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IMP -
Interactive Modelling of Potential
Field Data (Release 5)

RAPPORT

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IMP - Interactive Modelling of Potential Field Data (Release 5)

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IMP is an interactive, user-friendly, and pseudo 3D modelling program for magnetic and gravity data, and it forms a key-element in the IMP system developed over a total of 4 years. IMP is a forward modelling program which handles all the basic routines normally associated with such systems. In addition, the program provide statistical routines and on-line information on the characteristics of the local Earth's magnetic field (Norway). IMP can further display geographic maps (vector data) and/or magnetic/gravity grid images together with profile-lines and geological bodies in plane view (XY plane). Pdepth, an inversion program to calculate depth to magnetic basement can also run inside IMP, hence withnessing the integrated nature of the IMP system which brings it ahead of other systems. A gravity inversion program is currently also under development to run inside IMP.

Emneord:	Tolkning	Magnetometri
Geofysikk	Brukerdokumentasjon	Gravimetri

1. INTRODUCTION

IMP is an interactive, user-friendly, and pseudo 3D modelling program for magnetic and gravity data, and it forms a key-element in the IMP (Interactive Modelling of Potential field data) system developed by T.H. Torsvik over a total period of 4 years. IMP is a forward modelling program which handles all the basic routines normally associated with such systems. In addition, the program provide statistical routines and on-line information on the characteristics of the local Earth's magnetic field (Norway). IMP can further display geographic maps (vector data) and/or magnetic/gravity grid images together with profile-lines and geological bodies in plane view (XY Plane). PDEPTH, an inversion program to calculate depth to magnetic basement (Torsvik & Olesen 1992a) and IMPPET, a petrophysical data-base system (Torsvik & Olesen 1992b) can also run inside IMP, hence witnessing the integrated nature of the IMP system which brings it ahead of other systems. A gravity inversion program (GDEPTH) is currently also under development to run inside IMP.

1.1 HARDWARE REQUIREMENTS

System requirement:

- IBM AT or compatible (80286/386/486) computer
  run under MS-DOS 4 or preferentially MS-DOS 5.
- Mathematical co-processor (80287/387/487)
- EGA (colour) or VGA (colour) graphics card
- Hard-disk (minimum 40 MByte)
- Microsoft compatible mouse (3 button) (OPTIONAL)

Graphical Output Devices:

- HP-GL compatible pen-plotter,
- HP Laser/Deskjet compatible printer,
  HP Deskjet 500C (colour) the optimal choice, 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

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1.2 IMP FILE TYPES

IMP Basic:

IMP5.EXE	- Main modelling program
IMPMOD.SYS	- System configuration file
IMP.INT/.RED/.BLU/.GRN	- Graph demo files
PROFILE.EXE	- Import of non-standard IMP files
PROFILE.SYS	- Import system file
FIELD	- Earths magnetic field characteristics mainland Norway
*.MOD	- IMP model/body files
*.OUT	- IMP profile data files
*.UTM	- IMP geographic contour files
*.GRI/GRD	- IMP image grid files

Extension for IMP professional:

MDEPTH.EXE	- Simplified PDEPTH (Torsvik & Olesen 1992)
DEP300.EXE	- Sub-program used in MDEPTH.EXE

2. SOFTWARE THEORY

IMP V.5 was originally designed as a 2D forward modelling program by the author in 1988 and subsequently upgraded to a 2.5D modelling program at the University of Oxford (1989-1990). The current version is a PSEUDO 3D forward modelling program which also includes inverse modelling routines (Depth to magnetic basement calculations; Torsvik & Olesen 1992a). The theory for gravity and magnetic calculations are from Rasmussen & Pedersen (1979) whereas depth to magnetic basement algorithms are given by Phillips (1975;1979).

Polygon models (maximum 30) are created interactively and may have a maximum of 30 corners (vertices). Models are originally created in a clockwise sense in the XZ plane (X = profile direction in the horizontal plane; Z= vertical plane) and assigned an Y-value (half-strike length) which is half the total model length in the Y-direction (default value = 10 km). The model is by default created symmetrically along the X-direction (Fig. 1a & b). The operator can later modify the half-strike-length, the centre of the model can also be changed as well as rotated in the XY-plane (Fig. 1c), hence IMP is a PSEUDO 3D modelling tool. PSEUDO 4 is also considered in future versions, e.g. implementing density variations as function of depth.

FIGURE 1 Body/profile co-ordinate system

A

B

C

Body Number: 1
```
 Y    =     4.00
YMin=     -4.00
YCen=      0.00
YMax=      4.00
Rot  =     20.00
```

Body Number: 2
```
 Y    =     4.00
YMin=     -1.50
YCen=      0.00
YMax=      6.50
Rot  =     0.00
```
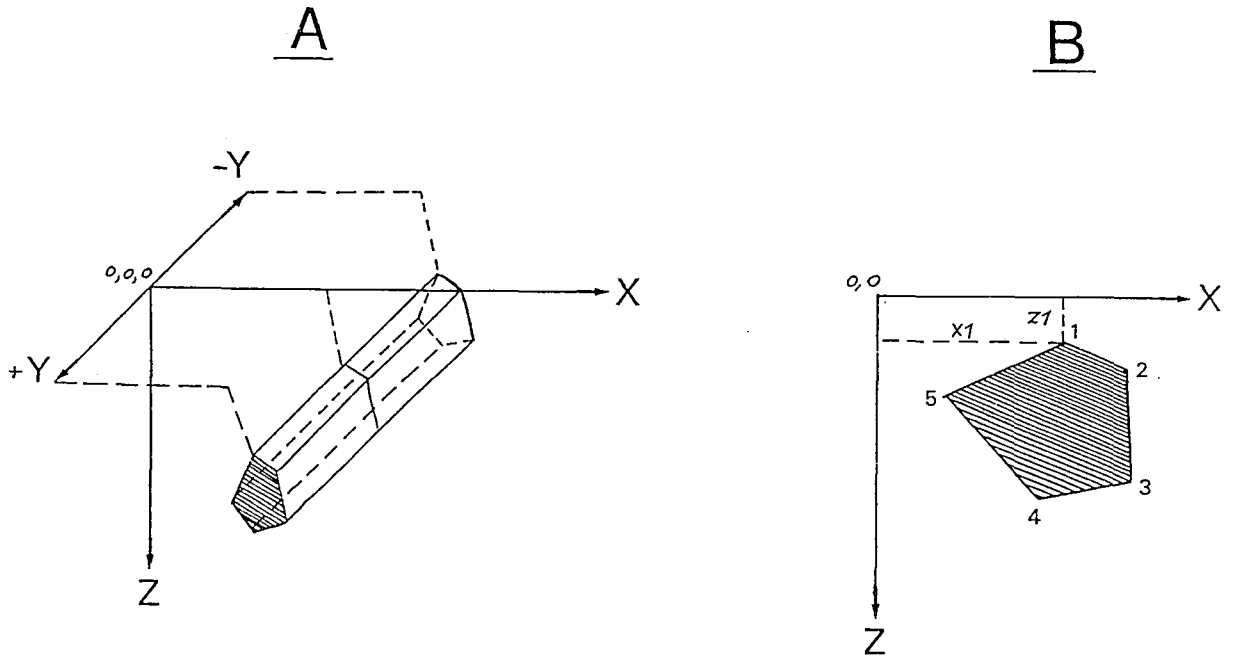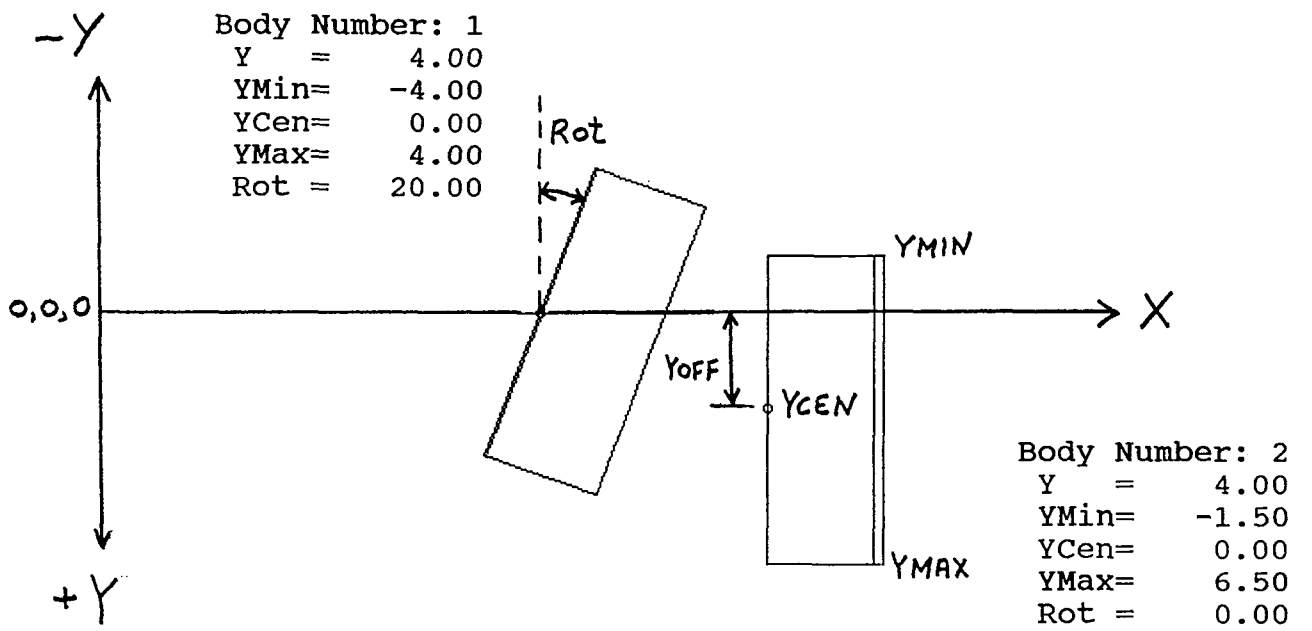
3. THE IMP SYSTEM

All programs that are integrated in the IMP system have been written by Trond H. Torsvik (except GDB - Mark A. Smethurst). The complete system contains the following programs (published programs are written in bold):

	DESCRIPTION	PROGRAM
DATABASES		
	MAGNETIC/GRAVITY GRID DATA	**GDB**
	MAGNETIC/GRAVITY PROFILE DATA	IMPPROF
	PETROPHYSICAL DATA	**IMPPET**
	GEOGRAPHIC DATA	**IMPATLAS**
MODELLING		
	DEPTH TO MAGNETIC BASEMENT	**PDEPTH**
	AUTOMATIC MAGNETIC BASEMENT DEPTHS	IMPDEPTH
	PSEUDO 3D GRAVITY/MAGNETIC	**IMP5**
	GRAVITY INVERSION	GDEPTH
OTHER		
	DIGITIZING PROGRAM	IMPDIG
	PROFILE CONVERTER PROGRAM	PROFILE
	PRINT DRIVER PROGRAM	**IMPRINT**

4. INSTALLATION OF IMP

- Create a sub-directory named MAGMOD (this must be done) on the
  hard-disk (drive c) by typing:

    C:>md MAGMOD

- Copy all programs and data-files from the supplied IMP disks
  to the hard-disk by typing:

    C:>copy a:*.* c:\magmod

- Trim AUTOEXEC.BAT AND CONFIG.SYS as suggested in Appendix 1
  in order to have the maximum memory available for the system.

- Add MAGMOD directory in the AUTOEXEC.BAT file by typing
  PATH C:\MAGMOD (see Appendix 1; page 74)

- Install MOUSE driver (see CONFIG.SYS example in Appendix 1)

5. DESCRIPTION OF IMP

Type IMP5 (i.e. for release 5) at the DOS system prompt. The program immediately searches for a configuration file named IMPMOD.SYS. If this file is not found on the \MAGMOD directory, IMPMOD.SYS is automatically created, containing the default values listed in 5.10.

After start-up the main menu is displayed (Fig. 2). An **option** in the menu may be selected through the use of the arrow keys, and executed by pressing <ENTER>.

