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GRAVANOM SOFTWARE
USER'S GUIDE

Final Report
July 1998

By
Bijon Sharma

March 1999

Performed Under Contract No. DE-AC22-94PC91008
(Original Report Number NIPER/BDM-0349)

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Gravanom Software
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Work Performed Under Contract DE-AC22-94PC91008
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TABLE OF CONTENTS

1.0	INTRODUCTION	1
1.1	Putting Gravity Modeling into More Hands.....	1
1.2	The Source of Gravity Anomalies.....	1
1.3	What Gravanom Can Do.....	2
1.4	Enhancements Planned.....	4
2.0	GETTING STARTED.....	5
2.1	System Requirements.....	5
2.2	Other Requirements	5
2.3	How to Install the Program	5
2.4	Technical Support Information.....	6
3.0	HOW TO USE GRAVANOM.....	7
3.1	How to Prepare Input Data for Gravanom.....	7
3.2	How to Run the Gravanom Program.....	9
3.3	How to Calculate Gravitational Anomalies of a Rectangular Body with Gravanom	10
3.4	How to Calculate the Gravity Anomaly of a Cylindrical Body	13
3.5	How to Calculate the Gravity Anomaly of a Sedimentary Structure.....	17

APPENDIX

GRAVANOM DATA.....	19
A Input File for Modeling a Sedimentary Structure	19
B Output File for a Sedimentary Structure	25

FIGURES

1-1	A 2-D sedimentary section along profile A-B.....	2
1-2	Gravity modeling of the geologic structure along profile A-B. Top, curves plotted from Gravanom-calculated data and measured gravity data. Bottom, six polygons are used to define the sedimentary beds (I, II, etc.).....	3
3-1	A rectangular body for computing gravitational anomalies.....	10
3-2	A cylindrical body for computing gravitational anomalies.....	14
3-3	Gravitational anomaly curves for theoretical and computed anomalies of a cylindrical body.....	15
3-4	A section from a sedimentary structure consisting of six distinct beds.....	17
3-5	The Gravanom-calculated gravity anomaly of the sedimentary structure with six beds (the output file was imported into a spreadsheet program, such as Excel, Lotus 1-2-3, or Quattro Pro, and plotted)	18

1.0 INTRODUCTION

1.1 PUTTING GRAVITY MODELING INTO MORE HANDS

In recent years, the oil and gas industry has seen increased use of high-speed computers to model high-resolution gravity data to resolve structural uncertainties and target areas for detailed exploration in sparsely drilled parts of a basin. Seeing the value of this technology, the National Petroleum Technology Office (NPTO) of the U.S. Department of Energy (DOE) commissioned a free software package to make gravitational imaging of two-dimensional (2-D) geological structures available to more operators working on exploration and field development.

Gravanom provides you with a simple, handy tool for modeling gravity data from 2-D geological structures on a personal computer. The software program offers you a:

- Means to model and refine your interpretation of inexpensive gravity data to target more precisely the areas to undertake costly seismic studies

Gravity data cost only a small fraction of the cost of acquiring high-resolution seismic data. The data often are available for a small price to the public from U.S. Geological Survey (USGS), state geological surveys, universities, private companies, and other institutions.

- Tool for structural and tectonic studies of areas with noisy or ambiguous seismic data caused by large-scale intrusives, salt domes, and other complex geological structures

Gravity data provide a much-needed independent source of information for confirmation or rejection of an interpretation by another method, such as seismic.

This manual provides instructions for Gravanom. The program was developed at BDM Petroleum Technologies by BDM-Oklahoma, Inc. for DOE, under contract No. DE-AC22-94PC91008.

1.2 THE SOURCE OF GRAVITY ANOMALIES

Gravity anomalies arise from horizontal and vertical variations in the density of subsurface rock formations. The gravity anomaly causes the gravity readings measured by a gravimeter to vary along the earth's surface. Gravity readings are taken in units called milligals (mgal). A gal, named after Galileo, is one cm/sec^2 . (The average acceleration on the earth's surface is about 980 gals.)

The density of each type of rock stems from its grain density, porosity, and the nature of the fluid in the pore spaces. Density readings may range from a low of 1.0 gm/cm^3 for diatomite to 3.0 gm/cm^3 for basic igneous rocks. Younger shales and unconsolidated sands tend to have densities from 1.7 gm/cm^3 to 2.2 gm/cm^3 . Older shales and compact sands tend to have densities from 2.5 gm/cm^3 to 2.6 gm/cm^3 . Heavy limestones may have densities around 2.7 gm/cm^3 .

1.3 WHAT GRAVANOM CAN DO

Gravanom is a computer program for modeling gravity data over 2-D structures. The program computes the gravity anomalies across 2-D structures (models) to allow you to compare observed and computed gravity data across the model structure. If a match between the computed and the observed gravity values is unsatisfactory, you construct a new model and rerun Gravanom to recalculate gravity values. In this way, you can continue calculations until you obtain a satisfactory match between the observed and the calculated values.

For example, Figure 1-1 shows the map of the Black Mesa Basin in northeast Arizona. The line AB across the basin in this figure represents a line on the surface, and a geological section along this line could be modeled with the help of Gravanom.

Figure 1-1 A 2-D sedimentary section along profile A-B

The variations of gravity anomaly along AB can be modeled by variations in geological structures along AB (see Fig. 1-2). In this manner, structural and tectonic information at different places in the basin may be obtained with the help of Gravanom.

Figure 1-2 Gravity modeling of the geologic structure along profile A-B. Top, curves plotted from Gravanom-calculated data and measured gravity data. Bottom, six polygons are used to define the sedimentary beds (I, II, etc.); seven polygons are used to represent the intrusive structures.

Using your knowledge of geology, gravity methods of exploration, and data from well logs, cores, and other sources, you first construct a polygon to represent the gravity effect of each geological bed. You specify the boundaries of the polygon using x, z coordinates (calculated from a point of origin located on the surface of the earth) and save these data in an input file. (You may construct the polygon with as many points as needed in order to accurately describe the geological structure, which can have a very irregular shape.)

Then the program calculates the combined gravity anomalies of all the beds and prints the gravity anomaly values at a set interval (say, every two kilometers or whatever matches the observed intervals) between points A and B along the earth's surface. You can then compare the Gravanom calculated result with the observed gravity anomaly (Fig. 1-2, top), and refine your polygon models (Fig. 1-2, bottom) until there is a good match.

The computations are based on the technique given by Talwani et. al in a paper entitled "Rapid Gravity Computations for Two-Dimensional Bodies with Application to the Mendocino Submarine Fracture Zone" (from the *Journal of Geophysical Research*, 1959, vol. 64: pages 49-59).

