NGU Rapport 93.066

# GDEPTH -
# Gravity Inversion and calculation of basement depths

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# REPORT

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Summary:

GDEPTH is a gravity inversion program that estimates the basement topography or a density surface at a given depth and a given density contrast across the surface. The IBM-PC compatible program is most applicable to determine the depth of sedimentary basins when the density contrast with underlying basement-rocks is significant. When combined with magnetic inversion (Torsvik & Olesen 1992) the program provides an important and cost-fast tool in early basin modelling.

| Keywords: | Gravity | Inversion |
|---|---|---|
| Modelling | Basins | |
| | | User manual |

# G D E P T H

Gravity inversion and calculation of basement depths

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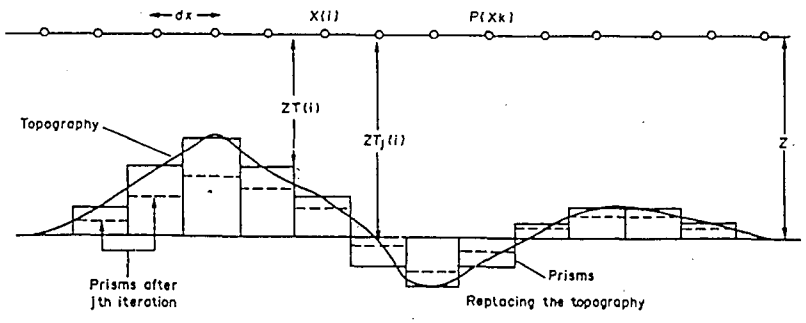
## 1. INTRODUCTION

GDEPTH is a gravity inversion program, modified from Murthy & Rao (1989), that estimates the basement topography or a density surface at a certain depth (Z) and a given density contrast across the surface (Fig. 1). The program is most applicable to determine the depth of sedimentary basins when the density-contrast which underlying basement-rocks is significant (say >0.2 1000kg/m$^3$). When combined with magnetic inversion (Torsvik & Olesen 1992) the program provides an important and cost-fast tool in early basin modelling. Inversion results are very suitable as input to the forward modelling program (Torsvik 1992a).

**FIGURE 1** Replacement of basement topography with vertical 2D prisms (from Murthy & Rao, 1989).



## 2. PROGRAM METHODOLOGY

Based on a sequence of equal-spaced gravity data, the program calculates the depth to the top of a basement surface below each gravity point. A regional anomaly is automatically determined and subtracted. The operator must assign a 'basic' depth Z (Fig. 1), for which the basement relief is to be worked out and the density contrast across that surface (Murthy & Rao 1989). The program assumes that the gravity anomaly completely covers a structure, hence the top of basement will therefore always be equal to Z at the start and the end of the profile (Fig. 1). In case of an assymetric gravity structure, i.e. a topography with different depths at the start and the end of the profile, a special option can be used (cf. details in option 'Profile Extension').

Below each gravity point the density surface is reduced to a vertical 2D-prism (Fig. 1) with a depth ZT to its top. During an iterative process these prisms are 'moved' up and down along the profile. Certain limits can be set by the operator (i.e. minium and maximum depths set in option 'RUN DEPTH'; cf. 5.3). The difference between observed and calculated gravity anomalies is iteratively minimized with the Marquardt's (1963) least-squares (LSQ) algorithm. Iteration will terminate with LSQ minimum or divergence defined by the dynamically controlled Marquardt's damping factor lambda exceeding 15 (cf. details in option 'RUN DEPTH').

## 3. INSTALLATION

- Type **A:INSTALL** at the DOS system prompts
  This will create a sub-directory named MAGMOD (if not already created) and copy all files to this directory.
- Add sub-directory MAGMOD to the path-command (if not already done) in the AUTOEXEC.BAT file (..;C:\magmod)

## 4. HARDWARE REQUIREMENTS

**System requirement:**

- IBM AT or compatible (80286/386/486) computer.
- Mathematical co-processor (80287/387/487)
- VGA or EGA graphics card
- Microsoft compatible mouse (3 button)

**Graphical Output Devices:**

- HP Laser/Deskjet compatible printer,
- HP-GL compatible pen-plotter, or
- almost any output devices via the use of HALO Graphics Kernel System. This, however, needs a separate software licence (Copyright Media Cybernetics, Inc., USA) and the use of the program IMPRINT (Torsvik 1992b).

**Hardcopy listing devices**

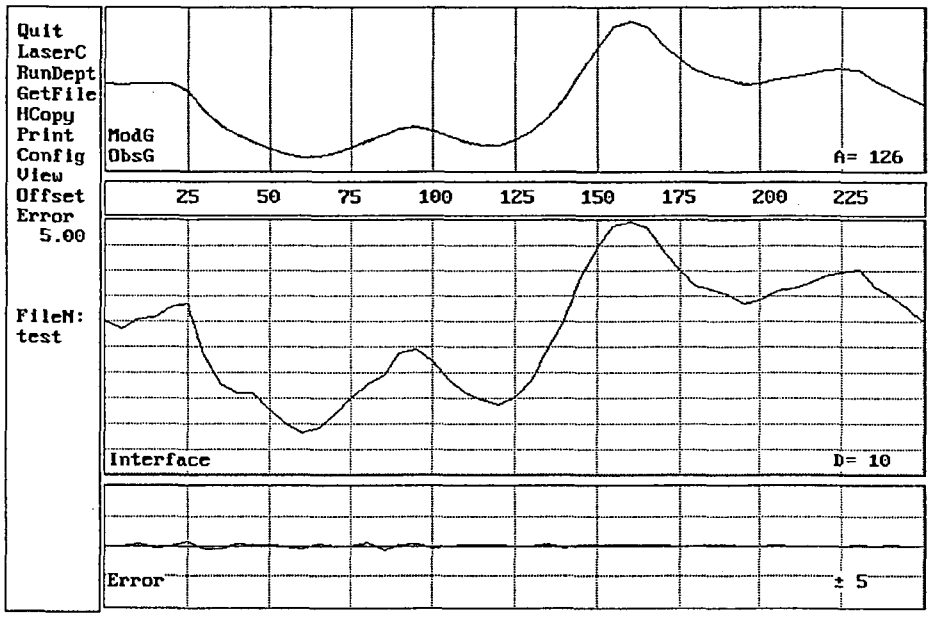
- Almost any printer

## 5. OPERATION OF GDEPTH

Type GDEPTH at the DOS system prompt or select GDEPTH from the IMP menu program. GDEPTH immediately loads a file named GD.OUT which is the last depth-calculation file created by the operator. The program also loads a system configuration-file named GDEPTH.SYS. The default content of this file can be changed in option 'CONFIGURE'.

