour scale
M -- Change the current colour scale interactively

Enter the colour scheme to use.
>
```

Figure 8

Colour scheme selection menu with interactive colour changing.

If Item M is chosen the graphics cursor will appear on the screen. You select the colour to change by placing the cursor over the colour in the colour bar and pressing the pick key. Note that the keys used for interactively changing colours are dependant on the terminal that you are using. Refer to Table 1 for a list of keys by terminal.

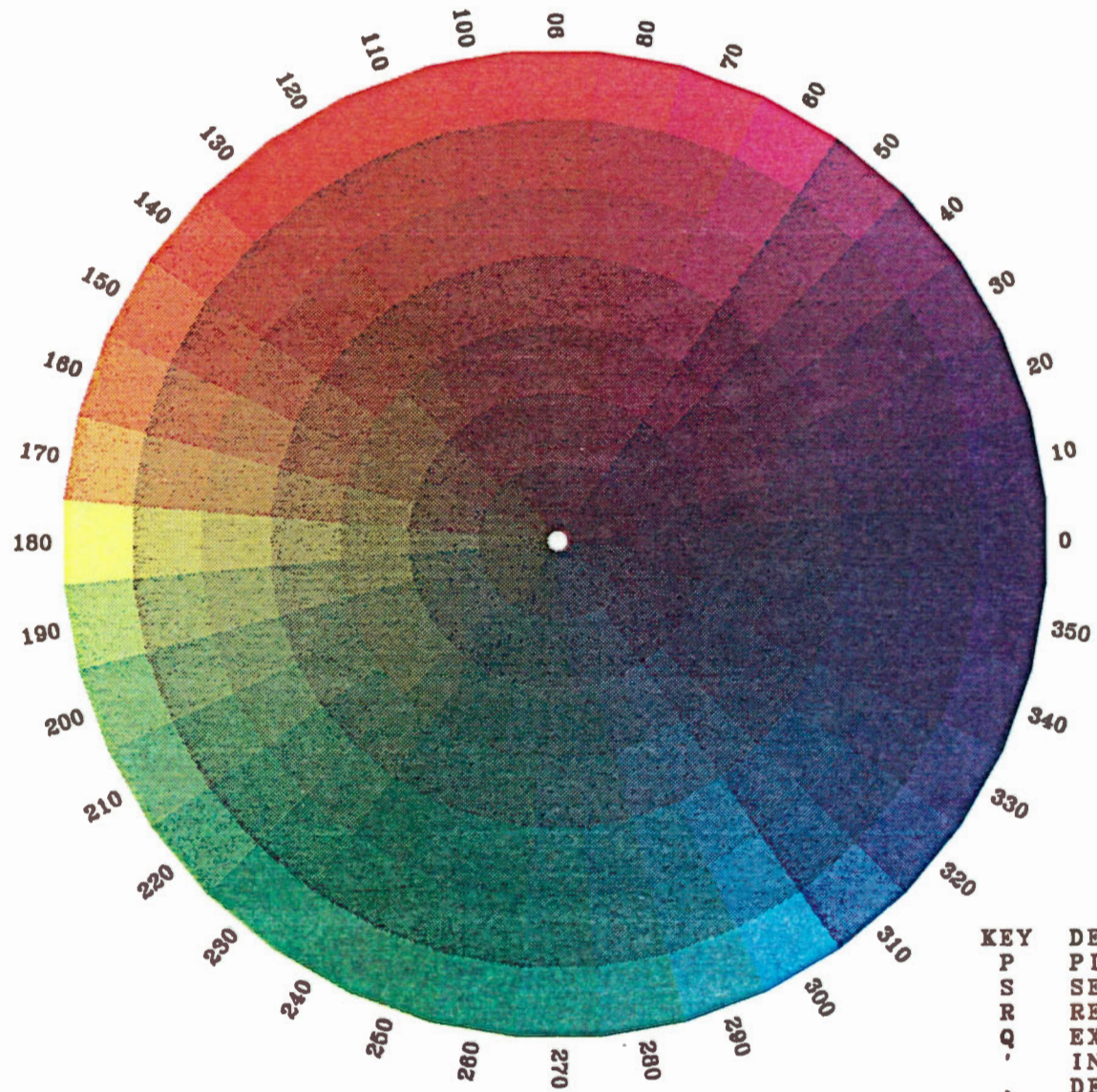
The position of the cursor will now determine the colour. The screen will represent an imaginary colour circle based on the hue, lightness and saturation colour system (HLS). This colour circle has blue to the right, red at the top, yellow to the left and green at the bottom, refer to figure 9. The saturation is 0% at the centre of the screen and increase to 100% at the edges. To change the colour, position the cursor and press the select key. The colour that was picked will immediately change to the selected colour. By moving the cursor to a new position and pressing the select key, the colour will again be changed. To retain the selected colour, press the pick key. To return the colour to its original value, press the reset key. Once a colour has been retained or reset a new colour from the colour bar may be picked.

The lightness of the picked colour is controlled by the lightness up and lightness down keys.

The whole colour scheme can be rotated through the colour bar by pressing the rotate up or rotate down keys.

Table 1 contains a list of graphics devices and the keys used to interactively change the colours.

FIGURE 9
HLS Colour Circle



KEY	DESCRIPTION
P	PICK/SET COLOUR
S	SELECT COLOUR
R	RESET COLOUR
Q	EXIT
.	INCREASE LIGHTNESS
,	DECREASE LIGHTNESS
[ROTATE COLOUR BAR UP
]	ROTATE COLOUR BAR DOWN

TEK 41XX MENU LIGHTNESS = 50

KEY NAME	PHYSICAL KEY		
	RASTER TECH 180	RASTER TECH 110	TEK 41XX
PICK	PUCK 0	MOUSE LEFT	P
SELECT	PUCK 3	MOUSE CENTRE	S
RESET	PUCK 5	MOUSE RIGHT	R
LIGHTNESS DOWN	PUCK C	F11	,
LIGHTNESS UP	PUCK D	F12	.
ROTATE DOWN	PUCK E	F9	[
ROTATE UP	PUCK F	F10]
EXIT	PUCK 6	F7	Q

Table 1
Interactive colour changing key chart

6.16 Sample Display Session

The following is an example of a complete session to plot a map.

