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MAGRAV USERS GUIDE

A Computer Program to Create Two-dimensional Gravity and/or Magnetic Models

by

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1.0 INTRODUCTION

MAGRAV is a computer program that aids interactive gravity and magnetics modelling of two-dimensional submarine features.

The user can:

(1) input actual magnetic or gravity anomalies digitized from a ship's recorder;

(2) input the coordinates and associated magnetic or gravity parameters of hypothetical two-dimensional subsea bodies;

(3) let the computer calculate the anomaly the hypothetical bodies would generate;

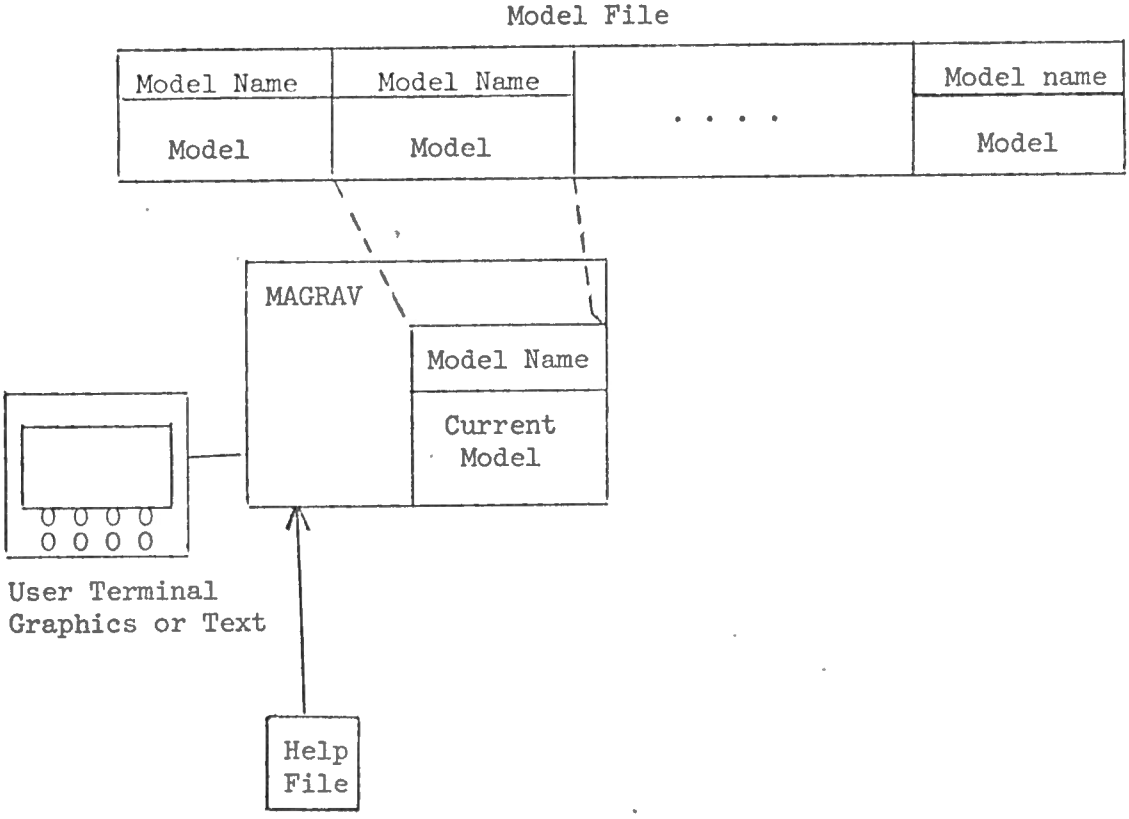
(4) change coordinates and parameters of the hypothetical bodies interactively until the hypothetical and actual anomalies are similar;

(5) store these models on disc and read them back at a later date.

Values can be entered either in text mode from a DECwriter-type terminal or graphically from a Tektronix-type terminal.

MAGRAV runs on a CDC 6400 computer using NOS/BE. MAGRAV is written in FORTRAN.

2.0 DIAGRAM OF MAGRAV



3.0 HOW TO START UP

MAGRAV is an interactive program. It is run from either a text terminal (such as DECwriter) or graphics terminal (such as a Tektronix 4010). First LOGON to computer to run program with standard MODELS file

```
-RUN
```

To create a new file, ABC, to store models:

```
DEFINE,ABC

RETURN,ABC

-RUN(MODELS=ABC)
```

To run with models file ABC

```
-RUN(MODELS=ABC)
```

To obtain copy of brief user instruction

in reply to WHAT TO DO?

type HELP

To set MAGRAV up on another account number

```
GET,RUN/UN=BIK1008

SAVE,RUN
```

4.0 BRIEF USER INSTRUCTIONS

This is the output from the 'HELP' command.

```
------------------------------------
MAGNETIC GRAVITY MODELLING PROGRAM
      COMMAND SUMMARY
------------------------------------
 TO START UP PROGRAM
      LOGIN
      -RUN
-----------------------------------------
     NOTE THAT CARRIAGE RETURN IN
      RESPONSE TO A QUESTION WILL
      RETAIN PREVIOUS ANSWER OR
      DEFAULT ANSWER.WHEN IN DOUBT,
      CARRIAGE RETURN.


     ALWAYS AWAIT QUESTION MARK '
     BEFORE REPLYING TO A QUESTION.
=========================================
ANOMALY          CALCULATES ANOMALY
                 FOR ALL BODIES
BODY             ENTER CO ORDINATES OF
                 A SPECIFIED BODY
                 TO DELETE A BODY SPECIFY
                 0 POINTS
COMMENTS         ENTER OR CHANGE COMMENTS
                    (150 CHARACTERS)
CROSSES          CROSSES MAY BE DRAWN AT
                    BODY POINTS
DELETE           DELETE A POINT FROM
                 A BODY
DRAW             PLOT BODIES AT  SCALE
                 X FROM 0 TO X SCALE
                 ALL OR 1 MAY BE PLOTTED
DUMP             DUMPS ALL VALUES
                 FOR CURRENT MODEL
END              STOP PROGRAM
MODEL            CHANGE NAME OF
                 CURRENT MODEL
GRAPH            TURN TO GRAPHICS
                 MODE WHERE COMMANDS
                 ARE CURSORED IN
                 ALWAYS HIT THE
                 P      FOR
                   CURSORING.
                 ? WILL RETURN YOU TO
                   WHAT TO DO MODE
                 C WILL REWRITE COMMANDS
                 A WILL ABORT A COMMAND
                 1 BELL-ENTER COMMAND
                 LOUD BELL-ERROR-REENTER
                              COMMAND
                 NO BELL-ENTER INFO ON
                        SCREEN
                 BODY,ANOMALY,PARAM
                 COMMANDS TAKE THE
                  BODY NUMBER FROM THE
                 KEY.
GRAVITY          SWITCH TO GRAVITY MODEL
                 ANOMALY MUST BE RECALCU-
                    LATED
HELP             LIST ALL COMMANDS
INSERT           REPLACE A POINT IN
                 A BODY
LIMITS           TYPES MAXIMUM,MINIMUM
                 AVERAGE ANOMALY.
```

	AN OFFSET MAY BE ENTERED THAT IS ADDED TO OBSERVED BEFORE PLOTTING. MUST BE SET EACH RUN.
MAGNETICS	SWITCH TO MAGNETICS MODEL SET X TO N ,DEC,DIP,Z CON ANOMALY MUST BE RECALCULATED
OBSERVATIONS	ADD OR MODIFY OBSERVATIONS TYPE CARRIAGE RETURN TO END
PANOM	PLOT ANOMALY BUT DO NOT RECALCULATE
PARAMETERS	REPLACE PARAMETERS FOR A SPECIFIED BODY. IF THE BODY NUMBER=0 THE VALUE(S) INPUT ARE ADDED TO ALL BODIES.
POINT	CHANGE THE VALUE OF A BODY POINT.
READ	READ A MODEL FROM FILE. MODEL IS SPECIFIED BY . FILES COMMAND. BODIES ARE CHECKED TO ENSURE THEY ARE CLOSED IF NOT,THEY ARE CLOSED.
RECOVER	CURRENT MODEL CAN BE RESTORED TO A PREVIOUS STATE. ALSO USED TO RECOVER WHEN PROGRAM *TERMINATED*
SCALE	SET SCALES FOR ANOMALY PLOTTING; MAX X,Z FR DRAW;NUMBER OF FIELD POINTS AND THEIR SPACING.
SKETCH	CHANGE TO SKETCH MODE.ONLY SCREEN SPECIFIED BY ZOOM WILL BE PLOTTED. SKETCHES ONE OR ALL BODIES.
SUPPRESS GRAPHICS	CAN TURN GRAPHICS ON OR OFF SO YOU DO NOT HAVE TO USE TEKTRONIX 40XX SCOPE.
TANOMALY	TYPES CALCULATED ANOMALY AT EACH FIELD POINT
TBODY	TYPES BODY POINTS AND PARAMETERS (0 FOR ALL)
TCOMMENTS	TYPE COMMENTS OUT
TMODELS	TYPES NAMES OF ALL MODELS STORED ON FILE(MAX 50)
TOBSERVATIONS	TYPE ALL NON ZERO OBSERVED
TPARAMETERS	TYPE PARAMETERS FOR ALL BODIES
TSCALE	TYPE SCALE PARAMETERS AND OTHER ASSORTED VALUES
WRITE	WRITES CURRENT MODEL TO MODEL FILE. NAME MUST BE SPECIFIED BY FILES.
ZOOM	SET EDGE OF SCREEN FOR SELECTION MODE

```
JULY, 1977.
NOTE: DELETING MAGNETIC GRAVITY MODELS
      FROM A FILE.
DELETING PROCESS INVOLVES THE CREATION
OF A SUBSET OF A FILE.
   IE. COPY DESIRED MODELS FROM ONE
       FILE TO ANOTHER.

FOR FURTHER INFORMATION PERFORM
THE FOLLOWING IN BATCH MODE:

   GET,UPMODEL/UN=DIK100B
   -UPMODEL(I=PFN1,O=PFN2)

   PFN1 IS THE NAME OF EXISTING FILE.
   PFN2 IS THE NAME OF THE UPDATED FILE.

WHEN ASKED 'WHAT TO DO', TYPE 'HELP'

* PFN2 WILL BE CREATED.
-----------------------------------
END OF INFORMATION ENCOUNTERED.
/
```

5.0 DEFINITIONS

MODELS file - This is a disc file that stores all the information about several gravity/magnetic models. Each model is identified by a unique 1-10 character identifier.

Model - A set of information containing model name body coordinates, or information about whether gravity or magnetic anomalies are to be calculated, a set of observed values, various scaling information, etc.

ZCON - A constant added to the Z coordinate of each body. Useful in magnetic modelling when using aeromagnetic data flown at constant height above sea level, in which case ZCON is the negative flight height.
The default is zero.

Body - A polygon representing the cross section through a geological formation.

XSCALE - The length of the section to be viewed in kilometres.

declination The angle between geographic north and magnetic north at the body, measured clockwise from geographic north in degrees.

dip The inclination of the magnetic field in degrees from the horizontal, positive in the northern hemisphere.

X to N angle The angle between the positive X-axis and geographic north, measured clockwise from geographic north in degrees.

X displacement The minimum value of X in kilometres for which observations are supplied and at which model calculations are made. Provides an offset to eliminate end effects.

point spacing - Distance in kilometres between field points.

observed offset-A value used for display purposes only. Before plotting this offset is added to each observed value.

magnetization - In units of 10^{-5} emu.

density - rho (ρ) in grams per cubic centimetre.

Z - Vertical distance in kilometres, positive down.

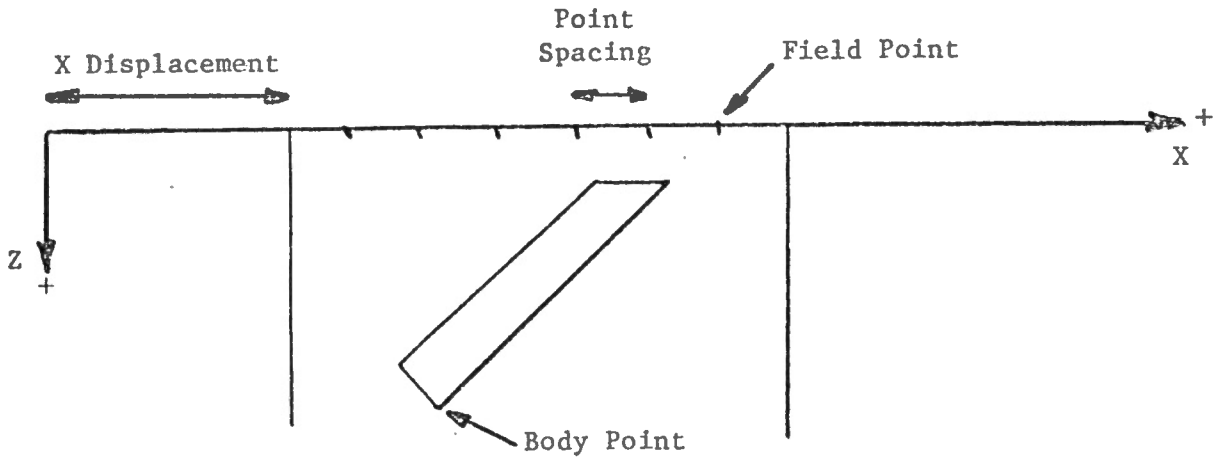


Illustration of Some DEFINITION Terms

6.0 SAMPLE RUN

This is a sample session.

Not listed is the LOGON procedure and

GET,RUN/UN=BIK1008.

Upper case listing is output from the computer and lower case is keyboard input.

```
-run
MAGRAV

HELLO

GRAVITY  MAGNETICS MODELLING PROGRAM
VERSION 4.0.2
-------------------------------------
 WHAT TO DO
? tmodels
     1 III
     2 TEST
     3 NDSEGH
     4 JAN
     5 BENCHMARK
     6 HARE1
     7 NDCH
     8 NDIJ
     9 NDEF
    10 NDAB
    11 NDCD
    12 HARE1BA
    13 BURL2
    14 DYER1
    15 BHARE1DETL
    16 CHARE1DETL
 WHAT TO DO
? model
MODEL NAME
? benchmark
BENCHMARK
 WHAT TO DO
? read
BENCHMARK  READ
 WHAT TO DO
? dump
 MODEL

BODY   1
     RHO=        .35
       1       -5.00        0.00
       2       15.00        0.00
       3       15.00         .50
       4        5.00         .50
       5        5.00        1.00
       6       -5.00        1.00

BODY   2
     RHO=        .21
       1       -5.00        1.00
       2        5.00        1.00
```

```
        3        5.00          .50
        4       15.00          .50
        5       15.00         2.00
        6       -5.00         2.00

 OBS
TOTAL ANOMALY
 GRAVITY
 MODEL=BENCHMARK
 COMMENTS

 X SCALE=       10.00
 Z SCALE=       20.00
 XDISP=          0.00
 POINT SPACING   1.00
 NO. OF POINTS    11
 ANOM MIN       10.00
 ANOM MAX       25.00
 OBS OFFSET      0.00
 NUMBER OF BODIES= 2
 SCOPE OUTPUT SUPPRESSED
 DRAW MODE
SKETCH LIMITS X       0.00    2000.00
              Z       0.00     100.00
 MAX PTS/BODY=         24
MAX NO.BODIES=         30
MAX NO.OBS=           100
 WHAT TO DO
? body
BODY,NUMBER OF POINTS
? 3,3
ENTER   3 X,Z
? 15,0
? 20,0,20,2
 WHAT TO DO
? parameters
BODY
? 3
RHO
? .3
 WHAT TO DO
? tratameters
 BODY     RHO
    1        .35
    2        .21
    3        .30
 WHAT TO DO
? tscale
 GRAVITY
 MODEL=BENCHMARK
 COMMENTS

 X SCALE=       10.00
 Z SCALE=       20.00
 XDISP=          0.00
 POINT SPACING   1.00
 NO. OF POINTS    11
 ANOM MIN       10.00
 ANOM MAX       25.00
 OBS OFFSET      0.00
 NUMBER OF BODIES= 3
 SCOPE OUTPUT SUPPRESSED
 DRAW MODE
SKETCH LIMITS X       0.00    2000.00
              Z       0.00     100.00
```

```
 MAX PTS/BODY=         24
MAX NO.BODIES=         30
MAX NO.OBS=           100
 WHAT TO DO
? tbody
BODY
? 3


BODY   3
     RHO=        .30
       1       15.00        0.00
       2       20.00        0.00
       3       20.00        2.00


 WHAT TO DO
? limits
  ANOMALY SCALE UPPER       0.00
                LOWER       0.00
                AVERAGE     0.00
ENTER OFFSET FOR OBSERVED
? 0
 WHAT TO DO
? crosses
CROSSES OFF
 WHAT TO DO
? crosses
CROSSES ON
 WHAT TO DO
? crosses
CROSSES OFF
 WHAT TO DO
? comments
TYPE COMMENTS
? Just a benchmark demonstration
 WHAT TO DO
? lcomments
JUST A BENCHMARK DEMONSTRATION


 WHAT TO DO
? tobs
 OBS
 WHAT TO DO
? observed
NO.,VALUE
? 1,10
? 2,20,3,40,2,30,4,20
? 0,0
 ERROR    0 ILLEGAL
NO.,VALUE
?
 WHAT TO DO
? tobserved
 OBS
  1        0.00       10.00
  2        1.00       30.00
  3        2.00       40.00
  4        3.00       20.00
 WHAT TO DO
? insert
BODY,INSERT AFTER POINT
? 3,3
Y,?
```

```
? 15,2
 WHAT TO DO
? tbod
BODY
? 3


BODY   3
     RHO=        .30
       1       15.00        0.00
       2       20.00        0.00
       3       20.00        2.00
       4       15.00        2.00


 WHAT TO DO
? point
BODY,POINT
? 3,4
OLD X,Z      15.00       2.00
? 15,1.5
  WHAT TO DO
? tbod
BODY
? 3


BODY   3
     RHO=        .30
       1       15.00        0.00
       2       20.00        0.00
       3       20.00        2.00
       4       15.00        1.50


 WHAT TO DO
? delete
BODY,DELETE POINT
? 3,4
POINT   4 DELETED=      15.00       1.50
 WHAT TO DO
? anomaly
ANOMALY CALCULATED
 WHAT TO DO
? tanomaly
BODY(0=ALL)
? 3
ANOMALY BODY  3
   1        0.00         .04
   2        1.00         .04
   3        2.00         .05
   4        3.00         .05
   5        4.00         .06
   6        5.00         .07
   7        6.00         .08
   8        7.00         .10
   9        8.00         .12
  10        9.00         .14
  11       10.00         .18
 WHAT TO DO
? zoom
FOR SKETCH MODE,ENTER MIN X,MAX X,UPPER Z,LOWER Z
? 100,100,0,3
FOR SKETCH MODE,ENTER MIN X,MAX X,UPPER Z,LOWER Z
? 100,1000,0,3
 WHAT TO DO
```

```
? suppress graphics
DO YOU WANT GRAPHICS SUPPRESSED
? yes
 WHAT TO DO
? scale
GRAVITY
 X SCALE
?
 Z SCALE
?
 X DISPLACEMENT
?
 POINT SPACING
?
 NO.OF POINTS
?
 ANOMALY MIN,MAX
?
 WHAT TO DO
? magnetics
MAGNETICS MODEL ENTER X TO N ANGLE
?
 DEC
?
 DIP
?
 ZCON
?
 WHAT TO DO
? tbod
BODY
? 0


BODY  1
     MAGNETIZATION      0.00
 DEC         0.00 DIP       0.00
       1       -5.00        0.00
       2       15.00        0.00
       3       15.00         .50
       4        5.00         .50
       5        5.00        1.00
       6       -5.00        1.00


 BODY   2
     MAGNETIZATION       0.00
 DEC         0.00 DIP       0.00
       1       -5.00        1.00
       2        5.00        1.00
       3        5.00         .50
       4       15.00         .50
       5       15.00        2.00
       6       -5.00        2.00


 BODY   3
     MAGNETIZATION       0.00
 DEC         0.00 DIP       0.00
       1       15.00        0.00
       2       20.00        0.00
       3       20.00        2.00


  WHAT TO DO
? tscale
```

```
MAGNETICS
MODEL=BENCHMARK
COMMENTS
JUST A BENCHMARK DEMONSTRATION
 X SCALE=       10.00
 Z SCALE=       20.00
 XDISP=          0.00
 POINT SPACING   1.00
 NO. OF POINTS      0
 ANOM MIN      -100.00
 ANOM MAX       100.00
 OBS OFFSET       0.00
 NUMBER OF BODIES= 3
        DEC=     0.00          DIP=     0.00
 X TO N ANGLE     0.00
        ZCON=      .00
 SCOPE OUTPUT SUPPRESSED
 DRAW MODE
SKETCH LIMITS X       0.00      10.00
              Z       0.00      20.00
 MAX PTS/BODY=          24
MAX NO.BODIES=          30
MAX NO.OBS=            100
 WHAT TO DO
? gravity
GRAVITY MODEL
ZCON
?
 WHAT TO DO
? graph
 WHAT TO DO
? sketch
BODY
?
 WHAT TO DO
? draw
BODY
?
 ERROR
 WHAT TO DO
? recover
HOW MANY BACKSPACES
? 3
MODEL BENCHMARK
 RECOVERED
 WHAT TO DO
? recver
HOW MANY BACKSPACES
? 30
MODEL BENCHMARK
 RECOVERED
 WHAT TO DO
? write
DUPLICATE MODEL.TYPE YES IF OK TO OVERWRITE
? no
MODEL BENCHMARK  WRITTEN
UNSUCCESSFULLY
 WHAT TO DO
? xxxx
? 05e JJ5e JJ WHAT TO DO
? help
-----------------------------------------
MAGNETIC GRAVITY MODELLING PROGRAM
      COMMAND SUMMARY
-----------------------------------------
 TO START UP PROGRAM
```

```
      LOGIN
      -RUN
-------------------------------------------
    NOTE THAT CARRIAGE RETURN IN
     RESPONSE  *INTERRUPTED*
*

   GET,UPMODEL/UN=BIK100B
   -UPMODEL()=P *INTERRUPTED*
*
? end
? GOOD-BYE
*
/bye

BIK100B   LOG OFF    16.30.46.
BIK100B   SRU      11.405 UNITS.
CONNECTED       0.533 HOURS.
SESSION COST    1.960 DOLLARS.
```