FIGURE 2 Main menu IMP5

```
IMP V. 5.0    Interactive Modelling of Potential field data

Written by T.H. Torsvik 1988-92              Copyright THT & NGU
```

```
   GRAPHICAL DISPLAY
   READ   PROFILE
   READ   BODIES
   SAVE   BODIES
   MERGE  BODIES
   EDIT   BODIES            Profile  File:NoName.OUT  Points       : 41
   EDIT   FIELD DATA        Body     File:           Bodies       : 0
   SAVE   ANOMALIES         Contour  File:           MEM STAT (k): 242
   CHANGE DIRECTORY         Image    File:           Mouse Status:ON
   CONFIGURATION
   READ IMAGE FILE                   **** PSEUDO 3D GRAVITY MODE ****
   HARDCOPY-UTILITY
   READ CONTOUR FILE
   IMPORT PROFILES
   RESET IMP SYSTEM
   END/EXIT TO DOS
```

The main menu has the following options:

OPTION	EFFECT
GRAPHICAL DISPLAY	ENTER GRAPHIC DISPLAY MODE
READ PROFILE	READ IMP PROFILE DATA FROM FILE
READ BODIES	READ BODY/MODEL DATA FROM FILE
SAVE BODIES	SAVE BODY DATA TO A FILE
MERGE BODIES	MERGE/APPEND BODY DATA
EDIT BODIES	EDIT BODY DATA IN MEMORY
EDIT FIELD-DATA	EDIT FIELD DATA IN MEMORY
SAVE ANOMALIES	SAVE CALCULATED ANOMALIES TO A FILE
CHANGE DIRECTORY	CHANGE CURRENT DIRECTORY
CONFIGURATION	CONFIGURE IMP
READ IMAGE FILE	LOAD AN IMAGE GRID FILE FROM DISK
HARDCOPY-UTILITY	HARDCOPY & UTILITY ROUTINES
READ CONTOUR FILE	LOAD A UTM (X-Y) CONTOUR FILE FROM DISK
IMPORT PROFILES	IMPORT/CONVERT NON-IMP PROFILES
RESET IMP SYSTEM	RESET ALL VARIABLES IN IMP (RESTART)
END/EXIT TO DOS	END PROGRAM EXECUTION

The information box next to the main menu contains information regarding Profile File Name, Number of Profile Points, Body File Name, Number of bodies, Contour File Name, Image grid file name, available Memory (RAM) in kilo-bytes, Image File Name, Mouse status (ON/OFF) and MODE (Pseudo 3D Gravity or Magnetic).

Note:

During initiation of the program, the program automatically checks for the presence of a MICROSOFT compatible mouse. If present, mousestatus is set by default to ON and can subsequently be used in 'GRAPHICAL DISPLAY' mode (sub-option 'DRAW' - 5.1.3). Mousestatus,

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however, can be switched to OFF in the 'CONFIGURATION' option (5.10). Note to install MOUSE.SYS (preferentially in high memory) before starting IMP (see example in Appendix 1 on how to load the mouse driver into high memory). Alternatively run the program MOUSE.COM which is supplied with mouse driver software. This however will use conventional base-memory (<640Kb) and is not to be recommended.

5.1 GRAPHICAL DISPLAY

The graphical display is divided into three sections (Fig. 3). The upper diagram shows the observed or calculated (stippled line) magnetic or gravity anomaly. The vertical scale is given in nT (magnetic mode) or mGal (gravity mode) whereas the horizontal scale is indicated in kilometres. The middle diagram displays model bodies portrayed in the XZ plane. Both the vertical and horizontal axis is given in kilometres. The lower box shows the modelled bodies in different colour or different ornaments (see 'CONFIGURATION'; 5.10).

If a profile has not been loaded ('READ PROFILE'; 5.2) the system defaults to:

Profile length	= 20km
Profile Direction/Trend	= 90º
Number of stations/points	= 41
Equal Data spacing	= 0.5km
Magnetic field intensity	= 50000nT
Field Declination	= 0
Field Inclination	= +70

These default parameters can subsequently be changed in option 'EDIT FIELD DATA' (5.7).

FIGURE 3   The 'GRAPHIC DISPLAY' mode
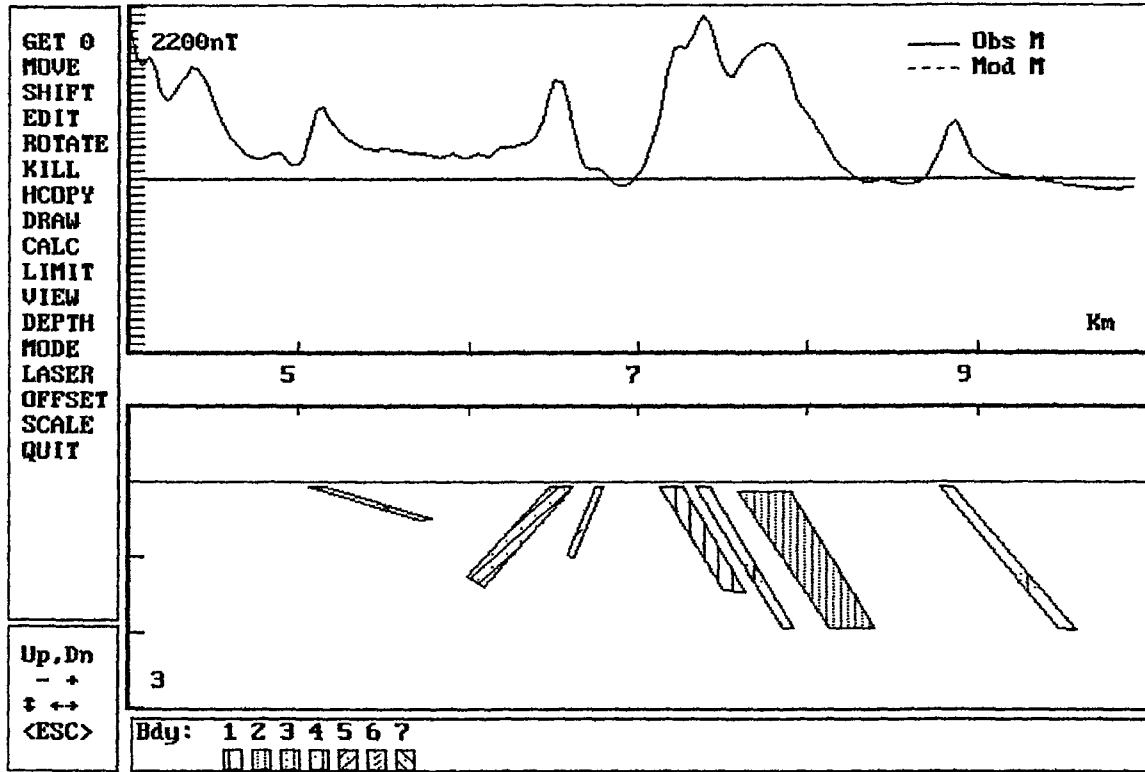
An option in the 'GRAPHICAL DISPLAY' menu is selected through the
use of the arrow keys (see left vertical box), and executed by
pressing <ENTER>, or alternatively by typing the first
(highlighted) character for the upper 11 options. The following
options have been implemented:

OPTION	EFFECT
GET (n)	RETRIEVE EARLIER BODY MODELS (1-N)

MOVE	MOVE ONE BODY ON THE SCREEN
	-Select BODY to MOVE by
	  using arrow keys (LEFT & RIGHT)
	  followed by <ENTER>

SHIFT	SHIFT/MOVE ALL BODIES -Specify movement in X and Z-direction in kilometres
EDIT	EDIT ONE OR ALL BODIES (5.6)

ROTATE	ROTATE A BODY IN XZ PLANE
	-Select BODY to rotate by
	  using arrow keys (LEFT & RIGHT)
	  followed by <ENTER>

KILL	KILL/ERASE A BODY
	-Select BODY to kill (in memory) by
	  using arrow keys (LEFT & RIGHT)
	  followed by <ENTER>

HCOPY	HARDCOPY OF BODIES & ANOMALIES TO HP- GL COMPATIBLE PEN-PLOTTER
DRAW	DRAW/CHANGE BODIES ON SCREEN
CALC	CALCULATE ANOMALY

LIMIT	ENTER Xmin & Xmax FOR SCREEN DISPLAY
	-This option will reduce calculation
	  times since only the anomaly effects
	  within the current window will be
	  calculated

VIEW	DRAW CONTOUR-MAP, PROFILE LINE & IMAGE
DEPTH	DEPTH TO MAGNETIC BASEMENT CALCULATION (EXECUTE PROGRAM MDEPTH.EXE)
MODE	CHANGE BETWEEN MAGNETIC/GRAVITY MODE -automatic recalculation
LASER	COPY SCREEN TO HP LASER/DESKJET OR FILE -same function as <F1>; see below
OFFSET	SET PROFILE OFFSET VALUE FOR START AND END OF A PROFILE - REGIONAL LINEAR

OPTION	EFFECT
SCALE	CORRECTION (see also 5.7) SCALE VERTICAL AXIS TO SAME SCALE AS HORIZONTAL AXIS (Approximately 1:1)
QUIT	RETURN TO MAIN MENU
<u>Function Keys:</u>	
<F1>	COPY SCREEN TO HP LASER/DESKJET OR FILE
<ESC>	RETURN TO MAIN MENU
<+> & <->	INCREASE & DECREASE ANOMALY AMPLITUDE - In nT(MAGNETICS) and mGal(GRAVITY)
<PGUP> & <PGDN>	INCREASE & DECREASE MODEL DEPTH - In Kilometres
LEFT/RIGHT ARROWS	MOVE PROFILE SIDEWAYS
UP/DOWN ARROWS	SELECT OPTION (SEE ABOVE) - Press <ENTER> to verify option

5.1.1 GET

Whenever changes occur within the program (e.g. creating new bodies, changing bodies or editing body parameters), the existing body file is saved (using file-names such as GET$_1$.MOD, GET$_2$.MOD etc.). Hence, the operator can always return to an earlier body file using this option.

NOTE - During start-up of IMP5 all backup files are deleted.

5.1.2 MOVE

The operator is prompted to register the BODY which should be moved interactively on the screen (see MESSAGE window at top-right part of the screen). A BODY is selected at the bottom window using arrow cursor (LEFT & RIGHT) followed by <ENTER>. <u>Then move the selected BODY to a new position (Message window displays the X and Z position of corner 1 for the selected body) with arrow cursor followed by <ENTER></u>. The BODY will now be redrawn in its new position.

5.1.3 ROTATE

Select BODY (see 5.1.2) to be rotated by using arrow cursor (LEFT & RIGHT) followed by <ENTER>. Then enter ROTATION ANGLE in degrees (+ is clockwise rotation). In order to perform a visually 'true' rotation, the depth-axis (vertical) and the profile length axis (horizontal) should be similar, i.e. to the same scale. Rotations in the XZ-plane are performed around the centre of the body.

Upon entering this mode a small cross (or alternatively the mouse arrow) will appear on the screen. The cross is moved around on the screen using arrow cursor (/or the mouse). For arrow cursor movements the current setting of 'ZOOM-STEP GRAPHICS' (in km) in the 'CONFIGURATION' (5.10) menu controls the resolution of cursor movements.

In this mode the following information is displayed:

(a) X (horizontal) and Z (depth) values   (Top Message Window)

(b) Closest corner-point for a body which is within a distance
     of the 'ZOOM-STEP GRAPHIC' setting   (Bottom Left Window)

(c) True dip in degrees between this point and the next point
     (clockwise) is displayed   (Bottom Left Window)

The following options (selected by typing the indicated character in the top message window; mouse bottoms shown in brackets) are available in option 'DRAW':

OPTION	EFFECT
A	Create a new body and add a new corner-point whenever a is typed. ***BODIES MUST BE GENERATED IN A CLOCKWISE SENSE*** - Move to new positions using arrow cursors or the mouse and type a once again - Quit option by pressing <ENTER> or <ESC> - Select body-parameters using arrow keys (LEFT & RIGHT) followed by <ENTER> (see bottom window) NOTE: If option 'MERGE COMMON BODY SEGMENTS' is set to y (yes) (see 'CONFIGURATION'; 5.10) then adding a corner point which is within the value of 'ZOOM-STEP GRAPHICS' (default 0.1km) will be assigned the value of the point to the respective body (check with bottom left window to see if you are close to a specific body; body and point number will be displayed.
M	Move an existing corner of a body which is located with the value of the 'ZOOM-STEP GRAPHIC'. Check with bottom left window. -Move corner using arrow cursors/mouse -Quit with <ENTER> NOTE: If option 'MERGE COMMON BODY SEGMENTS' is set to y (yes) then moving a corner point will also effect a neighbouring body which has a common body point.
D	Delete a point in a body which is within the value of the 'ZOOM-STEP GRAPHIC' setting Check bottom left window
I	Insert a point **prior** to a point which is within the distance of the 'ZOOM-STEP GRAPHIC' value. Move the inserted point to an appropriate position using arrow cursor/mouse.