```
$PLOTSYS
WELCOME TO THE GEOPHYSICS DATA BASE/APPLICATIONS GROUP PLOT SYSTEM

The default directory is set to : [ADJUST]

To change the default enter a new directory, else enter <cr>
Enter directory or <cr>: [AGC]

GSC$GRAVITY:[ADJUST.AGC]

The directory is set to : [ADJUST.AGC]

PLOTSYS MAIN MENU

  A - RETRIEVE DATA FROM THE GRAVITY ANOMALY DATA BASE
  B - CREATE A GRID FROM A RANDOM DATA SET
  C - GRID ENHANCEMENT
  D - DISPLAY A MAP
  E - PLOT A RDB FILE
  F - CHANGE DEFAULT DIRECTORY
  G - ISSUE A DCL COMMAND
  X - EXIT SYSTEM

Enter A-F or X: D

Enter PLOTSYS plot file folder name: NOVA

          WELCOME TO THE
          GEOPHYSICAL DATA DISPLAY PROGRAM 3.2
          CREATED BY
          APPLICATIONS SECTION
          GEOPHYSICS DIVISION
          GEOLOGICAL SURVEY OF CANADA

SEARCHING FOR PLOT FOLDERS

Only 1 PLOT FOLDER file was found.
The PLOT FOLDER file name is:
GSC$GRAVITY:[ADJUST.AGC]NOVA.FOLDER2;3

Do you wish to use this file? (Y/N)
>N

The directory searched was: [ADJUST.AGC]