7.0 DETAILED DESCRIPTION OF COMMANDS

MAGRAV consists of commands that initialize and change various parameters of a model and then allow the user to compare the calculated anomaly for this model to the anomaly observed.

The model and the observed data can be written on disc for future reference. The user can interactively change the model in either text or graphics mode.

In text mode, points to be changed are referred to by their body number and point number. Calculated and observed anomalies are listed on the terminal printer.

In graphics mode, anomalies and bodies are drawn on the graphics screen. Commands can be executed by shining a graphics cursor over a command displayed on the screen. The shape of bodies can be changed by shining the cursor on the body and point to be moved. The 'GRAPH' command puts MAGRAV in graphics mode.

Following is a list of all commands that can be entered in response to 'WHAT TO DO'. If at any time you are not sure what response is expected, just enter carriage return and the default answer will be assumed. To obtain a brief list of commands (70 lines), type 'help' in response to WHAT TO DO. Never enter your response before the question mark (?) prompts you. If you do, the system may throw you off (*TERMINATED*). In this case, to recover, enter:

```
-RUN

WHAT TO DO

? recover

HOW MANY BACKSPACES

? 2
```

ANOMALY — calculates the anomaly for each body that has been changed and then adds up the individual anomalies to get the total anomaly. This command does not plot the anomaly. ANOMALY CALCULATED is printed on successful completion.

An Error message is printed if the anomaly cannot be calculated. This may occur for magnetics models if bodies go right up to Z=0. If this happens use the MAGN command to set ZCON equal to a positive value.

BODY — creates or deletes a body. MAGRAV asks

```
BODY,NUMBER OF POINTS
```

(a) to delete an existing body reply with the body number, zero, i.e. 3,0.

The parameters for this body are retained.

(b) to create a new body reply with the 'body number, number of points'. The number of points in a body is equal to the number of vertices. The last point is not equal to the first.

If there is already a body with this body number, MAGRAV asks

"DUPLICATE BODY, TYPE YES IF OK TO OVERWRITE"

Answer "Y" to overwrite this body.

MARGRAV then asks

"ENTER X,Z"

Body points are then entered as consecutive pairs of numbers separated by commas, blanks, or carriage returns. Body points must be entered in a clockwise direction.

COMMENTS — Comments about the current model may be entered. These comments may be reprinted by using the "TCOMMENTS" command. Comments may be up to 150 characters long (including blanks).

CROSSES — When DRAWing or SKETCHing a body on the graphics screen, bodies may be drawn with a cross at each vertex. The cross makes it easier to identify where the vertices are. If the crosses are off (default value) when this command is executed, crosses are turned on. If on, they are turned off. Either "CROSSES OFF" or

"CROSSES ON" is printed.

DELETE — allows the user to remove a point from a body. MAGRAV asks

"BODY, DELETE POINT"

The user replies with a body number and the point number to be deleted. MAGRAV then prints out the X and Z value of the point deleted and removes the point.

DRAW — One body or several bodies are drawn on the graphics screen. The model is put in DRAW mode (as opposed to SKETCH mode). MAGRAV asks "BODY". Any valid body number may be entered. Body number zero means draw all bodies. If crosses are on (see "CROSS" command) a small cross is drawn at each vertex of each body. The horizontal scale goes from zero to XSCALE (see "SCALE" command). The vertical scale goes from 0 at the top to ZSCALE (see "SCALE" command) at the bottom.

If graphics are suppressed (see "SUPP" command), this is a do-nothing command.

DUMP prints all values that are stored for this model. The following information is dumped.

- model name
- the X,Z coordinates for each body
- if this is a gravity model, density (rho) is printed for each body
- if this is a magnetics model the declination, dip and magnetization of each body
- if this is a magnetics model the declination, dip and X to N angle of the field
- the nonzero observed values
- the total anomaly at each field point
- comments
- XSCALE
- ZSCALE
- X displacement
- point spacing
- number of field points
- minimum and maximum anomaly values
- total number of bodies
- a note to tell whether graphics is suppressed or not
- either SKETCH or DRAW mode
- SKETCH limits -when the SKETCH command is executed these are the X and Z ranges that are plotted
- MAX PTS/BODY - the MAGRAV program is currently set to handle this maximum number of points per body
- MAX NO. OF BODIES - MAGRAV will handle no more than this number of bodies
- MAX NO. OBS - MAGRAV will handle this number of observations. These three values can be changed by recompiling MAGRAV. If one is increased, others must be decreased because of core limitations. See 'How to Recompile', Section 9.

END — This command terminates MAGRAV. Of course, "STOP" works too.

MODEL — specify current model name. 1-10 characters long. Be sure not to have trailing blanks. MAGRAV reprints the model name. See "READ" and "WRITE" commands.

GRAPH — puts terminal in graphics mode.

The first time GRAPH is called, the screen is erased. No erases are performed thereafter by MAGRAV.

The screen is segmented into three areas. From top to bottom, these are:

(1) Anomaly screen

vertical scale goes from ANOMAX to ANOMIN (see 'SCALE' command)

horizontal scale goes from 0 to XMAX (see 'SCALE' command)

(2) Bodies screen

vertical scale goes from 0 (top) to ZMAX (bottom)

horizontal scale goes from 0 to XMAX

(3) Menu of commands

The bell is rung. The program is now ready for you to move the cursor over the menu command you want to execute (by hitting the character 'P' and carriage return). See the following notes for operation of each command.

The following special characters may be hit at any time on the keyboard to operate extra commands:

? returns user to 'WHAT TO DO' (text) mode

C rewrite the scales and menu of commands (handy if the screen is accidently erased)

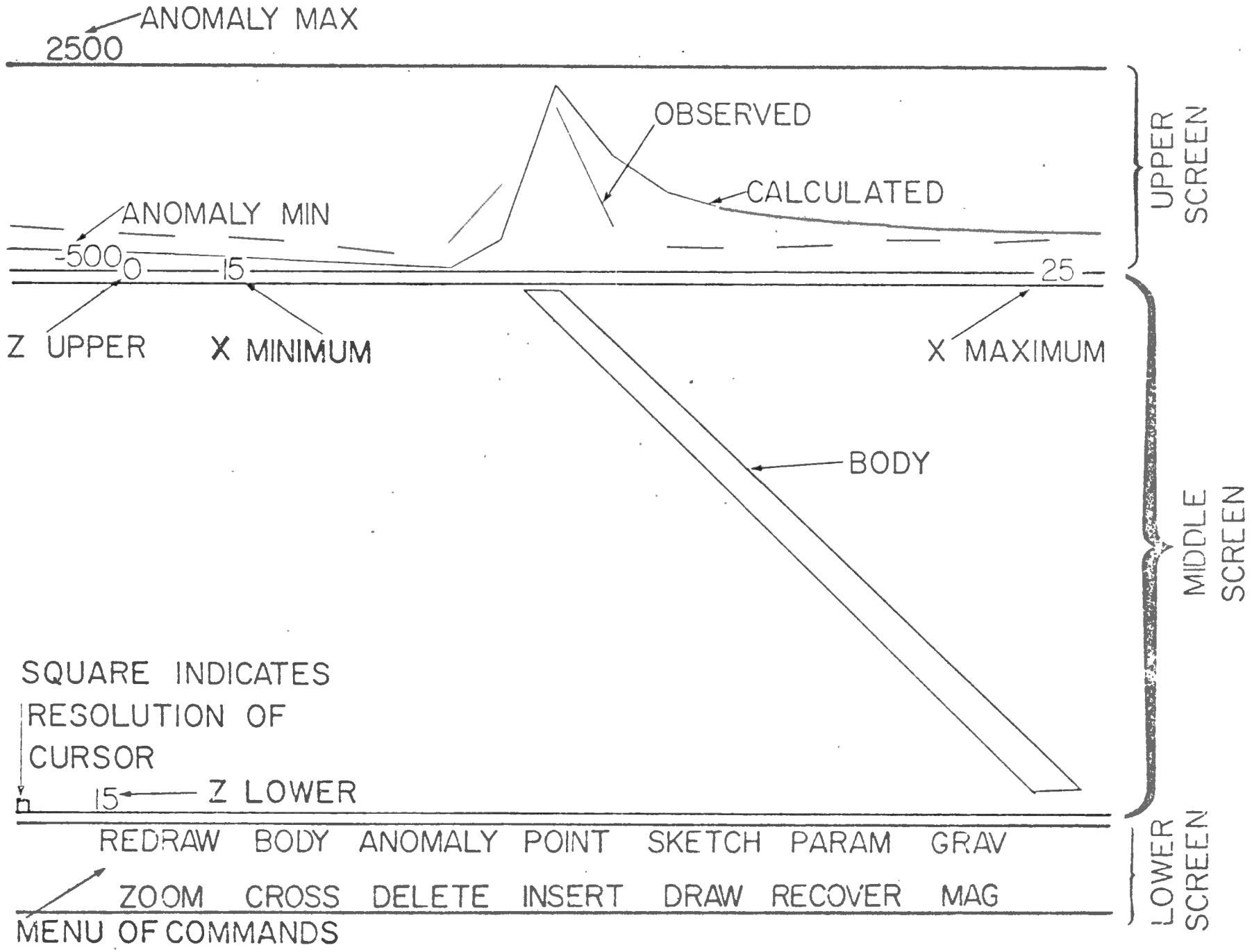
A aborts a command, rings the bell, and awaits a new command

MAGRAV responds in the following ways in graphics mode:

short bell - please enter a command

loud bell - you made an error

- retry command


ANOMALY MAX
2500
OBSERVED
CALCULATED
ANOMALY MIN
-500
0
15
25
Z UPPER
X MINIMUM
X MAXIMUM
BODY
UPPER SCREEN
MIDDLE SCREEN
SQUARE INDICATES RESOLUTION OF CURSOR
15
Z LOWER
REDRAW BODY ANOMALY POINT SKETCH PARAM GRAV
ZOOM CROSS DELETE INSERT DRAW RECOVER MAG
MENU OF COMMANDS
LOWER SCREEN

no bell - the command you executed expects more cursor input from screen

? in reply to PARAM command, enter parameter(s) on keyboard in same format as in text mode

MENU Commands

REDRAW redraws entire screen including scales, menu, bodies, observed and calculated anomaly

ZOOM user can specify SKETCH limits. Shine cursor first on bottom left corner and then upper right corner of area of Bodies screen to be enlarged

BODY user can draw in new bodies. To execute this command, do not use the 'P' key, instead use the key representing the body number, that is

'Body'	Letter
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	+
11	-
12	*
13	/
14	(
15	)
16	$

'Body	Letter
17	=
18	(blank)
19	, (comma)
20	. (period) (cannot be used)
21	#
22	[
23	]
24	%
25	" (quote)
26	_ (underline)
27	!
28	&
29	' (apostrophe)
30	? (cannot be used)

The cursor is placed on the first body point, the second, and so on. To close the body, type '.' (period) and your last point will be joined to the first. Alternately you could close the body yourself and then use a different key to create a second body. '.' will ring bell and return you to menu selection. Note that if any points are selected 'near' (that is, within the little square in the left corner's distance of) another point, it is made equal to it. If you make an error, just hit the 'A' key to abort. Points must be entered in a clockwise direction.

CROSS tells MAGRAV to put or remove crosses at each vertex of each body when DRAWing or SKETCHing. Note that the dimensions of the cross are equal to MAGRAV's point resolution.

ANOMALY Calculate and plot anomaly. Anomaly is plotted on same screen as observed. If the anomaly is not plotted when this command is executed, the anomaly is probably out of the scale - go to text mode and use the 'LIMITS" command. To plot the anomaly for one body, hit the body number's key instead of 'P'.

DELETE allows user to delete a point. Shine the cursor on the point to be deleted. Note that all bodies with this point will have this point deleted. All concerned bodies are reDRAWn or reSKETCHed.

POINT allows user to move a body point on the screen. First shine the cursor on the point to be moved, type 'P', carriage return, and then on the new location for this point, 'P', carriage return. Note that all bodies with this point will have the point moved. If the new point is within the resolution of another point, it is made equal to it. All bodies with a point moved are reDRAWn or reSKETCHed.

INSERT allows a new point to be inserted between two other 'end points.' First shine the cursor on one end point (hit 'P', carriage return), then on the point to be inserted (hit 'P', carriage return), and then on the other end point ('P', carriage return). All bodies with these end points next to each other will have the new point inserted. A loud bell (error) will sound if the two end points were not next to each other on any body or if the end points were not on a body, or if there already are 24 points in this body. The affected bodies are reDRAWn or reSKETCHed.

SKETCH Put the screen in SKETCH mode and sketch in the bodies. SKETCH mode means the X and Z scale set by the ZOOM command will be used as the screen limits for the bodies.

DRAW Put the screen in DRAW mode and draw the bodies. If crosses are on, crosses are drawn at each vertex. The horizontal scale goes from 0 to XMAX and the vertical scale 0 to ZMAX (see 'SCALE' command).

PARAM allows user to change parameters. The body number must be keyed in when this instruction is executed. Await question mark. If you are working on a gravity model enter density (rho). If you are working on a magnetics model enter magnetization, declination, dip. If '0' is entered as the body number, the values entered are added to all bodies (declination and dip are mod 360).

RECOVER allows a previous picture to be restored to screen. Each time RECOVER is executed, one change will be undone - that is if your previous command changed three bodies, several 'RECOVERS' may be required to completely restore your original picture. Everything is restored including DRAW/SKETCH mode, anomalies, etc.

GRAV — converts to Gravity mode as opposed to Magnetics mode. Re-initializes old variables, anomalies, etc. Plot gravity observed. Execute 'ANOMALY' to calculate anomaly.

MAG — converts to magnetics mode as opposed to Gravity mode. Re-initializes variable and plots magnetic observed. Execute 'ANOMALY' to calculate magnetic anomaly.

GRAVITY — switch to Gravity as opposed to magnetics. Anomaly is set to zero. Execute 'ANOMALY' to recalculate. ZCON can be reset or unchanged by hitting carriage return.

HELP — lists a 70-line file containing brief user instructions. To stop listing hit the 'Break' key, then 'P', carriage return. Repeat this if necessary to clear print buffer.

INSERT — allows user to enter a point after another on a body. MAGRAV types

BODY, INSERT AFTER POINT

Enter the body number and the point number.

MAGRAV requests the new X,Z. Enter these values separated by a blank or comma.

LIMITS — Prints the maximum, minimum and median values of the calculated anomaly. These will be zero if the anomaly has not been calculated (use 'ANOMALY' command). The user can then enter an offset to be added to the observed before plotting. Hit carriage return for default value (0).

MAGNETICS — switch to magnetics as opposed to gravity mode. The magnetic anomaly is set to zero (must be recalculated by 'ANOMALY' command). The Declination, dip and ZCON are requested for the whole field. If these values are to remain the same as in previous magnetics run, enter carriage return as the answer to each question.