A graphical presentation of the last depth estimate is displayed (Fig. 2) along with the main menu options. These options are selected by using the <Up> & <Down> cursor arrows. Select option followed by <ENTER> or input from keyboard the first character for the desired option. In addition the <PG UP> & <PG DN> keys will set the amplitude in the depth plot (see below).

**FIGURE 2** Main menu options in GDEPTH and the three graphic windows displaying observed & modelled gravity data (Window 1), calculated depths (Window 2) and errors (Window 3).




The main menu has the following options:

| OPTION | EFFECT |
|---|---|
| QUIT | END PROGRAM (EXIT TO DOS) |
| LASERC | COPY GRAPHIC IMAGE TO LASERJET/DESKJET |
| RUNDEPT | RUN GRAVITY INVERSION & ESTIMATE DEPTHS |
| GETFILE | READ A FILE FROM DISK |
| HCOPY | COPY PLOT TO A HPGL PEN PLOTTER |
| PRINT | PRINT RESULTS TO A LINE PRINTER |
| CONFIG | CONFIGURE SYSTEM |
| VIEW | DETERMINE/SAVE DEPTHS INTERACTIVELY |
| OFFSET | OFFSET DEPTH ESTIMATES |
| ERROR | SET SELECTED ACCURACY IN mG |
| PG UP/ PG DN | INCREASE/DECREASE DEPTH IN WINDOW 2 |

## 5.1 ERROR

This option allows the user to change the display in the error control window (Window 3). Error is difference (in mG) between observed gravity points and the modelled gravity anomaly. The diagram shows the zero base line together with ±ERROR amplitude (in mG) which is set by the operator with this option.

## 5.2 LASERC

Option 'LASERC' provides a screen-dump to a HP LASERJET/DESKJET compatible printer. Four plot-sizes are available, i.e. 1 (X width=4.8cm), 2 (X width=9.7cm), 3 (X-width=14.5cm) and 4 (full size, X width=19.4cm) which are selected in option 'CONFIGURE'. This option uses the communication port set for PRINTER (see option 'CONFIG').

**NOTE:**

This option assumes that sub-option 'Plot to IMPPRINT file' is set to **n** (no) in option 'CONFIGURE'. If a HP Laserjet/Deskjet is not available then set this sub-option to **y** (yes). Option 'LaserC' will then produce graphic image files (extensions .INT, .RED, .GRN and .BLU) which later can be printed using the program IMPPRINT (Torsvik 1992b). The operator is prompted for a file name (do not use any file

extensions) when creating IMPPRINT image files. Image files will be stored in sub-directory \MAGMOD.

## 5.3 RUNDEPTH

This option (Fig. 3) starts gravity inversion and estimates basement surface depths. Prior to accessing this option, the operator must load a file via option 'GETFILE'. Maximum number of data-points is 105 and the data must be equally spaced. Not equally spaced data can be interpolated by utility program PROFILE.

**FIGURE 3** Option 'RUNDEPTH'

```
                    G R A V I T Y   I N V E R S I O N
Number of iterations (100=default)                    :10
Lambda Control Factor (0.5=default)                   :.5
Lowpass Filter (moving average;1,3,5,7 or 9)          :5
Profile extension    (Y or N)                         :n
Depth to Interface   (in Km)                          :4
Minimum depth to interface        (in Km)             :0
Maximum depth to interface        (in Km)             :10
Density contrast across interface (in 1000kg/CM)      :0.4
Station Interval (in Km)                              :5

Continue Gravity Inversion (y/n):y
```

Parameters which affect the gravity inversion process are as follows:

1. Maximum iterations (100=default):

The gravity inversion routine uses an iteration scheme which employs Markquardt's (1963) optimization. Iteration will terminate when the least-square sum (LSQ) reaches a minimum (Fig. 4) or whenever the dynamically controlled Markquardt's damping factor (LAMBDA) becomes larger than 15 (see Murthy & Rao, 1989). The operator, however, can terminate iteration interactively at any stage by setting a low value of iterations (Fig. 5; maximum set to 3).