MOUSE OPERATION

LEFT BUTTON   - Add corners to a new body (as **A** above)
                              Quit by pressing MIDDLE BUTTON (as ESC/CR)

MIDDLE BUTTON   - <ENTER>/<ESC> option

RIGHT BUTTON   - Move an existing corner of a body (as **M** above)
                              Quit by pressing MIDDLE BUTTON

NOTE:

If 'MERGE COMMON SEGMENT' (5.10) is set to y (yes) in the configuration menu, please note that the first body which has a common corner point with a later created body always will be indicated in the bottom left window.

5.1.5 VIEW

It is useful to use option 'READ CONTOUR FILE' (5.13) in order to load a contour file (e.g. a coast-line file), but make sure that:

(1) the CONTOUR FILE has co-ordinates (at least partly) within the profiling area

(2) the CONTOUR FILE co-ordinates are in the same UTM-Zone as the START and END co-ordinates of your profile

(3) the CONTOUR FILE is in ten meters precision

In this option (Figs. 4-6) body models are displayed in plane-view (XY plane). Sub-options are selected by typing the first (and highlighted) character of the option name.

The following sub-options are implemented:

OPTION	EFFECT
IMAGE	DISPLAY MAGNETIC OR GRAVITY GRID DATA - see 5.11
ROTATE	ROTATE/OFFSET BODY IN XY PLANE (PLANEVIEW) - Select body using arrow keys (LEFT & RIGHT) followed by \<ENTER>/\<ESC> - Rotate body using LEFT & RIGHT arrow keys (counterclockwise & clockwise in 5 degrees steps; avoid angles >45 degrees Rotations are performed around the first corner-point in the body (Figs. 4 & 1c) - Offset bodies using UP & DOWN arrows (out & in in 500 meters interval; can be adjusted in 'CONFIGURATION' by setting the XY OFFSET STEP VALUE
MODEL	DISPLAY MODEL/BODY DATA IN XY-PLANE
SCALE	SET MAP-SCALE
EXPAN	EXPAND MAP (TIMES 2)
DECRE	DECREASE MAP (/2)
QUIT	END OPTION - RETURN TO MAIN MENU
UTMG	SET UTM SPACING IN KILOMETRES
F1	COPY SCREEN TO HP LASER/DESKJET or FILE

NOTE: The co-ordinate frame-work for option 'VIEW' is defined by START and END co-ordinates for the profile.

FIGURE 4 Sub-option 'VIEW' selected from option 'GRAPHIC DISPLAY' showing body models, the profile line and a contour map over the profiling area (MAGERØY, Northern Norway)

Profile name:MAG7.OUT
Title   :CREATED WITH PROFILE PROGRAM
Model name   :MAGER7.mod

1: 274279   57.141km/ 118.67°
                                              MAG7.OUT

‡ ↔

IMAGE
ROTAT
MODEL
SCALE
EXPAN
DECRE
QUIT
UTMG

107000   794000

Bdy: 1 2 3 4 5

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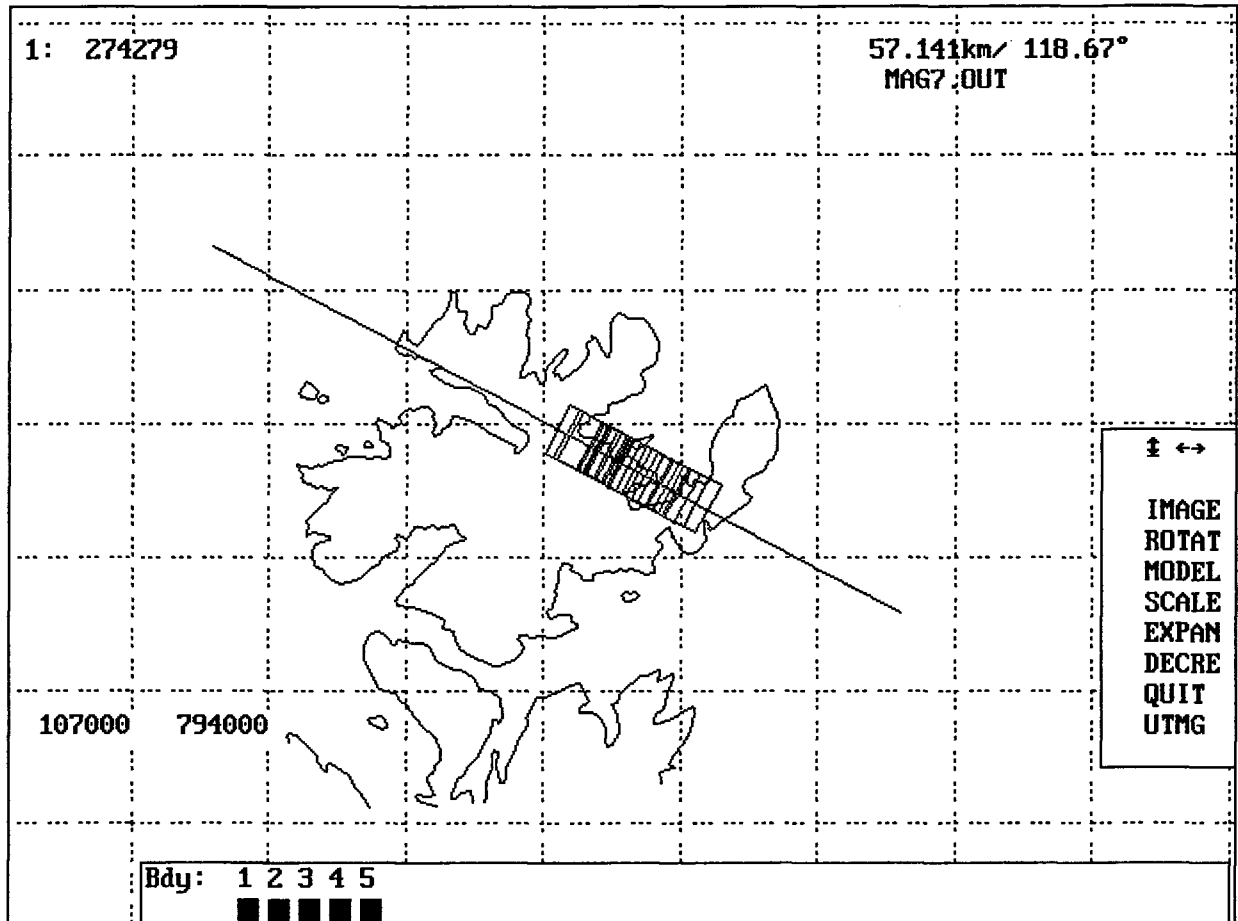
FIGURE 5 Example of an rotated and offsetted body

Profile name:MAG7.OUT
Title   :CREATED WITH PROFILE PROGRAM
Model name   :MAGER7.mod
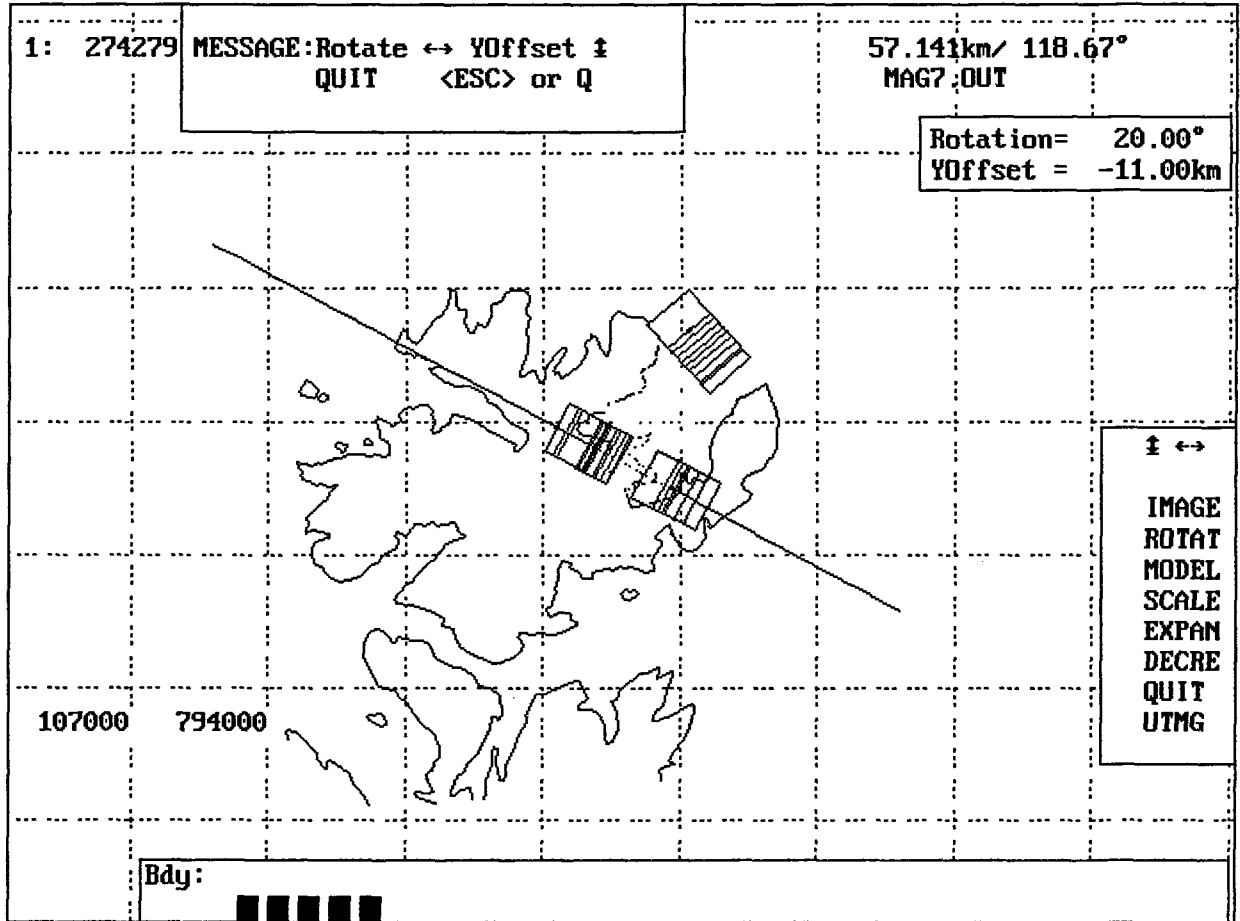
FIGURE 6 As Figure 4 but the original magnetic grid has been drawn as an overlay.
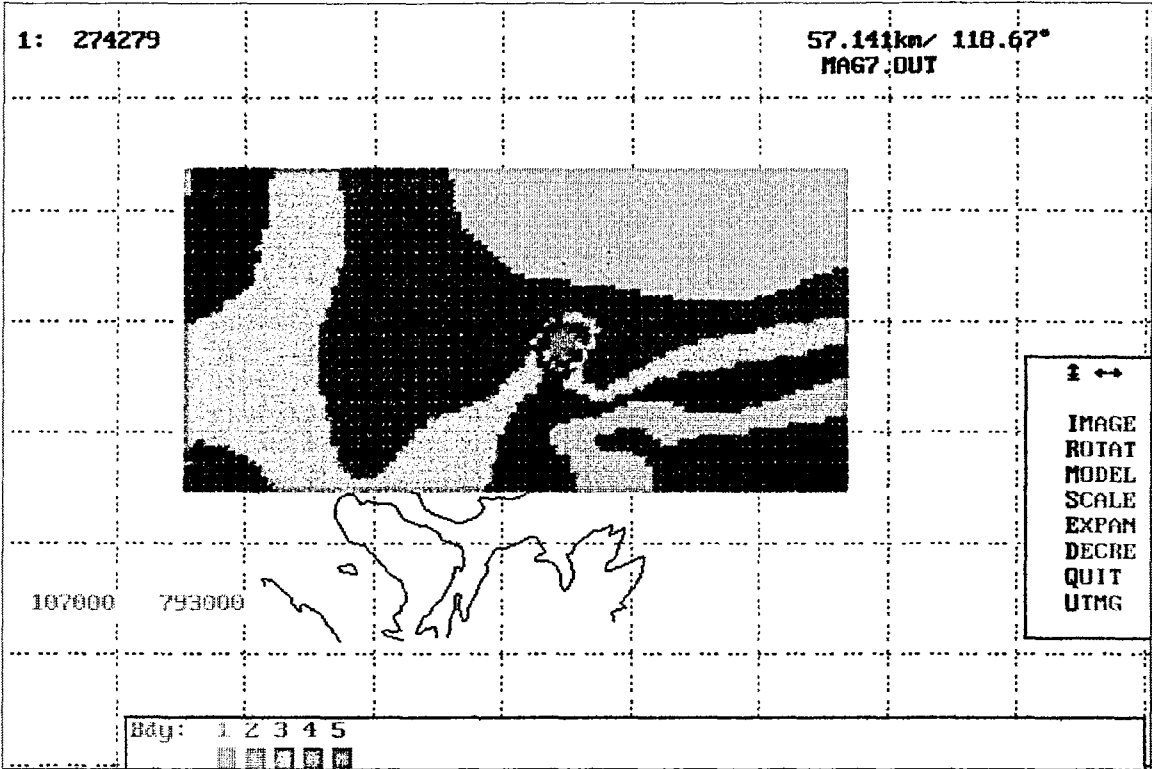
This sub-option allows the user to run a simplified version of PDEPTH (Torsvik & Olesen 1992a), a program to calculate depth to magnetic basement inside IMP (FIG. 7; the program used from IMP is actually named MDEPTH). This option can only be used for equally spaced data-points, and the user is prompted for length of the adaptive window (in number of data-points). 15 is a good starting value for profiles with approximately 100 data-points. An upper value (maximum) is indicated dependent on the depth-amplitude set in the lower graphic diagram. See Torsvik & Olesen (1992a) for detailed operation of PDEPTH.