Do you want to try another directory? (Y/N)
>N

The file search pattern used was: NOVA*.FOLDER2

Do you want to try another search pattern? (Y/N)
>N
```

Please choose the features you wish to display.

A -- COLOUR CONTOURS.....: YES
B -- LINE CONTOURS.....: NO
C -- DATA POSITIONS.....: NO
D -- MAP BASE.....: YES
E -- GEOGRAPHIC FEATURES..(WDB2).....: YES
F -- MAP NOTES.....: NO
G -- USER GEOGRAPHIC FEATURES.....: NO
H -- GEOGRAPHICAL NAMES.....: NO

Enter A to H to change, <cr> to continue

>✱

Please choose the features you wish to display.

A -- COLOUR CONTOURS.....: YES
B -- LINE CONTOURS.....: YES
C -- DATA POSITIONS.....: NO
D -- MAP BASE.....: YES
E -- GEOGRAPHIC FEATURES..(WDB2).....: YES
F -- MAP NOTES.....: NO
G -- USER GEOGRAPHIC FEATURES.....: NO
H -- GEOGRAPHICAL NAMES.....: NO

Enter A to H to change, <cr> to continue

>✱

Please choose the features you wish to display.

A -- COLOUR CONTOURS.....: YES
B -- LINE CONTOURS.....: YES
C -- DATA POSITIONS.....: YES
D -- MAP BASE.....: YES
E -- GEOGRAPHIC FEATURES..(WDB2).....: YES
F -- MAP NOTES.....: NO
G -- USER GEOGRAPHIC FEATURES.....: NO
H -- GEOGRAPHICAL NAMES.....: NO

Enter A to H to change, <cr> to continue

>✱✱✱

SEARCHING FOR GRID FILES

Only 1 GRID file was found.

The GRID file name is:

GSC\$GRAVITY:[ADJUST.AGC]NOVA.GRID;2

Do you wish to use this file? (Y/N)

>✱

Please wait, reading your grid file.

The grid covers following geographic area,

Southern latitude.....: N 42 0.00
Northern latitude.....: N 45 0.00
Eastern longitude.....: W 62 30.00
Western longitude.....: W 65 30.00

The map will cover the following area,

Southern latitude.....: N 42 0.00
Northern latitude.....: N 45 0.00
Eastern longitude.....: W 62 30.00
Western longitude.....: W 65 30.00

Are these the map boundaries O.K.? (Y/N)

>✱

The following DATA POSITION files have been found in directory:
[ADJUST.AGC]

File Name

A GSC\$[ADJUST.AGC]NOVA.DATA;2
B GSC\$[ADJUST.AGC]NOVA_BA.DAT;1

Enter the letter of the file you wish to use or <cr> to continue

><cr>

The directory searched was: [ADJUST.AGC]

Do you want to try another directory? (Y/N)

>N

The file search pattern was: *.DAT*

Do you wish to try another search pattern? (Y/N)

>N

Enter the file search pattern

><cr>

Only 1 DATA POSITION file was found.

The DATA POSITION file name is:

GSC\$:[ADJUST.AGC]NOVA_ALL_FA.XYZ:1

Do you wish to use this file? (Y/N)

>Y

Is the file in coded format (Y/N)?

>N

What is the order of your input data ?

A - LATITUDE, LONGITUDE, Z VALUE
B - LONGITUDE, LATITUDE, Z VALUE
C - Z VALUE, LATITUDE, LONGITUDE
D - Z VALUE, LONGITUDE, LATITUDE
E - LATITUDE, Z VALUE, LONGITUDE
F - LONGITUDE, Z VALUE, LATITUDE

Enter A - F

>A

Is the longitude positive west? (Y/N)

>N

You have the choice of plotting a rectangular map
or a map which follows the geographic boundaries.

A -- Rectangular.
B -- Geographic boundaries. (default)

Enter your choice A or B ?

><cr>

The area has the following z value limits,

Minimum z value.....: -0.5297827E+02
Maximum z value.....: 0.6265945E+02

How do you wish to set the contour intervals?

A -- Automatically, using a constant interval. (default)
B -- Manually, user enters contour levels.
C -- Histogram equalization.
D -- Specific intervals from a contour level file.

Enter A, B, C or D

><cr>

The default minimum contour level is : -52.97827
The actual minimum contour level will be a multiple
of the contour interval.

Enter the minimum contour level or <cr>
><cr>

The default maximum contour level is : 62.65945
The actual maximum contour level will be a multiple
of the contour interval.

Enter the maximum contour level or <cr>
><cr>

Enter the contour interval
>

Minimum contour level is : -50.00
Maximum contour level is : 60.00
Contour interval is : 5.00
Number of contour intervals : 23

Is this O.K.? (Y/N)
>

Enter the contour interval for labels, 0 for no labels.
>

Enter the contour interval for bold lines, 0 for no bold lines.
>

You may draw a histogram of the data distribution
within the contour intervals.

Do you wish to draw the histogram? (Y/N)
>

Do you want contour line annotation? (Y/N)
>

The line contours can be assigned colours.
The following schemes are available.

- 2 -- Blue below zero, green at zero, red above zero.
- 1 -- Blue below zero and red equal to and above zero.
- 0 -- User chooses a colour for every level.
- 1 -- All levels black.
- 2 to 32 -- All levels set to colour number.

Enter -2 to 32
>

Choose a colour scheme for the map.

- A -- UNIRAS DEFAULT (blue-green-red-yellow-white)
- B -- UNIRAS 2 (cyan-yellow-magenta)
- C -- Grey Scale (black to white)
- D -- Grey Scale (white to black)
- E -- Topographic Scale (green-yellow-brown)
- F -- HLS Scale (blue-cyan-green-yellow-red-magenta)
- G -- Standard Gravity Scale, FIXED (yellow at zero)
- H -- Standard Gravity Scale, FIXED (blue at zero)
- I -- Aeromag Total Field Scale
- J -- Aeromag North America Map Scale
- K -- Aeromag Vertical Gradient Scale
- L -- User defined colour scale

Enter the colour scheme to use.
>

Do you want to display a colour bar? (Y/N)
>

The data positions can be mark by one of 4 symbols
Press <enter> for the default symbol.
These symbols are:

A -- DOT . (default)
B -- PLUS +
C -- CROSS X
D -- ASTERISK *
E -- USER SUPPLIED FROM DATA FILE.