OBSERVATIONS — add or modify observed values at each field point. The X location of field point number N is equal to X displacement + (N-1)* point spacing. Two sets of observations are stored: one for magnetics and one for gravity. MAGRAV requests a field point number (1-100) and an observed anomaly value for that point. Values may be entered all on one line separated by commas or blanks. Type carriage return in response to '?' to end entering observations. Note that previous entries can be overwritten. Default value for an observation is zero.

PANOM — Plot anomaly but do not recalculate. This is not executed if graphics is suppressed. This is handy for viewing the anomaly before it is recalculated with your recent modifications.

PARAMETERS — replace parameters for a specified body (1-30). If in gravity mode, density (rho) can be replaced. If in magnetics mode, magnetization declination and dip can be entered. A constant can be added to the parameter of each body by specifying body number 0.

POINT — To change the value of a body point. MAGRAV requests body (1-30) and point (1-24). The previous value is printed out and your new value entered to replace it.

READ — reads a model from MODELS file. Use 'MODELS' command to name the model you want input. Use 'TMODELS' command to list all model names on this file. MAGRAV will correct the model by closing up opened bodies and deleting duplicated consecutive body points. If the model is read correctly, "model name READ" is printed. The READ command wipes out all previous values stored (that is, all the ones printed by the DUMP command).

RECOVER — used to restore a previous model. Handy if the system kicked you right out of MAGRAV before getting a chance to 'WRITE'. If MAGRAV prints

```
*TERMINATED*

/
```

at any time, then enter

```
-RUN

WHAT TO DO

? recover

HOW MANY BACKSPACES

? 2
```

The number of "BACKSPACES" is the number of model changes that have been made that are to be restored. Your model is automatically copied to a backup file after every three changes (such as a 'POINT' or 'BODY' command).

SCALE — sets scales for plotting. Two scales are stored: one for gravity and one for magnetics. MAGRAV first prints out the current mode, either GRAVITY or MAGNETICS.

Then MAGRAV requests X SCALE which is the maximum X value (in km) to be plotted. All bodies must lie between 0 and XMAX km. Hit carriage return to retain previous value.

Z-SCALE, the vertical scale is requested. This value is used for plotting purposes only. All bodies should lie between 0 and ZMAX in the vertical direction. XMAX and ZMAX provide the dimensions for the 'DRAW' command. Hit carriage return to retain previous values.

XDISP(lacement) is the distance in kilometres from zero where the first field point is located. This distance must be less than XMAX. Carriage return retains previous value.

Point spacing is the distance in kilometres between field points. Carriage return retains previous value.

NO. OF POINTS is the number of field points at which the anomaly is to be calculated. This must be less than 100 and the last point must not be at X greater than XMAX. Carriage return retains previous value.

The anomaly minimum (ANOM MIN) and maximum (ANOM MAX) can be entered. These are specified for plotting purposes only. Carriage return retains previous value.

The 'SKETCH' limits are initialized to 0-XMAX, 0-ZMAX and the anomaly is set to zero.

Change to 'SKETCH' mode and plot the bodies (unless graphics are suppressed). SKETCH limits are specified in the ZOOM command. Any body (1-30) can be plotted. Body number zero means all bodies.

SUPPRESS GRAPHICS Use this command if you are working at a text terminal - all graphic output routines from MAGRAV will be bypassed. MAGRAV asks "DO YOU WANT GRAPHIC SUPPRESSED?" Answering "Y" or "YES" will suppress graphics. Carriage return retains previous value.

TANOMALY Types the calculated anomaly value at each field point. The field point number, the distance this field point is from zero kilometres and the anomaly are printed at each field point where the anomaly is not zero (actually between -0.00001 and 0.00001). Anomalies for a single body (1-30) or all (0) may be listed.

TBODY Types a list of body numbers, body parameters (density for gravity; magnetization, declination, and dip for magnetics) and then X,Z values for all body points. A single body (1-30) or all (0) may be listed.

TCOMMENTS prints out any comments that have been entered by the 'COMMENTS' command.

TMODELS — lists all the model names on the MODELS file (max 50).

TOBSERVATIONS — Types observed values at each field point. The number of the field point, the distance in kilometres it is from zero, and the value of the observed that was entered by the 'OBSERVATIONS' command are listed for each nonzero observation. Note that observations are stored for both gravity and magnetics.

TPARAMETERS — Types out parameters (density for gravity, magnetization, declination, and dip for magnetics) for all bodies.

TSCALE — Types scale information. Lists whether in gravity or magnetics mode, model name, comments, X displacement, XMAX, ZMAX, point spacing, number of field points, number of bodies, whether sketch or draw mode, whether graphics output is suppressed or not, and sketch (zoom) limits. If in magnetics mode, the declination dip, and X to N angle are listed.

WRITE — Writes the current model to MODELS file. The model can be referred to by the name you specified in the 'MODEL' command. A maximum of 50 different models can be stored on one file. If the model name you are attempting to write already exists on the MODELS file, MAGRAV asks whether it is all right to overwrite the model on the file. If it is OK, "MODEL model name WRITTEN SUCCESSFULLY" is printed; if not, the model is not overwritten. Be sure 'MODELS' command or 'READ' command was executed before 'WRITE' otherwise a model will be written with a blank model name.

ZOOM — sets scales for SKETCH mode. Irrelevant if graphics suppressed. These four values determine what will be plotted when the 'SKETCH' command is executed. Enter the left X value, right X value, upper Z, and lower Z. Upper Z is less than lower Z. Left X is less than right X.

8.0 ENVIRONMENT

Computer CDC 6400

Operating System NOS/BE

Core 70000_8 words

Disc Files - Unit 1 model file direct access binary

Random access 5106 words/record (max 50)

Unit 9 scratch file indirect binary sequential

5106 words/record (max 300) check point file for models

Unit 5 input terminal (graphics or text)

Unit 6 output terminal (graphics or text)

Unit 7 brief user instructions indirect BCD

sequential 40 character records

Language - CDC FORTRAN IV

External References - Terminal Control System Software (Tektronix)

Address - Dr. R.T. Haworth

Atlantic Geoscience Centre
Geological Survey of Canada
Bedford Institute of Oceanography
P.O. Box 1006
Dartmouth, Nova Scotia
Canada B2Y 4A2
(902) 426-3149

Programmer - Ian Wells, Computing Services, BIO

9.0 HOW TO RECOMPILE SOURCE

The current BIO version of MAGRAV cannot be loaded in the interactive environment since our loader requests more than the 70K that is the interactive core limit. A job, COMPILE, must be submitted:

```
GET,COMPILE/UN=BIK1008

SUBMIT,COMPILE
```

The dayfile OK is returned if MAGRAV compiled and loaded correctly, BAD if it did not. The absolute (overlay) version is left as a direct access file, BINMOD3. This is a large file.

10.0 REFERENCES

Heirtzler, J.R., Peter, G., Talwani, M., and Zurflueh, E.G. (1962) Magnetic anomalies caused by two-dimensional structure: Their computation by digital computers and their interpretation. Technical Report No. 6, CU-6-62, Nonr-Geology, Columbia University, New York.

Macnab, R.F. (1966) Magnetic effects of two-dimensional structures. Bedford Institute of Oceanography Comptuer Note 66-1-C, April 1966.

Macnab, R.F. (1966) Gravitational effects of two-dimensional structures. Bedford Institute of Oceanography Computer Note 66-2-C, April 1966.

Program GRAV, written for PDP-11 by D. Heffler, Atlantic Geoscience Centre, Bedford Institute of Oceanography (unpublished).

Program GR2D - Fortran program written for CDC 3150, Atlantic Geoscience Centre, Bedford Institute of Oceanography (unpublished).

Program MAG written for PDP-11 by D. Heffler, Atlantic Geoscience Centre, Bedford Institute of Oceanography (unpublished).

Program MAG2NEW, Fortran program written for CDC 3150, Atlantic Geoscience Centre, Bedford Institute of Oceanography (unpublished).

Talwani M. and Heirtzler J.R. (1964) Computation of magnetic anomalies caused by 2 dimensional structures of arbitrary shape, in *Computers in the Mineral Industries* (ed. G.A. Parks), Stanford University (publisher), pp. 464-480.

"UPMODEL" - Utility package for handling MAGRAV files stored on disc at Dalhousie - Computing Services Technical Memorandum #69, Bedford Institute of Oceanography, August 1977.

APPENDIX A

SUBROUTINES

WHAT	Reads user command from keyboard and returns a value to calling procedure. arguments IWHAT (returned) IWHAT = 0 (unrecognized)
SCAL	asks questions and receives answers about X scale, Z scale, X displacement, point spacing, number of points, min/max anomaly. no arguments.
BODY	enter body coordinates from keyboard no arguments
POIN	change body point from keyboard no arguments
PARA	for gravity enter density value from keyboard for magnetics enter, magnetization, declination, dip from keyboard no arguments
HELP	reads help file and prints on output no arguments
DRAW	draws 1 or all bodies on scope no arguments
SKET	sketches 1 or all bodies on scope no arguments
READ	reads model specified by NAME from disc no arguments
WRIT	writes model on disc file no arguments

ANOM	calculates anomaly and stores in CALC
	no arguments
TANO	prints anomaly at each field point
	no arguments
OBSE	accepts observed anomaly from keyboard and stores in OBS
	no arguments
TBOD	prints body coordinates for 1 or all bodies
	no arguments
COMM	enter comments field into COMMNT from keyboard (max 150 character)
	no arguments
TCOM	print out arguments from KOMMNT
	no arguments
FMODE	accept model name (NAME) from keyboard
	no arguments
TMOD	list all model names stored on disc file
	no arguments
INSE	insert a body point in a model from keyboard
	no arguments
DELE	delete body point in a model from keyboard
	no arguments
END	terminate program
	no arguments
RECO	allows user to restore COMMON values to previous settings - read file 9
	no arguments
PANO	plot anomaly but does not recalculate it
	no arguments

TPAR — types all parameters on keyboard for all bodies

no arguments

GRAV — zero anomaly, sets ITYPE to 1 indicating gravity models will be run. The user enters a new ZCON value.

no arguments

MAGN — zero anomaly, sets ITYPE to 2 indicating magnetic models will be run. The user enters new X to N angle, declination, DIP and ZCON.

no arguments

CROS — Turns crosses alternately on or off.

no arguments

ZOOM — allows user to select window for SKETCH command

no arguments

LIMI — types maximum, minimum and average anomaly

no arguments

SUPP — allows user to suppress or turn on graphics

no arguments

REAN — sets anomaly (CALC) to all zero

no arguments

DUMP — types all possible information about current model

no arguments

WRITEF — Writes a new model on LUN.

IRET (returned) -1 OK
0 EOF
1 parity error
2 duplicate name

LUN (input) logical unit number

If LUN is the scratch file a record is BUFFERed out for it.

If this is the storage file and this is a duplicate entry, permission is asked to overwrite.

TYPBOD — types body coordinates and parameters for body IBOD

argument IBOD — 0 = all bodies

1,2 ... = body number

TYPAR — prints parameter for all bodies

argument IBOD — 0 = all bodies

1,2 ... = body number

TOBS — prints all nonzero observed (OBS)

no arguments

TYPANO — prints all nonzero anomaly values and X value at each field point

argument JBOD (input)

0 = all bodies

1,2 ... = body number

READF — does the reading of the model file. The model name is specified in word 1 of common:NAME. After a model is read several checks are done to make sure there are no open bodies, no duplicate points, etc. The random access file read is opened and closed within READF.

argument IRET (input)

0 search for and read model name specified in NAME

1 read each record and print each model NAME

NEGATIVE read the $(-IRET)^{th}$ last record in model on the DUMP file

IRET (output)

-1 OK

0 model NAME not found

1 parity error

LUN (input) logical unit number

SAV — saves current model

arguments

KOUNT (input) writes a copy of COMMON to ile ISCR every KOUNT times.

PLOBS — plot the observed data as a line between every other pair of points. Not executed if graphics suppressed.

no arguments

PLANOM — to calculate and/or plot the anomaly arguments

JBOD (input) body number

(= 0 for all)

KALK (input) = 1 calculate anomaly and plot

= 0 just plot anomaly

PLBOD — plot bodies

argument — IBOD (input) body number

0 for all
plots body and draws a cross at each vertex if ICROSS = 1

DRCROS — plots a cross

arguments — XX (input) X coordinate for vertex in virtual coordinates

ZZ (input) Z coordinate

SETSCL — sets internal scales and determines where on screen to plot them. Draws scales.

arguments — IWHICH (input)

= 1 set scales for graph to plot anomaly and observed

= 2 set scales for middle graph to plot bodies

= 3 set area for drawing commands and draw menu.

ISCL (input

= 0 do not plot scales

= 1 plot scales

CALCAN — calculates total anomaly and stores in

(CALC(MAXCAL,I),I=1,NF)

(no arguments)

If ITYPE = 2 magnetics is calculated

If ITYPE = 1 gravity is calculated

GRAP — executes GRAPH command

(no arguments)

A bell is rung and the user shines the cursor over any one of the menu commands. All menu commands are executed in this subroutine.

NUMB — converts character code to integer

argument

NUMB (returned), body number
(0 if invalid)

ICHAR (input) ASCII character code accepted from keyboard

CHECK — sees if a given body point is anywhere one in an existing body

arguments

NUMBER (input) check for the NUMBERth point equal to the given point.

XX (input) X coordinate of given point

ZZ (input) Z coordinate of given point

IDUPBD (returned) body number containing point near given point

equals zero if given point not near any other

IDUPPT (returned) point number of point near given point

equals zero if given point not near any other

IRET (returned)

0 given point is near another

-1 given point is not "near" is

"near" is defined as being within a rectangle XDIS by ZDIS around the body point

COORD — a function that gives the X location in kilometres of each field point

arguments COORD (returned) distance in kilometres

INDEX (input) field point number

INSERT — subroutine to insert a point in a body after a certain point

arguments

XX (input) X value of new point

ZZ (input) Z coordinate of new point

IBOD (input) number of body that is to contain new point

NPT (input) number of point after which new point is to be inserted

IRET (returned) = 0 could not insert point

= 1 point inserted successfully

DELETE — subroutine to delete a point from a body

arguments IBOD (input) body number

NPT (input) point number to be deleted

IRET (returned) = 0 point not deleted

= 1 point deleted

ALPHAM — subroutine to turn Tektronix terminal from graphics to alphanumeric mode

no arguments

MAG — subroutine to calculate magnetic anomaly at each field point. Anomaly is placed in CALC (IBOD,K),K=1,NF

arguments IBOD (input) body number

Error messages:

BODY j POINT k CANNOT BE CALCULATED WITH
PRESENT ALGORITHM VALUE OUT OF RANGE
ANOMALY SET TC ZERO
USE GRAV OR MAGN COMMAND TO SET A
LARGER ZCON VALUE

Points have to be greater than 0 km deep.

GRAVC — calculate gravitational anomaly for body BIOD

arguments IBOD body number

DEGSIN — a function to calculate sine of an angle in degrees

argument (input) DEGREE angle to compute

(returned) DEGSN sine of this angle

PARAM — reads parameters for a body for gravity or magnetics from keyboard entry.

arguments IBOD (input) body number. If equal to zero, the values input are added to all bodies.

For magnetics magnetization, declination, and dip are read.

For gravity, density (rho) is read.

TSOA — prints out scales and limits within which models are drawn.

APPENDIX B

LISTING OF PROCEDURE FILES

```
 lnh,f=run
RUN - RUNS MAGRAV.
RETURN(TAPE2)
P(OUTPUT,N,NR)/ MAGRAV
*        DR. HAWORTH BIO
*         IAN WELLS BIO
*         APRIL 1977
*          -RUN
*          -RUN(MODELS=NNN) WHERE NNN IS ANOTHER MODELS FILE
ATTACH,TAPE1=MODELS/M=W.
GET,TAPE7=HELP/UN=BIK1008.
RFL,70000.
GET,RUNLOD3/UN=BIK1008.
P(OUTPUT,N,NR)/
ATTACH,BINMOD3/UN=BIK1008.
REDUCE(-)
P(OUTPUT,N,NR)/
RUNLOD3.
RETURN(MODELS)
P(OUTPUT,N,NR)/GOOD-BYE
*
 END OF INFORMATION ENCOUNTERED.
/
```

```
 lnh,f=ldsorc3
      PROGRAM LODER
C
C       THIS PROGRAM IS COMPILED INTO A LOAD AND GO FILE CALLED
C                       RUNLOD3
C         IE       REWIND(RUNLOD3)
C                   FTN,L 0,I=LDSORC3,OPT=1,B=RUNLOD3.
C                  REPLACE,RUNLOD3
C
C                     IAN WELLS BIO OCT 77
C                     PART OF  MAGRAV SYSYEM
C                        ATLANTIC GEOSCIENCE CENTRE
C
      CALL OVERLAY(7HBINMOD3,0,0)
      END
 END OF INFORMATION ENCOUNTERED.
/
```

```
 set,compile
/lnh,f=compile
MAGRAV,T20,CM77000.
ACCOUNT(BIK1008,[redacted])
GET,MAGRAV3.
PURGE,BINMOD3/NA.
PURGE,LOADOK/NA.
PURGE,LOADBAD/NA.
DEFINE,BINMOD3.
RFL,46000.
FTN,L=0,OPT=1,I=MAGRAV3.
RFL,70000.
REWIND,LGO.
RETRIEV(PLOT10)
$LIBRARY,PLOT10.
LOAD,LGO.
NOGO,BINMOD3.
PERMIT,BINMOD3,REGE021.
DAYFILE,LOADOK.
REPLACE,LOADOK.
EXIT.
DAYFILE,LOADBAD.
REPLACE,LOADBAD.

 END OF INFORMATION ENCOUNTERED.
/
```