NOTE 1

Option 'RUN DEPTH' within PDEPTH cannot be used when PDEPTH is called from IMP due to memory problems. On the return from PDEPTH, the first lag (depth solution 1) of the primary data-solution is drawn in the lower diagram and corrected for flight-altitude which can be set in the 'EDIT FIELD DATA' option (5.7).

NOTE 2

The program may run out of memory (RAM) when calling PDEPTH. If so, the program aborts program execution, but the depth of the

first lag (primary solution) will be displayed in IMP. Reconfigure the IBM compatible computer in order to have the maximum memory available before starting IMP (see AUTOEXEC.BAT & CONFIG.SYS in Appendix 1; page 74).

FIGURE 7   PDEPTH run from IMP
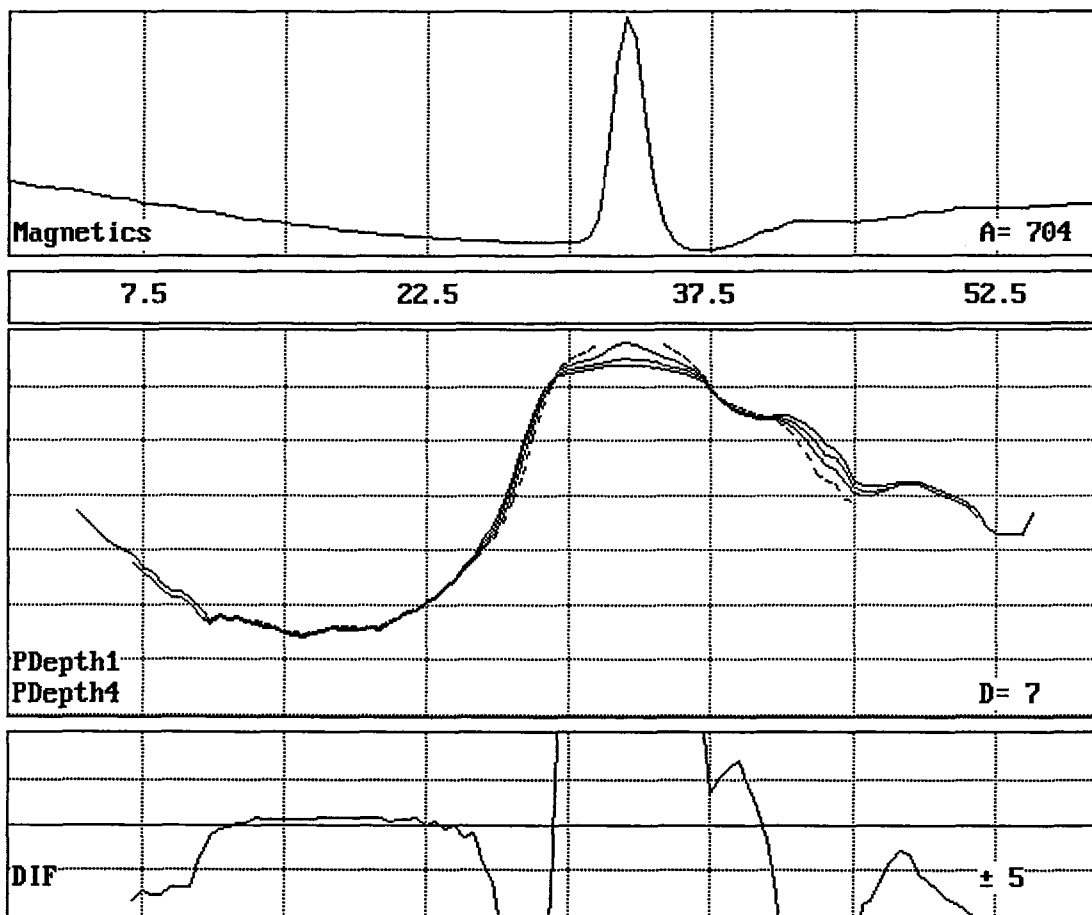
This option provides a hardcopy of the screen (can also use F1) to a HP LASER/DESKJET compatible printer (will not work if a POST-SCRIPT cartridge is installed). Use option 'HCOPY' for output to a HP-GL compatible pen-plotter.

For any other output-device make sure that option 'PLOT TO FILE' (in 'CONFIGURATION'; 5.10) is set to y (yes). This will create a plot-file named 'G'+'BODYNAME'+'.INT'. In option 'VIEW' (5.1.5), the plot-file name will be 'V'+'BODYNAME'+'.INT'. These files can later be plotted using the program IMPRINT (Torsvik 1992b) with HALO device drivers.

5.1.8   OFFSET

This option is used for a linear regional correction of gravity or magnetic data (can also be done in option 'EDIT FIELD DATA'; 5.7). Type start and end OFFSET values (positive value lower the observed anomaly). Note to later save the corrected profile data (5.7).

5.2 READ PROFILE

Upon entering this option the operator is prompted for a file extension mask (*.OUT by default). Change mask (e.g. to *.DAT) or press <ENTER> to accept the current mask setting. According to the mask setting the current directory is sorted and data-files are displayed (Fig. 8). Use cursor arrows (use <PGUP> & PGDN> keys to change directory 'page') to select the appropriate IMP 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.

After selecting a profile-file, the following information is displayed on the screen:

1.   Header

2.   Creator

3.   UTM zone and units (always km):

4.   Data-mode (m or g; magnetic or gravity mode)

5.   Field D,I & INT (Field declination, inclination and intensity)

6.   Profile points (<300)

8.   Profile interval (in km)

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9. Profile Length (in km)

10. Profile Trend/Direction (in degrees)

11. Start UTM Co-ordinates X & Y (in km)

12. End   UTM Co-ordinates X & Y (in km)

NOTE 1

The program calculates (checks) the profile distance and the profile trend (direction) if START and END X-Y UTM co-ordinates are provided. The calculated values are later used in the program.

NOTE 2

All co-ordinates, distances etc. should be in kilometre (i.e. the Y Co-ordinate will always have 4 integer digits, e.g. 7664.0674). The program checks that the START and END co-ordinates are in kilometres, if not, the START and END co-ordinates (and all other distances/co-ordinates) are scaled to kilometre. Hence, it is possible to have IMP profile files in e.g. meter as long as all parameters have the same unit.

NOTE 3

The program essentially works with magnetic anomaly data or Bouguer gravity data (free air need topography), and e.g. total magnetic field values should not be inputted for modelling. The operator can level the data by typing y (yes) during input. There are two

levelling techniques implemented (option a or r). Type a to level the data by subtracting the average value, or type r to subtract a regional background field value provided by the operator. The program provides a warning when levelling should be performed. After levelling the details are written in the data profile header. Tilting of the profile (regeional linear correction) is carried out in the 'Edit Field Data' option, or using option 'OFFSET' in the 'Graphical Display' mode.

NOTE 4

This option only reads IMP compatible profile data. Use option 'IMPORT PROFILES' (5.14) to convert non-standard files to IMP format.

FIGURE 8 Sorted list of profile files using option 'READ PROFILES'

```
 ┌────────────────────────────────────────────────────────────────┴─┐  ┐
 │ D.OUT        DEPTH.OUT     GAMMA.OUT     GAMMA2.OUT    GM1.OUT     │  │
 │ GM2.OUT      GM3.OUT       GM4.OUT       GM5.OUT       GM6.OUT     │══╡
 │ GM7.OUT      GM8.OUT       MAG7.OUT      NONAME.OUT    PHTEST.OUT  │  ┘
 │ PR770.OUT    PR810.OUT     PR890.OUT     RR.OUT        TEST.OUT    │
 │ TEST2.OUT    TROND.OUT     TT.OUT        TULL.OUT                  │
 │                                                                    │  ┐
 │                                                                    │  │
 │                                                                    │  │
 │                                                                    │  │
 │                                                                    │  │
 │                                                                    │  │
 │                                                                    │  ┘
 │═C:\MAGMOD\*.out                   ( 25 files)═════════════════THT91═┘
   ‖    READ CONTOUR FILE    ‖
 ┌────────────────────────────────────────────────────────────────┐
 │ <ESC> Quit <ENTER> Load   <D> Delete   <C> Copy   <V> View   <R> Rename │
 └────────────────────────────────────────────────────────────────┘
```

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5.3 READ BODIES

BODY files created with the IMP system automatically uses the file extension *.MOD and upon entering this mode a sorted list of BODY data-files are displayed (as in 5.2). Use cursor arrows (use <PGUP> & PGDN> keys to change directory 'page') to select the appropriate profile file followed by <ENTER>. Use <ESC> to leave this option without selecting a file.

In this mode (as in 'READ PROFILE'; 5.2) you can DELETE (type d), COPY (type c), VIEW (type v) or RENAME (type r) a body file.

5.4 SAVE BODIES

This option is used to SAVE/STORE bodies to a file which have previously been created in option 'GRAPHICAL DISPLAY' (5.1) or to store MERGED BODIES (5.5) under a new file name. The user is prompted for a file-name. If file-name exist the user is prompted to confirm overwriting (y/n; yes/no).

5.5 MERGE BODIES

Use this option to combine/merge two BODY files to a common file.
BODIES in memory is merged with a BODY file on the disk. Select
file to merge according to section 5.3.

Use option 'SAVE BODIES' (5.4) to save combined files to a common
file-name.

5.6 EDIT BODIES

After having loaded a BODY file (5.3) or created BODIES in 'GRAPHICAL DISPLAY' mode (5.1), the BODY PARAMETERS can be inputted/edited using this option (Fig. 9).

Upon entering this option the following variables are displayed (see Figure 1c):

- Body number

- Y   = HalfStrike Length in km (10 km by default)

- YMIN = negative Y length (defaults to -Y; see above)

- YCENT = origin of body; Y Offset value (by default zero)

- YMAX = positive Y length (defaults to +Y; see above)

- ROT   = Body rotation angle in the XY plane (in degrees)

         + clockwise, - anticlockwise rotation

         (defaults to zero)

- Density Contrast (in Mg/m^3)

- Absolute Susceptibility (10^{-6} SI units)

- Remanent Declination (0-360 degrees)

- Remanent Inclination (0 to ±90 degrees)

- Absolute Remanent Intensity (mA/M)

In addition the Konigsberger ratio (Q value), i.e. the ratio of REMANENT and INDUCED magnetizatuion (Q = REMANENT/INDUCED field

component), the total Vector (REMANENT+INDUCED vector) and the paired body co-ordinates (X and Y in kilometres). Note that the IMP system automatically create an extra X and Z value which matches the first point in the body.