Which symbol do you wish to use, enter A-E
><enter>

The height of the symbols and text can be between
0.1 and 10.0 millimetres. The default is 0.5 mm for
the symbol height and 1.5 mm for the text height.

Enter the height for the symbols or <enter> for the default
><enter>

Do you want the values displayed also? (Y/N)
>N

The data positions will be plotted using,

Symbol.....: DOT
Symbol height.....: 0.500

The data values will not be plotted

Are these O.K.? (Y/N)
>Y

The following base maps are available:

A -- Corner positions marked.
B -- Corner positions marked and annotated.
C -- Frame with annotation and grid lines.
The default is a frame with annotation, option C.

Enter A-C or <enter> for default
><enter>

The map can have a latitude longitude grid.
If you want a grid enter the latitude spacing
in degrees and minutes. If you do not want a
grid press <enter>.

The map latitude spans are:

From N 42 0.000 to N 45 0.000

Enter the latitude grid separation
>N

Enter the latitude tic mark separation
>0 15

The map can have a latitude longitude grid.
If you want a grid enter the longitude spacing
in degrees and minutes. If you do not want a
grid press <enter>.

The map longitude spans are:

From W 62 30.000 to W 65 30.000

Enter the longitude grid separation
>N

Enter the longitude tic mark separation
>0 10

The latitude longitude grid separation is,
Latitude : 1 0.000
Longitude : 1 0.000

The latitude longitude tic mark separation is,
Latitude : 0 15.000
Longitude : 0 15.000

Is this O.K.? (Y/N)
>Y

You have chosen to display geographical features. Coast lines, major islands, lakes and double line rivers are the minimum that will be displayed. In addition to the above, the following can be displayed,

A -- Additional major islands, lakes and rivers....: YES
B -- Minor islands, lakes and rivers.....: YES
C -- International Boundaries.....: YES
D -- Internal Boundaries (U.S.A & Canada only).....: YES
E -- Coast line, major islands, rivers line width..: 0.35
F -- Minor islands, lakes and rivers line width....: 0.35
G -- International boundary line width.....: 0.75
H -- Internal boundary line width.....: 0.50

Enter A-H to change, <enter> to continue
>C

Do you wish to produce a double exposure map? (Y/N)
>N

The data values units are :MILLIGALS

Is this O.K.? (Y/N)
>Y

Do you want English titles first? (Y/N)
>Y

The title block will contain the following:

line

1:AGC 88720, 88739 AND IGDB DATA
2:
3:
4:COMPILED BY THE GEOPHYSICS DIVISION
5:GEOLOGICAL SURVEY OF CANADA, ENERGY, MINES AND RESOURCES
6:COMPILATION PAR LA DIVISION DE LA GEOPHYSIQUE
7:COMMISSION GEOLOGIQUE DU CANADA, ENERGIE, MINES ET RESSOURCES

Is this O.K.? (Y/N)
>Y

Which line do you wish to change (1-7)? 0 to exit
>2

Enter the new text
>FREE AIR A GRAVITY ANOMALY

Which line do you wish to change (1-7)? 0 to exit
>C

The title block will contain the following:

line

1:AGC 88720, 88739 AND IGDB DATA
2:FREE AIR GRAVITY ANOMALY
3:
4:COMPILED BY THE GEOPHYSICS DIVISION
5:GEOLOGICAL SURVEY OF CANADA, ENERGY, MINES AND RESOURCES
6:COMPILATION PAR LA DIVISION DE LA GEOPHYSIQUE
7:COMMISSION GEOLOGIQUE DU CANADA, ENERGIE, MINES ET RESSOURCES

Is this O.K.? (Y/N)

>Y

Where do you want the title?

- A -- Above the map
- B -- To the side of the map (default)

Enter A or B

>B

What map scale do you wish?

For a scale of 1:50,000 enter 50000

NOTE...if you choose a display terminal for your output device and the map is larger then the device, then the map will be scaled to fill the device

Enter the map scale

>100000

The size of the map will be

X direction size (millimetres)...: 249.5
Y direction size (millimetres)...: 335.5

The size of the map with the surround will be

X direction size (millimetres)...: 469.5
Y direction size (millimetres)...: 395.5

At the scale of.....: 1: 1000000.0

Are these O.K.? (Y/N)

>Y

The following devices are available for displaying your map,

DISPLAY TERMINALS

- A -- Raster Technologies Model One/80
- B -- Raster Technologies Model One/10
- C -- DEC Regis Graphics Terminals
- D -- Tektronix 41XX Terminals
- E -- Tektronix 40XX Terminals

PLOTTERS

- F -- Versatec Model CE3436 Electrostatic Plotter
- G -- Applicon Ink Jet Plotter
- H -- Optronics Film Plotter
- I -- Hewlett Packard DraftPro Pen Plotter

Enter your choice A-I

>F

Your plot can be produced on the following media.

- A -- Paper. (default)
- B -- Mylar.

Enter A, B or <cr>

>A

Do you want to retain the RDB file? (Y/N)

>N

Do you want to run this job interactively? (Y/N)

>N

The following batch queue are available

- 1 -- NIGHT - Processing starts at 6 pm and is suspended at 7 am
- 2 -- SYS\$BATCH - Processing starts immediately but with a low priority

Which batch queue, 1 or 2 ?

>N

FORTRAN STOP

Job NOVA (queue NIGHT, entry 1417) pending

Enter <cr> to continue: <cr>

The directory is set to : [ADJUST.AGC]

PLOTSYS MAIN MENU

- A - RETRIEVE DATA FROM THE GRAVITY ANOMALY DATA BASE
- B - CREATE A GRID FROM A RANDOM DATA SET
- C - GRID ENHANCEMENT
- D - DISPLAY A MAP
- E - PLOT A RDB FILE
- F - CHANGE DEFAULT DIRECTORY
- G - ISSUE A DCL COMMAND
- X - EXIT SYSTEM

Enter A-F or X: N

\$

7.0 PLOTTING A RDB FILE