1.4   ENHANCEMENTS PLANNED

Enhancements to the software are planned for the future to increase user friendliness, such as by automating the input of data points using a digitizing tablet. Among the enhancements contemplated is 3-D modeling of structures, which will be useful for particular geological situations. As the accuracy of collecting gravity data increases with better instrumentation, enhancements to the interpretive software to extract useful information from these data also will follow. Please check the NPTO Web site at <http://www.npto.doe.gov> for news on updates to this and other software packages.

2.0 GETTING STARTED

2.1 SYSTEM REQUIREMENTS

Check that your personal computer meets these minimum system and software requirements:

- ◆ Personal computer with a 386 or more advanced processor running DOS 4.0 or more advanced DOS/Windows operating system
- ◆ 8 MB of memory (16 MB or more preferred)
- ◆ 20 MB of available hard-disk space for data storage and modeling (requirements vary with the complexity of the model)
- ◆ Gravanom.exe (the executable program)

2.2 OTHER REQUIREMENTS

You also will need the following:

- ◆ Reliable observed data—gravity data measured or interpolated in milligals—along a straight line perpendicular to the strike of the geological structure that you wish to model. The source of these data may be the U.S. Geological Survey, state geological surveys, universities, or other sources.
- ◆ Graph paper for manual input or a digitizing tablet to automate the input of x and z coordinates of the polygons that approximate the geological structures
- ◆ Knowledge of structural geology and some understanding of the gravity method of exploration
- ◆ Information on subsurface density variations. This information may be obtained from core or drill cuttings, interpretations of wireline logs, or borehole gravity investigations.

2.3 HOW TO INSTALL THE PROGRAM

Follow these steps to install the software:

1. Verify that there is adequate space (20 MB of available hard-disk space per model) on the drive to which you are trying to install the software.
2. Insert the disk containing Gravanom.exe (the executable program) into your computer's diskette drive.
3. Follow these steps to install the software using DOS from disk:

- a. Create the directory you wish to store the program in. For example, type the following to create the **gravy** subdirectory on the **c:** drive:
md c:\gravy <Enter>
- b. Change to the floppy drive containing the disk. For example to change to the a: drive, type:
a:<Enter>
- c. Copy all files from the floppy diskette to your hard drive. For example, to change to the **c:** drive, **gravy** subdirectory, type at the DOS prompt:
Copy *.* c:\gravy <Enter>

NOTES:

Users can change the directory name to whatever is convenient.

Now go to Section 3.1 for detailed instructions on how to prepare the input files.

2.4 TECHNICAL SUPPORT INFORMATION

If you have any general questions or comments about the Gravanom software, please contact Rhonda Lindsey (e-mail: rlindsey@npto.doe.gov, phone: 918-699-2037, fax: 918-699-2005) of the U.S. DOE.

If you have followed all the steps in this user's guide but still have problems or questions on how to use the program, please contact Bijon Sharma of the Geology staff (e-mail: bsharma@bdm.com, phone: 918-338-4471, fax: 918-338-4561). When you call, fax, or send e-mail, please include answers to the following questions:

- ◆ Which version of the software you are using?
- ◆ Can you supply a brief and concise explanation of the question or problem that you are experiencing?
- ◆ What actions have you taken to correct the problem(s)?
- ◆ What is your phone number and time zone, fax number, and/or e-mail address?

A copy of the source code for Gravanom is available upon request from the National Petroleum Technology Office, U.S. Department of Energy, and from Robert Welch, director of Information Management, BDM Petroleum Technologies (e-mail: rwelch@bdm.com, phone: 918-338-4498, fax: 918-338-4543).

3.0 HOW TO USE GRAVANOM

3.1 HOW TO PREPARE INPUT DATA FOR GRAVANOM

The input file for Gravanom is an ASCII data file. You can construct and then save your input file with any standard editing program. The data in the file will be read sequentially by the program, so all data must be supplied in an exact order for the calculation to be meaningful. Each piece of datum must be isolated by one or more spaces (represented in the following paragraphs by a gap). Follow this structure:

First Data Line

number of beds (NB),   number of points for calculation (NN),   calculation interval
in kilometers (CI),   regional correction (GREG)

NOTES: The numbers for NB and NN are whole numbers, but CI and GREG are used in floating point calculations and must include a decimal point. The number for GREG may be positive, negative, or zero, and its unit is milligals. When GREG is used, it makes an adjustment uniformly across all intervals to compensate for special regional gravity effects. Please note that negative CI indicates points of calculation in the increasing x direction.

EXAMPLE:

3 30 1. 0.

This line states that the geological model has 3 beds, there are 30 points at which gravitational attraction are to be calculated, the interval of calculation is every kilometer, and the calculation points are in the negative x direction from the origin. Also, there is no regional correction across all intervals.

EXAMPLE:

12 90 -2. 295.

This line states that there are 12 beds in the model, there are 90 points of calculation, the interval is every 2 kilometers in the positive x direction, and there is a regional correction (across all intervals) of 295 milligals.

Second Data Line (First Bed)

number of points (vertices) in the polygon describing the first bed (NC) plus 1,
density of this bed in gm/cm³ (DENS)

NOTES: The number for NC is specified as a whole number. The number one is added because the first point in the polygon and the last point in the polygon are specified

separately, even though they happen to be same point. The number for DENS is used in a floating point calculation and must include a decimal point.

EXAMPLE:

8 1.75

This line states that there are 7 points (vertices) on the polygon whose anomaly is to be calculated, and the density of the polygon is 1.75 grams/cm³.

EXAMPLE:

50 2.35

This line states that there are 49 points (vertices) on the polygon, and the density of the first bed is 2.35 grams/cm³.

Coordinate Lines (First Bed)

x and z coordinates of the first vertex of the first polygon are input in kilometers (km), then repeat x and z for all the vertices in the polygon, clockwise

NOTES: List the coordinates of the polygon in a clockwise direction, starting at a point closest to 0,0 and remember to close the polygon by listing the last coordinate. Therefore, a five-sided polygon will have six sets of x, z values, the first and the sixth set being the same. (These coordinates may be input in a two-column list of coordinate pairs, or in a row format with an unbroken row of x z x z x z, etc.)

EXAMPLE:

30. 2.5

50. 2.5

50. 2.7

30. 2.7

30. 2.5

These lines say that there are 4 points (vertices) on the first polygon.

Subsequent Beds (for Additional Polygons)

The data lines for each additional bed are in exactly the same format as for the first bed. For each additional bed, specify another:

- "Second Data Line" to specify the number of points in that bed (polygon) and the density
- "Coordinate Lines" to specify the x, z coordinates of that polygon

EXAMPLE:

6 .55
20. 1.5
40. 1.5
40. 1.7
30. 1.9
20. 1.7
20. 1.5

These seven lines states that there are 6 points (vertices) on the polygon (five-sided) to be calculated, the density of the first bed is 0.55 grams/cm³, and the 6 coordinates (x, z) of the points (vertices) on the polygon are 20. 1.5, 40. 1.5, 40. 1.7, 30. 1.9, 20. 1.7, and 20. 1.5.