Sub-options are as follows:

OPTIONS	EFFECT
A	ABORT OPTION

E	EDIT BODY (see Appendix 3 for editor)
	-Edit 1. Density contrast (mG/m^3)
	      2. Absolute susceptibility $(10^{-6}$ SI)
	      3. Remanent Declination (degrees)
	      4. Remanent Inclination (degrees)
	      5. Absolute Intensity or Q (mA/M)
	    NOTE - **Qx.x (e.g. Q0.2) to input Q ratio**
	      6. HalfStrike Length (in km)
	      7. YCENTER offset (in km)
	      8. Rotation in XY plane (in degrees)
	        + = clockwise
	        - = counterclockwise

ESC	QUIT EDIT BODY
UP/DOWN ARROWS	MOVE UP/DOWN ONE LINE DURING EDITING
OTHER KEYS	ADVANCE ONE BODY FORWARD

FIGURE 9   Example of 'EDIT BODY' option

```
Body Number: 1      DENSITY  ABSOLUTE      ** REMANENT MAGNETIZATION **
 Y   =    2.00      CONTRAST SUS(10-6SI)  DECL    INCL     ABS INT(mA/M)   Q
 YMin=   -2.00       0.200      15000.0   215.0   57.0        2000.0    0.00000
 YCen=    0.00      Total Vector          215.0   57.0
 YMax=    2.00
 Rot =    0.00              Density  constrast       :.2
 CORNER CO-ORDINATES        Absolute Sus (SI E-6)    :15000
   X        Z               Remanent Declination     :215
 31.800    0.000            Remanent Inclination     :57
 31.900   -0.300            Abs. Int. (mA/M) or Qx.x:2000
 32.000   -0.300            Half-length (Y)          :2
 32.600   -0.200            YOffset                  :0
 32.900   -0.100            Rotation Angle XY plane  :0
 33.300    0.000
 33.800   -0.100
 33.800    0.000
 33.800    0.100
 31.700    0.000
 31.800    0.000


         Hit any Key or <E> to edit Model data, or <A> to abort listing
```

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In this option (FIG. 10) the operator can input/edit the following

parameters:

PARAMETER	DESCRIPTION

PROFILE DISTANCE
PROFILE TREND
PROFILE POINTS
	PROFILE LENGTH (IN KM)
	ANGLE (0-360)
	NUMBER OF DATA-POINTS (MAX 300)
	
	Note Data-spacing for calculation of
	    anomalies will be
	    (DISTANCE/POINTS-1) for equal
	    spaced data
	    NEVER CHANGE THIS VALUE FOR REEL
	    DATA

FIELD DECLINATION
FIELD INCLINATION
FIELD INTENSITY
OBS ALTITUDE
GRAV OFFSET START
            END
MAG OFFSET START
            END
REGIONAL CORRECT.
	PEF DECLINATION (TYPICALLY 0±10)
	PEF INCLINATION (TYPICALLY 71-78)
	TYPICALLY BETWEEN 49000-53000nT
	FLIGHT ALTITUDE FOR MAGNETIC DATA
	START/END OFFSET VALUE FOR LINEAR
	REGIONAL CORRECTION OF GRAVITY DATA
	START/END OFFSET VALUES FOR LINEAR
	REGIONAL CORRECTION OF MAGNETIC DATA
	ONLY LINEAR CORRECTION IMPLEMENTED YET

SAVE FIND DEC-INC-INT	SAVE CHANGES TO DISK FIND DECLINATION, INCLINATION AND FIELD-INTENSITY FOR NORWAY BY ENTERING LOCAL MAP-SHEET NUMBER (4 FIRST DIGITS) (see FIG. 11) M711 series
PETROPHYSICS	START IMPPET (Torsvik & Olesen 1992b) (see Fig.12)
QUIT	RETURN TO MAIN MENU

NOTE: PROFILE TREND AND DISTANCE WILL BE AUTOMATICALLY CALCULATED
       IF START AND END CO-ORDINATES (UTM) ARE PROVIDED IN THE
       FILE (PEF = Present Earths Field)

FIGURE 10 Option 'EDIT FIELD DATA'.

```
┌──────────────────────────────────────────────────────────────────────┐
│ IMP V. 5.0    Interactive Modelling of Potential field data            │
│                                                                        │
│ Written by T.H. Torsvik 1988-92              Copyright THT & NGU        │
└──────────────────────────────────────────────────────────────────────┘
                    ┌──────────────────────────────────┐
                    │ PROFILE DISTANCE        57.14     │
         ┌──────────│ PROFILE TREND          118.67     │
         │ GRAPHICAL DISPLAY│ PROFILE POINTS    116      │
         │ READ   PROFILE   │ FIELD DECLINATION    5.60  │
         │ READ   BODIES    │ FIELD INCLINATION   78.60  │──────────────┐
         │ SAVE   BODIES    │ FIELD INTENSITY  53140     │              │
         │ MERGE  BODIES    │ OBS ALTITUDE (km)    0.80  │ oints    : 116│
         │ EDIT   BODIES    │ GRAV OFFSET START    0.00  │ odies    : 0  │
         │ EDIT   FIELD DATA│            END       0.00  │ EM STAT (k): 242│
         │ SAVE   ANOMALIES │ MAG  OFFSET START -150.00  │ ouse Status:ON│
         │ CHANGE DIRECTORY │            END       0.00  │               │
         │ CONFIGURATION    │ REGIONAL CORRECT. LINEAR   │ ETICS MODE ****│
         │ READ IMAGE FILE  │ SAVE TO DISK              │───────────────┘
         │ HARDCOPY-UTILITY │ FIND DEC-INC-INT          │
         │ READ CONTOUR FILE│ QUIT                      │
         │ IMPORT PROFILES  └──────────────────────────────┘
         │ RESET IMP SYSTEM │
         │ END/EXIT TO DOS  │
         └──────────────────┘
```

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FIGURE 11 Mapsheet Divison for Norway (M711).
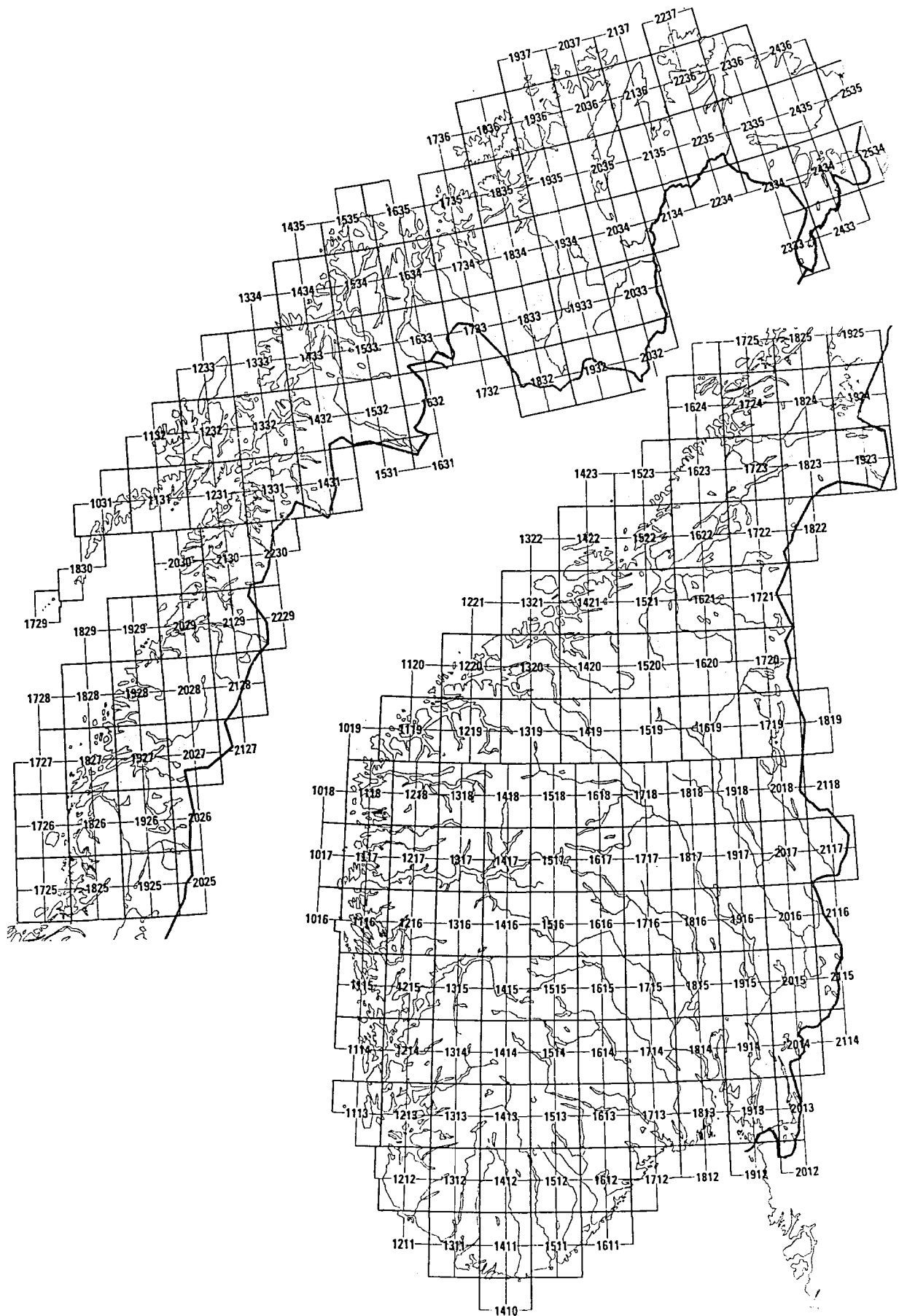
FIGURE 12 Main Menu IMPPET (Cf. Torsvik & Olesen 1992b).

```
┌────────────────────────────────────────────────────────────────────┐
│ IMPPET RELEASE 1.0        (c) 1992      Software by T.H. Torsvik & NGU │
└────────────────────────────────────────────────────────────────────┘

┌──────────────────────────────Main Menu──────────────────────────────┐
│ SEARCH LATITUDE    FILTER SETTING    MAPPER DISPLAY    SUBSET DBASE     │
│ NEXT    RECORD     SET FILTER ON     STAT  ANALYSIS    CONFIGURE IMPPET │
│ PREVIOUS RECORD    PRINTER LISTING   GRAPH ANALYSIS    QUIT             │
└──────────────────────────────────────────────────────────────────────┘

┌────────────────────────────────────────────────────────────────────┐
│ Current File:petro.bin    Record Length: 14813                         │
└────────────────────────────────────────────────────────────────────┘
```

```
┌─Rec      1─────────────────────────────────────────────────────────────┐
│Map     Lat      Long    LC  MC SC  Density Suscept.  RInt   Info    SampNo │
│15112   58.1953  8.3470  M04 M      2709    .00027   -999.99 2454AS 87 1   │
└─────────────────────────────────────────────────────────────────────────┘
```

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5.8 SAVE ANOMALIES

This option is used to create a profile data-file (given extension *.out) for calculated anomalies (in option 'GRAPHICAL DISPLAY').

5.9 CHANGE DIRECTORY

Set CURRENT DIRECTORY to any valid path (e.g. c:\magmod)

5.10 CONFIGURATION

This option permits the adjustment of parameters which control program output and performance. QUIT/EXIT this option by pressing <ESC>.

A configuration file named IMPMOD.SYS (free format ASCHI file) contains names of the variables which are adjusted using 'CONFIGURATION'. Whenever a parameter is changed, the file IMPMOD.SYS is automatically updated, thus recording the adjustment even after IMP5 is terminated.