If you wish to plot a previously created Raster Data Base (RDB) file, you would choose item E - PLOT A RDB FILE from the PLOTSYS main menu. After selecting item E, a list of all the RDB files in the current directory will be displayed. To specify the file to be plotted, enter its full file name and extension.

A RDB file is created for a specific device. Therefore, PLOTSYS creates RDB file extensions that reflect the device for which the RDB file was created. A file extension of `.RDB_VERS` is for the VERSATEC, `.RDB_APPL` is for the APPLICON and `.RDB_OPTR` is for the OPTRONICS. If the RDB file has an extension of just `.RDB` then the file was created by a program other than PLOTSYS. These files can be plotted through the PLOTSYS system but you must know for which hard copy device the RDB file was created.

If the RDB file extension is `.RDB`, you will be asked to select the hard copy device. If the RDB file extension contains a device specifier, then that device will automatically be selected. Depending on the hard copy device, you will be asked to select such things as the type of median to plot on (VERSATEC), the speed to use while plotting (APPLICON), number of sheets which will be plotted (APPLICON) and possibly your name and the delivery stop number (APPLICON and OPTRONICS). You will also have a choice of running the plot job interactively or placing it into one of the batch queues.

8.0 CHANGING THE DEFAULT DIRECTORY

You may change the default directory from the PLOTSYS main menu. To change the directory select item F - CHANGE DEFAULT DIRECTORY from the menu. You will then be asked to enter the name of the new directory. The syntax of this directory name is the same as the Digital Command Language command SET DEFAULT.

9.0 ISSUING A DCL COMMAND

You may issue almost any Digital Command Language (DCL) command from the PLOTSYS main menu. To issue a DCL command select item G - ISSUE A DCL COMMAND from the PLOTSYS main menu. You will then be asked to enter the DCL command that you wish to execute. When the execution of the command is finished, you will return to the PLOTSYS main menu.

APPENDIX A Standard Geophysics Grid Format

The grid file is a variable length record binary file. It consists of two major parts, the grid header and the grid node values. The grid header contains information on the grid's projection, grid cell size, data units and geographical position. The grid header is stored as character data.

The grid node value portion of the grid contains the grid nodes offsets from the projection origin in number of grid cells (in both the X and Y directions), the grid node undefined value and the z values for each grid node. This portion of the grid file is stored as binary data.

The detail grid file description follows.

<u>Line #</u>	<u>Byte #</u>	<u>Description</u>
1	1 -80	Header for grid (character*80)
1	81-90	Number of fields on line #2 (integer I10)
2	1 -10	Projection name (character*10)
2	11-20	Central meridian (real F10.5)
2	21-30	South parallel (real F10.5)
2	31-40	North parallel (real F10.5)
2	41-50	Number of survey area corners, maximum 50 (integer I10)
2	51-60	Number of fields on grid, always 1 (integer I10)
2	61-70	Line direction azimuth, always 0 (integer I10)
2	71-80	Grid cell size in metres (real F10.4)
2	81-90	Extra word (real F10.5)
2	91-100	Extra word (real F10.5)
3	1 -10	Latitude of survey area corner #1 (real F10.5)
3	11-20	Longitude of survey area corner #1 (real F10.5)
3	21-30	Latitude of survey area corner #2 (real F10.5)
3	31-40	Longitude of survey area corner #2 (real F10.5)
3	:	Latitude longitude pairs are continued until for
3	:	the number of survey area corners, maximum 50 pairs.
4	1 -10	Data field name part 1 (character*10)
4	11-20	Data field name part 2 (character*10)
4	21-30	Data field name part 3 (character*10)
4	31-40	Data field name part 4 (character*10)
5	1 - 4	Grid X origin in grid cells from projection origin (integer*4)
5	4 - 8	Grid Y origin in grid cells from projection origin (integer*4)
5	9 -12	Grid X maximum in grid cells from projection origin (integer*4)
5	12-16	Grid Y maximum in grid cells from projection origin (integer*4)
5	17-20	Grid node undefined value (real*4)
6	1- *	First column of grid (west most), from south to north. (real*4)
7	1- *	Second column of grid.
8	1- *	Each column contains [(Y maximum)-(Y origin)+1] grid nodes.
:	:	The number of columns is [(X maximum)-(X origin)+1]

APPENDIX B Grid File Folder

Contents of file folder.....: [PLOTSYS.DEMO]VISLAND.FOLDER
Input data file name.....: [PLOTSYS.DEMO]VISLANDBOUGUER.DATA
Input file form.....: CODED
Input file data order.....: A
Input file longitude positive west...: NO
Grid south latitude.....: N 48 0.000
Grid north latitude.....: N 52 0.000
Grid east longitude.....: W 121 30.000
Grid west longitude.....: W 130 30.000
Grid minimum allowable data value...: -0.1000000E+21
Grid maximum allowable data value...: 0.9000000E+04
Grid projection.....: 3 Lambert Conformal Projection (LCP)
Grid central meridian.....: W 126 0.000
Grid south parallel.....: N 48 40.000
Grid north parallel.....: N 51 20.000
Griding method.....: 1 UNIRAS GINTPF - Weighted average interpolation.
Grid cells in the X direction.....: 355
Grid cells in the Y direction.....: 247
Grid X minimum co-ordinate (metres)..: -0.3540000E+06
Grid X maximum co-ordinate (metres)..: 0.3540000E+06
Grid Y minimum co-ordinate (metres)..: -0.2400000E+06