APPENDIX C

LISTING OF MAGRAV

The comments at the beginning list all variable names in COMMON. Every subroutine must have an identical COMMON area. Common, from NAME to KEND, is the area used for 'READ", for 'WRITE', and RECOVER. All code is, of course, self-documenting.

```
      PROGRAM MAGRAV3(TAPE1,TAPE9=0,INPUT,OUTPUT
     $     ,TAPE5=INPUT,TAPE6=OUTPUT,TAPE7=800/40
     X         )
C         INTERACTIVE GRAVITY AND MAGNETICS MODELLING
C
C
C          AUTHOR I.WELLS,COMPUTING SERVICES ,BIO,JAN 1977
C          WRITTEN FOR DR.HAWORTH,AGC,BIO
C          COMPUTER -CDC6400,DAL
C          NOS  ,TEKTRONIX 4010-1 SCOPE
C          IO
C          INPUT-DECWRITER TERMINAL OR CURSOR INPUT FROM GRAPHICS TERMINA
C          OUTPUT-DECWRITER TERMINAL OR GRAPHICS
C          TAPE1-DIRECT ACCESS DISK STORAGE FOR MODELS
C          TAPE7- FILE OF USER DIRECTIONS TO MAGRAV
C          TAPE9-TEMPORARY DISK FILE OF MODELS FOR
C          ERROR RECOVERY
C
C
C
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C
C VALUES IN COMMON
C
C NAME           A10 NAME GIVEN IN MODEL COMMAND
C ITYPE          1 FOR GRAVITY
C                2 FOR MAGNETICS
C BDIP(MAXBOD) DIP FOR EACH BODY(MAG ONLY)
C NFIELD(NTYPES)NUMBER OF FIELD POINTS
C ANOMIN(NTYPES)MINIMUM VALUE ON ANOMALY SCALE
C ANOMAX(NTYPES)MAXIMUM VALUE ON ANOMALY SCALE
C KOMMNT(15)     15A10 COMMENTS ABOUT MODEL
C XMAX           RIGHT HAND SIDE OF GRAPH IN DRAW MODE
C                ALL BODIES AND FIELD POINTS SHOULD BE < THIS
C ZMAX           MAXIMUM DISTANCE FROM SURFACE(0.) TO BOTTOM
C                OF SCREEN
C XMINS(NTYPES)X DISPLACEMENT. X VALUE OF FIRST FIELD POINT
C SPACE(NTYPES)SPACING BETWEEN FIELD POINTS
C XTON           X TO N ANGLE.ORIENTATION OF X AXIS .MAG ONLY
C                          0-360. DEGREES
C DEC            DECLINATION OF FIELD.MAG ONLY
C                          0-360. DEGREES
C DIP            DIP OF THE FIELD.MAG ONLY
C                          0-360. DEGREES
C ZCON           A CONSTANT ADDED TO Z COORD OF ALL BODIES.MAG ONLY
C MODEL          UNIT NUMBER OF MODEL FILE
C ISCOPE         1 ALL GRAPHICS IN EFFECT
C                2 ALL GRAPHICS SUPPRESSED-FOR TEXT ONLY TERMINAL
```

```
C NBACK         MODEL IS BACKED UP AFTER EVERY NBACK CHANGES


C NBODS         NUMBER OF BODIES IN CURRENT MODEL
C X(MAXNPT,MAXBOD+1)
C               X CO ORDINATES OF ALL BODIES
C Z(MAXNPT,MAXBOD)
C               Z CORD OF EACH BODY POINT
C NPTS(MAXBOD) NUMBER OF POINTS CURRENTLY IN EACH BODY
C RHO(MAXBOD)  DENSITY OF EACH BODY.GRAVITY ONLY
C BMAG(MAXBOD) MAGNETIZATION OF EACH BODY EMU*100000
C BDEC(MAXBOD) DECLINATION OF EACH BODY.CLOCKWISE FROM NORTH
C OBS(NTYPES,MAXOBS)
C               SET OF OBSERVED VALJES
C XMAXS(NTYPES)CO ORDINATE OF LAST OBSERVED VALUE
C IANOM(MAXBOD)0 ANOMALY HAS NOT BEEN CALCULATED FOR THIS BODY
C               -1 ANOMALY HAS BEEN CALCULATED FOR THIS BODY AND
C                  IS STORED IN CALC
C MODE          DRAW MODE
C               2 SKETCH MODE
C               1 DRAW MODE
C CALC(MAXBOD+1,MAXOBS)
C               ANOMALY CALCULATED FOR EACH BODY AT EACH OBSERVED POINT
C               CALC(MAXBOD+1,..)STORES TOTAL ANOMALY
C SKXMAX        CURRENT RIGHT HAND SCREEN LIMIT BEING USED FOR GRAPHICS
C SKXMIN        CURRENT LEFT HAND SCREEN LIMIT
C SKZMAX        CURRENT LOWER SREEN LIMIT
C SKZMIN        CURRENT UPPER SCREEN LIMIT
C KEND          999 END OF RECORD DELIMETER.ALL COMMON UP TO KEND
C               IS WRITTEN TO DISK FOR SAVING MODELS
C PI            PI CONSTANT
C NTYPE,        NUMBER OF TYPES OF MODELS THIS PROGRAM WILL HANDLE
C                (MAG,GRAV)
C ICROSS        =0 ON GRAPHICS OUTPJT BODIES ARE DRAWN AS SET OF LINES
C               =1 DRAWS CROSSES AT EACH VERTEX
C XDIS          DISTANCE IN SCALED JNITS IN X DIRECTION FOR RESOLUTION
C                ON PINPOINTING FOR CURSOR INPUT OF BODIES
C ZDIS          SAME IN Z DIRECTION
C IX(2*LNGIX+1)BUFFER USED FOR DIRECT ACCESS STORAGE,OF MODELS
C LNGIX         MAX NUMBER OF MODELS THAT CAN BE STORED
C LNGMOD        NUMBER OF WORDS IN COMMON UP TO KEND
C OFFSET(NTYPES)       NUMBER ADDED TO OBSERVED FOR PLOTTING ONLY
C MAXNPT        MAX NO. OF POINTS PER BODY
C MAXBOD        MAX NO. OF BODIES
C MAXOBS        MAX NO OF OBSERVATIONS
C MAXCAL        MAX NO OF BODIES PLJS ONE
C IHELP       UNIT NUMBER OF DISK FILE WITH USER INSTRUCTIONS
C              ON IT .READ(IHELP,10)
C                  10  FORMAT (4A10)
C ISCR        UNIT NUMBER OF SCRATCH FILE.AFTER EVERY CNBACK
C             CHANGES TO THE MODEL IT IS BACKED UP ON THIS UNIT.
C             AFTER 300 BACKUPS THE FILE IS REWOUND
C ITTY        TELETYPE INPUT UNIT NUMBER
C IPR         PRINTER OUTPUT UNIT NUMBER
C
C
C
C
C
      DATA IBLANK/1OH          /
C
C        INITIALIZE
C
      CALL INITT(30)
      ISCR=9
      MODEL=1
```

```
      IHELP=7


      ITTY=5
      IPR=6
      ISCOPE=1
      NBACK=3
      ITYPE=1
      NBODS=0
      MAXNPT=25
      MAXBOD=30
      MAXOBS=100
      MAXCAL=MAXBOD+1
      NTYPES=2
C
C        CALCULATE SIZE OF OUTPUT RECORD FOR STORING MODELS
C
      LNGMOD=33+2*(MAXBOD*MAXNPT)+6*MAXBOD+2*MAXOBS
     X                +6*NTYPES
      LNGIX=50
      NCOMMS=31
      XMAX=2000.
      ZMAX=100.
      SKXMAX=XMAX
      SKXMIN=0.
      SKZMAX=ZMAX
      SKZMIN=0.
      ICROSS=1
      XTON=0.
      PI=3.1415926535
      XDIS=0.
      ZDIS=0.
      MODE=1
      DEC=0.
      DIP=0.
      ZCON=0.000001
C
C        OPEN MODEL FILE TO INITIALIZE IX ARRAY
C
      LNGIX2=LNGIX*2
      DO 100 I=1,LNGIX2
  100 IX(I)=0
      IX(LNGIX2+1)=0
C
      CALL OPENMS(MODEL,IX,LNGIX,1)
      CALL CLOSMS(MODEL)
      KEND=999
      DO 123 J=1,NTYPES
      OFFSET(J)=0.
      ANOMAX(J)=100.
      ANOMIN(J)=-100.
      NFIELD(J)=0
      XMAXS(J)=XMAX
      XMINS(J)=0.
       SPACE(J)=1.
      DO 123 I=1,MAXOBS
  123 OBS(J,I)=0.
C
C
C
      CALL REAN
C
      DO 125 I=1,MAXBOD
      NPTS(I)=0
      RHO(I)=0.
      BMAG(I)=0.
```

```
      BDEC(I)=0.


      BDIP(I)=0.
  125 CONTINUE
C
      DO 150 I=1,15
  150 KOMMNT(I)=IBLANK
      NAME=IBLANK
C
C
      WRITE(IPR,300)
  300 FORMAT(5HHELLO////
     X   37HGRAVITY  MAGNETICS MODELLING PROGRAM
     $,/14HVERSION 4.0.3  ,/36(1H-))
     $)
      GO TO 400
C
  350 CALL SAV(NBACK)
C
C
C
C*****************************************************************
C                  WHAT TO DO    MODE
C*****************************************************************
C
C
  400 CALL WHAT(IWHAT)
C
C             EXECUTE COMMAND INPUT FROM TERMINAL
C
      IF(IWHAT.NE.0)GO TO 500
      WRITE(IPR,450)
  450 FORMAT(6HPARDON)
            GO TO 400
C
  500  GO TO(1000,2000,3000,4000,5000,6000,7000,8000,
     X     9000,10000,11000,12000,13000,14000,15000,
     X    16000,17000,18000,19000,20000,21000,22000,
     X    23000,24000,25000,26000,27000,28000,29000,
     X    30000,31000,32000,33000),IWHAT
C
C
 1000 CALL SCAL
      GO TO 350
C
 2000 CALL BODY
      GO TO 350
C
 3000 CALL POIN
      GO TO 350
C
 4000 CALL PARA
      GO TO 350
C
 5000  CALL HELP
      GO TO 400
C
 6000 CALLDRAW
      GO TO 400
C
 7000 CALL SKET
      GO TO 400
C
 8000 CALL READ
      GO TO 350
```

```
C
 9000 CALL WRIT
      GO TO 400
C
10000 CALL ANOM
      GO TO 350
C
11000 CALL TANO
      GO TO 400
C
12000 CALL OBSE
      GO TO 350
C
13000 CALL TOBS
      GO TO 400
C
14000 CALL COMM
      GO TO 400
C
15000 CALL TCOM
      GO TO 350
C
16000 CALL FMODE
      GO TO 350
C
17000 CALL TMOD
      GO TO 400
C
18000 CALL INSE
      GO TO 350
C
19000 CALL DELE
      GO TO 350
C
20000 CALL END
      GO TO 350
C
21000 CALL GRAP
      GO TO 400
C
22000 CALL RECO
      GO TO 400
23000 CALL DUMP
      GO TO 400
C
24000 CALL PANO
      GO TO 400
C
25000 CALL TPAR
      GO TO 400
C
26000 CALL MAGN
      GO TO 350
C
27000 CALL GRAV
      GO TO 350
C
28000 CALL CROS
      GO TO 400
C
29000 CALL ZOOM
      GO TO 350
C
30000 CALL LIMI
```

```
      GO TO 400


C
31000 CALL SUPP
      GO TO 350
C
32000 CALL TBOD
      GO TO 400
C
33000  CALL TSCA
      GO TO 400
C
C
C
      END
      SUBROUTINE WHAT(IWHAT)
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
      DIMENSION KOMMS(33)
      DATA KOMMS/4HSCAL,4HBODY,4HPOIN,4HPARA,4HHELP,4HDRAW,4HSKET,
     X           4HREAD,4HWRIT,4HANOM,4HTANO,4HOBSE,4HTOBS,4HCOMM,
     X           4HTCOM,4HMODE,4HTMOD,4HINSE,4HDELE,4HEND  ,
     X           4HGRAP,4HRECO,4HDUMP,4HPANO,4HTPAR,4HMAGN,4HGRAV,
     X           4HCROS,4HZOOM,4HLIMI,4HSUPP,4HTBOD,4HTSCA/
      DATA NKOMMS/33/
C
C                WHAT TO DO SUBROUTINE
C
C
C             READS USER COMMAND AND RETURNS APPROPRIATE VALUE OF
C                          IWHAT
C                               IWHAT=0-UNRECOGNIZED COMMAND
      WRITE(IPR,100)
  100 FORMAT(12H WHAT TO DO )
      READ (ITTY,150)IANS
  150 FORMAT(A4)
      IF(EOF(ITTY).NE.0)GO TO 900
C
      DO 200 IWHAT=1,NKOMMS
      IF(KOMMS(IWHAT).EQ.IANS)RETURN
  200 CONTINUE
C
  900 IWHAT=0
      RETURN
      END
      SUBROUTINE SCAL
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C*************************************************************
C         SCALE
```

```
C          ACCEPTS INPUT SETTING SCALES OF GRAPHS

C
C
C
      IF(ITYPE.EQ.1)WRITE(IPR,1001)
      IF(ITYPE.EQ.2)WRITE(IPR,1002)
 1001 FORMAT(7HGRAVITY)
 1002 FORMAT(9HMAGNETICS)
      WRITE(IPR,1009)
 1009  FORMAT(9H X SCALE )
      READ(ITTY,*)ANS
      IF(EOF(ITTY).EQ.0)XMAX=ANS
C
      WRITE(IPR,1013)
 1013 FORMAT(9H Z SCALE )
      READ(ITTY,*)ANS
      IF(EOF(ITTY).EQ.0)ZMAX=ANS
 1014 WRITE(IPR,1015)
 1015 FORMAT(15H X DISPLACEMENT )
      READ(ITTY,*)ANS
      IF(EOF(ITTY).EQ.0)XMINS(ITYPE)=ANS
C
      IF(XMINS(ITYPE).GT.XMAX)GO TO 1014
 1016 WRITE(IPR,1017)
C
 1017 FORMAT(15H POINT SPACING )
      READ(ITTY,*)ANS
      IF(EOF(ITTY).NE.0)GO TO 1019
C
      SPACE(ITYPE)=ANS
 1019 WRITE(IPR,1021)
 1021 FORMAT(14H NO.OF POINTS )
      READ(ITTY,*)IANS
      IF(EOF(ITTY).NE.0)GO TO 1022
C
      NFIELD(ITYPE)=IANS
      IF(NFIELD(ITYPE).GT.MAXOBS.OR.NFIELD(ITYPE).LT.0)GO TO 1016
 1022 XMAXS(ITYPE)=COORD(NFIELD(ITYPE))
      IF(XMAXS(ITYPE).GT.XMAX )WRITE(IPR,1025)XMAX,XMAXS(ITYPE)
      IF(XMAXS(ITYPE).LT.0.)GO TO 1016
C
      WRITE(IPR,1023)
 1023 FORMAT(17H ANOMALY MIN,MAX )
      READ(ITTY,*)ANS1,ANS2
      IF(EOF(ITTY).NE.0)GO TO 1024
C
      IF(ANS1.GE.ANS2)GO TO 1022
      ANOMAX(ITYPE)=ANS2
      ANOMIN(ITYPE)=ANS1
 1024 SKXMIN=XMINS(ITYPE)
      SKXMAX=XMAXS(ITYPE)
      SKZMIN=0.
      SKZMAX=ZMAX
C
      CALL REAN
      RETURN
 1025 FORMAT(9H*WARNING*,F10.2,18H IS EDGE OF SCREEN
     X ,F10.2,20H IS LAST FIELD POINT)
C
C
      END
      SUBROUTINE BODY
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(35),XMAX,ZMAX,XMINS(2),SPACE(2)
```

```
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS

      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
       DATA IYES/1HY/
C*************************************************************
C          BODY
C
 1100 WRITE(IPR,1110)
 1110 FORMAT(21HBODY,NUMBER OF POINTS)
      READ(ITTY,*)IBOD,NPT
      IF(EOF(ITTY).NE.0)GO TO 1170
      IF(IBOD.GT.MAXBOD.OR.IBOD.LT.1)GO TO 1170
      IF(NPT.GE.MAXNPT)GO TO 1150
      IF(NPTS(IBOD).LE.0)GO TO 1118
      IF(NPT.EQ.0)GO TO 1180
      WRITE(IPR,1115)
 1115 FORMAT(42HDUPLICATE BODY,TYPE YES IF OK TO OVERWRITE)
      READ(ITTY,1117)IANS
      IF(EOF(ITTY).NE.0)RETURN
 1117 FORMAT(A1)
      IF(IANS.NE.IYES)RETURN
C
 1118 IANOM(IBOD)=0
C
      IF(IBOD.GT.NBODS)NBODS=IBOD
C
C
C
      NPT=NPT+1
      NPTS(IBOD)=NPT
      NPT1=NPT-1
      WRITE(IPR,1120)NPT1
 1120 FORMAT(5HENTER,I4,4H X,Z)
      READ(ITTY,*)(X(IBOD,I),Z(IBOD,I),I=1,NPT1)
      IF(EOF(ITTY).NE.0)GO TO 1180
      X(IBOD,NPT)=X(IBOD,1)
      Z(IBOD,NPT)=Z(IBOD,1)
C
      RETURN
C
C               TOO MANY POINTS
C
 1150 WRITE(IPR,1160)MAXNPT
 1160 FORMAT(10HSORRY ONLY,I6,23HPOINTS ALLOWED PER BODY)
      GO TO 1100
 1170 WRITE(IPR,1175)
 1175 FORMAT(6H ERROR)
      RETURN
C
 1180 WRITE(IPR,1185)IBOD
 1185 FORMAT(5H BODY,I3,8H DELETED)
      WRITE(IPR,1186)IBOD
 1186 FORMAT(21HTYPE YES TO TYPE BODY,I3)
      READ (ITTY,1117)IANS
      IF(EOF(ITTY).NE.0)GO TO 1190
      IF(IANS.NE.IYES)GO TO 1190
      CALLTYPBOD(IBOD)
C
 1190 IANOM(IBOD)=0
```

```
      NPTS(IBOD)=0


C       IF BODY BEING DELETED REDUCE BODY COUNTER
      IF(IBOD.EQ.NBODS)NBODS=NBODS-1
      RETURN
C
      END
      SUBROUTINE POIN
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C*************************************************************
C          POINT
C
 1200 WRITE(IPR,1210)
 1210 FORMAT(10HBODY,POINT)
      READ(ITTY,*)IBOD,NPT
      IF(EOF(ITTY).NE.0)GO TO 400
      IF(IBOD.GT.NBODS)GO TO 400
      IF(IBOD.LE.0)GO TO 400
      IF(NPT.GE.NPTS(IBOD))GO TO 400
      IF(NPT.LE.0)GO TO 400
      WRITE(IPR,1220)X(IBOD,NPT),Z(IBOD,NPT)
 1220 FORMAT(7HOLD X,Z,2F10.2)
      READ(ITTY,*)XX,ZZ
      IF(EOF(ITTY).NE.0)GO TO 400
      X(IBOD,NPT)=XX
      Z(IBOD,NPT)=ZZ
      IANOM(IBOD)=0
      IF(NPT.NE.1)RETURN
C
C     FIRST AND LAST POINTS CHANGED
C
      NPT=NPTS(IBOD)
      X(IBOD,NPT)=X(IBOD,1)
      Z(IBOD,NPT)=Z(IBOD,1)
      RETURN