**FIGURE 4** Example of a converging solution (6 iterations).

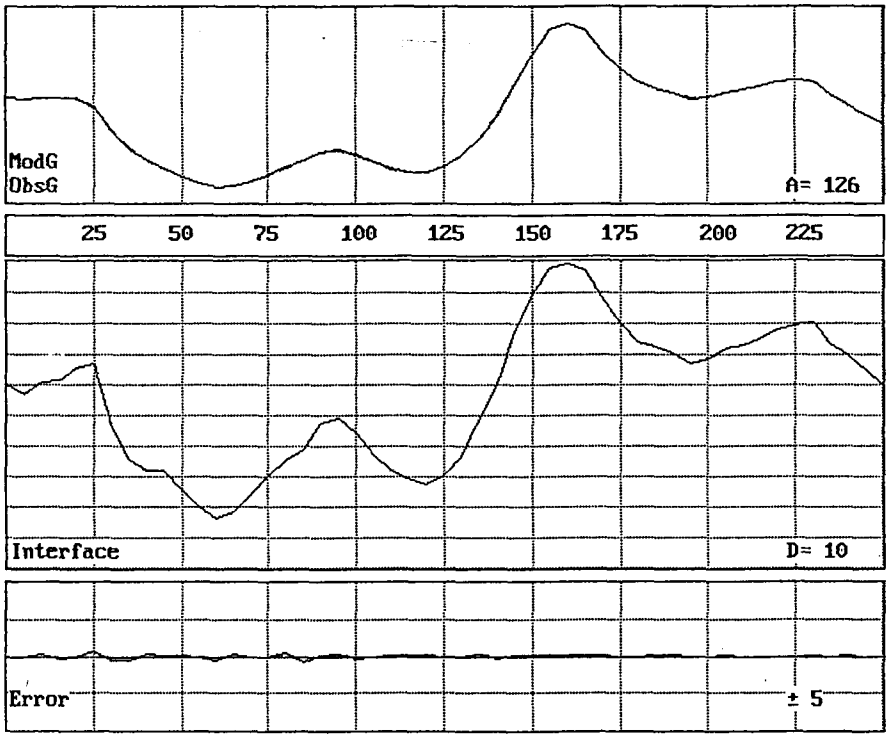
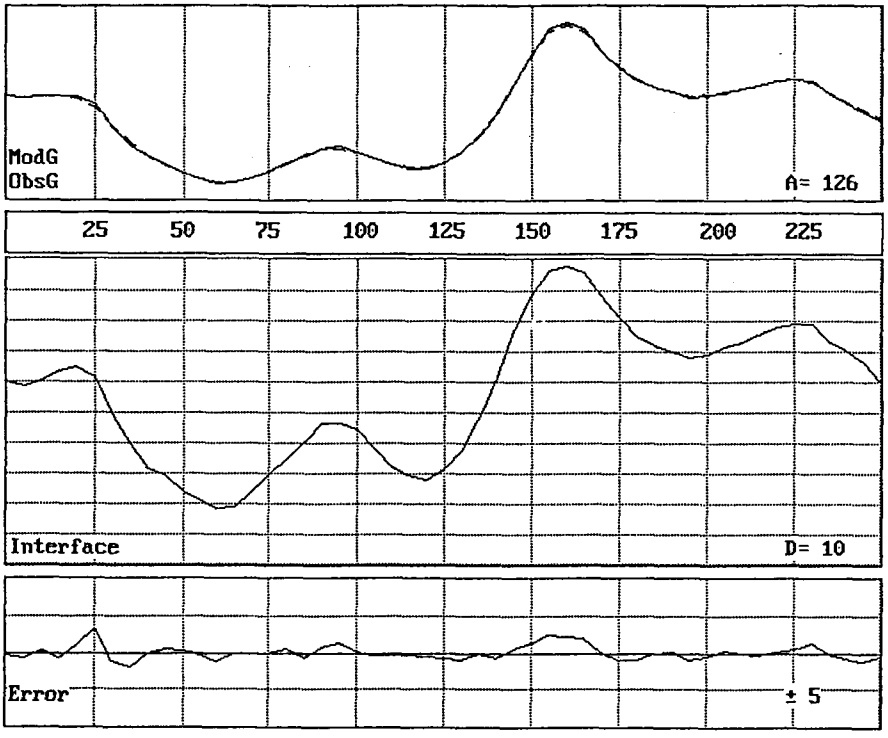



**FIGURE 5** Example of setting a low number of iterations (=3). Same example as Fig. 4; note higher 'errors' in the lower diagram.



2. LAMBDA Control Factor (CF; 0.5=default):

Markquardt's (1963) damping factor LAMBDA is dynamically controlled due to the condition of the inversion process. The user can influence the dynamical change of LAMBDA by means of a control factor CF defined by:

$$LAMBDA = CF*(2^{n-1}-1)$$

n is counter and dynamically changed as follows:

n=1 ... at the beginning of the program, i.e. LAMBDA=0

n=n+1 ... if the LSQ sum is not converging, n is iterative increased to a maximum of n=15

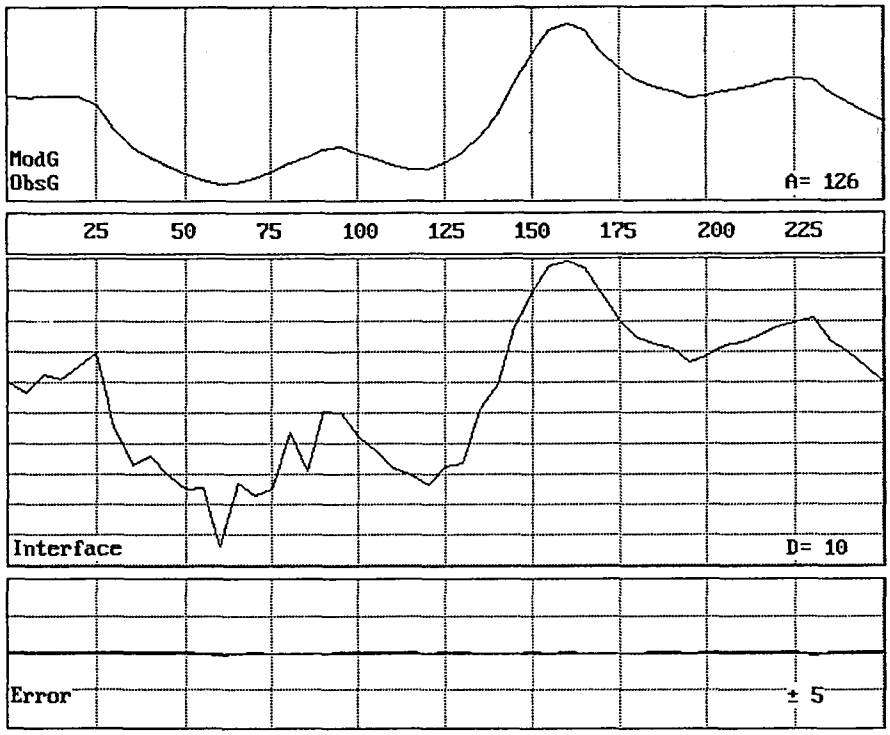
n=n-0.2.. if the LSQ sum is converging again, n is iterative decreased to n=1

A value of CF=0.5 (default) is recommended. Higher values for CF should be chosen in case of divergence problems, lower values to speed up the iteration process.

3. Lowpass Filter Value (odd number;5=default):

In order to 'smooth' oscillating depth estimates a lowpass filter (moving average) has been implemented. Only odd numbers should be used (1,3,5,7 etc.). The effect of not employing a lowpass filter is shown in Figure 6.