Once you have created the input file, you will be ready to run the Gravanom program for the modeling calculations. Please note that Section 3.2 describes how to run the Gravanom program, and subsequent sections in this chapter contain step-by-step examples of simple and also increasingly complex and realistic modeling.

3.2 HOW TO RUN THE GRAVANOM PROGRAM

Once Gravanom.exe has been installed in the **gravy** subdirectory (described in Section 2.3), you are ready to run Gravanom.

1. To run Gravanom, go to the **gravy** subdirectory and type at the DOS prompt:
Gravanom <Enter>

NOTE: The screen will prompt: **enter input file name**

2. Type in the name of the input file and press **<Enter>**.

NOTE: The screen will prompt: **enter output file name**

3. Type in the name of the output file and press **<Enter>**.

NOTE: The resulting output file first lists the input data, followed by the calculated output data. The output data calculated from your polygon model list NN numbers of points and the calculated gravity reading at each of those NN points.

3.3 HOW TO CALCULATE GRAVITATIONAL ANOMALIES OF A RECTANGULAR BODY WITH GRAVANOM

The following examples show how to compute the gravity anomalies of **Rectangular Body ABCD** step by step with the help of Gravanom.

The gravity anomaly of a simple rectangular body with vertices A, B, C, and D (see Fig. 3-1) will be calculated. Geologically, a rectangular body may represent a horizontal intrusive mass that has a density that contrasts with that of surrounding beds. This body is assumed to have a density contrast of 0.5 gm/cm^3 . That is, say, the surrounding rocks have a density of 2.3 gm/cm^3 , and the intrusive mass has a density of 2.8 gm/cm^3 .

Figure 3-1 A rectangular body for computing gravitational anomalies

Use the following parameters for the input data file (parameters are annotated here in parentheses):

1 60 -1. 0.	(NB or number of beds = 1, NN or total number of points of calculations on the surface = 60, CI or interval of calculations = -1 km, and the calculation will be performed in the positive x direction from the origin, GREG or regional correction = 0.)
5 .5	(NC = number of sides of the polygon +1 = 5, DENS = density of a body or contrast in density of body with the surrounding rock mass = 0.5 gm/cm^3 , x and z coordinates of the polygon describing the rectangular body are then input in the clockwise direction.)

20. 1.5   (Coordinates of points A, B, C, D, and A again to close the polygon.)
40. 1.5
40. 1.7
20. 1.7
20. 1.5

In this example, let us call the input file **Trial1.in**, and its actual contents would be as follows:

1 60 -1. 0
5 .5
20. 1.5
40. 1.5
40. 1.7
20. 1.7
20. 1.5

NOTE: Although the polygon has 4 corners, it will have 5 x, z pairs of coordinates because the polygon has to be closed, and therefore the first and last coordinates are the same.

In this example, **Gravanom** is loaded in the **C:** directory.

1. At the **C:** prompt, we type:
Gravanom<Enter>
2. Gravanom will ask for the input file name, so we type:
Trial1.in<Enter>
3. Gravanom will then ask for the output file name, so we type:
Trial1.out<Enter>

The Gravanom program will perform calculations and put the calculated values in **Trial1.out**.

The output file, **Trial1.out**, would list the input information followed by the calculated output information. The output data listed in the first line are NB, NN, CI. The output data listed in the second line are NC+1, DENS. The third line lists the x, z coordinates of the vertices of the first polygon sequentially (i.e., in rows). If more than one polygon are being calculated, the third and subsequent lines are repeated for each polygon.

Following the line "GRAVITY ANOMALY IN MILLIGALS," the output data list (in the first column) the NN points where calculations are performed by Gravanom. The computed gravity values corresponding to each NN values are shown in the second column.

1 60 -1. 0

5 .5

20. 1.5 40. 1.5 40. 1.7 20. 1.7

20.00 40.00 40.00 20.00 20.00 1.50 1.50 1.70

1.70 1.50

GRAVITY ANOMALY IN MILLIGALS

0.000 0.053

1.000 0.057

2.000 0.062

3.000 0.068

4.000 0.074

5.000 0.081

6.000 0.089

7.000 0.099

8.000 0.110

9.000 0.124

10.000 0.141

11.000 0.161

12.000 0.187

13.000 0.221

14.000 0.266

15.000 0.328

16.000 0.429

17.000 0.562

18.000 0.804

19.000 1.250

20.000 1.993

21.000 2.734

22.000 3.178

23.000 3.417

24.000 3.555

25.000 3.640

26.000 3.695

27.000 3.730

28.000 3.752

29.000 3.764

30.000 3.768

31.000 3.763

32.000 3.749

33.000 3.725

34.000 3.688

35.000 3.632

36.000 3.546

37.000 3.407

38.000	3.167
39.000	2.724
40.000	1.985
41.000	1.246
42.000	0.802
43.000	0.560
44.000	0.418
45.000	0.327
46.000	0.265
47.000	0.221
48.000	0.187
49.000	0.161
50.000	0.140
51.000	0.124
52.000	0.110
53.000	0.099
54.000	0.089
55.000	0.081
56.000	0.074
57.000	0.067
58.000	0.062
59.000	0.057

3.4 HOW TO CALCULATE THE GRAVITY ANOMALY OF A CYLINDRICAL BODY

The gravity anomaly of a horizontal cylindrical body will be calculated next. Geologically, such a body may represent a buried horizontal pipe, tunnel (presenting a negative gravity anomaly), or other intrusive mass having a density in contrast with its surroundings. In this example, the body is assumed to have a density contrast of 0.5 gm/cm³ (i.e., if the surrounding rocks have a density of 2.5 gm/cm³, the intrusive mass has a density of 2.8 gm/cm³).

For Gravanom computations, a cross section of the horizontal cylinder may be approximated by an n-sided polygon. In Figure 3-2, the cylinder is approximated by a 9-sided polygon. The x and z coordinates of the 10 vertices of the 9-sided polygon (A, B, C, D, E, F, G, H, I, A) are computed using graph paper or a digitizing tablet.

As a double-check of the program, the exact gravity anomaly of a horizontal cylinder also can be computed from this theoretical formula:

$$G_z = 41.896 \frac{\rho R^2}{z} \left[1 + \left(\frac{x}{z} \right)^2 \right]^{-1}$$

Figure 3-2 A cylindrical body for computing gravitational anomalies

Select the following parameters for the input file:

First Data Line

NB = number of beds = 1

NN = total number of points of calculations on the surface = 70

CI = interval of calculations in km (at what intervals are calculations made) = -1.0

GREG = regional correction, if any = 0.