The following parameters can be changed/updated (Fig. 13):

PARAMETER	VALUE
PLOTTER PORT (HP-GL COMPATIBLE) (Initial value=lpt1:)	com1:,com2,lpt1: or lpt2:
BAUDRATE (for com1: or com2:) (Initial value=9600)	110,300,600,1200,2400,4800 or 9600
PARITY (for com1: or com2:) (Initial value=n)	no, even or odd
DATABITS (for com1: or com2:) (Initial value=8)	7 or 8
STOPBIT (for com1: or com2:) (Initial value=1)	1 or 2
PDEPTH - Obs. or Mod. output (Initial value='o'	o or m This allows the operator to output an observed or model anomaly to PDEPTH

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PARAMETER	VALUE
	anomaly to PDEPTH. Option 'DEPTH' in 'GRAPHIC DISPL'
Merge common body segments (Initial value='n'	y or n See 5.1.4
ZOOM-STEP GRAPHICS (Initial value=0.1) -This value controls the resolution for cursor-movement (not mouse-movements) & MOVE BODY step	any value in km
BODY SHADING (Initial value=COL (colour) bodies)	COL, BW or OFF
TOPOGRAPHY Offset Level (Initial value=1 km)	any positive value in km This value controls the position of the zero line in the graphic mode
DEPTH AMPLITUDE (Initial value=10)	any positive value in km
MAG-GRAV AMPLITUDE (Initial value=400)	any pos. value (mT or mG)
MOUSE STATUS (Initial value=on if mouse is present)	on or off
PLOTTER PAPER SIZE (Initial value=4)	3 or 4 (i.e. A3/A4)
PLOTTER PEN (Initial value=1)	1 to 8
PLOTTER SPEED (Initial value=20)	1 to 80
SCREEN TYPE (Initial value=ega)	ega or vga
PLOT TO FILE	

PARAMETER	VALUE
(Initial value=n)	y or n (yes or no) If y is selected copying of the screen will be directed to a file which later can be read/plotted using the program IMPRINT (F1 SCREEN DUMP FEATURE)
PRINTER PORT FOR SCREEN DUMP (Initial value=lpt1:)	com1:, com2:,lpt1: or lpt2: ACTIVATED WITH F1
PLOT SIZE LASER DUMP (Initial value=3	1(small) 2, 3 or 4 (large)

NOTE Whenever screen-dumps (F1) are performed to black-white output devices 'BODY SHADING' should be set to 'BW' (oraments) or 'OFF'.

FIGURE 13 The configuration menu

```
===========================CONFIGURE  -  SYSTEM==========
HPGL      Plotter Port              (lpt1: com2:  ) :com1:
          Baudrate                  (110 to 9600  ) :9600
          Parity                    (n,o or e     ) :n
          Databits                  (8 or 7       ) :8
          Stopbits                  (1 or 2       ) :1
          PDEPTH - Obs. or Mod. output (o or m)      :o
          Merge common body segments (y or n)        :y
          Zoom-Step Graphics        (in km        ) :0.1
          Body Shading              (COL, BW, OFF ) :bw
          Topography Offset Level   (in km        ) :1
                                                     :
          Depth Amplitude           (in km        ) :3
          Mag-grav Amplitude        (in nT        ) :2200
          Mouse Status              (ON or OFF    ) :ON
HPGL      Plotter Paper Size        (3 or 4       ) :3
HPGL      Plotter Pen               (1 to 8       ) :1
HPGL      Plotter Speed             (1 to 80      ) :20
          Screen Type               (EGA or VGA   ) :vga
F1        Plot to file              (y/n)            :y
LIST/F1   Printer Port/Screen Dump  (lpt1: com1:  ) :lpt1:
F1        Plot Size LASER-DUMP      (1 to 4)      ) :3
```

5.11 READ IMAGE FILE (not for release 5.0)

This option loads an IMAGE grid file. Upon entering this routine the current file mask for IMAGE files is displayed (initial value=*.gri). Change mask 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.

NOTE: THIS OPTION IS YET NOT IMPLEMENTED FOR RELEASE 5.0

This option (Fig. 14) provides **hardcopy** listing of field-data, body-data, body-anomalies and the total anomaly for a given profile. I addition this option provide facilities for standard STATISTICS (e.g. on susceptibility or density) and spherical directional statistics (remanence directions, DECLINATION and INCLINATION), i.e. FISHER STATISTICS (Fisher 1953).

The following options are implemented:

OPTION	EFFECT
PRINT FIELD-DATA	COPY FIELD-DATA TO LINE PRINTER
PRINT BODY DATA	COPY BODY-DATA TO LINE PRINTER
PRINT BODY-ANOM	COPY INDIVIDUAL BODY ANOMALIES TO PRINT
PRINT TOTAL-ANOM	COPY TOTAL ANOMALIES TO LINE PRINTER
M-INV:	DEFAULT MAGNETIC INVERSION METHOD (Only Phillips method used as yet)
G-INV	DEFAULT GRAVITY INVERSION METHOD (under development)
STATISTICS	CALCULATE AVERAGE VALUES -INPUT NUMBER OF DATA POINTS -INPUT DATA VALUES THE RESULT IS PRINTED AS ARIMETRIC AND LOGARITHMIC MEANS. THE FORMER IS GIVEN WITH A STANDARD ERROR, AND THE LATTER GIVEN WITH LOW/HIGH LOGARITHMIC BOUNDARIES. -HIT ANY KEY TO ABORT
FISHER STATISTICS	PERFORM FISHER STATISTICS -INPUT NUMBER OF VECTORS -INPUT DEC,INC (DECLINATION,INCLIN.)

OPTION	EFFECT
	OUTPUT PROVIDES: DEC=MEAN DECLINATION INC=MEAN INCLINATION A95=ALFA95 CONFIDENCE ERROR K =PRECISON PARAMETER R =TOTAL UNITY VECTOR LENGTH -HIT ANY KEY FOR A STEREOPLOT -HIT ANY KEY TO ABORT
QUIT	RETURN TO MAIN MENU

FIGURE 14 Option 'HARDCOPY-UTILITY'

```
IMP V. 5.0    Interactive Modelling of Potential field data

Written by T.H. Torsvik 1988-92              Copyright THT & NGU

                  PRINT FIELD-DATA
                  PRINT BODY -DATA
        GRAPHIC   PRINT BODY-ANOM
        READ   P  PRINT TOTAL-ANOM
        READ   B  M-INV:PHILLIPS
        SAVE   B  G-INV:NONE
        MERGE  B  STATISTICS        le File:MAG7.OUT   Points     : 116
        EDIT   B  FISHER STATISTICS    File:           Bodies     : 0
        EDIT   F  QUIT              ur File:           MEM STAT (k): 242
        SAVE   A                       File:           Mouse Status:ON
        CHANGE DIRECTORY
        CONFIGURATION                 **** PSEUDO 3D MAGNETICS MODE ****
        READ IMAGE FILE
        HARDCOPY-UTILITY
        READ CONTOUR FILE
        IMPORT PROFILES
        RESET IMP SYSTEM
        END/EXIT TO DOS
```

5.13 READ CONTOUR FILE

This option loads a contour data-file, i.e. a UTM file with paired X (EAST) and Y (NORTH) co-ordinates (Standard ASCII file with X and Y co-ordinates; -9999.0 -9999.0 indicate 'pen-up'). A UTM file can be generated with the program IMPATLAS (cf. Torsvik 1992a) for Norwegian data.

Make sure that the UTM file is generated with 10 meters precision, i.e. using factor 100 in IMPATLAS (Torsvik 1992a). Also assure that UTM file, START/END co-ordinates of profile and/or original GRAVITY/MAGNETIC IMAGE file use the same UTM zone (30 to 37).

Upon entering this routine the current file mask for contour files is displayed (initial value=*.utm). Change mask 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.

Display of contour-files in option 'VIEW' (5.1.5).

5.14 IMPORT PROFILES

This is an important routine which converts almost any profile data to IMP profile files (which can be read with option 'READ PROFILE'; 5.2).

Upon entering this routine, 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 IMP 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. Future parameter
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)
17. IMP 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

IMP 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

The program may run out of memory (RAM) when calling this routine from IMP5. If so, reconfigure the computer in order to have the maximum memory available before starting IMP5 (trim AUTOEXEC.BAT & CONFIG.SYS; see Appendix 1). It is however, also possible to run a stand-alone program named PROFILE (same description as above) which will convert profiles to IMP5 format.

NOTE 4

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.

5.14.1 SPLINE FITTING

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 IMP5 (maximum 300 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 300 if e.g. data points exceed this limit of IMP5.

FIGURE 15 The 'IMPORT PROFILE' option

```
LINE1:   574902.25   7664067.50    53809.699    177.000
LINE2:   574959.19   7664088.50    53895.199    171.000
LINE3:   574998.38   7664104.00    53962.699    165.000
---------------------------------------------------------------------
Lines of Header                      :0
Total number of columns              :4
X column                             :1
Y column                             :2
Z column                             :0
Magnetic Anomaly column              :3
Gravity  Anomaly column              :
Flight Altitude Magnetics            :0
UTM Zone (30-37)                     :33
START X co-ordinate             *:
START Y co-ordinate             *:
END   X co-ordinate             *:
END   Y co-ordinate             *:
Profile Direction               *:
...........................    :
Data spacing                    *:
Spline Fitting        (y/n) :
IMP OUTPUT FILE-NAME           :test.out
```

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5.15 RESET IMP SYSTEM

In case a serious error occurred in the program, abnormal program performance, or one simply wish to start a new modelling session from 'scratch' use this option to reset all program variables/names etc; actually restart IMP.

Synthetic Gravity modelling (no profile data)

Start

-Run IMP5 (Type IMP5 at the DOS system prompt)

-IMP5 defaults to GRAVITY mode during start-up

-Select option 'GRAPHICAL DISPLAY' (5.1) in the main menu

(Since no profile data are loaded the system defaults to the

parameters listed in 5.1)

Create body 1

-Select option 'DRAW' (5.1.4)

-Move mouse-arrow to a selected position and click the left-

most button (or type a) to 'add' a point to body 1. Move the

mouse-arrow around and click the left-most button whenever you

wish to add a point to the body. E.g. create a simple body as

indicated in Fig. 16 and click the middle button (or press

<ENTER>) to end adding mode.

-The system prompts for selecting body parameters (provided for

earlier bodies). Simply press <ENTER> since this is the first

body.

Edit body 1 (set density contrast)

-Select option 'EDIT BODIES' (5.6) since we need some physical

parameters for our first body.

-Type e (edit) and input e.g. 0.2 as density contrast

-Notice that half-strike length (Y) defaults to 10 km;

no offset or rotation (see Fig. 1C)

-In edit mode you can always end inpputing by pressing the

<ESC> key.

-Type <a> to abort the edit option

Calculate the anomaly body 1

-Select option 'CALC' to calculate the gravity anomaly for the

first body (Fig. 16)

-Adjust amplitude (/vertical) scale in the upper diagram using

the <+> or <-> keys.

Change the shape of body 1

-Select option "DRAW' (5.1.4) and move the mouse-arrow near

point 2 in the first body. Notice in the lower-left part of

the screen that body 1, point 2 is highlighted and click the

right-most button to initiate 'move point' or type m.

-Move point 2 to a new position (e.g. as in Fig. 17) and

click the middle button or <ENTER>

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Recalculate the anomaly from body 1

-Select option 'CALC' to recalculate the anomaly after changing

the shape of the body.

Add a second body

-Select option 'DRAW' (5.1.4)

-Move mouse-arrow to a selected position and click the left-

most button (or type a) to 'add' a point, now to body 2. Move the

mouse-arrow around and click the left-most button whenever you

wish to add a point to the body. E.g. create a simple body as

indicated in Fig. 18 and click the middle button (or press

<ENTER>) to end adding mode.

-The system prompts for selecting a body (insert physical

parameters similar to the selected body). In our case, simply

press <ENTER> since you can only obtain values given body 1 at the

moment (only one body available).

-Change density for body 2 if necessary using option 'EDIT BODIES'

Calculate the combined anomaly from bodies 1 & 2

-Select option 'CALC' to calculate the anomaly for the two

bodies (Fig. 18).

Save body models

-Press <ESC> or select option 'QUIT' to return to the main

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menu.