C
  400 WRITE(IPR,500)
  500 FORMAT(6H ERROR)
      RETURN
C
      END
      SUBROUTINE PARA
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C*************************************************************
C          PARAM
C
 1300 WRITE(IPR,1310)
```

```
      READ(ITTY,*)IBOD

      IF(EOF(ITTY).NE.0)GO TO 2000
 1310 FORMAT(4HBODY)
      IF(IBOD.GT.MAXBOD)GO TO 2000
      IF(IBOD.LT.0)GO TO 2000
      IF(ITYPE.EQ.2)WRITE(IPR,1320)
      IF(ITYPE.EQ.1)WRITE(IPR,1370)
      CALL PARAM(IBOD)
      RETURN
 1320 FORMAT("MAGNETIZATION (EMU*100,000),DECLINATION,DIP")
 1370 FORMAT(3HRHO)
C
 2000 WRITE(IPR,2100)
 2100 FORMAT(6H ERROR)
      RETURN
C
      END
      SUBROUTINE HELP
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C**********************************************************************
      DIMENSION LINE(4)
C
C
C          WILL READ MODEL AND PRODUCE LISTING
C                OF COMMANDS AND USE
C
      REWIND IHELP
  100 READ(IHELP,200)LINE
  200 FORMAT(4A10)
      IF(EOF(IHELP).NE.0)RETURN
      WRITE(IPR,200)LINE
      GO TO 100
C
      END
      SUBROUTINE DRAW
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C**********************************************************************
C          DRAW
C
 1500 WRITE(IPR,1510)
 1510 FORMAT(4HBODY)
      READ(ITTY,*)IBOD
      IF(EOF(ITTY).NE.0)GO TO 400
      IF(IBOD.LT.0.OR.IBOD.GT.NBODS)GO TO 400
      MODE=1
      CALL PLBOD(IBOD)
```

```
      IF(ISCOPE.EQ.2)RETURN


      CALL MOVABS(10,770)
      CALL ALPHAM
      RETURN
C
  400 WRITE(IPR,500)
  500 FORMAT(6H ERROR)
      RETURN
      END
      SUBROUTINE SKET
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C*************************************************************
C
C*************************************************************
C          SKETCH
C
 1600 MODE=2
      WRITE(IPR,1610)
 1610 FORMAT(4HBODY)
      READ(ITTY,*)IBOD
      IF(EOF(ITTY).NE.0)RETURN
      IF(IBOD.LT.0.OR.IBOD.GT.MAXBOD)GO TO 400
      CALL PLBOD(IBOD)
      IF(ISCOPE.EQ.2)RETURN
      CALL MOVABS(10,770)
      CALL ALPHAM
      RETURN
C
  400 WRITE(IPR,500)
  500 FORMAT(6H ERROR)
      CALL ALPHAM
      RETURN
C
      END
      SUBROUTINE READ
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C*************************************************************
C          READ
C
 1700 IRET=0
      CALL SAV(100)
      CALL READF(IRET,MODEL)
      IF(IRET.EQ.-1)WRITE(IPR,1815)NAME
 1815 FORMAT(A10,5H READ)
      IF(IRET.NE.-1)WRITE(IPR,1710)NAME
 1710 FORMAT(6HMODEL ,A10,10H NOT FOUND)
```

```
      RETURN


      END
      SUBROUTINE WRIT
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C
C**********************************************************************
C          WRITE
C
 1800 CALL WRITEF(IRET,MODEL)
      WRITE(IPR,1810)NAME
 1810 FORMAT(6HMODEL ,A10,8H WRITTEN)
      IF(IRET.NE.-1)WRITE(IPR,1820)
 1820 FORMAT(14HUNSUCCESSFULLY)
      RETURN
C
      END
      SUBROUTINE ANOM
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C**********************************************************************
C          ANOMALY
C
      IBOD=0
      KALK=1
      CALL PLANOM(IBOD,KALK)
      CALL PLOBS
      IF(ISCOPE.EQ.2)WRITE(IPR,101)
  101  FORMAT(18HANOMALY CALCULATED)
      IF(ISCOPE.EQ.2)RETURN
      CALL MOVABS(10,770)
      CALL ALPHAM
      RETURN
      END
C
      SUBROUTINE TANO
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C**********************************************************************
```

```
C*************************************************************

C          TYPEANOM
C
      WRITE(IPR,300)
  300 FORMAT(11HBODY(0=ALL))
      READ(ITTY,*)IBOD
      IF(EOF(ITTY).NE.0)GO TO 400
      IF(IBOD.LT.0.OR.IBOD.GT.MAXCAL)GO TO 400
      CALL TYPANO(IBOD)
      RETURN
C
  400 WRITE(IPR,500)
  500 FORMAT(6H ERROR)
      RETURN
C
      END
      SUBROUTINE OBSE
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C*************************************************************
C          UPDATEOBS
C
  100 WRITE(IPR, 200)
  200 FORMAT(9HNO.,VALUE)
  300 READ(ITTY,*)J,ANS
      IF(EOF(ITTY).NE.0)RETURN
      IF(J.LE.0.OR.J.GT.NFIELD(ITYPE))GO TO 900
      OBS(ITYPE,J)=ANS
      GO TO  300
C
  900  WRITE(IPR,950)J
  950  FORMAT(6H ERROR,I5, 8H ILLEGAL)
       GO TO 100
C
      END
      SUBROUTINE TBOD
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C*************************************************************
C
C          TYPEBODY
C
      WRITE(IPR,200 )
  200 FORMAT(4HBODY)
      READ(ITTY,*)IBOD
      IF(EOF(ITTY).NE.0)GO TO 400
      IF(IBOD.LT.0.OR.IBOD.GT.NBODS)GO TO 400
      CALL TYPBOD(IBOD)
```

```
      RETURN


  400 WRITE(IPR,500)
  500 FORMAT(6H ERROR)
      RETURN
C
      END
      SUBROUTINE COMM
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C*************************************************************
C          INPUT COMMENTS
C
      WRITE(IPR,2410)
 2410 FORMAT(13HTYPE COMMENTS)
      READ(ITTY,2420)KOMMNT
 2420 FORMAT(15A10)
      RETURN
C
      END
      SUBROUTINE TCOM
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C*************************************************************
C          COMMENTS
C
      WRITE(IPR,600)KOMMNT
  600 FORMAT(4A10)
      RETURN
C
      END
      SUBROUTINE FMODE
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C*************************************************************
C          MODELS
C
      WRITE(IPR, 300)
  300 FORMAT(10HMODEL NAME)
      READ(ITTY,350 )NAME
      IF(EOF(ITTY).NE.0)GO TO 400
```

```
      WRITE(IPR,350 )NAME


  350 FORMAT(A10)
      RETURN
C
  400 WRITE(IPR,450)
  450 FORMAT(6H ERROR)
      RETURN
C
      END
      SUBROUTINE TMOD
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C**********************************************************************
C**********************************************************************
C       LIST MODELS
C
 2700 IRET=1
      CALL READF(IRET,MODEL)
C
C
      RETURN

C
      END
      SUBROUTINE INSE
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C**********************************************************************
C          INSERT
C
      WRITE(IPR, 100)
  100 FORMAT(23HBODY,INSERT AFTER POINT)
      READ(ITTY,*)IBOD,NPT
      IF(EOF(ITTY).NE.0)GO TO 400
      IF(IBOD.LT.1.OR.IBOD.GT.NBODS)GO TO 400
      IF(NPT.GE.NPTS(IBOD))GO TO 400
      WRITE(IPR, 200)
  200 FORMAT(3HX,Z)
            READ(ITTY,*)XX,ZZ
      IF(EOF(ITTY).NE.0)GO TO 400
      CALL INSERT(XX,ZZ,IBOD,NPT,IRET)
      IF(IRET.LT.0)RETURN
  400 WRITE(IPR,450)
  450 FORMAT(6H ERROR)
      RETURN
      END
      SUBROUTINE DELE
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
```

```
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)


      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C
C*************************************************************
C          DELETE
C
      WRITE(IPR,2910)
 2910 FORMAT(17HBODY,DELETE POINT)
      READ(ITTY,*)IBOD,NPT
      IF(EOF(ITTY).NE.0)GO TO 2930
      IF(IBOD.GT.NBODS.OR.IBOD.LT.1)GO TO 2930
      IF(NPT.LT.1.OR.NPT.GE.NPTS(IBOD))GO TO 2930
      XX=X(IBOD,NPT)
      ZZ=Z(IBOD,NPT)
      CALL DELETE(IBOD,NPT,IRET)
      IF(IRET.LT.0)WRITE(IPR,2920)NPT,XX,ZZ
 2920 FORMAT(5HPOINT,I3,9H DELETED=,2F10.2)
      RETURN
C
 2930 WRITE(IPR,2940)
 2940 FORMAT(6HERROR )
      RETURN
C
      END
      SUBROUTINE END
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C*************************************************************
C          STOP
C
      IF(ISCOPE.EQ.1)CALL ALPHAM
      IF(ISCOPE.EQ.1)CALL FINITT(0,767)
      WRITE(IPR,3010)
 3010 FORMAT(8HGOOD-BYE)
      STOP
      END
      SUBROUTINE RECO
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C*************************************************************
C          RECOVER
```

```
C
      WRITE(IPR,3220)
 3220 FORMAT(19HHOW MANY BACKSPACES )
      READ(ITTY,*)IRET
      IF(EOF(ITTY).NE.0)RETURN
      IF(IRET.LE.0)RETURN
      IRET=-IRET
      CALL READF(IRET,ISCR)
      WRITE(IPR,3240)NAME
 3240 FORMAT(6HMODEL ,A10)
      IF(IRET.GE.0)WRITE(IPR,3250)
 3250 FORMAT(14H NOT RECOVERED)
      IF(IRET.LT.0)WRITE(IPR,3260)
 3260 FORMAT(10H RECOVERED)
      RETURN
C
      END
      SUBROUTINE PANO
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C**********************************************************************
C          PLOT ANOMALY BUT DO NOT RECALCULATE
C
 3400 IBOD=0
      IF(ISCOPE.EQ.2)RETURN
      KALK=0
      CALL PLANOM(IBOD,KALK)
      CALL ALPHAM
      RETURN
      END
      SUBROUTINE TPAR
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C**********************************************************************
C
C
C**********************************************************************
C          TYPE PARAMETERS
C
 3500 CALL TYPAR(0)
      RETURN
C
      END
      SUBROUTINE GRAV
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
```

```
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)

      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C**********************************************************
C              GRAVITY
C
      IF(ITYPE.NE.1)CALL REAN
      ITYPE=1
      WRITE(IPR,3650)
 3650 FORMAT(13HGRAVITY MODEL/"ZCON")
      READ(ITTY,*)ANS
      IF(EOF(ITTY).EQ.0)ZCON=ANS
       IF(ZCON.EQ.0.)ZCON=.000001
      RETURN
C
      END
      SUBROUTINE MAGN
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C**********************************************************
C
C              MAGNETICS
C
      ITYPE=2
      CALL REAN
      WRITE(IPR,3710)
 3710 FORMAT(34HMAGNETICS MODEL ENTER X TO N ANGLE)
C
      READ(ITTY,*)ANS
      IF(EOF(ITTY).NE.0)GO TO 3711
      XTON=AMOD(ANS,360.)
      IF(XTON.LT.0.)XTON=XTON+360.
 3711 WRITE(IPR,3730)
 3730 FORMAT(4H DEC )
      READ(ITTY,*)ANS
      IF(EOF(ITTY).NE.0)GO TO 3731
      DEC=AMOD(ANS,360.)
      IF(DEC.LT.0.)DEC=DEC+360.
 3731 WRITE(IPR,3740)
 3740 FORMAT(5H DIP )
      READ(ITTY,*)ANS
      IF(EOF(ITTY).NE.0)GO TO 3750
      DIP=AMOD(ANS,360.)
      IF(DIP.LT.0.)DIP=DIP+360.
C
 3750 WRITE(IPR,3755)
 3755 FORMAT(5H ZCON)
      READ(ITTY,*)ANS
      IF(EOF(ITTY).EQ.0)ZCON=ANS
      IF(ZCON.EQ.0.)ZCON=0.000001
      RETURN
C
```

```
C
      END
      SUBROUTINE CROS
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C*************************************************************
C
C               CROSS
C
      IF(ICROSS.NE.0)GO TO 3840
      ICROSS=1
      WRITE(IPR,3810)
 3810 FORMAT(10HCROSSES ON)
      RETURN
C
 3840 ICROSS=0
      WRITE(IPR,3850)
 3850 FORMAT(11HCROSSES OFF)
      RETURN
      END
      SUBROUTINE ZOOM
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C*************************************************************
C
C               ZOOOM
C
 3900 WRITE(IPR,3910)
 3910 FORMAT(49HFOR SKETCH MODE,ENTER MIN X,MAX X,UPPER Z,LOWER Z)
      READ *,ANS1,ANS2,ANS3,ANS4
      IF(EOF(ITTY).NE.0)RETURN
      IF(ANS1.GE.ANS2)GO TO 3900
      IF(ANS3.GE.ANS4)GO TO 3900
      IF(ANS3.LT.0.)GO TO 3900
      SKXMIN=ANS1
      SKXMAX=ANS2
      SKZMIN=ANS3
      SKZMAX=ANS4
      RETURN
      END
C*************************************************************
C
C
C
      SUBROUTINE LINI
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
```

```
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)


      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C
C*************************************************************
C
C     FINDS MIN MAX OF ANOMALY
C    AND SETS OBSERVATION OFFSET(2)
C
C
C
C
      IF(NBODS.EQ.0)GO TO 4050
      IF(NFIELD(ITYPE).EQ.0)GO TO 4050
C
      AAMAX=CALC(MAXCAL,1)
      AAMIN=AAMAX
C
      NF=NFIELD(ITYPE)
      DO 4010 J=2,NF
      VAL=CALC(MAXCAL,J)
      IF(VAL.GT.AAMAX)AAMAX=VAL
      IF(VAL.LT.AAMIN)AAMIN=VAL
 4010 CONTINUE
      GO TO 4060
C
C            NO ANOMALY
C
 4050 AAMAX=0.
      AAMIN=0.
 4060 AAVG=(AAMAX-AAMIN)/2.+AAMIN
      WRITE(IPR,4070)AAMAX,AAMIN,AAVG
 4070 FORMAT(21H  ANOMALY SCALE UPPER,F10.2/15X,6H LOWER
     X           ,F10.2/15X,8H AVERAGE,F8.2)
C
C      OPTION TO OFFSET OBSERVED WHEN PLOTTING
C
      WRITE(IPR,4080)
 4080 FORMAT(25HENTER OFFSET FOR OBSERVED)
      READ(ITTY,*)ANS
      IF(EOF(ITTY).NE.0)RETURN
      OFFSET(ITYPE)=ANS
      RETURN
      END
      SUBROUTINE SUPP
C*************************************************************
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C
C
C          SUPPRESS GRAPHICS
C
```

```
 4100 WRITE(IPR,4110)

 4110 FORMAT(31HDO YOU WANT GRAPHICS SUPPRESSED)
      READ(ITTY,4120)IANS
 4120 FORMAT(A1)
      IF(EOF(ITTY).NE.0)RETURN
      IF(IANS.EQ.1HY)ISCOPE=2
      IF(IANS.NE.1HY)ISCOPE=1
      RETURN
      END
      SUBROUTINE REAN
C.....................................................................
C          PURPOSE TO REINITIALIZE ARRAY CALC AND IANOM
C
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C
      DO 100 I=1,MAXCAL
      DO 100 J=1,MAXOBS
      CALC(I,J)=0.
  100 CONTINUE
      DO 200 I=1,MAXBOD
      IANOM(I)=0
  200 CONTINUE
      RETURN
      END
      SUBROUTINE DUMP