Second Data Line

NC = number of sides of the polygon +1 = 10

DENS = density of a body or contrast in density of body with the surrounding rock mass = 0.3 gm/cm³

Coordinates Lines

x and z coordinates of the polygon describing the cylinder are then input in the clockwise direction with the last coordinates repeating the first:

x and z coordinates of point A = 30. 12.1

x and z coordinates of point B = 38. 11.2

x and z coordinates of point C = 42.5 15

x and z coordinates of point D = 43.9 19.8

x and z coordinates of point E = 42.7 24.1

x and z coordinates of point F = 37.5 28

x and z coordinates of point G = 32. 27.6

x and z coordinates of point H = 27.2 24

x and z coordinates of point I = 26.5 17.5

x and z coordinates of point J = 30. 12.1

In this example, the input file is called **cylinder.in**, and its contents would be as follows:

```
1 70 -1.0 0.  
10 .30  
30. 12.1  
38. 11.2  
42.5 15.  
43.9 19.8  
42.7 24.1  
37.5 28.  
32. 27.6  
27.2 24.  
26.5 17.5  
30. 12.1
```

The theoretical and the computed gravity anomalies across a horizontal cylinder are compared in Figure 3-3 over the cross section of the cylinder. By taking a larger number of sides, the Gravanom calculations may be made to approach the theoretical values as closely as desired. By taking, say, 30 sides, the polygon would approximate the horizontal cylinder much better, and the computed anomaly would be much closer to the theoretical anomaly.

Figure 3-3 Gravitational anomaly curves for theoretical and computed anomalies of a cylindrical body

In this example, **Gravanom** is loaded in the **C:** directory.

1. At the **C:** prompt, we type:
Gravanom
2. Gravanom will ask for the input file name, so we type:
cylinder.in
3. Gravanom will then ask for the output file name, so we type:
cylinder.out

The Gravanom program will perform calculations and put the calculated values in **cylinder.out**.

The contents of the output file, **cylinder.out**, consist of the contents of the input file (as discussed in the case of the rectangular body) plus the following computed gravity values (listed here in three parallel columns to save space):

GRAVITY ANOMALY IN MILLIGALS

0.	10.923	24.000	34.792	48.000	32.019
1.000	11.412	25.000	36.300	49.000	30.537
2.000	11.931	26.000	37.782	50.000	29.090
3.000	12.482	27.000	39.213	51.000	27.686
4.000	13.066	28.000	40.569	52.000	26.333
5.000	13.687	29.000	41.822	53.000	25.034
6.000	14.346	30.000	42.946	54.000	23.793
7.000	15.046	31.000	43.913	55.000	22.611
8.000	15.789	32.000	44.699	56.000	21.488
9.000	16.578	33.000	45.283	57.000	20.424
10.000	17.416	34.000	45.649	58.000	19.417
11.000	18.305	35.000	45.786	59.000	18.466
12.000	19.247	36.000	45.689	60.000	17.568
13.000	20.245	37.000	45.362	61.000	16.722
14.000	21.300	38.000	44.813	62.000	15.925
15.000	22.414	39.000	44.058	63.000	15.174
16.000	23.587	40.000	43.117	64.000	14.467
17.000	24.819	41.000	42.015	65.000	13.801
18.000	26.110	42.000	40.780	66.000	13.174
19.000	27.456	43.000	39.437	67.000	12.583
20.000	28.853	44.000	38.016	68.000	12.027
21.000	30.296	45.000	36.541	69.000	11.503
22.000	31.774	46.000	35.037		
23.000	33.278	47.000	33.524		

3.5 HOW TO CALCULATE THE GRAVITY ANOMALY OF A SEDIMENTARY STRUCTURE

The computation of gravity anomalies across 2-D sedimentary structures that are more relevant to oil and gas exploration will now be illustrated. A structural section along profile AB across a 2-D sedimentary structure is shown in Figure 3-4. The structural section is made up of six different beds, each having a distinct density and structural configuration.

Figure 3-4 A section from a sedimentary structure consisting of six distinct beds

The x and z coordinates of the six beds are obtained using either graph paper or a digitizing tablet. Select the following parameters for the input file (and then run the program):

First Data Line

NB = number of beds = 6

NN = total number of points of calculations on the surface = 94

CI = interval of calculations in km (i.e., at what intervals are calculations made) = -2.0

GREG = regional correction, if any = 0.

Second Data Line (First Bed)

NC = number of sides (75) of the polygon for bed 1 plus 1 = 76

DENS = density of bed 1 or contrast in density of bed 1 with the surrounding rock mass = 2.35 gm/cm^3

Coordinates Lines (First Bed)

x and z coordinates of the polygon describing the first bed are then input in the clockwise direction with the last coordinates repeating the first

Subsequent Beds

Repeats the second data line and coordinate lines for each remaining bed

The complete input data file and output data file are listed in Appendix, Sections A and B, respectively. Figure 3-5 shows a plot of the gravity anomaly calculated with Gravanom across the sedimentary structure shown in Figure 3-4.

Figure 3-5 The Gravanom-calculated gravity anomaly of the sedimentary structure with six beds (the output file was imported into a spreadsheet program, such as Excel, Lotus 1-2-3, or Quattro Pro, and plotted)

APPENDIX GRAVANOM DATA

A INPUT FILE FOR MODELING A SEDIMENTARY STRUCTURE

The following data are the contents of the input data file for the example described in Section 3-5. Please note that to save on space, the data have been artificially arranged into three columns on each page, where the bottom of each column will continue at the top of the next column.

6 94 -2. 0.	76.0000 32.9655	147 2.4
76 2.35	74.0000 32.1877	-50. .5
-50. .0001	72.0000 32.0068	4.0000 32.4146
146. 0.01	70.0000 32.3377	6.0000 35.5125
146.0000 27.7210	68.0000 34.9820	8.0000 38.3401
144.0000 22.9730	66.0000 37.5604	10.0000 41.0718
142.0000 20.3176	64.0000 38.5403	12.0000 42.0278
140.0000 19.0724	62.0000 37.1146	14.0000 42.9498
138.0000 20.4475	60.0000 34.6495	16.0000 45.0349
136.0000 22.6771	58.0000 32.0496	18.0000 44.4455
134.0000 24.2238	56.0000 31.9449	20.0000 43.4308
132.0000 24.6913	54.0000 35.9125	22.0000 43.4562
130.0000 24.9919	52.0000 38.2128	24.0000 42.0136
128.0000 25.6880	50.0000 38.7810	26.0000 41.4498
126.0000 26.6267	48.0000 37.5369	28.0000 37.3292
124.0000 27.8727	46.0000 35.3060	30.0000 34.8229
122.0000 30.9791	44.0000 34.3142	32.0000 34.9279
120.0000 32.5879	42.0000 35.2370	34.0000 37.9760
118.0000 39.9186	40.0000 38.3421	36.0000 41.3112
116.0000 46.9291	38.0000 40.7840	38.0000 40.7840
114.0000 47.0857	36.0000 41.3112	40.0000 38.3421
112.0000 43.0694	34.0000 37.9760	42.0000 35.2370
110.0000 39.3801	32.0000 34.9279	44.0000 34.3142
108.0000 33.4397	30.0000 34.8229	46.0000 35.3060
106.0000 31.3499	28.0000 37.3292	48.0000 37.5369
104.0000 30.3547	26.0000 41.4498	50.0000 38.7810
102.0000 30.1033	24.0000 42.0136	52.0000 38.2128
100.0000 30.0921	22.0000 43.4562	54.0000 35.9125
98.0000 30.2297	20.0000 43.4308	56.0000 31.9449
96.0000 31.1856	18.0000 44.4455	58.0000 32.0496
94.0000 37.9581	16.0000 45.0349	60.0000 34.6495
92.0000 43.0622	14.0000 42.9498	62.0000 37.1146
90.0000 48.8501	12.0000 42.0278	64.0000 38.5403
88.0000 55.2059	10.0000 41.0718	66.0000 37.5604
86.0000 57.2620	8.0000 38.3401	68.0000 34.9820
84.0000 54.9428	6.0000 35.5125	70.0000 32.3377
82.0000 49.3374	4.0000 32.4146	72.0000 32.0068
80.0000 43.8072	-50. .5	74.0000 32.1877
78.0000 38.3036	-50. .0001	76.0000 32.9655