-Select option 'SAVE BODIES' and enter a file-name

FIGURE 16   Example of creating a simple body (option 'DRAW') and calculating the gravity effect (option 'CALC') using a density contrast of 0.2
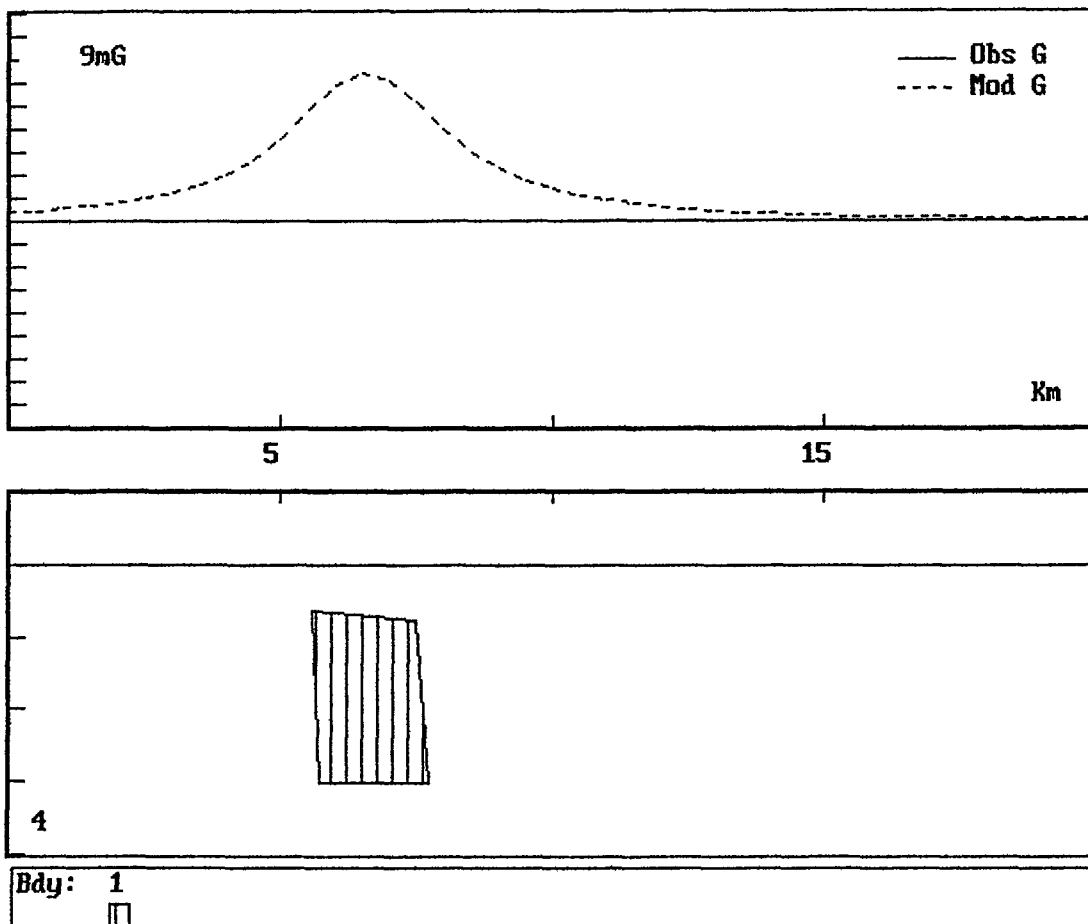
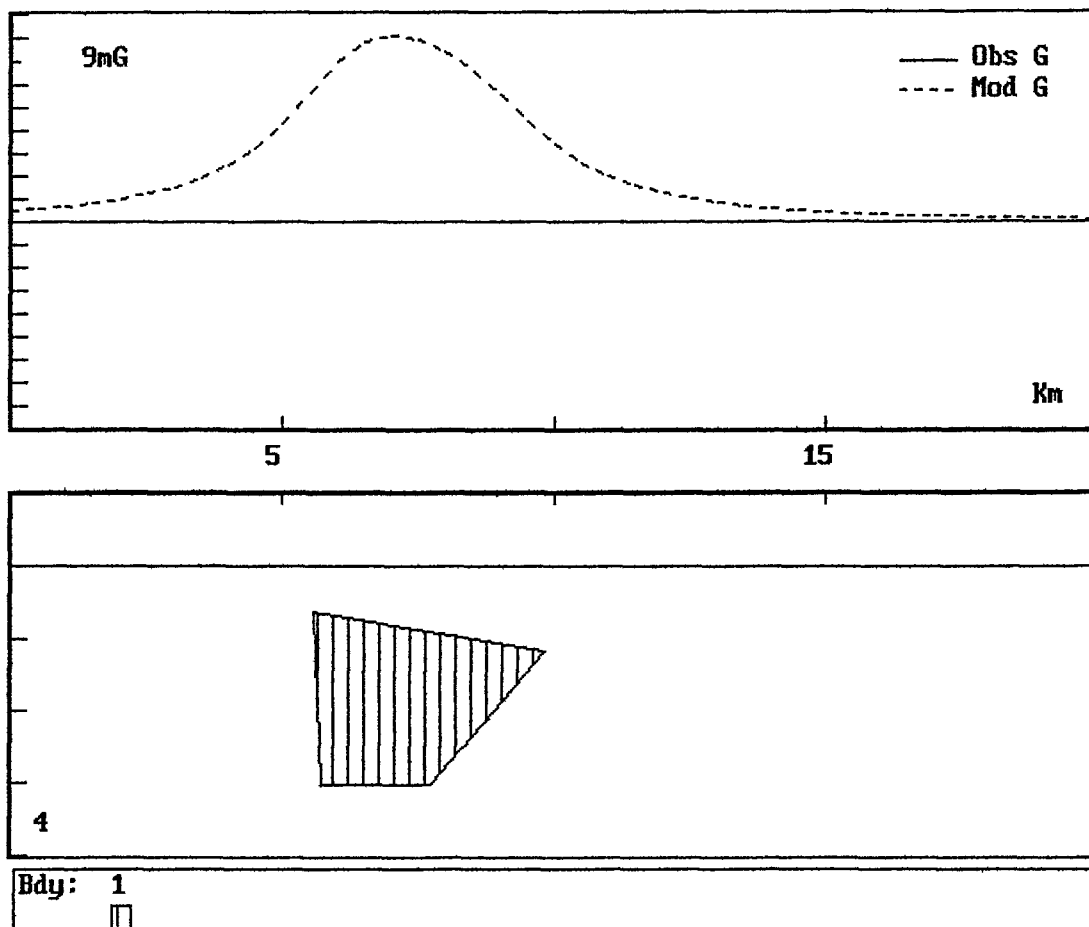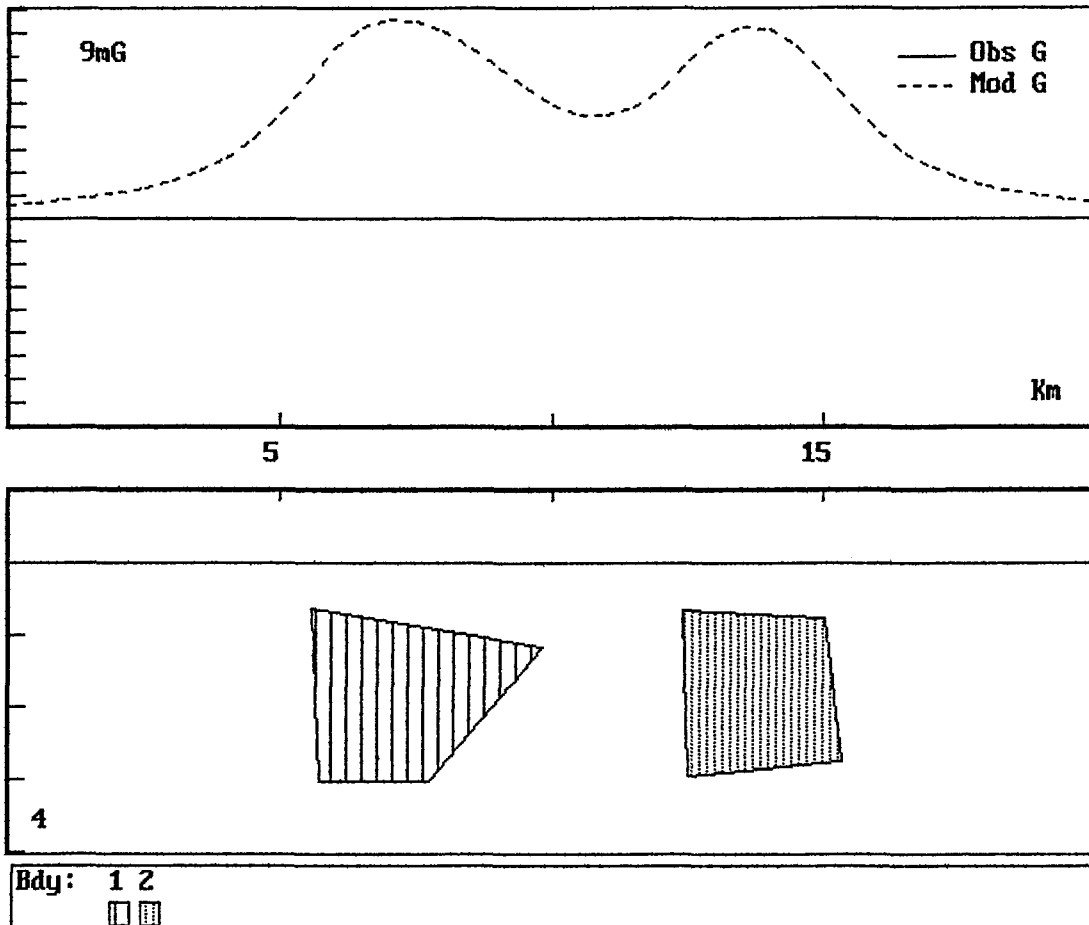**FIGURE 17** Example of modifying body 1 (see Fig. 16) and calculating the new gravity anomaly.

FIGURE 18   Example of adding a new body and calculating the combined gravity anomaly.

Read/display/calculate (test example from Magerøy, N. Norway)

Read profile

-Select option 'READ PROFILE' in the main menu

-Select file MAG7.OUT

-Type n or press <ENTER> to indicate no levelling of the observed magnetic data

Read bodies

-Select option 'READ BODIES' in the main menu

-Select file MAGER7.MOD

Read coast-line file

-Select option 'READ CONTOUR FILE' in the main menu

-Select file MAGER.UTM

Display profile & bodies

-Select option 'GRAPHICAL DISPLAY' in the main menu

-Adjust vertical scales using <+> & <-> keys (anomaly window) and <PGUP> & <PGDN> for depths in body window.

Calculate the total anomaly from the bodies

-Select option 'CALC' (Fig. 19)

-Select option 'LASER' or press <F1> to copy screen image

to HP Laser/Deskjet compatible printer

Calculate depth to magnetic basement

-Select option 'DEPTH'

-Enter 10 as window-length

 (cf. Torsvik & Olesen 1992a for details)

-Type g to quit PDEPTH menu (Cf. Torsvik & Olesen 1992a)

-Depth to magnetic basement (1 leg; primary solution) is

 now displayed (corrected for flight altitude of 0.8km in

 this example; Fig. 20).