Grid Y maximum co-ordinate (metres)..: 0.2520000E+06
Grid cell size (metres).....: 2000.000
Grid search radius (metres).....: 10000.000
Grid smoothing level.....: 0
Grid file name.....: [PLOTSYS.DEMO]VISLAND.GRID
Grid header.....: VANCOUVER ISLAND - BOUGUER GRAVITY
Grid data value units.....: Milligals
Grid point undefined value.....: -0.9999000E+04
Total number of input data points...: 28473
Southern most latitude of input data: N 47 0.000
Northern most latitude of input data: N 52 59.956
Eastern most longitude of input data: W 121 0.000
Western most longitude of input data: W 130 59.993
Minimum input data point value.....: -0.2071720E+03
Maximum input data point value.....: 0.9999000E+04
Total number of screened data points: 27485
Southern most point of screened data: N 47 12.060
Northern most point of screened data: N 52 47.999
Eastern most point of screened data.: W 121 0.000
Western most point of screened data.: W 130 59.993
Minimum screened data point value...: -0.2071720E+03
Maximum screened data point value...: 0.2177600E+03

APPENDIX C Colour Scheme File Format

The colour scheme file is a free format ASCII file. The colours are based on the hue, lightness and saturation colour system (HLS). The HLS system is based on a double ended cone, where the colour is a vector quantity. Hue is the angle that the vector makes with the axis of the cone. The hue can have the value of 0° to 360°. A hue of 0° corresponds to blue, 120° to red and 240° to green.

The lightness is the vector's position along the cones axis. The lightness can have the value of 0% to 100%. A lightness of 0% is black and 100% is white.

Saturation is the vector's length from the axis. It also can have the value of 0% to 100%. A saturation of 0% is a shade of grey, while a saturation of 100% is the most intense colour having that hue.

The file format is a header record followed by the HLS colours. There is only one colour per record.

The header record contains two values. The first value is the number of colours in the file. The second number is the colour record number for the display of the zero contour level. If this number is zero, then the complete colour scheme is used and every Nth value is used, where N is determined by the number of contour levels and the number of colours within the colour scheme file. If the second number is not zero and is positive, then the colour located on this record number is used as the zero contour level colour and the colours are assigned sequentially to the remaining contour levels.

Sample Colour Scheme File

17	8		17 colours with colour # 8 at contour level 0
0	0	0	first HLS colour (black)
330	50	100	(dark blue)
300	50	100	(aqua)
300	66	100	(light blue)
240	34	100	(dark green)
240	50	100	(green)
210	50	100	(light green)
195	50	100	contour level 0 colour (yellow-green)
180	50	100	(yellow)
168	47	100	(light orange)
166	41	100	(light brown)
164	34	100	(brown)
150	50	100	(orange)
120	50	100	(bright red)
120	41	100	(red)
120	28	100	(dark red)
0	100	0	last HLS colour (white)

APPENDIX D UNIRAS Default Colour Scale

COLOUR NUMBER	H	L	S	COLOUR
0	-	-	-	BACKGROUND
1	-	-	-	FOREGROUND
2	120	50	100	RED
3	240	50	100	GREEN
4	0	50	100	BLUE
5	300	50	100	CYAN
6	60	50	100	MAGENTA
7	180	50	100	YELLOW
8	150	50	100	ORANGE
9	210	50	100	YELLOW-GREEN
10	270	50	100	TURQUOISE
11	330	50	100	CYAN-BLUE
12	30	50	100	VIOLET
13	90	50	100	PURPLE
14	-	33	0	DARK GREY
15	-	66	0	LIGHT GREY
16	120	50	50	REDDISH BROWN
17	180	50	50	ABSINTHE
18	240	50	50	GREYISH GREEN
19	300	50	50	STEEL-GREY
20	0	50	50	LAVENDER
21	60	50	50	GREYISH-MAGENTA
22	120	25	100	DARK RED
23	240	25	100	DARK GREEN
24	0	25	100	DARK BLUE
25	120	75	100	DIM RED
26	240	75	100	DIM GREEN
27	0	75	100	DIM BLUE
28	-	14	0	DARK GREY
29	-	44	0	MEDIUM GREY
30	-	56	0	LIGHT GREY
31	-	86	0	VERY LIGHT GREY
32	-	0	-	BLACK

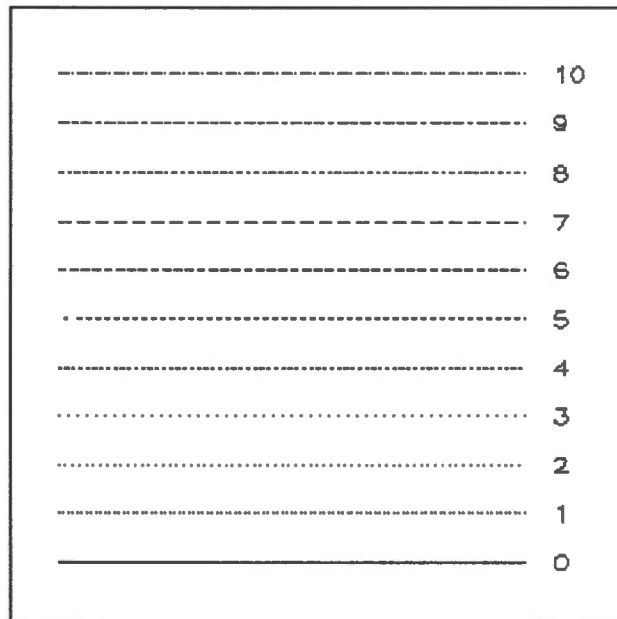
APPENDIX E User Supplied Geographic Features File Format

The user supplied geographic features file contains line segments, which can be displayed on a map. The end points of the line segments are in geographical coordinates with north latitudes and west longitudes being positive. The file can either be a coded text file or a binary file.

Both the coded text file and binary file format contain two types of records. The first record type (description line) contains the number of geographical coordinate pairs (integer), the line style number (integer), the line colour number (integer) and the line width (real). The second record type (coordinate line) contains latitude-longitude pairs (real). These record types can be in free format.

In a coded text file, the description line must be followed by coordinate lines that contain the specified number of coordinate pairs. In a binary file, the description record must be followed by a single record containing all of the specified coordinate pairs.

The line style number has the range of 0 to 10. The line styles are displayed below.



The line colour number is the from the UNIRAS default colour scale, refer to Appendix D.

The line width is either in millimetres or pixels. If the line width is a positive number, the line width will be in millimetres. If the line width is negative, the line width will be in pixel.

Sample User Supplied Geographic Feature File using a Coded Text Format