78.0000	38.3036	112.0000	55.4215	6.0000	48.9572
80.0000	43.8072	110.0000	53.2176	4.0000	46.1370
82.0000	49.3374	108.0000	45.7184	-50. 1.	
84.0000	54.9428	106.0000	44.0316	-50. .5	
86.0000	57.2620	104.0000	43.4160	147 2.55	
88.0000	55.2059	102.0000	43.1956	-50. 1.	
90.0000	48.8501	100.0000	43.1640	4.0000	46.1370
92.0000	43.0622	98.0000	43.2075	6.0000	48.9572
94.0000	37.9581	96.0000	44.6879	8.0000	51.7572
96.0000	31.1856	94.0000	50.5047	10.0000	54.1018
98.0000	30.2297	92.0000	58.6911	12.0000	54.9115
100.0000	30.0921	90.0000	63.6994	14.0000	56.5070
102.0000	30.1033	88.0000	68.2465	16.0000	56.4299
104.0000	30.3547	86.0000	70.4536	18.0000	56.8226
106.0000	31.3499	84.0000	66.8200	20.0000	56.6653
108.0000	33.4397	82.0000	61.5000	22.0000	57.9756
110.0000	39.3801	80.0000	56.0183	24.0000	56.5446
112.0000	43.0694	78.0000	51.5926	26.0000	52.4820
114.0000	47.0857	76.0000	48.6084	28.0000	49.5611
116.0000	46.9291	74.0000	47.7947	30.0000	48.6785
118.0000	39.9186	72.0000	48.4929	32.0000	49.5766
120.0000	32.5879	70.0000	50.1595	34.0000	52.1643
122.0000	30.9791	68.0000	52.8843	36.0000	54.4078
124.0000	27.8727	66.0000	54.1828	38.0000	54.2514
126.0000	26.6267	64.0000	52.9579	40.0000	52.4422
128.0000	25.6880	62.0000	50.5518	42.0000	50.5272
130.0000	24.9919	60.0000	48.3262	44.0000	50.0047
132.0000	24.6913	58.0000	47.8459	46.0000	50.0748
134.0000	24.2238	56.0000	50.0842	48.0000	50.8883
136.0000	22.6771	54.0000	52.2632	50.0000	52.3604
138.0000	20.4475	52.0000	52.8226	52.0000	52.8226
140.0000	19.0724	50.0000	52.3604	54.0000	52.2632
142.0000	20.3176	48.0000	50.8883	56.0000	50.0842
144.0000	22.9730	46.0000	50.0748	58.0000	47.8459
146.0000	27.7210	44.0000	50.0047	60.0000	48.3262
		42.0000	50.5272	62.0000	50.5518
146.0000	32.0927	40.0000	52.4422	64.0000	52.9579
144.0000	28.0823	38.0000	54.2514	66.0000	54.1828
142.0000	25.4881	36.0000	54.4078	68.0000	52.8843
140.0000	24.6436	34.0000	52.1643	70.0000	50.1595
138.0000	25.5656	32.0000	49.5766	72.0000	48.4929
136.0000	27.5235	30.0000	48.6785	74.0000	47.7947
134.0000	30.2941	28.0000	49.5611	76.0000	48.6084
132.0000	32.4021	26.0000	52.4820	78.0000	51.5926
130.0000	33.5552	24.0000	56.5446	80.0000	56.0183
128.0000	34.9400	22.0000	57.9756	82.0000	61.5000
126.0000	36.5658	20.0000	56.6653	84.0000	66.8200
124.0000	38.2593	18.0000	56.8226	86.0000	70.4536
122.0000	45.0275	16.0000	56.4299	88.0000	68.2465
120.0000	47.0975	14.0000	56.5070	90.0000	63.6994
118.0000	55.1139	12.0000	54.9115	92.0000	58.6911
116.0000	61.2705	10.0000	54.1018	94.0000	50.5047
114.0000	59.0878	8.0000	51.7572	96.0000	44.6879