**FIGURE 6** Same example as in Fig. 4, but not using a lowpass filter (lowpass value is set to 1).



4. Profile Extension (y or n; n=default):

The program automatically subtracts a linear regional trend from the gravity data (if not already removed). This implicates that inversion of asymmetric gravity profiles associated with asymmetric basement topography, i.e. different depths at the start and at the end of the profile, results in erroneous depth estimates. These cases, however, can be handled by a prolongation (extension) of the original profile. The profile is extended to twice of its original length. In the first half of the extension the original end profile value is kept constant. In the second half the anomaly values are linearly decreased from the original end profile value to an end value equal to the start value (Fig. 9). Depth values according to the original profile will now be correct, but it is obvious that depth estimates along the extended part of the profile are meaningless and should not be used.

Fig. 7 shows a synthetic gravity anomaly generated from an asymmetric basement topography employing the IMP5 modelling program (Torsvik 1992a). The model was prolonged in both directions in order to minimize edge-effects and we used a density contrast of 0.4 (1000kg/$m^3$) to calculate the gravity anomaly. The synthetic gravity anomaly was subsequently imported to GDEPTH and the depth estimate (erroneous) without using profile extension is shown in Fig. 8. The usefulness of profile extension is demonstrated in Fig. 9. In the

latter case we observe two basement surface estimates close to our original model (1 and 4 kilometre depths) in Fig. 7.

**FIGURE 7** Generation of an asymmetric gravity anomaly associated with an asymmetric basement topography.

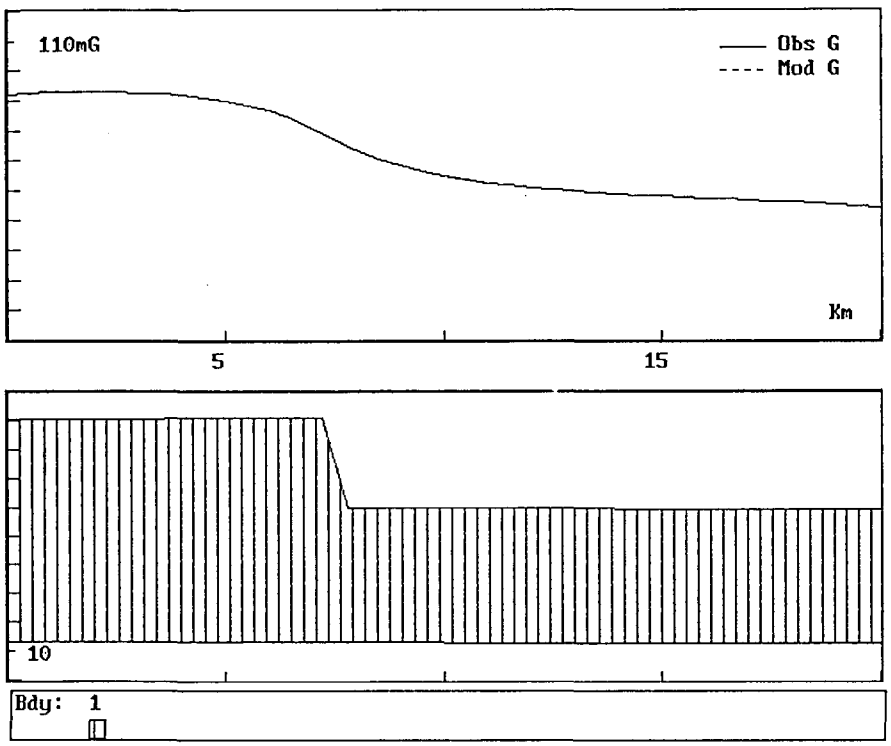


FIGURE 8 Gravity inversion of gravity anomaly produced in Fig. 7. No profile extension.

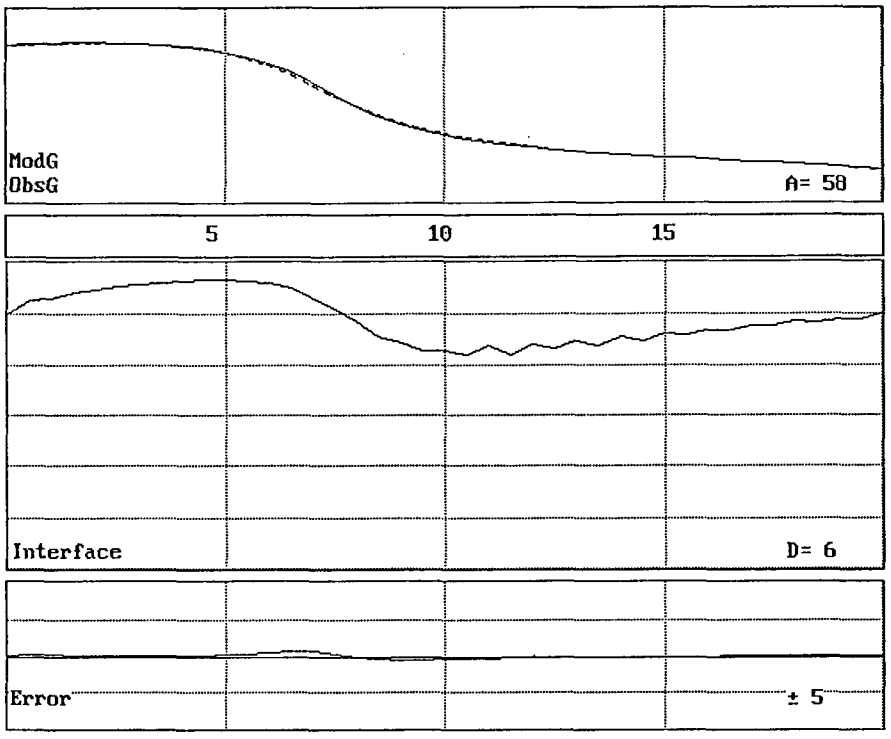
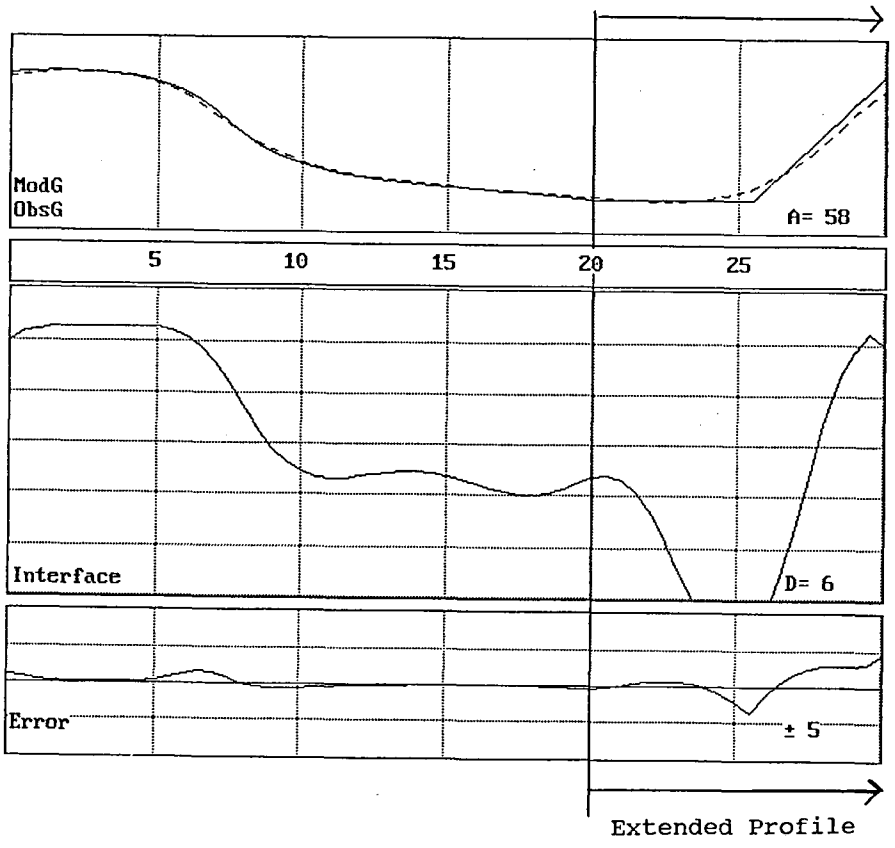