```
10 4 2 0.5
60.0 90.0 60.1 90.0 60.2 90.1 60.3 90.15 60.45 90.14 60.5432 90.1339
60.6 90.12 60.78 90.112 60.8123 90.1001 69.999 90.0
5 0 1 -1
60.5 90.5 60.5 90.6 60.4 90.6 60.4 90.5 60.5 90.5
```

The first line describes that there will be 10 latitude longitude pairs following. The next two lines contain the 10 latitude longitude pairs. These coordinates will be plotted with a dashed red line with a width of 0.5 millimetres. The fourth line contains second line segment description, which says there will be 5 points using a solid black line with a width of 1 pixel. The sixth line contains the 5 latitude longitude pairs.

BOUGUER GRAVITY MAP OF BAIE-COMEAU PRODUCED BY PLOTSYS

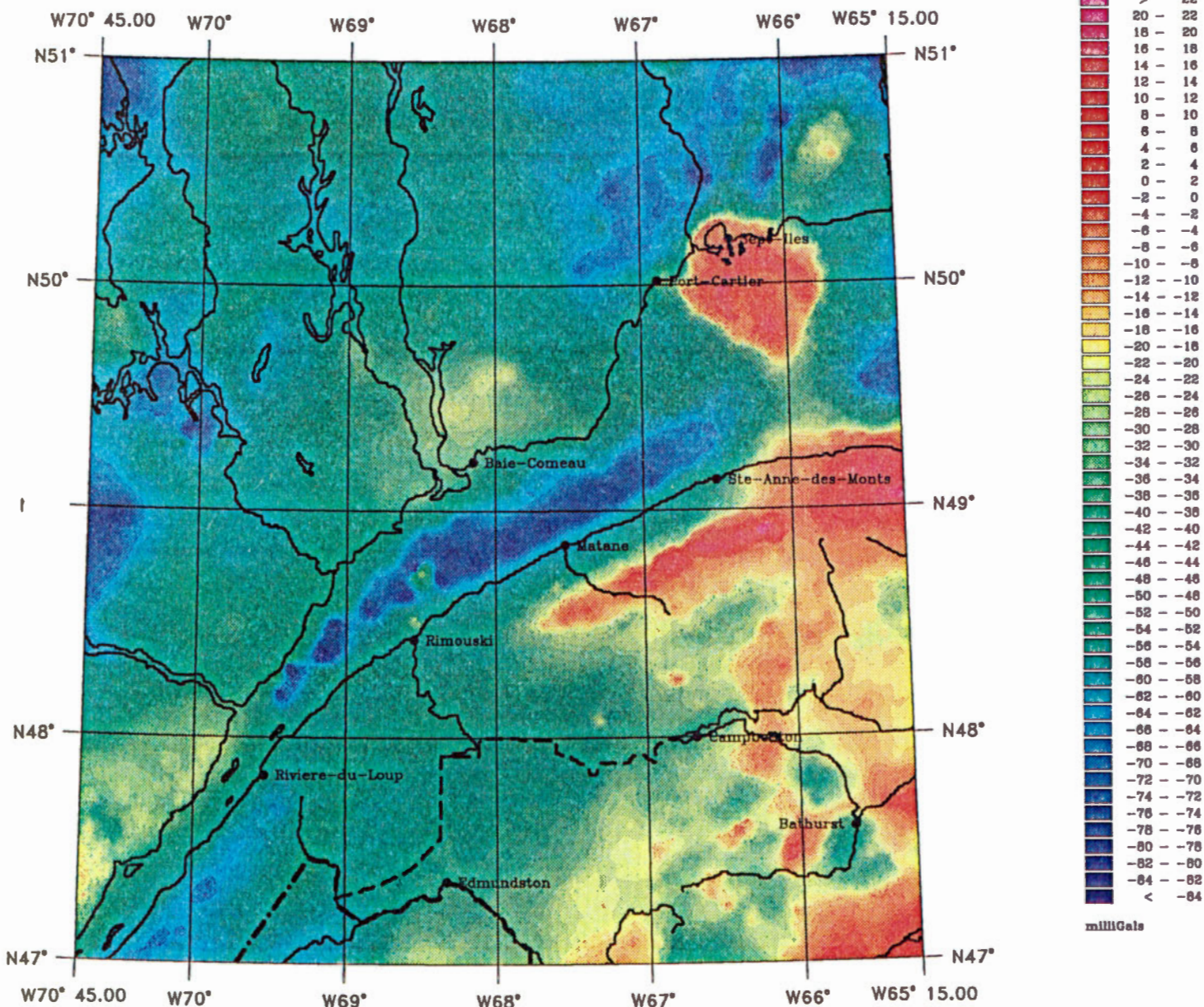
COMPILED BY THE GEOPHYSICS DIVISION

GEOLOGICAL SURVEY OF CANADA, ENERGY, MINES AND RESOURCES

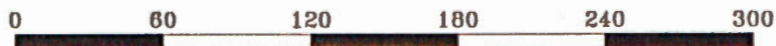
COMPILATION PAR LA DIVISION DE LA GEOPHYSIQUE

COMMISSION GEOLOGIQUE DU CANADA, ENERGIE, MINES ET RESSOURCES

8-JUL-89



SCALE 1:3000000 ECHELLE



KILOMETRES

LAMBERT CONFORMAL CONIC PROJECTION

PROJECTION CONIQUE CONFORME DE LAMBERT

CENTRAL MERIDIAN W68° MERIDIEN CENTRAL 68°W

STANDARD PARALLELS N47°40.00 AND N50°20.00

PARALLELES D'ECHELLE CONSERVEES 47°40.00N ET 50°20.00N

APPENDIX G Gravity Data Base Retrievals

If you wish to display data from the Gravity Data Base, you can submit a retrieval request from PLOTSYS by selecting menu item A. Since the Gravity Data Base presently resides on the CYBER mainframe computer system, a retrieval job is created on the VAX then sent to the CYBER for execution. The selected data is sent back to the VAX and placed into a file in the directory where the retrieval request originated.

Required Information

To submit a Gravity Data Base retrieval the following information will be required.

PLOTSYS file folder name.

CYBER user name.

CYBER account number.

CYBER permanent file ID.

The password of the VAX user account that is currently being used.

Geographical limits of the area for retrieval.

Type of data required from the data base, one or more of the following;

- Elevations,
- Depths,
- Adjusted Gravity,
- Terrain Corrections,
- Free Air Anomaly,
- Bouguer Anomaly.

Whether the free air anomaly is to be used offshore, when the bouguer anomaly is requested.

CYBER job execution specifications.

A one degree surround will automatically be added to the geographical area specified. This allows for proper edge fitting, when an adjacent map is produced. It also allows for filtering and grid enhancement.

File Naming Conventions

When the data base retrieval has completed, it will send the selected data back from the CYBER to the VAX. There will be one data file for every selected data type that was retrieved. The data files on the VAX are named according to the file folder name and the type of data that they contain.

The file folder name will be suffixed by the data type. These suffixes are ELEV for elevation data, DEPTH for depths, ADJGRAV for adjusted gravity, TERCOR for terrain corrections, FREEAIR for free air anomaly and BOUGUER for the Bouguer anomaly. The file extension will always be ".DATA".

As an example of this naming convention; if you requested a data base retrieval of the free air anomaly and had chosen a file folder name of TEST, the free air data would reside in a file named TESTFREEAIR.DATA in the directory from which the retrieval request was issued.

File Format

The file format of the retrieved data is a formatted ASCII file, which contains one data point per record. The data record contains the latitude, longitude and requested data value, respectively. The latitude is positive north and the longitude is negative west. An undefined data point has the requested data value set to 9999.0.

Sample Gravity Data Base Retrieval Session