98.0000	43.2075	92.0000	72.3545	12.0000	63.1984
100.0000	43.1640	90.0000	78.0295	14.0000	65.0291
102.0000	43.1956	88.0000	83.0126	16.0000	66.5508
104.0000	43.4160	86.0000	84.6923	18.0000	67.1367
106.0000	44.0316	84.0000	80.4739	20.0000	66.9679
108.0000	45.7184	82.0000	71.8222	22.0000	65.9992
110.0000	53.2176	80.0000	66.0103	24.0000	63.9476
112.0000	55.4215	78.0000	60.3903	26.0000	62.4395
114.0000	59.0878	76.0000	59.2567	28.0000	62.8102
116.0000	61.2705	74.0000	58.5904	30.0000	63.9203
118.0000	55.1139	72.0000	59.5729	32.0000	65.0156
120.0000	47.0975	70.0000	61.7415	34.0000	67.0557
122.0000	45.0275	68.0000	64.5597	36.0000	68.0908
124.0000	38.2593	66.0000	65.0785	38.0000	67.5180
126.0000	36.5658	64.0000	63.7881	40.0000	65.8082
128.0000	34.9400	62.0000	61.0326	42.0000	63.5609
130.0000	33.5552	60.0000	58.9556	44.0000	61.8148
132.0000	32.4021	58.0000	59.2174	46.0000	61.9867
134.0000	30.2941	56.0000	61.9949	48.0000	62.4646
136.0000	27.5235	54.0000	64.3272	50.0000	63.5217
138.0000	25.5656	52.0000	64.5715	52.0000	64.5715
140.0000	24.6436	50.0000	63.5217	54.0000	64.3272
142.0000	25.4881	48.0000	62.4646	56.0000	61.9949
144.0000	28.0823	46.0000	61.9867	58.0000	59.2174
146.0000	32.0927	44.0000	61.8148	60.0000	58.9556
		42.0000	63.5609	62.0000	61.0326
146.0000	37.9624	40.0000	65.8082	64.0000	63.7881
144.0000	33.9846	38.0000	67.5180	66.0000	65.0785
142.0000	31.6522	36.0000	68.0908	68.0000	64.5597
140.0000	30.7407	34.0000	67.0557	70.0000	61.7415
138.0000	32.3368	32.0000	65.0156	72.0000	59.5729
136.0000	35.8471	30.0000	63.9203	74.0000	58.5904
134.0000	39.6518	28.0000	62.8102	76.0000	59.2567
132.0000	43.0279	26.0000	62.4395	78.0000	60.3903
130.0000	44.0130	24.0000	63.9476	80.0000	66.0103
128.0000	45.2913	22.0000	65.9992	82.0000	71.8222
126.0000	47.0726	20.0000	66.9679	84.0000	80.4739
124.0000	49.2677	18.0000	67.1367	86.0000	84.6923
122.0000	55.6545	16.0000	66.5508	88.0000	83.0126
120.0000	57.0675	14.0000	65.0291	90.0000	78.0295
118.0000	74.8165	12.0000	63.1984	92.0000	72.3545
116.0000	79.3489	10.0000	61.2382	94.0000	62.7993
114.0000	76.4748	8.0000	58.6941	96.0000	60.0105
112.0000	71.3828	6.0000	55.8847	98.0000	58.9145
110.0000	67.2036	4.0000	53.3798	100.0000	58.6176
108.0000	60.3882	-50. 2.		102.0000	58.3438
106.0000	58.9449	-50. 1.		104.0000	58.6863
104.0000	58.6863	147 2.6		106.0000	58.9449
102.0000	58.3438	-50. 2.0		108.0000	60.3882
100.0000	58.6176	4.0000	53.3798	110.0000	67.2036
98.0000	58.9145	6.0000	55.8847	112.0000	71.3828
96.0000	60.0105	8.0000	58.6941	114.0000	76.4748
94.0000	62.7993	10.0000	61.2382	116.0000	79.3489

118.0000	74.8165	70.0000	74.6643	34.0000	76.2952
120.0000	57.0675	68.0000	76.9716	36.0000	78.2634
122.0000	55.6545	66.0000	76.0115	38.0000	77.6970
124.0000	49.2677	64.0000	72.4314	40.0000	75.7533
126.0000	47.0726	62.0000	67.6256	42.0000	61.7524
128.0000	45.2913	60.0000	64.8705	44.0000	62.1254
130.0000	44.0130	58.0000	64.9542	46.0000	65.2376
132.0000	43.0279	56.0000	64.9215	48.0000	65.5651
134.0000	39.6518	54.0000	71.9153	50.0000	70.3347
136.0000	35.8471	52.0000	72.0159	52.0000	72.0159
138.0000	32.3368	50.0000	70.3347	54.0000	71.9153
140.0000	30.7407	48.0000	65.5651	56.0000	64.9215
142.0000	31.6522	46.0000	65.2376	58.0000	64.9542
144.0000	33.9846	44.0000	62.1254	60.0000	64.8705
146.0000	37.9624	42.0000	61.7524	62.0000	67.6256
146.0000	46.3295	40.0000	75.7533	64.0000	72.4314
144.0000	41.3178	38.0000	77.6970	66.0000	76.0115
142.0000	39.1183	36.0000	78.2634	68.0000	76.9716
140.0000	38.9216	34.0000	76.2952	70.0000	74.6643
138.0000	40.4095	32.0000	73.6863	72.0000	70.3721
136.0000	43.0172	30.0000	69.8734	74.0000	67.9703
134.0000	47.0317	28.0000	68.3032	76.0000	68.3683
132.0000	50.2828	26.0000	67.8947	78.0000	70.8321
130.0000	51.5486	24.0000	68.0113	80.0000	76.5150
128.0000	53.0629	22.0000	71.7121	82.0000	83.7922
126.0000	54.6782	20.0000	73.4908	84.0000	89.0023
124.0000	57.0110	18.0000	73.8225	86.0000	91.3112
122.0000	65.1224	16.0000	73.4416	88.0000	88.3235
120.0000	67.2509	14.0000	72.2477	90.0000	83.6466
118.0000	87.5153	12.0000	70.2168	92.0000	78.7940
116.0000	91.0249	10.0000	68.1759	94.0000	71.6992
114.0000	88.7653	8.0000	66.0807	96.0000	68.3263
112.0000	85.2773	6.0000	63.0944	98.0000	67.6044
110.0000	71.7849	4.0000	61.1076	100.0000	67.4407
108.0000	69.6617	-50.	2.8	102.0000	67.7403
106.0000	68.9246	-1.	2.0	104.0000	68.1596
104.0000	68.1596	147	2.65	106.0000	68.9246
102.0000	67.7403	-50.	2.8	108.0000	69.6617
100.0000	67.4407	4.0000	61.1076	110.0000	71.7849
98.0000	67.6044	6.0000	63.0944	112.0000	85.2773
96.0000	68.3263	8.0000	66.0807	114.0000	88.7653
94.0000	71.6992	10.0000	68.1759	116.0000	91.0249
92.0000	78.7940	12.0000	70.2168	118.0000	87.5153
90.0000	83.6466	14.0000	72.2477	120.0000	67.2509
88.0000	88.3235	16.0000	73.4416	122.0000	65.1224
86.0000	91.3112	18.0000	73.8225	124.0000	57.0110
84.0000	89.0023	20.0000	73.4908	126.0000	54.6782
82.0000	83.7922	22.0000	71.7121	128.0000	53.0629
80.0000	76.5150	24.0000	68.0113	130.0000	51.5486
78.0000	70.8321	26.0000	67.8947	132.0000	50.2828
76.0000	68.3683	28.0000	68.3032	134.0000	47.0317
74.0000	67.9703	30.0000	69.8734	136.0000	43.0172
72.0000	70.3721	32.0000	73.6863	138.0000	40.4095