FIGURE 9 Gravity inversion (as Fig. 8), but invoking profile extension. The depth estimates are now in better correspondence with the initial model (Cf. Fig. 7).



5. Depth to interface (in km):

The gravity inversion procedure initially assumes a flat basement topography, e.g the density surface between sediments and basement, at a specific depth (see Fig. 1 - Z) which is set by the operator. The top of the density surface will be equal to Z and the start and the end of the profile. The choice of minimum and maximum depth's (see below) will dictate inversion convergence. An example with more restricted maximum/minimum depths are shown in Fig. 10.

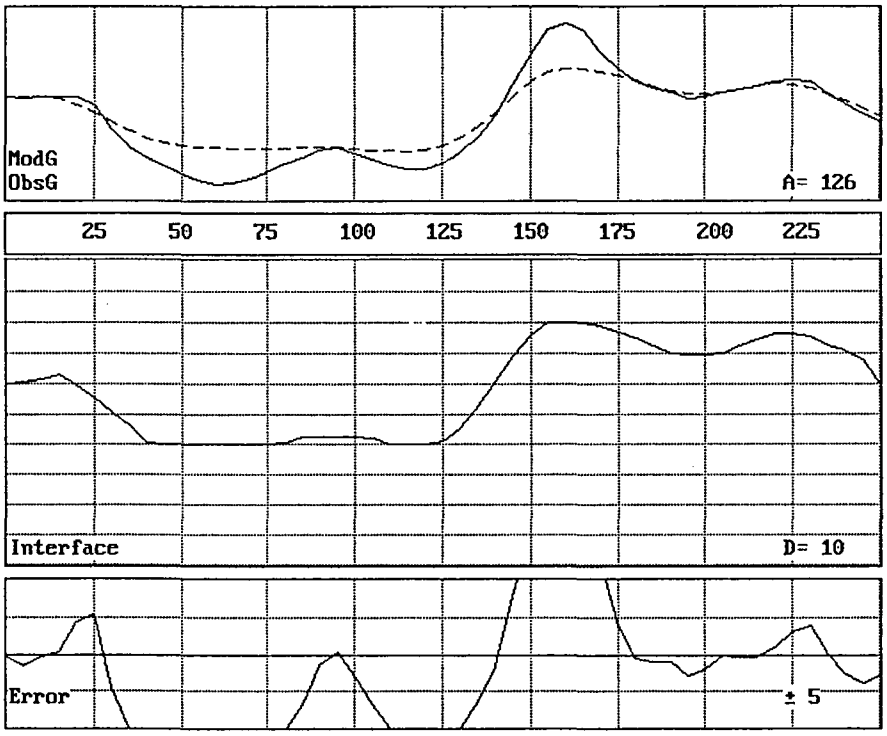
6. Minimum depth to interface (in km):

Set minimum depth to interface (see pt. 5 and section 2). If minimum depths are not known, this value should be set to zero.

7. Maximum depth to interface (in km):

Set maximum depth to interface (see pt. 5 and section 2). If maximum depths are not known, value should be set to 3 times the depth value set under point 5.

FIGURE 10 As Fig. 4 but with more restricted maximum and minimum depth values, i.e. allowing smaller variations along the density surface. Note larger differences between observed and modelled gravity data.




8. Density contrast across interface (in 1000kg/m$^3$):

Set density contrast across the interface. In case of a rough topography a varying density contrast may be expected, e.g. basement highs versus deep basins. These cases should be handled by separating the profile into parts which should be inverted separately.