C.....................................................................
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C
C
C         PURPOSE PRINTS ALL VALUES IN CURRENT RECORD ON PRINTER
C
C
      WRITE(IPR,50)
   50 FORMAT(7H MODEL   ,A10//)
      CALL TYPBOD(0)
C
      CALL TOBS
C
      IBOD=0
      CALL TYPANO(IBOD)
      CALL TSCA
      RETURN
      END
      SUBROUTINE WRITEF(IRET,LUN)
C.....................................................................
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
```

```
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)


      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C
C
C         PURPOSE WRITES A NEW MODEL ON LOGICAL UNIT LUN
C               IF LUN IS THE SCRATCH FILE A RECORD IS ADDED TO THE END
C               IF A DUPLICATE NAME IS FOUND ON FILE IT MAY BE OVERWITTE
C               IF THIS IS THE SCRATCH FILE IT IS ASSUMEDTO BE ATTHE EOF
C
C               IRET -1 O.K
C                     0 EOF
C                     1 PARITY
C                     2 DISALLOWED DUPLICATE NAME OR PARITY ERROR ON REA
C
C
C         IF THIS IS SCRATCHFILE WRITE RECORD HERE
C
      IF(LUN.EQ.ISCR)GO TO 2000
C
C         ELSE SEARCH THRU DISK FILE TO CHECK FOR DUPLICATE NAMES
C
C
C         MOVE TO END OF FILE BEFORE REWINDING
C
      IWRITE=0
      IRET=-1
C         IF OUTPUT IS ON SCRATCH FILE IT IS SEQUENTIAL
C
C
C
C
C
C         MODEL FILE TO BE WRITTEN ON
C          CHECK FOR DUPLICATE NAMES
      DO 800 I=1,LNGIX
C
      IF(NAME.NE.IX(I))GO TO 800
C         DUPLICATE NAME
C
      WRITE(IPR,700)
  700  FORMAT(43HDUPLICATE MODEL.TYPE YES IF OK TO OVERWRITE)
      READ(ITTY,710)IANS
      IF(EOF(ITTY).NE.0)GO TO 8000
  710  FORMAT(A1)
      IF(IANS.NE.1HY)GO TO 8000
C
C           REWRITE IN PLACE
C
  777  IWRITE=1
      GO TO 1000
C
  800  CONTINUE
C
C           ADD ON
C
C
C
```

```
      IWRITE=0


C
 1000 CALL OPENMS(MODEL,IX,LNGIX,1)
      CALL WRITMS(MODEL,NAME,LNGMOD,NAME,IWRITE,1)
      CALL CLOSMS(MODEL)
      RETURN
C
C          SCRATCH FILE - ADD ON TO END
C
 2000 BUFFER OUT(ISCR,0)(NAME,KEND)
      IRET=UNIT(ISCR)
      RETURN
C
C
C
C          ERROR
 8000 IRET=2
      RETURN
      END
      SUBROUTINE TYPBOD(IBOD)
C.....
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C
C          TYPES BODY CO ORDINATES AND PARAMETERS
C
C          IBOD=0  -  PRINT ALL BODIES
C          ELSE IBOD=BODY NUMBER
      IF(NBODS.EQ.0)RETURN
C
C
      IF(IBOD.NE.0)GO TO 100
C
C          ALL BODIES
C
      IBEGIN=1
      IEND=NBODS
      GO TO 200
C
C           ONE BODY
C
  100 IBEGIN=IBOD
      IEND=IBOD
C
  200 DO 1000 I=IBEGIN,IEND
      WRITE(IPR,250)I
  250  FORMAT(//5HBODY ,I3)
      IF(NPTS(I).EQ.0)GO TO 1000
      IF(ITYPE.EQ.1)WRITE(IPR,270)RHO(I)
  270 FORMAT(5X,4HRHO=,F10.2)
      IF(ITYPE.EQ.2)WRITE(IPR,280)BMAG(I),BDEC(I),BDIP(I)
  280 FORMAT(5X,13HMAGNETIZATION,F10.2/5H DEC ,F10.2,5H DIP ,F10.2)
      NPT1=NPTS(I)-1
      DO 500 J=1,NPT1
      WRITE(IPR,290)J,X(I,J),Z(I,J)
  290 FORMAT(5X,I3,1X,F10.2,1X,F10.2)
```

```
  500  CONTINUE


 1000  CONTINUE
       WRITE(IPR,1010)
 1010  FORMAT(/)
C
       RETURN

       END
       SUBROUTINE TYPAR(IBOD)
C.....
       COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
       COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
       COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
       COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
       COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
       COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
       COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
       COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C
C
C          SUBROUTINE TO PRINT BODY PARAMETERS
C
       IF(ITYPE.EQ.2)GO TO 2000
C
C          GRAVITY
C
       WRITE(IPR,100)
  100  FORMAT(12H BODY     RHO)
       DO 200 I=1,NBODS
       IF(NPTS(I).GT.0)WRITE(IPR,150)I,RHO(I)
  150  FORMAT(I5,1X,3F10.2)
  200  CONTINUE
       RETURN
C
C          MAGNETICS
C
 2000  WRITE(IPR,2100)
 2100  FORMAT(5H BODY,4X,14H MAGNETIZATION,6H DEC  ,6H   DIP)
       DO 2200 I=1,NBODS
       IF(NPTS(I).GT.0)WRITE(IPR,150)I,BMAG(I),BDEC(I),BDIP(I)
 2200  CONTINUE
       RETURN
       END
       SUBROUTINE TOBS
C.....
       COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
       COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
       COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
       COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
       COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
       COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
       COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
       COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C
C          PURPOSE TO PRINT THE OBSERVATIONS
C
C
       WRITE(IPR,50)
    50 FORMAT(4H OBS)
       NF=NFIELD(ITYPE)
```

```
      DO 200 I=1,NF

      IF(OBS(ITYPE,I).EQ.0.)GO TO 200
      WRITE(IPR,100)I,COORD(I),OBS(ITYPE,I)
  100  FORMAT(I3,1X,F10.2,1X,F10.2)
  200  CONTINUE
      RETURN
      END
      SUBROUTINE TYPANO(JBOD)
C.....
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C
C         PURPOSE PRINTS OUT ANOMALY FOR BODY IBOD
C                 IF IBOD EQ.0 OR MAXBOD+1,TOTAL ANOMALY IS PRINTED
C
      IBOD=JBOD
      IF(JBOD.EQ.0)IBOD=MAXCAL
      IF(IBOD.LT.MAXCAL)WRITE(IPR,100)IBOD
  100  FORMAT(12HANOMALY BODY,I3)
      IF(IBOD.EQ.MAXCAL)WRITE(IPR,200)
  200  FORMAT(13HTOTAL ANOMALY)
      NF=NFIELD(ITYPE)
      DO 500 I=1,NF
      IF(CALC(IBOD,I).GT.-.00001.AND.CALC(IBOD,I).LT..00001)GO TO 500
      WRITE(IPR,400)I,COORD(I),CALC(IBOD,I)
  400  FORMAT(I3,1X,F10.2,1X,F10.2)
  500  CONTINUE
      RETURN
C
      END
      SUBROUTINE READF(IRET,LUN)
C.....
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C
C         PURPOSE   TO READ THE DISK FILE LUN AND LOOK
C               FOR FILE NAME INNAME
C         OPERATION IS DETERMINED BY IRET
C               INPUT IRET=0 SEARCH FOR AND FIND FILE INNAME
C                            1 READ EACH RECORD AND LIST FILE NAME
C                           LT.0 READ THE (-IRET)TH LAST RECORD
C
C
C         OUTPUT IRET
C                        -1 O.K
C                         0 NOT FOUND
C                         1 PARITY ERROR
C
```

```
C
      KOUNT=1
C
      IF(IRET.EQ.1)GO TO 2000
      IF(IRET.EQ.0)GO TO 3000
C
C      READ THE -RET TH LAST RECORD
 1200 NTIMES=1-IRET
      DO 1210 I=1,NTIMES
      BACKSPACE LUN
 1210 CONTINUE
      BUFFER IN(LUN,0)(NAME,KEND)
      IRET=UNIT(LUN)
      CALL REAN
      RETURN
C
 1300 IRET=-1
      RETURN
C
C
C          IRET =1 LIST  FILE NAMES
C
 2000 NF=1
      DO 2100 KOUNT=2,LNGIX,2
      IF(IX(KOUNT).EQ.0)GO TO 2101
      WRITE(IPR,2200)NF,IX(KOUNT)
 2100 NF=NF+1
C
 2200 FORMAT(1X,I5,1X,A10)
 2101 IRET=-1
      RETURN
C
C          READ APPROPRIATE FILE
C
 3000  CALL SAV(100)
C
C     FIRST CHECK TO MAKE SURE THERE IS SUCHAFILE
C
      DO 3100 KOUNT=2,LNGIX,2
       IF(IX(KOUNT).EQ.NAME)GO TO 3200
 3100 CONTINUE
      IRET=0
C
C     MODEL NAME NOT FOUND
C
      RETURN
C
 3200 CALL OPENMS(MODEL,IX,LNGIX,1)
      CALL READMS(MODEL,NAME,LNGMOD,NAME)
      CALL CLOSMS(MODEL)
C
C             CHECK OVER THE MODELS AND FIX UP
C             ANY OPEN BODIES
C              (I HOPE THIS IS NEVER NEEDED!)
      DO 3300 IBOD=1,NBODS
      IF(NPTS(IBOD).LE.0)GO TO 3290
      NPT=NPTS(IBOD)
      IF(X(IBOD,1).EQ.X(IBOD,NPT).AND.
     X   Z(IBOD,1).EQ.Z(IBOD,NPT))GO TO 3250
C
C       WOOPS AN OPEN BODY
C
      IF(NPT.EQ.MAXNPT)NPT=NPT-1
      NPT=NPT+1
```

```
      NPTS(IBOD)=NPT

      IANOM(IBOD)=0
      X(IBOD,NPT)=X(IBOD,1)
      Z(IBOD,NPT)=Z(IBOD,1)
C
      WRITE(IPR,3240)IBOD
 3240 FORMAT(4HBODY,I3,7H CLOSED)
C
C
C  IF ANY BODY HAS DUPLICATE CONSECUTIVE POINTS,
C        DELETE ONE OF THEM
C
 3250 NPT1=NPTS(IBOD)-1
      DO 3270 KOUNT=1,NPT1
      IF(X(IBOD,KOUNT).NE.X(IBOD,KOUNT+1))GO TO 3270
      IF(Z(IBOD,KOUNT).NE.Z(IBOD,KOUNT+1))GO TO 3270
C
C        DELETE THIS POINT
C
        CALL DELETE(IBOD,KOUNT,IRET)
       IF(IRET.EQ.0)GO TO 3270
      WRITE(IPR,3260)IBOD,KOUNT
 3260 FORMAT(4HBODY,I3,6H POINT,I3,22H DUPLICATE AND DELETED)
      GO TO 3250
C
 3270 CONTINUE
      IF(NPTS(IBOD).GT.2)GO TO 3290
C
      NPTS(IBOD)=0
      WRITE(IPR,3280)IBOD
 3280 FORMAT(4HBODY,I3,8H DELETED)
C
C        RESET ALL BODY COORDS TO (0,0) IF BODY DELETED
C
 3290  IF(NPTS(IBOD).GT.0)GO TO 3300
      DO 3295 KOUNT=1,NPT1
      X(IBOD,KOUNT)=0.
      Z(IBOD,KOUNT)=0.
 3295   CONTINUE
C
 3300 CONTINUE
      CALL REAN
      IRET=-1
      RETURN
      END
      SUBROUTINE SAV(KOUNT)
C.....................................................................
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C
      DATA ITOT/0/
C
C         PURPOSE TO SAVE THE CURRENT MODEL IN CASE OF SYSTEM CRASH OR O
C                  OR USER ERROR
C
C         MODEL IS BACKED UP EAFTER EVERY NBACK REVISIONS
```

```
C
      DATA NREW/300/
C          AFTER NREW RECORDS ARE OUTPUT ,BACKUP FILE IS REWOUND
C             SO FILE IS NOT TOO BIG
C
      IREW=IREW+1
      IF(IREW.LT.NREW)GO TO 10
      REWIND ISCR
      IREW=0
   10 CONTINUE
      ITOT=ITOT+KOUNT
      IF(ITOT.LT.NBACK)RETURN
C
      ITOT=0
      CALL WRITEF(IRET,ISCR)
      RETURN
      END
      SUBROUTINE PLOBS
C.....................................................................
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C
C
C
C         PURPOSE TO PLOT THE OBSERVED DATA ON THE TEKTRONIX SCOPE AS A
C                  DASHED LINE.EACH DASH BEGINS AND ENDS ON A DATA POINT
C
      IF(ISCOPE.EQ.2)RETURN
C
C         SET UP SCALES FOR DRAWING
C
      CALL SETSCL(1,0)
C
C         PLOT ALL POINTS
C
C
      NF=NFIELD(ITYPE)
      DO 100 I=1,NF,2
      XX=COORD(I)
      ZZ=OBS(ITYPE,I)+OFFSET(ITYPE)
      CALL POINTA(XX,ZZ)
      IF(I.EQ.NFIELD(ITYPE))GO TO 100
      J=I+1
      XX=COORD(J)
      ZZ=OBS(ITYPE,J)+OFFSET(ITYPE)
      CALL DRAWA(XX,ZZ)
  100 CONTINUE
      RETURN
      END
      SUBROUTINE PLANOM(JBOD,KALK)
C.....................................................................
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
```

```
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)


C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C
C
C        PURPOSE TO CALCULATE AND/OR PLOT THE ANOMALY
C                    JBOD BODY NUMBER
C                   KALK=1,CALCULATE ANOMALY ELSE PLOT
C
C        CALL SUBROUTINE TO CALCULATE ANOMALY
C
      IF(KALK.EQ.1)CALL CALCAN
C
      IF(ISCOPE.EQ.2)RETURN
C
C
      IBOD=JBOD
      IF(JBOD.EQ.0)IBOD=MAXCAL
C
C        CALL ROUTINE TO SET SCALES
C
      CALL SETSCL(1,0)
C
C        PLOT ANOMALY

      XX=COORD(1)
      CALL POINTA(XX,CALC(IBOD,1))
      NF=NFIELD(ITYPE)
      DO 100 I=2,NF
      XX=COORD(I)
      CALL DRAWA(XX,CALC(IBOD,I))
  100 CONTINUE
      RETURN
      END
      SUBROUTINE PLBOD(IBOD)
C.....
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C
C
C
C        PURPOSE TO PLOT BODIES
C                 BODY IBOD IS PLOTTED
C                IF IBOD=0,ALL BODIES ARE PLOTTED
C
      IF(ISCOPE.EQ.2)RETURN
C
C        SET SCALE UP
C
      CALL SETSCL(2,0)
C
      IST=IBOD
      IEND=IBOD
      IF(IBOD.NE.0)GO TO 100
```

```
      IST=1


      IEND=NBODS
C
  100 DO 200 I=IST,IEND
      NPT=NPTS(I)
      IF(NPT.LT.1)GO TO 200
      ZZ=-Z(I,1)
      CALL POINTA(X(I,1),ZZ)
      DO 111 J=2,NPT
      ZZ=-Z(I,J)
      CALL DRAWA(X(I,J),ZZ)
      IF(ICROSS.NE.0)CALL DRCROS(X(I,J),ZZ)
  111 CONTINUE
  200 CONTINUE
      RETURN
      END
      SUBROUTINE DRCROS(XX,ZZ)
C
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C
C
C**************************************************************
C           DRAWS A CROSS AT POINT X,Z
C
      XDIS2=XDIS
      ZDIS2=ZDIS
      CALL POINTA(XX+XDIS2,ZZ)
      CALL DRAWA(XX-XDIS2,ZZ)
      CALL POINTA(XX,ZZ+ZDIS2)
      CALL DRAWA(XX,ZZ-ZDIS2)
      CALL POINTA(XX,ZZ)
      RETURN
      END
      SUBROUTINE SETSCL(IWHICH,ISCL)
C.....................................................................
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C
      DIMENSION LINE(13)
C
C
C
C
C         PURPOSE TO SET UP WINDOWS AND SCALES FOR GRAPHING
C                 SCALES MAY OPTIONALLY BE PUT ON
C
C         IWHICH=1 UPPER GRAPH SET UP (ANOMALIES)
```

```
C                2 MIDDLE GRAPH(BODIES)


C                3 LOWER GRAPH(COMMANDS)
C
C          ISCL =0  DO NOT PLOT SCALES ON SCREEN
C                1 PLOT SCALES (Z ON UPPER,MIDDLE AND X ON LOWER)
C
C          X SCALE DEPENDS ON MODE MODE=1 SCALES FROM 0 TO XMAX -DRAW
C                                 2 SCALES FROM XMINS TO XMAXS-SKET
C
      IF(MODE.EQ.2)GO TO 20
C
C          IN DRAW MODE
C
      XXMIN=0.
      XXMAX=XMAX
      GO TO 500
C
C          IN SKETCH MODE
C
   20 XXMIN=SKXMIN
      XXMAX=SKXMAX
  500 SXXMIN=XXMIN
      SXXMAX=XXMAX
      GO TO (1000,2000,3000),IWHICH
C
C          UPPER GRAPH - PLOTS ANOMALIES
C
 1000 ZZMIN=ANOMIN(ITYPE)
      ZZMAX=ANOMAX(ITYPE)
      CALL TWINDO(10,1013,585,770)
      LENZ=770-585
      GO TO 5000
C