140.0000	38.9216	50.0000	76.2728	54.0000	76.7794
142.0000	39.1183	48.0000	65.1811	56.0000	64.9495
144.0000	41.3178	46.0000	65.0258	58.0000	64.7451
146.0000	46.3295	44.0000	61.6380	60.0000	69.1814
		42.0000	61.8220	62.0000	74.1428
146.0000	47.8715	40.0000	81.0819	64.0000	79.3980
144.0000	42.4189	38.0000	82.4720	66.0000	82.8857
142.0000	40.8944	36.0000	82.6827	68.0000	82.3839
140.0000	40.1236	34.0000	81.6627	70.0000	79.9398
138.0000	41.9035	32.0000	79.1785	72.0000	73.2134
136.0000	45.0319	30.0000	73.3231	74.0000	73.2987
134.0000	48.5646	28.0000	71.7998	76.0000	73.3285
132.0000	50.3911	26.0000	71.3930	78.0000	73.2784
130.0000	52.0649	24.0000	71.5605	80.0000	74.8445
128.0000	53.2297	22.0000	74.1805	82.0000	89.6796
126.0000	54.9059	20.0000	75.5954	84.0000	97.4779
124.0000	56.9202	18.0000	76.2027	86.0000	101.7540
122.0000	65.4201	16.0000	76.0958	88.0000	98.8756
120.0000	67.6612	14.0000	75.4324	90.0000	90.1571
118.0000	87.7020	12.0000	73.9925	92.0000	81.8222
116.0000	91.1675	10.0000	72.2288	94.0000	71.5813
114.0000	89.0045	8.0000	70.1895	96.0000	68.2522
112.0000	84.0411	6.0000	68.1178	98.0000	67.4183
110.0000	71.5492	4.0000	65.8296	100.0000	67.4542
108.0000	69.5300	-50. 3.5		102.0000	67.6804
106.0000	68.7898	-50. 2.8		104.0000	68.1246
104.0000	68.1246	76 2.7		106.0000	68.7898
102.0000	67.6804	-50. 3.5		108.0000	69.5300
100.0000	67.4542	4.0000	65.8296	110.0000	71.5492
98.0000	67.4183	6.0000	68.1178	112.0000	84.0411
96.0000	68.2522	8.0000	70.1895	114.0000	89.0045
94.0000	71.5813	10.0000	72.2288	116.0000	91.1675
92.0000	81.8222	12.0000	73.9925	118.0000	87.7020
90.0000	90.1571	14.0000	75.4324	120.0000	67.6612
88.0000	98.8756	16.0000	76.0958	122.0000	65.4201
86.0000	101.7540	18.0000	76.2027	124.0000	56.9202
84.0000	97.4779	20.0000	75.5954	126.0000	54.9059
82.0000	89.6796	22.0000	74.1805	128.0000	53.2297
80.0000	74.8445	24.0000	71.5605	130.0000	52.0649
78.0000	73.2784	26.0000	71.3930	132.0000	50.3911
76.0000	73.3285	28.0000	71.7998	134.0000	48.5646
74.0000	73.2987	30.0000	73.3231	136.0000	45.0319
72.0000	73.2134	32.0000	79.1785	138.0000	41.9035
70.0000	79.9398	34.0000	81.6627	140.0000	40.1236
68.0000	82.3839	36.0000	82.6827	142.0000	40.8944
66.0000	82.8857	38.0000	82.4720	144.0000	42.4189
64.0000	79.3980	40.0000	81.0819	146.0000	47.8715
62.0000	74.1428	42.0000	61.8220	146.	95.
60.0000	69.1814	44.0000	61.6380	-50.	95.0001
58.0000	64.7451	46.0000	65.0258	-50.	3.5
56.0000	64.9495	48.0000	65.1811		
54.0000	76.7794	50.0000	76.2728		
52.0000	77.4231	52.0000	77.4231		

B OUTPUT FILE FOR A SEDIMENTARY STRUCTURE

The following data are the contents of the output data file for the example described in Section 3-5. Please note that the first two lines and six blocks repeat the input data file (as discussed in the case of the rectangular body, Section 3.3). The actual Gravanom calculated output data are in the section following "GRAVITY ANOMALY IN MILLIGAL." These output data list the distance from origin and the corresponding computed gravity anomalies.

6 94 -2.000 0.000
76 2.350

-50.00	146.00	146.00	144.00	142.00	140.00	138.00	136.00
134.00	132.00	130.00	128.00	126.00	124.00	122.00	120.00
118.00	116.00	114.00	112.00	110.00	108.00	106.00	104.00
102.00	100.00	98.00	96.00	94.00	92.00	90.00	88.00
86.00	84.00	82.00	80.00	78.00	76.00	74.00	72.00
70.00	68.00	66.00	64.00	62.00	60.00	58.00	56.00
54.00	52.00	50.00	48.00	46.00	44.00	42.00	40.00
38.00	36.00	34.00	32.00	30.00	28.00	26.00	24.00
22.00	20.00	18.00	16.00	14.00	12.00	10.00	8.00
6.00	4.00	-50.00	-50.00	0.00	0.01	27.72	22.97
20.32	19.07	20.45	22.68	24.22	24.69	24.99	25.69
26.63	27.87	30.98	32.59	39.92	46.93	47.09	43.07
39.38	33.44	31.35	30.35	30.10	30.09	30.23	31.19
37.96	43.06	48.85	55.21	57.26	54.94	49.34	43.81
38.30	32.97	32.19	32.01	32.34	34.98	37.56	38.54
37.11	34.65	32.05	31.94	35.91	38.21	38.78	37.54
35.31	34.31	35.24	38.34	40.78	41.31	37.98	34.93
34.82	37.33	41.45	42.01	43.46	43.43	44.45	45.03
42.95	42.03	41.07	38.34	35.51	32.41	0.50	0.00
147	2.400						

-50.00	4.00	6.00	8.00	10.00	12.00	14.00	16.00
18.00	20.00	22.00	24.00	26.00	28.00	30.00	32.00
34.00	36.00	38.00	40.00	42.00	44.00	46.00	48.00
50.00	52.00	54.00	56.00	58.00	60.00	62.00	64.00
66.00	68.00	70.00	72.00	74.00	76.00	78.00	80.00
82.00	84.00	86.00	88.00	90.00	92.00	94.00	96.00
98.00	100.00	102.00	104.00	106.00	108.00	110.00	112.00
114.00	116.00	118.00	120.00	122.00	124.00	126.00	128.00
130.00	132.00	134.00	136.00	138.00	140.00	142.00	144.00
146.00	146.00	144.00	142.00	140.00	138.00	136.00	134.00
132.00	130.00	128.00	126.00	124.00	122.00	120.00	118.00
116.00	114.00	112.00	110.00	108.00	106.00	104.00	102.00
100.00	98.00	96.00	94.00	92.00	90.00	88.00	86.00
84.00	82.00	80.00	78.00	76.00	74.00	72.00	70.00
68.00	66.00	64.00	62.00	60.00	58.00	56.00	54.00