9. Station interval (in Km):

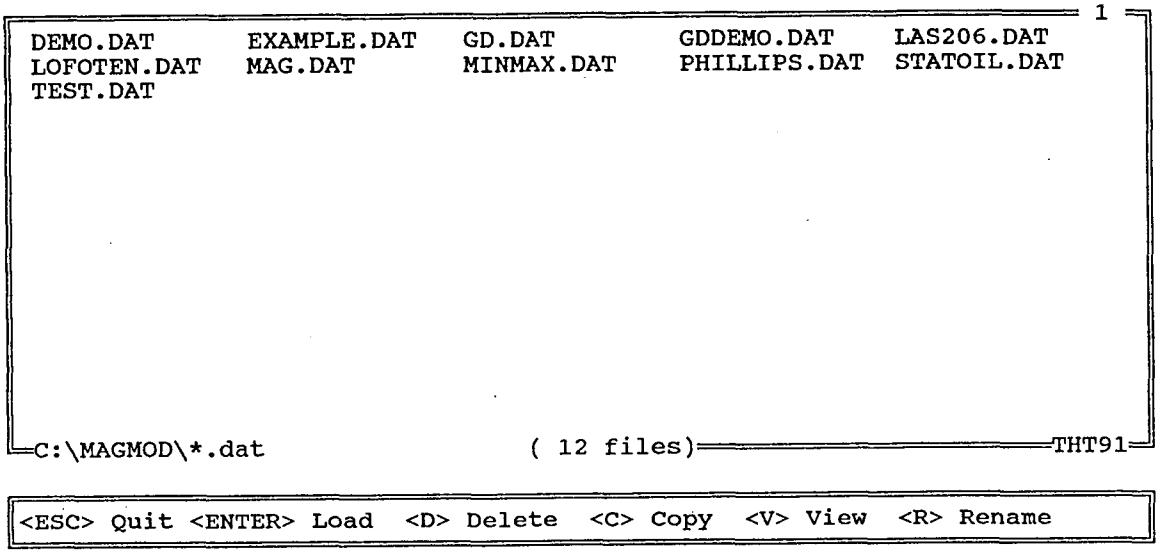
All data-points must be equally spaced (maximum 105) and station interval is given in kilometre. Utility program PROFILE (section 7) however has built-in cubic spline

functions, hence this program can (1) equally space irregular data and/or (2) reduce data-points to the maximum of 105 data-points that are allowed in GDEPTH.

## 5.4 GETFILE

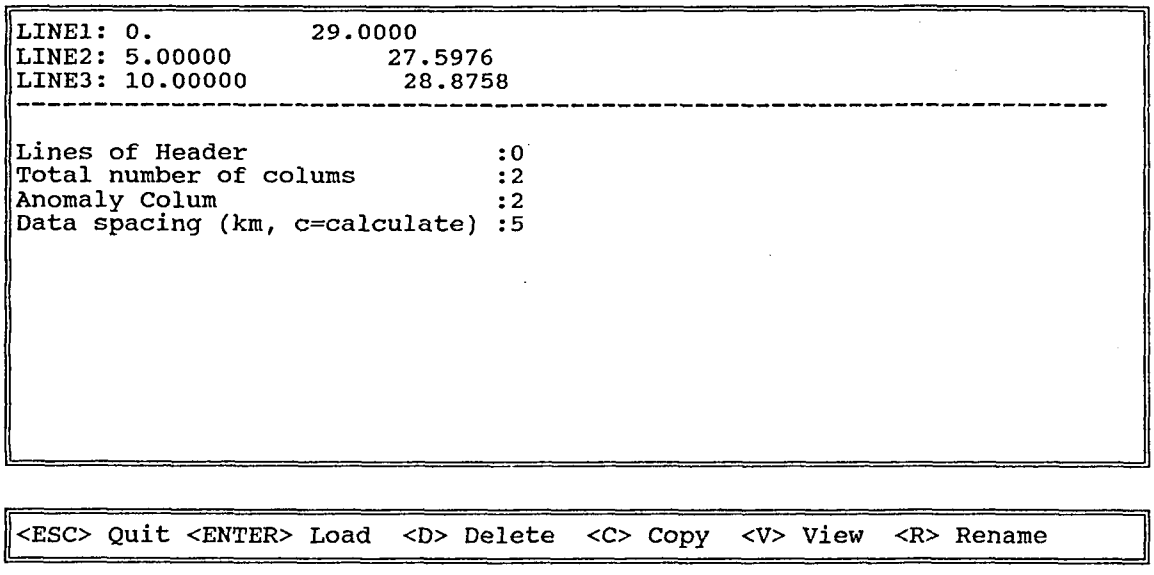
This option allows the operator to load a new file for calculation of magnetic basement depths. Any file extension is allowed and the operator is prompted for a file mask (e.g. *.DAT). **Note that if extension *.OUT is used, the system assumes that the file-format conforms to IMP5 standard.** If the operates wish to change the current directory use the cursor up arrow to edit the directory. The current directory is scanned and a sorted list of files is displayed (Fig. 11). A file is then selected and loaded using cursor arrows followed by <ENTER>. Use keys <PG UP> or <PG DN> if there are several pages of data-files. This option also allows the operator to DELETE, COPY, VIEW or RENAME files.

**FIGURE 11** 'GETFILE' option. Files are sorted and displayed. Select file using cursor arrows followed by <ENTER>




After selecting a file with extension unlike .OUT, a standard file-format is indicated (format of the last loaded file which is saved on the GDEPTH.SYS file) on the screen (Fig. 12). Change format if necessary, i.e. number of lines of header, total number of columns, location of anomaly (i.e. gravity) column and data-spacing in kilometre. For calculation of data-spacing type c in data-spacing field followed by X UTM column and Y UTM column. This must only be done for linear profiles which has nearly the same data-spacing. An average spacing is calculated, but also minimum and maximum spacing values are displayed.

**FIGURE 12** Definition of file format after selecting a file in option 'GETFILE'. Three top lines of file are displayed. Adjust file format to fit the selected file.



## 5.5 HCOPY

This option starts hardcopying of plots to a HP-GL compatible pen plotter which accepts HP-GL codes. The communication-port is selected under PLOTTER PORT (see option in CONFIG below). See option 'CONFIGURE' for plotting control.

## 5.6 PRINT

This option provides a listing to printer of depth estimates. The printed information is shown in Fig. 13.