C          MIDDLE GRAPH - BODIES PLOTTED HERE
C
 2000 IF(MODE.EQ.2)GO TO 2500
C
C          DRAW MODE
C
      ZZMIN=-ZMAX
      ZZMAX=0.
      GO TO 2700
C
C                SKETCH MODE
C
 2500 ZZMIN=-SKZMAX
      ZZMAX=-SKZMIN
C
C          BODIES ARE PLOTTED ON NEGATIVE SCALE WITH ZERO AT TOP
C
 2700 CALL TWINDO(10,1013,100,575)
      LENZ=575-100
      GO TO 5000
C
C          LOWER  GRAPH - COMMANDS PRINTED HERE
C
 3000 XXMIN=0.
      XXMAX=7.4
      ZZMIN=1.
      ZZMAX=3.
      CALL TWINDO(10,1013,10,90)
      LENZ=90-10
C
 5000 CALL DWINDO(XXMIN,XXMAX,ZZMIN,ZZMAX)
```

```
      XDIS=((XXMAX-XXMIN)/FLOAT(1003))*6.


      ZDIS=((ZZMAX-ZZMIN)/FLOAT(LENZ))*6.
      IF(ISCL.EQ.0)RETURN
C
C         NOW PLOT SCALES
C
      CALL POINTA(XXMIN,ZZMAX)
      CALL DRAWA(XXMAX,ZZMAX)
      CALL POINTA(XXMAX,ZZMIN)
      CALL DRAWA(XXMIN,ZZMIN)
C
      GO TO (5100,5200,5300),IWHICH
C                 **********
C
C
C         ANOMALY SCALE PRINTED
C
 5100  CALL POINTA(XXMIN,ZZMAX)
      ENCODE(8,5110,LINE)ZZMAX
 5110 FORMAT(F8.0)
      CALL AOUTST(8,LINE)
      CALL POINTA(XXMIN,ZZMIN)
      ENCODE(8,5110,LINE)ZZMIN
      CALL AOUTST(8,LINE)
      RETURN
C
C
C         MARK X AND Z SCALES ON GRAPH OF BODIES
C
 5200 CALL POINTA(XXMIN,ZZMAX)
      ENCODE(8,5110,LINE)ZZMAX
      CALL AOUTST(8,LINE)
      CALL POINTA(XXMIN,ZZMIN)
      ENCODE(8,5110,LINE)-ZZMIN
      CALL AOUTST(8,LINE)
C
      XPOS=XXMAX-(XXMAX-XXMIN)/8.
      CALL POINTA(XPOS,ZZMAX)
      ENCODE(8,5110,LINE)XXMAX
      CALL AOUTST(8,LINE)
      XPOS=XXMIN+(XXMAX-XXMIN)/8.
      CALL POINTA(XPOS,ZZMAX)
      ENCODE(8,5110,LINE)XXMIN
      CALL AOUTST(8,LINE)
C      DRAW A LITTLE SQUARE THE SIZE OF TOLERANCE ALLOWED FOR
C        CURSOR INPUT
C
      CALL POINTA(XXMIN,ZZMIN)
      XX=XXMIN+2.*XDIS
      CALL DRAWA(XX,ZZMIN)
      ZZ=ZZMIN+2.*ZDIS
      CALL DRAWA(XX,ZZ)
      CALL DRAWA(XXMIN,ZZ)
      CALL DRAWA(XXMIN,ZZMIN)
C
C
      RETURN
C
C         DRAW MENU OF COMMANDS
C
 5300 CALL POINTA(0.,2.5)
       ENCODE(70,5320,LINE)
 5320 FORMAT(
     X 6QH  REDRAW     BODY     ANOMALY    POINT    SKETCH    PARAN
```

```
     X        ,10H   GRAV            )

      CALL AOUTST(60,LINE)
      CALL ALPHAM
      CALL POINTA(6.0,2.5)
      CALL AOUTST(10,LINE(7))
      CALL POINTA(0.,1.5)
      ENCODE(70,5330,LINE)
      CALL AOUTST(60,LINE)
      CALL POINTA(6.0,1.5)
      CALL AOUTST(10,LINE(7))
 5330 FORMAT(50H   ZOOM     CROSS     DELETE    INSERT     DRAW
     X      ,20H  RECOVER     MAG          )
      RETURN
      END
      SUBROUTINE CALCAN
C.....
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C
C
C
C         PURPOSE TO CALCULATE THE GRAVITY OR MAGNETIC ANOMALY
C                 AND PUT THE NEW ONE IN CALC(MAXCAL,1-NFIELD)
C
C
C
C
      DO 100 I=1,MAXOBS
      CALC(MAXCAL,I)=0
  100 CONTINUE
C
C         CALCULATE ANOMALY FOR ANY BODY THAT HAS BEEN CHANGED
C
      DO 1000 IBOD=1,NBODS
      IF(NPTS(IBOD).LE.0)GO TO 700
      IF(IANOM(IBOD).LT.0)GO TO 700
C
      IF(ITYPE.EQ.2)CALL MAG(IBOD)
      IF(ITYPE.EQ.1)CALL GRAVC(IBOD)
C
      IANOM(IBOD)=-1
C
C
  700 NF=NFIELD(ITYPE)
      DO 800 I=1,NF
      CALC(MAXCAL,I)=CALC(MAXCAL,I)+CALC(IBOD,I)
  800 CONTINUE
C
 1000 CONTINUE
C
      CALL SAV(NBACK)
      RETURN
      END
      SUBROUTINE GRAP
C.....
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
```

```
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS

      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C
      DIMENSION LINE(3)
C
C
C
C          PURPOSE - THIS ROUTINE HANDLES ALL DISPLAYS AND INPUTS
C                    IN GRAPHICS MODE.THE COMMANDS TYPED AT TH E
C                    BOTTOM OF THE SCREEN CAN BE ACTIVATED BY PLACING THE
C                    CURSOR OVER THE COPMMAND AND HITTING ANY CHARACTER
C                     (NOTE-SOME COMMANDS INTERPRET THE CHARACTER AS A BO
C                     NUMBER(0=ALL))
C
C                    A SINGLE BELL MEANS THE PROGRAM IS EXPECTING A COMMA
C                     A LONG BELL MEANS AN ERROR HAS OCCURED AND A NEW
C                     SHOULD BE CURSORD IN
C
      DATA IQUEST/63/,IDOT/46/,IC/67/,IA/65/
C
C          CONTROL CAN BE RETURNED TO 'WHAT TO DO' MODE ANY TIME
C          BY HITTING THE QUESTION MARK
C          CONTROL CAN BE RETURNED TO COMMAND MODE BY HITTING C
C          CONTRAL CAN BE RETURNED TO COMMAND INPUT(1 BELL)
C               AT ANY TIME BY HITTING A
C
      IF(ISCOPE.EQ.2)RETURN
   15 DO 20 I=1,3
      CALL SETSCL(I,1)
   20 CONTINUE
C
C          PRINT OUT COMMANDS
C
      CALL PLOBS
      GO TO 100
C
C          ERROR ON LAST GRAPHIC INPUT-RETRY COMMAND
C
   25 DO 50 I=1,13
   50 CALL BELL
C
C          AWAIT NEXT COMMAND
C
  100 CALL BELL
      NRECOV=0
  200 CALL SETSCL(3,0)
C
      CALL VCURSR(ICHAR,XX,ZZ)
      IF(ICHAR.EQ.0)GO TO 25
      IF(ICHAR.EQ.IQUEST)GO TO 9900
      IF(ICHAR.EQ.IC)GO TO 15
      IF(ICHAR.EQ.IA)GO TO 25
      IF(ZZ.LE.0..OR.ZZ.GE.3.)GO TO 25
      IF(XX.LE.0.)GO TO 25
C
C          CALCULATE WHICH COMMAND HAS BEEN CURSORD
C
```

```
      ICOM=2*IFIX(XX)+IFIX(ZZ)


      IF(ICOM.LT.1.OR.ICOM.GT.14)GO TO 25
      GO TO (1100,1200,1300,1400,1500,1600,1700,1800,1900,2000
     $      ,2100,2200,2300,2400),ICOM
C     ------------------------------------------------------------
C
C
C
C          ZOOM
C
C               SETS DRAW PARAMETERS - USER POINTS TO LOWER LEFT
C                                      CORNER AND UPPER RIGHT
C                                      TO RESET DRAW
C
 1100 CALL SETSCL(2,0)
C             BOTTOM LEFT
      CALL VCURSR(ICHAR,XXB,ZZB)
      IF(ICHAR.EQ.0)GO TO 25
      ZZB=-ZZB
      IF(ICHAR.EQ.IQUEST)GO TO 9900
      IF(ICHAR.EQ.IC)GO TO 15
      IF(ICHAR.EQ.IA)GO TO 25
C             TOP RIGHT
      CALL VCURSR(ICHAR,XXT,ZZT)
      IF(ICHAR.EQ.0)GO TO 25
      ZZT=-ZZT
      IF(ICHAR.EQ.IQUEST)GO TO 9900
      IF(ICHAR.EQ.IC)GO TO 15
      IF(ICHAR.EQ.IA)GO TO 25
      IF(ZZT.LT.0.)GO TO 25
      IF(XXB.GE.XXT)GO TO 25
      IF(ZZB.LE.ZZT)GO TO 25
      SKXMAX=XXT
      SKXMIN=XXB
      SKZMIN=ZZT
      SKZMAX=ZZB
      GO TO 100
      CALL ALPHAM
      RETURN
C
C          REDRAW
C
 1200 DO 1210 I=1,3
      CALL SETSCL(I,1)
 1210 CONTINUE
      IBOD=0
      CALL PLBOD(IBOD)
      CALL PLANOM(IBOD)
      CALL PLOBS
      GO TO100
C
C          CROSS
C
C             CROSSES CAN BE TURNED ON AND OFF BY THIS COMMAND
C
 1300 IF(ICROSS.EQ.1)KROSS=0
      IF(ICROSS.EQ.0)KROSS=1
      ICROSS=KROSS
      GO TO 100
C
C          BODY
C
 1400 LASTBD=-1
C
C          THE USER SHINES THE CURSOR AROUND,HITS THE BODY NUMBER
```

```
C          SUCCESSIVLY UNTIL HE WANTS TO FINNISH DRAWING THE

C          BODY. HE CAN DO THIS BY HITTING . OR BY CHANGING BODY NUMBER
C          THAT HE IS HITTING
C
      CALL SETSCL(2,0)
 1420 CALL VCURSR(ICHAR,XX,ZZ)
      ZZ=-ZZ
      IF(ICHAR.EQ.0)GO TO 1440
      IF(ICHAR.EQ.IQUEST)GO TO 1440
      IF(ICHAR.EQ.IC)GO TO 1440
      IF(ICHAR.EQ.IA)GO TO 1440
C
      IF(ICHAR.NE.IDOT)GO TO 1450
C
C          THIS IS THE LAST POINT IN THE BODY.JOIN END TO BEGINNING
C          AND RETURN TO COMMAND MODE
C
C
C          IF LAST CHAR.WAS A COMMAND,ERROR
C           THAT IS IF THERE ARE NO POINTS IN THE BODY
C
      IF(LASTBD.EQ.-1)GO TO 25
      XX=X(LASTBD,1)
      ZZ=Z(LASTBD,1)
      NPT=NPTS(LASTBD)+1
      IF(NPT.GE.MAXNPT)GO TO 1440
      X(LASTBD,NPT)=XX
      Z(LASTBD,NPT)=ZZ
      REVZ=-ZZ
      CALL DRAWA(XX,REVZ)
      NPTS(LASTBD)=NPT
      CALL SAV(NBACK)
      IANON(LASTBD)=0
      GO TO 100
C
C     BODY BUILDING ABORTED
C
 1440 IF(NPT.LT.MAXNPT)NPT=NPT+1
      X(LASTBD,NPT)=X(LASTBD,1)
      Z(LASTBD,NPT)=Z(LASTBD,1)
      IANON(IBOD)=0
      REVZ=-ZZ
      CALL DRAWA(XX,REVZ)
      GO TO 25
C
C
C          NEW BODY POINT TO BE ADDED AND DRAWN
C
 1450 IBOD=NUMB(ICHAR)
      IF(IBOD.LT.1.OR.IBOD.GT.MAXBOD)GO TO 1440
      IF(IBOD.GT.NBODS)NBODS=IBOD
C
C          CALL ROUTINE TO CHECK WHETHER THIS POINT IS SPOSED
C          TO HAVE THE SAME CO.ORDS AS A PREVIOUS ONE
C
      NUMBER=1
      CALL CHECK(NUMBER,XX,ZZ,IDUPBD,IDUPPT,IRET)
C
C          IF POINT OUT OF RANGE,ERROR
C
      IF(IRET.GT.0)GO TO 1440
C
      NPT=NPTS(IBOD)
      IF(NPT.GE.MAXNPT)GO TO 1440
```

```
      IF(NPT.EQ.0)GO TO 1470


C
C       IF ADDING POINTS TO PREVIOUS BODY
C       SKIP AROUND LAST POINT
      IF(LASTBD.EQ.-1)NPT=NPT-1
C
C          DRAW THE NEW LINE OR POINT
C
      REVZ=-Z(IBOD,NPT)
      IF(ICROSS.EQ.1)CALL DRCROS(X(IBOD,NPT),REVZ)
      IF(ICROSS.NE.1)CALL POINTA(X(IBOD,NPT),REVZ)
      REVZ=-ZZ
      CALL DRAWA(XX,REVZ)
      IF(ICROSS.EQ.1)CALL DRCROS(XX,REVZ)
      GO TO 1475
 1470 REVZ=-ZZ
      IF(ICROSS.EQ.1)CALL DRCROS(XX,REVZ)
      IF(ICROSS.NE.1)CALL POINTA(XX,REVZ)
 1475 LASTBD=IBOD
      NPT=NPT+1
      X(IBOD,NPT)=XX
      Z(IBOD,NPT)=ZZ
      NPTS(IBOD)=NPT
      IANOM(IBOD)=0
       CALL SAV(NBACK)
      GO TO 1420
C
C          DELETE
C
 1500 CALL SETSCL(2,0)
C
C          INPUT POINT TO BE DELETED
C
      CALL VCURSR(ICHAR,XOLD,ZOLD)
      ZOLD=-ZOLD
      IF(ICHAR.EQ.0)GO TO 25
      IF(ICHAR.EQ.IQUEST)GO TO 9900
      IF(ICHAR.EQ.IC)GO TO 15
      IF(ICHAR.EQ.IA)GO TO 25
      KOUNT=-1
      NUMBER=1
 1510 KOUNT=KOUNT+1
      CALL CHECK(NUMBER,XOLD,ZOLD,IBOD,NPT,IRET)
      IF(IRET)1520,1530,25
C
C          UNASSIGNED POINT
C
 1520 IF(KOUNT.GT.0)GO TO 100
      GO TO 25
C
C          POINT BELONGS TO BODY IBOD,POINT NPT
C
 1530 CALL DELETE(IBOD,NPT,IRET)
      IF(NPT.NE.1)GO TO 1540
C
C      FOR FIRST POINT IN BODY,REJOIN WITH LAST
C
      NP=NPTS(IBOD)
      X(IBOD,NP)=X(IBOD,1)
      Z(IBOD,NP)=Z(IBOD,1)
 1540 CALL PLBOD(IBOD)
      CALL SAV(NBACK)
      GO TO 1510
C
```

```
C
C          ANOMALY
C
 1600 IBOD=NUMB(ICHAR)
      KALK=1
C
C          CALCULATE ANOMALY AND PLOT
C
      CALL PLANOM(IBOD,KALK)
      GO TO 100
C
C          INSERT
C
 1700 CALL SETSCL(2,0)
C
C          CURSOR IN THE 2 POINTS ON EITHER SIDE OF NEW ONE
C
      CALL VCURSR(ICHAR,XONE,ZONE)
      ZONE=-ZONE
      IF(ICHAR.EQ.0)GO TO 25
      IF(ICHAR.EQ.IQUEST)GO TO 9900
      IF(ICHAR.EQ.IC)GO TO 15
      IF(ICHAR.EQ.IA)GO TO 25
      CALL VCURSR(ICHAR,XNEW,ZNEW)
      ZNEW=-ZNEW
      IF(ICHAR.EQ.0)GO TO 25
      IF(ICHAR.EQ.IQUEST)GO TO 9900
      IF(ICHAR.EQ.IC)GO TO 15
      IF(ICHAR.EQ.IA)GO TO 25
      CALL VCURSR(ICHAR,XTWO,ZTWO)
      ZTWO=-ZTWO
      IF(ICHAR.EQ.0)GO TO 25
      IF(ICHAR.EQ.IQUEST)GO TO 9900
      IF(ICHAR.EQ.IC)GO TO 15
      IF(ICHAR.EQ.IA)GO TO 25
      NUMBER=1
      CALL CHECK(NUMBER,XNEW,ZNEW,IDUPBD,IDUPPT,IRET)
      IF(IRET.EQ.1)GO TO 25
      NCHANG=0
      KOUNT=0
 1720 NUMBER=0
 1723 NUMBER=NUMBER+1
C
C          CHECK THE FIRST OCCURENCE OF POINT ONE
C
      CALL CHECK(NUMBER,XONE,ZONE,IBOD,NPT,IRET)
      IF(IRET)1790,1730,25
 1730 NUM2=0
 1732 NUM2=NUM2+1
 1735 CALL CHECK(NUM2,XTWO,ZTWO,IBOD2,NPT2,IRET)
      IF(IRET)1723,1740,25
 1740 IF(NPT2.NE.(NPT+1))GO TO 1732
      IF(IBOD.NE.IBOD2)GO TO 1732
C
C          THE POINT FOUND IS THE ONE AFTER THE FIRST
C
      CALL INSERT(XNEW,ZNEW,IBOD,NPT,IRET)
      CALL PLBOD(IBOD)
      NCHANG=NCHANG+1
 1790 IF(KOUNT.NE.0)GO TO 1795
C
C          GO THRU ALL LINES IN BOTH DIRECTIONS
C
      KOUNT=1
      SAVER=XONE
      XONE=XTWO
```

```
      XTWO=SAVER


      SAVER=ZONE
      ZONE=ZTWO
      ZTWO=SAVER
      GO TO 1720
C
C          IF NO BODIES WERE INSERTED INTO,ERROR
C
 1795 CALL SAV(NBACK)
      IF(NCHANG.EQ.0)GO TO 25
      GO TO 100
C
C          POINT
C
 1800 CALL SETSCL(2,0)
C
C          ACCEPT CURSOR OF POINT TO BE MOVED
C
      CALL VCURSR(ICHAR,XOLD,ZOLD)
      ZOLD=-ZOLD
      IF(ICHAR.EQ.0)GO TO 25
      IF(ICHAR.EQ.IQUEST)GO TO 9900
      IF(ICHAR.EQ.IC)GO TO 15
      IF(ICHAR.EQ.IA)GO TO 25
C
C          ACCEPT NEW POINT
C
      CALL VCURSR(ICHAR,XNEW,ZNEW)
      ZNEW=-ZNEW
      IF(ICHAR.EQ.0)GO TO 25
      IF(ICHAR.EQ.IQUEST)GO TO 9900
      IF(ICHAR.EQ.IC)GO TO 15
      IF(ICHAR.EQ.IA)GO TO 25
      NUMBER=1
      NCHANG=0
      CALL CHECK(NUMBER,XNEW,ZNEW,IDUPBD,IDUPPT,IRET)
      IF(IRET.EQ.1)GO TO 25
      NUMBER=1
 1827 CALL CHECK(NUMBER,XOLD,ZOLD,IBOD,NPT,IRET)
      IF(IRET)1840,1830,25
C
 1830 IF(IDUPBD.EQ.IBOD.AND.IDUPPT.EQ.NPT)GO TO 25
      CALL SAV(NBACK)
      IANON(IBOD)=0
      NCHANG=NCHANG+1
      X(IBOD,NPT)=XNEW
      Z(IBOD,NPT)=ZNEW
      CALL PLBOD(IBOD)
      GO TO 1827
C
C        FIRST DATA POINT NOT THERE
C
 1840 IF(NCHANG.GT.0)GO TO 100
      GO TO 25
C
C          DRAW
C
 1900 MODE=1
      IBOD=0
      CALL PLBOD(IBOD)
      GO TO 100
C
C          SKETCH
C
```

```
 2000 MODE=2
      IBOD=0
      CALL PLBOD(IBOD)
      GO TO 100
C
C          RECOVER
C
 2100 NRECOV=NRECOV-1
C
C           NRECOV COUNTS HOW FAR BACK TO RECOVER
C           IF(THE RECOVER COMMAND IS REPEATEDLY EXECUTED
C            EACH EXECUTION WILL RECOVER A MORE PREVIOUS MODEL
C
      IRET=NRECOV
      CALL READF(IRET,ISCR)
      IF(IRET.GE.0)GO TO 25
      IBOD=0
      CALL PLBOD(IBOD)
      GO TO 200
C
C
C
C          PARAM
C
 2200 IBOD=NUMB(ICHAR)
      IF(IBOD.LT.0.OR.IBOD.GT.MAXBOD)GO TO 25
      CALL POINTA(6.0,2.5)
      CALL ALPHAN
      CALL PARAM(IBOD)