```
$ PLOTSYS

WELCOME TO THE GEOPHYSICS DATA BASE/APPLICATIONS GROUP PLOT SYSTEM

The default directory is set to : [PLOTSYS.DEMO]

To change the default enter a new directory, else enter <cr>
Enter directory or <cr>: CR

The directory is set to : [PLOTSYS.DEMO]

PLOTSYS MAIN MENU

  A - RETRIEVE DATA FROM THE GRAVITY ANOMALY DATA BASE
  B - CREATE A GRID FROM A RANDOM DATA SET
  C - GRID ENHANCEMENT
  D - DISPLAY A MAP
  E - PLOT A RDB FILE
  F - CHANGE DEFAULT DIRECTORY
  G - ISSUE A DCL COMMAND
  X - EXIT SYSTEM

Enter A-F or X: A
Enter PLOTSYS file folder name: VISLAND

ANOMALY RETRIEVAL

%DCL-I-SUPERSEDE, previous value of SYS$INPUT has been superseded

VAX-CYBER ANOMALY RETRIEVAL SYSTEM

Enter your CYBER user ID:
>IUSER

Enter your CYBER account number:
>12345

Enter your VAX password:
>VPASS
```

PLEASE ENTER THE BOUNDARIES OF YOUR AREA

SOUTHERN LATITUDE? N48
NORTHERN LATITUDE? N52
EASTERN LONGITUDE? W122
WESTERN LONGITUDE? W130

THE LATITUDE AND LONGITUDE BOUNDARIES OF YOUR MAP AREA ARE:

SOUTHERN LATITUDE -- N 48 0.0000
NORTHERN LATITUDE -- N 52 0.0000
EASTERN LONGITUDE -- W 122 0.0000
WESTERN LONGITUDE -- W 130 0.0000

ARE ALL THESE VALUES CORRECT? REPLY ONE OF
YES, NO, QUIT, ABORT OR ? FOR HELP YES

Enter the security codes of the data to be retrieved

Enter "9" for all securities
Enter just <CR> to end selection
Immediate <CR> will select security 0 only

><CR>

Enter the numbers of the fields to be transferred:

Enter "9" for all fields
Enter "0" for just <CR> to stop selection

1: Elevation
2: Depth
3: Adjusted Gravity
4: Terrain Correction
5: Free Air Anomaly
6: Bouguer Anomaly,

>5
>6
><CR>

You have selected the following plot field(s):

5 - Free Air
6 - Bouguer Gravity

Is this correct?

>Y

Do you want free-air, not bouguer, offshore?

>N

Enter the CYBER file ID:

>USER

CYBER JOB SPECIFICATIONS ARE:

CP time : 777 (octal) 511 (decimal)
IO time : 7777 (octal) 4095 (decimal)
Priority : STWDJ

Are these O.K. ? (Y or N) : N

Enter CP time in decimal seconds:

>600

Enter IO time in decimal seconds:

>3000

Enter priority (P0, P2 or STWDJ):

>P2

CYBER JOB SPECIFICATIONS ARE:

CP time : 1130 (octal) 600 (decimal)
IO time : 11610 (octal) 5000 (decimal)
Priority : P2

Are these O.K. ? (Y or N) :
FORTRAN STOP

Sending Anomaly Retrieval Job to cyber for execution...

Enter <cr> to continue: <cr>

The directory is set to : [PLOTSYS.DEMO]

PLOTSYS MAIN MENU

A - RETRIEVE DATA FROM THE GRAVITY ANOMALY DATA BASE
B - CREATE A GRID FROM A RANDOM DATA SET
C - GRID ENHANCEMENT
D - DISPLAY A MAP
E - PLOT A RDB FILE
F - CHANGE DEFAULT DIRECTORY
G - ISSUE A DCL COMMAND
X - EXIT SYSTEM

Enter A-F or X: X

\$

This retrieval selects the Free Air and Bouguer anomaly data for the area around Vancouver Island, geographical boundaries of N 48 and N 52 degrees latitude and W 122 and W130 degrees longitude.

The CYBER account number that the retrieval job is charged to is 12345. The job was executed with the job I.D. of IUSER. The default data security was used. The CYBER job specifications were bumped up to insure that the job ran until completion.

If all goes well with the data transfers between the computers, two files will be created in the directory [PLOTSYS.DEMO]. These files will be named VISLANDFREEAIR.DATA and VISLANDBOUGUER.DATA for the Free Air and Bouguer anomaly data sets respectively.

These two files will also reside on the CYBER for 5 days. This is in case the file transfer fails then the files can be transferred to the VAX at a later time. For the sample retrieval above, the files will be cataloged with the permanent file names of VISLANDFREEAIR and VISLANDBOUGUER and the permanent file ID of USER. All catalogs will reside on the CYBER disk set IGDB.