**FIGURE 13** Example of listing of data to printer.

PARAMETERS USED FOR FILE:GDDEMO.DAT

Iterations : 100 Lamda : .5 FLength : 5 Extension:n
Depth : 4 MinDepth: 2 MaxDepth: 6 Interval :
DenContrast: .4

DEPTH ESTIMATES:

| No. | Location | Depth | ObsG | ModG | Error |
|---|---|---|---|---|---|
| 1 | 0.00 | 4.00 | 29.00 | 29.39 | -0.39 |
| 2 | 5.00 | 3.96 | 27.60 | 29.20 | -1.60 |
| 3 | 10.00 | 3.86 | 28.88 | 29.20 | -0.32 |
| 4 | 15.00 | 3.69 | 28.64 | 28.31 | 0.33 |
| 5 | 20.00 | 4.03 | 28.71 | 24.31 | 4.40 |
| 6 | 25.00 | 4.46 | 24.08 | 18.64 | 5.44 |
| 7 | 30.00 | 4.89 | 7.88 | 12.51 | -4.63 |
| 8 | 35.00 | 5.41 | -4.10 | 6.40 | -10.50 |
| 9 | 40.00 | 5.97 | -11.00 | 1.36 | -12.36 |
| 10 | 45.00 | 6.00 | -16.93 | -1.56 | -15.37 |
| 11 | 50.00 | 6.00 | -22.33 | -3.12 | -19.21 |
| 12 | 55.00 | 6.00 | -26.89 | -4.11 | -22.78 |
| 13 | 60.00 | 6.00 | -29.65 | -4.81 | -24.84 |
| 14 | 65.00 | 6.00 | -28.34 | -5.33 | -23.01 |
| 15 | 70.00 | 6.00 | -25.67 | -5.67 | -20.00 |
| 16 | 75.00 | 6.00 | -21.33 | -5.74 | -15.59 |
| 17 | 80.00 | 5.93 | -15.61 | -5.37 | -10.24 |
| 18 | 85.00 | 5.74 | -11.63 | -4.78 | -6.85 |
| 19 | 90.00 | 5.74 | -6.04 | -4.59 | -1.45 |
| 20 | 95.00 | 5.74 | -4.53 | -4.76 | 0.23 |
| 21 | 100.00 | 5.74 | -8.10 | -5.20 | -2.90 |

## 5.7 CONFIG

This option sets communication ports, configuration of plots and graphic monitor types (EGA or VGA). A complete list of sub-options is shown below. Use up/down cursor arrows to edit the various options.

| OPTION | ALTERNATIVES |
|---|---|
| Plotter Port (HP-GL) | lpt1: lpt2: com1: com2: |
| Baudrate | 300 600 1200 2400 4800 9600 |
| Parity | n (none) e (even) o (odd) |
| Databits | 7 or 8 |
| Stopbits | 2 or 1 |
| X-length in cm. (HP-GL) | 10 to 40 cm (horizontal axis) |
| Y-length in cm. (HP-GL) | 2 to 25 cm (vertical axis) |
| Plot Anomaly (HP-GL) | y or n (include/exclude) |
| Plot Depth (HP-GL) | y or n |
| Plot Error (HP-GL) | y or n |
| Name of DEPTH SAVE file | any valid file-name (cf. 5.8) |
| Plotter Format | 3 or 4 (A3/A4) |
| Plotter Pen | 1 to 8 |
| Plotter Speed | 0 to 20 |
| Monitor | EGA or VGA |
| Plot to IMPRINT file | y (yes) or n (no) |
| Printer Port | as plotter port (se above) |
| Plot Size LASER DUMP | 1(small),2,3,4(full size) |

Notes:

(1) Options such as baudrate, parity, databits and stopbits are only required to be set for serial communication (com1: or com2:)

(2) A4 paper (max X length is 19 cm) is inserted in the plotter in a vertical position.

(3) The options shown above are stored in a file named GDEPTH.SYS.

(4) All plotter settings (except PLOT SIZE LASER-DUMP applies to HP-GL compatible pen plotters.

**FIGURE 14** Option 'CONFIGURE'

```
                    C O N F I G U R E  -  S Y S T E M
HPGL      Plotter Port              (lpt1: com2:  ) :lpt1:
          Baudrate                  (110 to 9600  ) :9600
          Parity                    (n,o or e     ) :n
          Databits                  (8 or 7       ) :8
          Stopbits                  (1 or 2       ) :1
HPGL      X-Length                  (max 40/19cm  ) :18
HPGL      Y-Length                  (max 25/25cm  ) :3.5
HPGL      Plot Anomaly              (y or n       ) :y
HPGL      Plot Depth                (y or n       ) :y
HPGL      Plot Error                (y or n       ) :y
          Name of DEPTH SAVE file   (auto .PTZ ext) :trond
                                                    :
                                                    :
                                                    :
HPGL      Plotter Format            (3 or 4       ) :3
HPGL      Plotter Pen               (1 to 8       ) :1
HPGL      Plotter Speed             (1 to 80      ) :20
          Monitor                   (EGA or VGA   ) :VGA
HPGL/F1   Plot to IMPRINT file      (y or n       ) :Y
LIST/F1   Printer Port LIST/F1      (lpt1: com1:  ) :lpt1:
F1        Plot Size LASER-DUMP      (1 to 4)      ) :3
```

## 5.8 VIEW

This option allows the operator to read the depths interactively in Window 2 using the Mouse. The mouse cursor will appear in Window 2 and can be moved around using the mouse. X (=distance along profile in kilometres) and D (=depth in kilometres) are displayed at the bottom left of the screen.

The operator can now interactively select depths in option 'VIEW' and store these depth-estimates in a file. This option is essentially used in association with program IMPPROF (Torsvik & Olesen 1993). The file-name is set in option 'CONFIGURE' ('Name of Depth Save File') and they are automatically given file-extension .PTZ. This file (free format ASCII file) contain the following information:

-Profile Name
-Inverted (-1) or regular profile (1) (USED WITH IMPPROF)
-Distance along profile in kilometre
-Actual Depth in kilometre

For a particular project the operator can use the same file-name since depths from consecutive profile depth estimates are 'appended' to the existing data.