      CALL SAV(NBACK)
      GO TO 100
C
C
C             MAGNETICS MODE
C
 2300 IF(ITYPE.NE.2)CALL REAN
      ITYPE=2
      CALL PLOBS
      GO TO 100
C
C             GRAVITY MODE
C
 2400 IF(ITYPE.NE.1)CALL REAN
      ITYPE=1
      CALL PLOBS
      GO TO 100
C
C               END RETURN TO WHAT TO DO
C
 9900 CALL ALPHAN
      RETURN
      END
      FUNCTION NUMB(ICHAR)
C.....................................................................
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C
C             CALCULATE BODY NUMBER FOR CHARACTER BODY NUMBER ICHAR
```

```
C           IF BODY IS INVALID NUMB=0

C
      DATA IZERO/48/
      NUMB=ICHAR-IZERO
      IF(NUMB.GT.0.AND.NUMB.LE.MAXBOD)RETURN
      NUMB=0
      RETURN
      END
      SUBROUTINE CHECK(NUMBER,XX,ZZ,IDUPBD,IDUPPT,IRET)
C.....................................................................
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C
C        CHECKS POINTS INPUT TO BODY,IF THIS POINT IS IN APPROX THE
C        SAME PLACE AS ANOTHER IT IS MADE EQUAL TO IT
C        OUT OF RANGE POINTS MAY ALSO BE CHECKED FOR
C
C        THE NUMBER TH DUPLICATE POINT IS CHECKED FOR
C
C
C        XX-X VALUE TO BE CHECKED
C        ZZ-Z VALUE TO BE CHECKED
C        C          RETURN POINT OUT OF RANGE
C               IRET=1
C               IDUPBD=0
C               IDUPPT=0
C
C        POINT DUPLICATED
C               IRET=0
C               IDUPBD=BODYNUMBEROF IDENTICAL POINT
C               IDUPPT=POINT NO. OF IDENTICAL POINT
C
C        POINT UNIQUE
C               IRET=-1
C               IDUPBD=0
C               IDUPPT=0
C
      NUMDUP=0
      DO 100 IDUPBD=1,NBODS
      NPT=NPTS(IDUPBD)
      IF(NPT.LE.0)GO TO 100
      DO 90 IDUPPT=1,NPT
C
      IF(ABS(XX-X(IDUPBD,IDUPPT)).GT.XDIS)GO TO 90
      IF(ABS(ZZ-Z(IDUPBD,IDUPPT)).GT.ZDIS)GO TO 90
C
C        DUPLICATE POINT
C
      NUMDUP=NUMDUP+1
      IF(NUMDUP.LT.NUMBER)GO TO 90
      IRET=0
      XX=X(IDUPBD,IDUPPT)
      ZZ=Z(IDUPBD,IDUPPT)
      RETURN
C
   90 CONTINUE
```

```
  100 CONTINUE


C
C          UNIQUE POINT
C
      IRET=-1
      IDUPBD=0
      IDUPPT=0
      RETURN
C
      END
      FUNCTION COORD(INDEX)
C.....................................................................
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C
C
C          PURPOSE -TO CALCULATE KM DISTANCE OF OBS. INDEX
C
      IF(INDEX.LT.1.OR.INDEX.GT.MAXOBS)GO TO 100
      COORD=XMINS(ITYPE)+SPACE(ITYPE)*(INDEX-1)
      RETURN
C
  100 COORD=0.0
      RETURN
      END
      SUBROUTINE INSERT(XX,ZZ,IBOD,NPT,IRET)
C
C.....................................................................
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C
C
C          PURPOSE TO INSERT POINT(XX,ZZ) IN BODY IBOD AFTER POINT NPT
C
C                    IRET =0      POINT NOT INSERTED
C                         -1      POINT INSETRTED
C
      IRET=0
      IF(IBOD.GT.NBODS)RETURN
      IF(IBOD.LT.1)RETURN
      IF(NPT.GT.NPTS(IBOD))RETURN
      IF(NPTS(IBOD).GE.MAXNPT)RETURN
      IEND=NPTS(IBOD)
      NPT=NPT+1
      NPTS(IBOD)=NPTS(IBOD)+1
      IF(NPT.EQ.NPTS(IBOD))GO TO 100
      L=NPTS(IBOD)
      DO 50 I=NPT,IEND
```

```
      X(IBOD,L)=X(IBOD,L-1)


      Z(IBOD,L)=Z(IBOD,L-1)
      L=L-1
   50 CONTINUE
  100 IANOM(IBOD)=0
      X(IBOD,NPT)=XX
      Z(IBOD,NPT)=ZZ
      IRET=-1
C
C     SET LAST POINT = FIRST JUST TO BE SURE
C
      X(IBOD,IEND+1)=X(IBOD,1)
      Z(IBOD,IEND+1)=Z(IBOD,1)
      RETURN
      END
      SUBROUTINE DELETE(IBOD,NPT,IRET)
C.....................................................................
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C
C
C         PURPOSE TO DELETE POINT NPT FROM BODY IBOD
C
C         IRET=0 POINT NOT DELETED
C         IRET=-1 POINT DELETED
C
      IRET=0
      IF(IBOD.GT.NBODS.OR.IBOD.LT.1)RETURN
      IF(NPT.LT.1.OR.NPT.GT.NPTS(IBOD))RETURN
      IEND=NPTS(IBOD)-1
      NPTS(IBOD)=IEND
      IF(NPT.GE.IEND)GO TO 200
      DO 100 I=NPT,IEND
      II=I+1
      X(IBOD,I)=X(IBOD,II)
      Z(IBOD,I)=Z(IBOD,II)
  100 CONTINUE
  200 IANOM(IBOD)=0
      X(IBOD,IEND)=X(IBOD,1)
      Z(IBOD,IEND)=Z(IBOD,1)
      IRET=-1
      RETURN
      END
      SUBROUTINE ALPHAN
C.....................................................................
C         PURPOSE TO CHANGE TERMINAL FROM GRAPHICS TO ALPHANUMERIC MODE
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
```

```
C
C
      CALL ANMODE
      RETURN
      END
      SUBROUTINE MAG(IBOD)
C.....
C          PURPOSE TO CALCULATE THE MAGNETIC ANOMALY FOR BODY IBOD
C
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,X4INS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C
C
C          SOURCES BIO COMPUTER NOTE 66-1-C APRIL 1966
C                  PROGRAM MAG WRITTEN FOR PDP-11 BY D.HEFFLER,AGC,BIO 19
C                  CDC3150 FORTRAN PROGRAM MAG2NEW,AGC,BIO,197...
      CDIPD=DEGCOS(DIP)
      SDIPD=DEGSIN(DIP)
      SDD=DEGCOS(XTON-DEC)
      CDIP=DEGCOS(BDIP(IBOD))
      SDIP=DEGSIN(BDIP(IBOD))
      SD=DEGCOS(XTON-BDEC(IBOD))
C
C          CHECK EACH FIELD POINT
C
      NF=NFIELD(ITYPE)
      DO 3100 K=1,NF
      PTOT=0.
      QTOT=0.
      X1=X(IBOD,1)-COORD(K)
      Z1=Z(IBOD,1)-ZCON
C
C
      IF(X1)300,400,380
  300 IF(Z1.GE.0)GO TO 375
      THETA=ATAN(Z1/X1)-PI
      GO TO 600
C
  375 THETA=ATAN(Z1/X1)+PI
      GO TO 600
C
  380 THETA=ATAN(Z1/X1)
      GO TO 600
C
  400 IF(Z1)420,430,450
  420 THETA=-PI/2.
      GO TO 600
C
  430 THETA=0.0
      GO TO 600
C
  450 THETA=PI/2.
C
  600 NPT=NPTS(IBOD)
      DO 3000J=2,NPT
      X2=X(IBOD,J)-COORD(K)
      Z2=Z(IBOD,J)-ZCON
C
```

```
C         IF 2 POINTS THE SAME CHECK THE POINT AFTER

C
      IF(X1.EQ.X2.AND.Z1.EQ.Z2)GO TO 3000
      IF(X2)1100,1400,1800
 1100 IF(Z2.GE.0)GO TO 1300
C
      THETB=ATAN(Z2/X2)-PI
      GO TO 1900
C
 1300 THETB=ATAN(Z2/X2)+PI
      GO TO 1900
C
 1400 IF(Z2)1500,1600,1700
 1500 THETB=-PI/2.
      GO TO 1900
C
 1600 THETB=0.
      GO TO 1900
C
 1700 THETB=PI/2.
      GO TO 1900
C
 1800 THETB=ATAN(Z2/X2)
C
 1900 OMEGA=THETA-THETB
      IF(OMEGA.LT.0.)GO TO 2300
      IF(OMEGA.GT.PI)GO TO 2700
C
      THETD=OMEGA
      GO TO 2800
C
 2300 IF((OMEGA+PI).LT.0.)GO TO 2500
      THETD=OMEGA
      GO TO 2800
C
 2500 IF(OMEGA.GE.0.)GO TO 2700
      THETD=OMEGA+2.*PI
      GO TO 2800
C
 2700 THETD=OMEGA-2.*PI
C
 2800 X12=X1-X2
      Z21=Z2-Z1
      XSQ=X12*X12
      ZSQ=Z21*Z21
      XZ=Z21*X12
       SUM=XSQ+ZSQ
       DIV=X1*X1+Z1*Z1
C
C   IF BOTTOM IS GOING TO BE ZERO,SET EQUAL TO 1/100 TH
C            OF AN INTERVAL
      RPROD=X2*X2+Z2*Z2
C
C       TOP AND BOTTOM OF LOG >0. SINCEZCON NOT=0.
C
C
      IF(RPROD.EQ.0.)GO TO 9999
      IF(DIV.EQ.0.)GO TO 9999
C
      GL=.5*ALOG(RPROD/DIV)
      PCONS=(THETD*ZSQ+GL*XZ)/SUM
      QCONS=(THETD*XZ-GL*ZSQ)/SUM
C
      PTOT=PTOT+PCONS
```

```
      QTOT=QTOT+QCONS

C
      X1=X2
      Z1=Z2
      THETA=THETB
 3000 CONTINUE
C
C
C
      H=2.*BMAG(IBOD)*((CDIP*SD*PTOT)+(SDIP*QTOT))
      V=2.*BMAG(IBOD)*((CDIP*SD*QTOT)-(SDIP*PTOT))
      CALC(IBOD,K)=H*CDIPD*SDD+V*SDIPD
 3100 CONTINUE
C
      RETURN
C
C     ERROR
C
 9999 IF(ISCOPE.EQ.1)CALL BELL
      IF(ISCOPE.EQ.1)CALL ANMODE
      WRITE(IPR,9998)IBOD,K
 9998  FORMAT(" BODY ",I3," POINT ",I3/
     X" CANNOT BE CALCULATED WITH PRESENT ALGORITHM"/
     X" VALUE OUT OF RANGE "/
     X" ANOMALY SET TO ZERO"
     X/"USE GRAV OR MAGN COMMAND TO SET A LARGER ZCON VALUE")
      DO 9997 K=1,NF
 9997 CALC(IBOD,K)=0.0
      IANOM(IBOD)=0
      RETURN
      END
      SUBROUTINE GRAVC(IBOD)
C.....................................................................
C          PURPOSE-TO CALCULATE THE GRAVITATIONAL ANOMALY FOR BODY IBOD
C
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C
C          REFERENCES BIO COMPUTER NOTE 66-2-C APRIL 1966 GRAVITATIONAL
C                      EFFECTS OF 2 DIMENSIONAL STRUCTURES
C                     PROGRAM GRAV D.HEFFLER FOR PDP-11
C                     PROGRAM GR2D RUNNING ON CDC3150
C
      DATA FACTOR/1000./
C
      NPT1=NPTS(IBOD)-1
      NF=NFIELD(ITYPE)
      DO 10 K=1,NF
   10 CALC(IBOD,K)=0.
      IF(RHO(IBOD).EQ.0.)RETURN
C                        ==========
C
      NF=NFIELD(ITYPE)
      DO 1000 K=1,NF
C
      SUM=0.
```

```
      DIST=COORD(K)


C
      DO 900 J=1,NPT1
C
C         LEFT JUSTIFY MODEL
C
      XJ=(X(IBOD,J)-DIST)*FACTOR
      XJ1=(X(IBOD,J+1)-DIST)*FACTOR
      ZJ=(Z(IBOD,J)*FACTOR)
      ZJ1=(Z(IBOD,J+1)*FACTOR)
C
      C=XJ1*ZJ-XJ*ZJ1
      IF(C.EQ.0.)GO TO 900
C
      DX=XJ1-XJ
      DZ=ZJ1-ZJ
C
      A=C/(DX*DX+DZ*DZ)
      ALN=(XJ1*XJ1+ZJ1*ZJ1)/(XJ*XJ+ZJ*ZJ)
C
      IF(ZJ1.NE.0.)GO TO 750
      ARC2=PI/2.
      IF(XJ1.LT.0.)ARC2=-PI/2.
      GO TO 770
C
  750 ARC2=ATAN(XJ1/ZJ1)
C
  770 IF(ZJ.NE.0.0)GO TO 780
      ARC1=PI/2.
      IF(XJ.LT.0.)ARC1=-PI/2.
      GO TO 790
C
  780 ARC1=ATAN(XJ/ZJ)
C
  790 ARCTAN=ARC2-ARC1
      DELG=-(0.01334)*RHO(IBOD)*A*(.5*DZ*ALOG(ALN)+DX*ARCTAN)
  800 SUM=SUM+DELG
C
  900 CONTINUE
      CALC(IBOD,K)=SUM
C
 1000 CONTINUE
      RETURN
      END
      FUNCTION DEGSIN(DEGREE)
C.....................................................................
C         PURPOSE -TO CALCULATE THE SINE OF DEGREE IN DEGREES
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),NODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XOIS,ZOIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C
      RADIAN=(PI/180.)*DEGREE
      DEGSIN=SIN(RADIAN)
      RETURN
      END
      FUNCTION DEGCOS(DEGREE)
C         PURPOSE TO CALCULATE THE COSINE OF DEGREE DEGREES
```

```
C
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C
      RADIAN=(PI/180.)*DEGREE
      DEGCOS=COS(RADIAN)
      RETURN
      END
      SUBROUTINE PARAM(IBOD)
C.....
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C
C
C         PURPOSE TO INPUT PARAMETERS FOR GRAVITY OR MAGNETICS BODY
C         PARAMETERS ARE READ FOR BODY IBOD
C         IF IBOD =0, VALUES ARE ADDED TO ALL BODIES
C
      IF(IBOD.EQ.0)GO TO 1380
      IANOM(IBOD)=0
      IF(ITYPE.EQ.1)GO TO 1360
C
C         MAGNETICS
C
      READ(ITTY,*)ANS1,ANS2,ANS3
      IF(EOF(ITTY).NE.0)RETURN
      BMAG(IBOD)=ANS1
      BDEC(IBOD)=AMOD(ANS2,360.)
      IF(BDEC(IBOD).LT.0.)BDEC(IBOD)=BDEC(IBOD)+360.
      BDIP(IBOD)=AMOD(ANS3,360.)
      IF(BDIP(IBOD).LT.0.)BDIP(IBOD)=BDIP(IBOD)+360.
      RETURN
C
C         GRAVITY
C
 1360 READ(ITTY,*)ANS
      IF(EOF(ITTY).EQ.0)RHO(IBOD)=ANS
      RETURN
C
C         BODY NUMBER = 0 ADD THIS VALUE TO ALL BODIES
C
 1380 DO1385 I=1,NBODS
      IANOM(I)=0
 1385 CONTINUE
      IF(ITYPE.EQ.1)GO TO 1390
C
C         MAGNETICS
C
```

```
      READ(ITTY,*)DBXOR,DBDEC,DBDIP


      IF(EOF(ITTY).NE.0)RETURN
      DO 1387 I=1,NBODS
      BMAG(I)=BMAG(I)+DBXOR
C
C
      BDEC(I)=BDEC(I)+DBDEC
      BDEC(I)=AMOD(BDEC(I),360.)
      IF(BDEC(I).LT.0.)BDEC(I)=BDEC(I)+360.
      BDIP(I)=BDIP(I)+DBDIP
      BDIP(I)=AMOD(BDIP(I),360.)
      IF(BDIP(I).LT.0.)BDIP(I)=BDIP(I)+360.
 1387 CONTINUE
      RETURN
C
C          GRAVITY
C
 1390 READ(ITTY,*)DRHO
      IF(EOF(ITTY).NE.0)RETURN
      DO 1395 I=1,NBODS
      RHO(I)=RHO(I)+DRHO
 1395 CONTINUE
      RETURN
      END
      SUBROUTINE TSCA
C*************************************************************
C
C        TYPES SCALE ETC
C
      COMMON NAME,ITYPE,BDIP(30),NFIELD(2),ANOMAX(2),ANOMIN(2)
      COMMON KOMMNT(15),XMAX,ZMAX,XMINS(2),SPACE(2)
      COMMON XTON,DEC,DIP,ZCON,ISCOPE,NBACK,NBODS,ICROSS
      COMMON X(30,25),Z(30,25),NPTS(30),RHO(30),BMAG(30),BDEC(30)
      COMMON OBS(2,100),XMAXS(2),IANOM(30),MODE
      COMMON SKXMAX,SKXMIN,SKZMAX,SKZMIN,KEND,CALC(31,100)
C
C
      COMMON PI,NTYPES,XDIS,ZDIS,IX(101),LNGIX,LNGMOD,OFFSET(2)
      COMMON MODEL,MAXNPT,MAXBOD,MAXOBS,MAXCAL,IHELP,ISCR,ITTY,IPR
C
      IF(ITYPE.EQ.1)WRITE(IPR,10)
   10 FORMAT(8H GRAVITY)
      IF(ITYPE.EQ.2)WRITE(IPR,20)
   20 FORMAT(10H MAGNETICS)
      WRITE(IPR,50)NAME
      WRITE(IPR,46)KOMMNT
   46 FORMAT(10H COMMENTS /15A10)
   50 FORMAT(7H MODEL=,A10)
      WRITE(IPR,100)XMAX,ZMAX,XMINS(ITYPE),SPACE(ITYPE),
     X          NFIELD(ITYPE),ANOMIN(ITYPE),ANOMAX(ITYPE)
     X          ,OFFSET(ITYPE)
  100 FORMAT(9H X SCALE=,F11.2/9H Z SCALE=,F11.2  /
     $,7H XDISP=  ,F13.2
     $/14H POINT SPACING,F6.2/15H NO. OF POINTS ,15/9H ANOM MIN   ,
     $F12.2/9H ANOM MAX,F12.2/11H OBS OFFSET ,F10.2)
      WRITE(IPR,200)NBODS
  200 FORMAT(18H NUMBER OF BODIES= ,I2)
      IF(ITYPE.EQ.2)WRITE(IPR,210)DEC,DIP,XTON
      WRITE(IPR,211)ZCON
  210 FORMAT(8X,4HDEC=,F8.2,8X,4HDIP=,F8.2/
     X13H X TO N ANGLE,F6.2)
  211    FORMAT(8X," ZCON=",F8.2)
      IF(ISCOPE.EQ.2)WRITE(IPR,215)
  215  FORMAT(24H SCOPE OUTPUT SUPPRESSED)
```

```
      IF(MODE.EQ.2)WRITE(IPR,225)
  225  FORMAT(12H SKETCH MODE)
      IF(MODE.EQ.1)WRITE(IPR,226)
  226  FORMAT(10H DRAW MODE)
      WRITE(IPR,227)SKXMIN,SKXMAX,SKZMIN,SKZMAX
  227 FORMAT(15HSKETCH LIMITS X,2F10.2/
     X       13X,          2H Z,2F10.2)
C
      NPT1=MAXNPT-1
      WRITE(IPR,300)NPT1,MAXBOD,MAXOBS
  300 FORMAT(14H MAX PTS/BODY=,I10/
     X,14HMAX NO.BODIES=,I10/
     X11HMAX NO.OBS=,I13)
      RETURN
      END


09.01.28.UCLP, 54,      3.136 KLNS.
```