-Select option 'LASER' or press <F1> to copy screen image

 to HP Laser/Deskjet compatible printer

Display profile & models in plane-view

-Select option 'VIEW' and Fig. 21 is displayed

-Type m to display models

-Select option 'LASER' or press <F1> to copy screen image

   to HP Laser/Deskjet compatible printer

FIGURE 19   Display of body file MAGER7.MOD and a comparison of
            the observed magnetic anomaly along profile MAG7.OUT
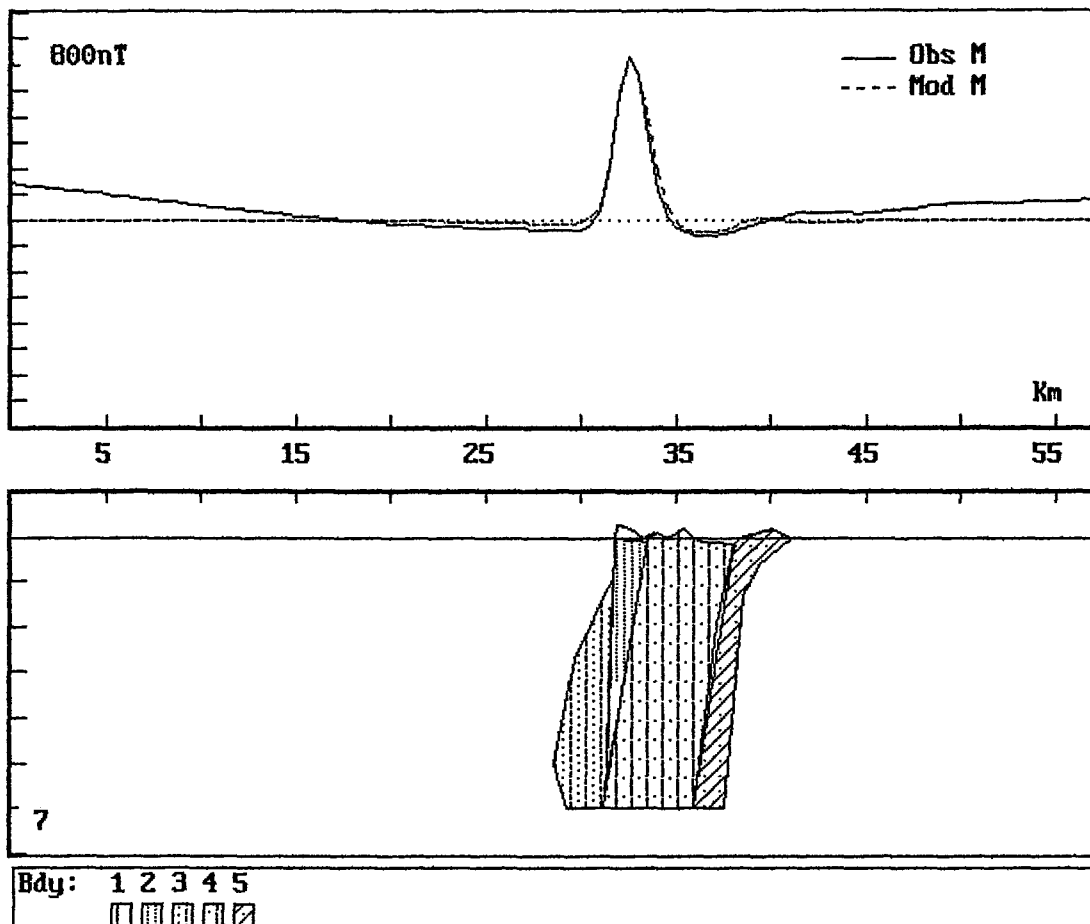   and that calculated from the models (stippled)

FIGURE 20 As Fig. 19, but now also displayed with depth to magnetic basement (1 leg; primary solution).
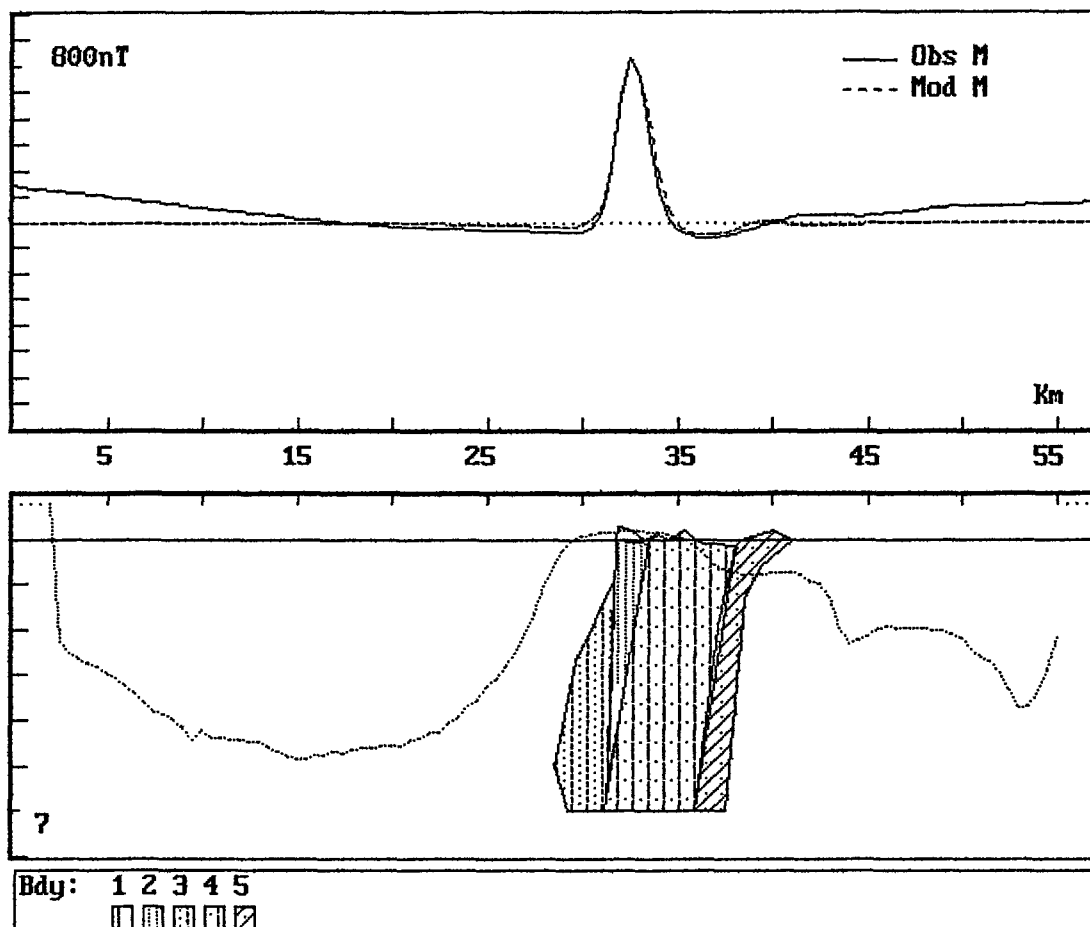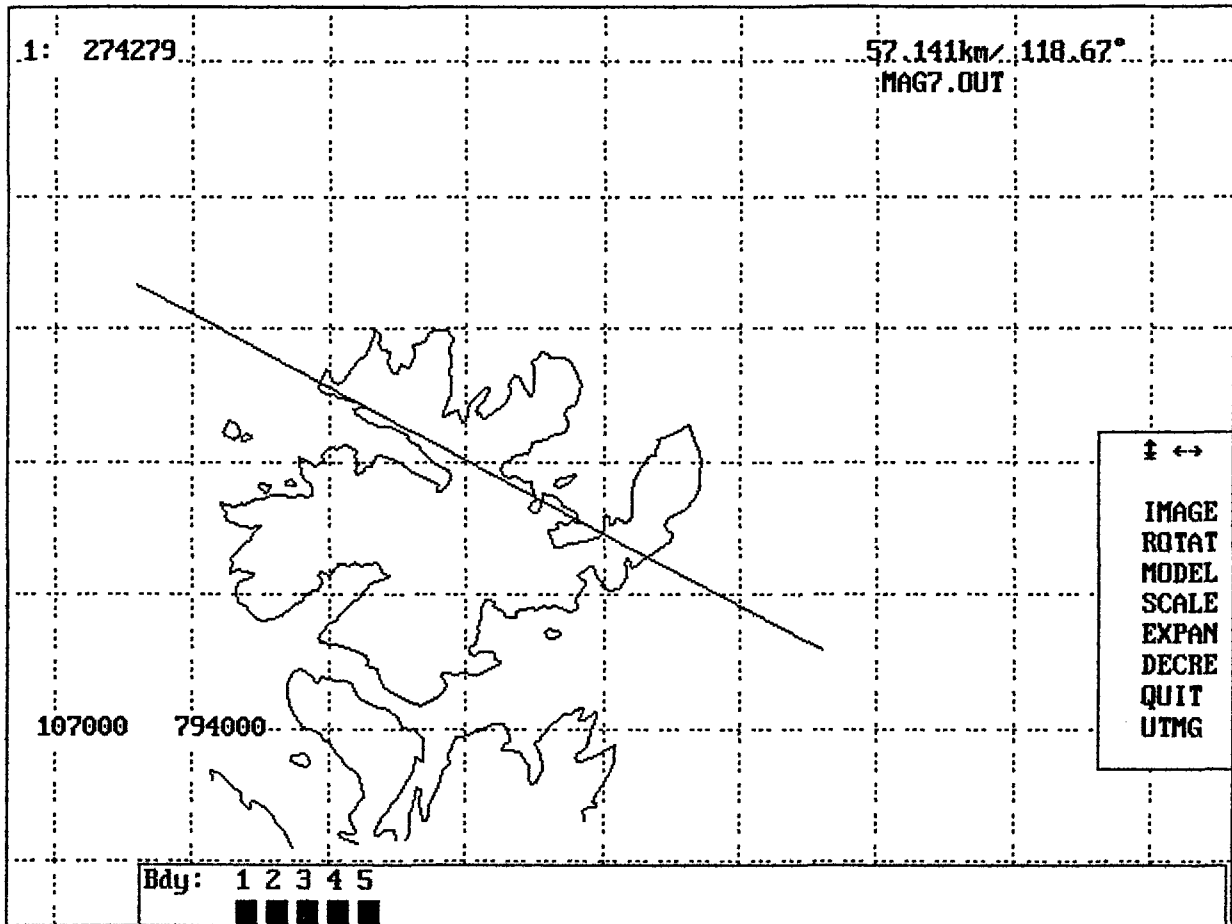
FIGURE 21 Profile MAG7.OUT shown in plane view along with UTM contour file MAGER.UTM

7 REFERENCES

Fisher, R.A., 1953. Dispersion on a sphere. Proc. R. Soc. Lond. Ser. A., 217, 295-305.

Rasmussen, R. & Pedersen, L.B., 1979. End corrections in potential Field Modelling. Geophysical Prospecting, 27, 749-760.

Phillips, J.D. 1975: Statistical analysis of magnetic profiles and geomagnetic reversal sequences. Ph.D. thesis. Stanford University, 134 pp.

Phillips, J.D. 1979: ADEPT: A program to estimate depth to magnetic basement from sampled magnetic profiles. U.S. geol. Surv. open-file report 79-367, 35 pp.

Torsvik, T.H., 1992a. IMPATLAS - Geographic database and map-generating system. NGU Report 92.223, 14pp.

Torsvik, T.H., 1992b. IMPPRINT - A Print-Driver Program. NGU Report 92.304, 14 pp.

Torsvik, T.H. & Olesen, O., 1992a. PDEPTH - Calculation of depth to magnetic basement from profile data. NGU Report 92.212, 26pp.

Torsvik, T.H. & Olesen, O., 1992b. IMPPET - Petrophysical Database System. NGU Report 92.275, 35pp.

8 ACKNOWLEDGEMENTS

APPENDIX 1   SETTING AUTOEXEC.BAT & CONFIG.SYS IN MS-DOS 5

Example of AUTOEXEC.BAT set-up with QEMM memory manager

```
@ECHO OFF
PROMPT $p$g
PATH C:\dos
SET COMSPEC=C:\DOS\COMMAND.COM
SET DOS16M=11
SET TEMP=C:\DOS
MODE CON CODEPAGE PREPARE=((865) C:\DOS\EGA.CPI)
MODE CON CODEPAGE SELECT=865
c:\qemm\loadhi /r:1 c:\dos\doskey.com
PATH C:\MAGMOD
c:\qemm\loadhi /r:2 c:\mouse\mouse.com
```

Example of CONFIG.SYS set-up with QEMM memory manager

```
break=on
device=c:\dos\setver.exe
dos=high
DEVICE=C:\QEMM\QEMM386.SYS x=1000-B0FF ROM RAM MA=0
COUNTRY=47,865,C:\DOS\COUNTRY.SYS
BUFFERS=20
FILES=30
STACKS=0,0
SHELL=C:\DOS\COMMAND.COM /P /E:640
device=c:\qemm\loadhi.sys /r:1 c:\dos\display.sys con=(ega,865,1)
INSTALL=c:\qemm\loadhi.com /r:2 /tsr c:\dos\keyb.com
        _no,865,c:\dos\keyboard.sys
lastdrive=z
```

APPENDIX 2 EDITOR USE IN IMP5

When entering a single data-entry or editing table's etc., the following general features are implemented:

Up/Dn arrows   : Move up/down in input tables

Left/Right arrows: Move Left/Right within a single data-entry

<RETURN>   : Move to next entry field or end a

                    single data entry routine

<ESC>   : Escape/Quit input/edit mode

<INS>   : Change from INSERT to REPLACE (overwrite)

                    mode or from REPLACE to INSERT mode.

                    (Defaults to REPLACE mode)