How to select depths interactively:

-Select option 'VIEW'

-Move mouse cursor to a selected depth (distance=X and depth=D is displayed in the lower left corner) and click any mouse bottom. This will save ('append') the actual depth value and distance in the file defined in option 'CONFIGURE'

End/Quit option by pressing the <CR>/<ENTER> or <ESC> key.

## 5.9 OFFSET

The basement relief calculated from the program will always equal Z (Fig. 1) at the start and the end of program. If a certain depth within the profile is known with better confidence, the operator should observe the depth difference between a known point and the basement topography estimate with option 'VIEW'. Then access option 'OFFSET' and input the observed depth difference in kilometre. This will automatically adjust the Z value (Fig. 1). This is an approximate process and the operator must engage option 'RUNDEPTH' in order to achieve a new solution based on the new Z value. Repeat 'OFFSET' procedure until there is a perfect match between a known depth and the top to the basement topography.

GDEPTH is supplied on one floppy disk which contains the following programs and files:

| | |
|---|---|
| GDEPTH.EXE | Main depth program |
| GINV.EXE | Help program for depth calculations |
| GDEPTH.SYS | System file |
| GDEPTH.SYS | System file (see below) |
| GDEMO.OUT | Demonstration test file |
| PROFILE.EXE | A universal profile converter program |
| PROFILE.SYS | System file for PROFILE.EXE |

The operator uses the option 'GETFILE' to import profiles into the system. No special data format are required since data-format can be specified during input. The simplest form of a file only contains one column with gravity data-values.

## 7 IMPORT PROFILES

An utility program named PROFILE.EXE (used for IMP5, PDEPTH or GDEPTH) is enclosed to handle irregular spaced data or large data-files.

Type PROFILE at the DOS system prompt or select PROFILE in the IMP menu program. Upon entering this program, the current directory and a file mask is displayed (initial value = *.*). Change mask (e.g. to *.DAT) or press <ENTER> to continue. According to the mask setting the current directory is sorted. Use cursor arrows to select the appropriate profile file followed by <ENTER>. Use <ESC> to leave this option without selecting a file. In this mode you can also DELETE (type **d**), COPY (type **c**), VIEW (type **v**) or RENAME (type **r**) a profile file.

When a file has been selected for import (Fig. 15), the three first data lines of the file is displayed and the operator must *define/set the following parameters:*

1. LINES OF HEADER
2. TOTAL NUMBER OF COLUMNS
3. X-COLUMN (in km)
   -EAST UTM VALUE OR DISTANCE ALONG PROFILE IF Y-COLUMN NOT DEFINED
4. Y-COLUMN (in km)
   -NORTH UTM VALUE (CAN BE UNDEFINED IF X IS DISTANCE)
5. Z-COLUMN (TOPOGRAPHY (+values) OR BATHOMETRY (- values) (in km)
6. MAGNETIC ANOMALY COLUMN (in nT)
7. GRAVITY ANOMALY COLUMN (in mG)
8. FLIGHT ALTITUDE MAGNETICS (in km)
9. UTM ZONE (30-37)

10. START X CO-ORDINATE (in km)
    -Automatically calculated if X and Y co-ordinates exist
11. START Y CO-ORDINATE (in km)
    -Automatically calculated if X and Y co-ordinates exist
12. END X CO-ORDINATE (in km)
    -Automatically calculated if X and Y co-ordinates exist
13. END Y CO-ORDINATE (in km)
    -Automatically calculated if X and Y co-ordinates exist
13. PROFILE DIRECTION
    -Automatically calculated if X and Y co-ordinates exist
14. OUTPUT FORMAT (IMP5 or FREE format)
    -I produces an IMP5 formatted output (Torsvik 1992a)
    -F produces a simplified free format output (no header) consisting of X(or distance), Y, Z and Anomaly value. This format is suitable for GDEPTH and PDEPTH.
15. DATA SPACING (if equal spaced data; in km)
    -Automatically calculated if X and Y co-ordinates exist
16. SPLINE FITTING (Y/N)
    -Used to equal-space data or reduce long profiles to less point/stations (e.g. 300 which is the maximum limit for IMP5; 1024 for PDEPTH; 105 for GDEPTH)
17. OUTPUT FILE-NAME
    (Initial value=test.out)

After reading the original profile file, the program displays the number of data-points, calculated data-spacing, distance and direction.

**NOTE 1**

Parameters marked with '*' on the screen display are automatically calculated if X & Y co-ordinates exist.

**NOTE 2**

The program operates in kilometre units, but it is possible to import profiles given in any units if (1) X & Y co-ordinates exists and (2) all parameters are given in the same unit.

**NOTE 3**

If Y co-ordinates are undefined and no START/END co-ordinates

are provided, the program defaults to START X/Y=0/0, END X/Y=X(END)/0 and profile trend=90 degrees.

The import profile option provides an option for 'SPLINE FITTING', i.e. fitting a smooth curve to the observed data using a 'natural cubic spline' function. This is a convenient method of creating equal-spaced data or reduce the number of stations/ observations such as the imported profile can run within PDEPTH (maximum 105 points). If 'Spline Fitting' is set to y (yes) the operator is prompted for the number of equal-spaced points to be generated from the spline fitting routine (number of points controls the data-spacing). The value defaults to the original number of data points. Use the default value, or set it to 105 if data points exceed this limit of GDEPTH.

**FIGURE 15** Import profile

```
LINE1:  51933
LINE2:  51935
LINE3:  51955
-------------------------------------------------------------------------
Lines of Header                 :0
Total number of columns         :1
X column                        :0
Y column                        :0
Z column                        :0
Magnetic Anomaly column         :1
Gravity  Anomaly column         :0
Flight Altitude Magnetics       :0
UTM Zone (30-37)                :32
START X co-ordinate            *:
START Y co-ordinate            *:
END   X co-ordinate            *:
END   Y co-ordinate            *:
Profile Direction              *:
Output Format (I=IMP, F=FREE)   :i
Data spacing                   *:
Spline Fitting          (y/n)  :
IMP OUTPUT FILE-NAME            :test.out
```

## 8. REFERENCES

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