52.00	50.00	48.00	46.00	44.00	42.00	40.00	38.00
36.00	34.00	32.00	30.00	28.00	26.00	24.00	22.00
20.00	18.00	16.00	14.00	12.00	10.00	8.00	6.00
4.00	-50.00	-50.00	0.50	32.41	35.51	38.34	41.07
42.03	42.95	45.03	44.45	43.43	43.46	42.01	41.45
37.33	34.82	34.93	37.98	41.31	40.78	38.34	35.24
34.31	35.31	37.54	38.78	38.21	35.91	31.94	32.05
34.65	37.11	38.54	37.56	34.98	32.34	32.01	32.19
32.97	38.30	43.81	49.34	54.94	57.26	55.21	48.85
43.06	37.96	31.19	30.23	30.09	30.10	30.35	31.35
33.44	39.38	43.07	47.09	46.93	39.92	32.59	30.98
27.87	26.63	25.69	24.99	24.69	24.22	22.68	20.45
19.07	20.32	22.97	27.72	32.09	28.08	25.49	24.64
25.57	27.52	30.29	32.40	33.56	34.94	36.57	38.26
45.03	47.10	55.11	61.27	59.09	55.42	53.22	45.72
44.03	43.42	43.20	43.16	43.21	44.69	50.50	58.69
63.70	68.25	70.45	66.82	61.50	56.02	51.59	48.61
47.79	48.49	50.16	52.88	54.18	52.96	50.55	48.33
47.85	50.08	52.26	52.82	52.36	50.89	50.07	50.00
50.53	52.44	54.25	54.41	52.16	49.58	48.68	49.56
52.48	56.54	57.98	56.67	56.82	56.43	56.51	54.91
54.10	51.76	48.96	46.14	1.00	0.50		

147 2.550

-50.00	4.00	6.00	8.00	10.00	12.00	14.00	16.00
18.00	20.00	22.00	24.00	26.00	28.00	30.00	32.00
34.00	36.00	38.00	40.00	42.00	44.00	46.00	48.00
50.00	52.00	54.00	56.00	58.00	60.00	62.00	64.00
66.00	68.00	70.00	72.00	74.00	76.00	78.00	80.00
82.00	84.00	86.00	88.00	90.00	92.00	94.00	96.00
98.00	100.00	102.00	104.00	106.00	108.00	110.00	112.00
114.00	116.00	118.00	120.00	122.00	124.00	126.00	128.00
130.00	132.00	134.00	136.00	138.00	140.00	142.00	144.00
146.00	146.00	144.00	142.00	140.00	138.00	136.00	134.00
132.00	130.00	128.00	126.00	124.00	122.00	120.00	118.00
116.00	114.00	112.00	110.00	108.00	106.00	104.00	102.00
100.00	98.00	96.00	94.00	92.00	90.00	88.00	86.00
84.00	82.00	80.00	78.00	76.00	74.00	72.00	70.00
68.00	66.00	64.00	62.00	60.00	58.00	56.00	54.00
52.00	50.00	48.00	46.00	44.00	42.00	40.00	38.00
36.00	34.00	32.00	30.00	28.00	26.00	24.00	22.00
20.00	18.00	16.00	14.00	12.00	10.00	8.00	6.00
4.00	-50.00	-50.00	1.00	46.14	48.96	51.76	54.10
54.91	56.51	56.43	56.82	56.67	57.98	56.54	52.48
49.56	48.68	49.58	52.16	54.41	54.25	52.44	50.53
50.00	50.07	50.89	52.36	52.82	52.26	50.08	47.85
48.33	50.55	52.96	54.18	52.88	50.16	48.49	47.79
48.61	51.59	56.02	61.50	66.82	70.45	68.25	63.70
58.69	50.50	44.69	43.21	43.16	43.20	43.42	44.03
45.72	53.22	55.42	59.09	61.27	55.11	47.10	45.03
38.26	36.57	34.94	33.56	32.40	30.29	27.52	25.57
24.64	25.49	28.08	32.09	37.96	33.98	31.65	30.74
32.34	35.85	39.65	43.03	44.01	45.29	47.07	49.27

55.65	57.07	74.82	79.35	76.47	71.38	67.20	60.39
58.94	58.69	58.34	58.62	58.91	60.01	62.80	72.35
78.03	83.01	84.69	80.47	71.82	66.01	60.39	59.26
58.59	59.57	61.74	64.56	65.08	63.79	61.03	58.96
59.22	61.99	64.33	64.57	63.52	62.46	61.99	61.81
63.56	65.81	67.52	68.09	67.06	65.02	63.92	62.81
62.44	63.95	66.00	66.97	67.14	66.55	65.03	63.20
61.24	58.69	55.88	53.38	2.00	1.00		

147 2.600

-50.00	4.00	6.00	8.00	10.00	12.00	14.00	16.00
18.00	20.00	22.00	24.00	26.00	28.00	30.00	32.00
34.00	36.00	38.00	40.00	42.00	44.00	46.00	48.00
50.00	52.00	54.00	56.00	58.00	60.00	62.00	64.00
66.00	68.00	70.00	72.00	74.00	76.00	78.00	80.00
82.00	84.00	86.00	88.00	90.00	92.00	94.00	96.00
98.00	100.00	102.00	104.00	106.00	108.00	110.00	112.00
114.00	116.00	118.00	120.00	122.00	124.00	126.00	128.00
130.00	132.00	134.00	136.00	138.00	140.00	142.00	144.00
146.00	146.00	144.00	142.00	140.00	138.00	136.00	134.00
132.00	130.00	128.00	126.00	124.00	122.00	120.00	118.00
116.00	114.00	112.00	110.00	108.00	106.00	104.00	102.00
100.00	98.00	96.00	94.00	92.00	90.00	88.00	86.00
84.00	82.00	80.00	78.00	76.00	74.00	72.00	70.00
68.00	66.00	64.00	62.00	60.00	58.00	56.00	54.00
52.00	50.00	48.00	46.00	44.00	42.00	40.00	38.00
36.00	34.00	32.00	30.00	28.00	26.00	24.00	22.00
20.00	18.00	16.00	14.00	12.00	10.00	8.00	6.00
4.00	-50.00	-1.00	2.00	53.38	55.88	58.69	61.24
63.20	65.03	66.55	67.14	66.97	66.00	63.95	62.44
62.81	63.92	65.02	67.06	68.09	67.52	65.81	63.56
61.81	61.99	62.46	63.52	64.57	64.33	61.99	59.22
58.96	61.03	63.79	65.08	64.56	61.74	59.57	58.59
59.26	60.39	66.01	71.82	80.47	84.69	83.01	78.03
72.35	62.80	60.01	58.91	58.62	58.34	58.69	58.94
60.39	67.20	71.38	76.47	79.35	74.82	57.07	55.65
49.27	47.07	45.29	44.01	43.03	39.65	35.85	32.34
30.74	31.65	33.98	37.96	46.33	41.32	39.12	38.92
40.41	43.02	47.03	50.28	51.55	53.06	54.68	57.01
65.12	67.25	87.52	91.02	88.77	85.28	71.78	69.66
68.92	68.16	67.74	67.44	67.60	68.33	71.70	78.79
83.65	88.32	91.31	89.00	83.79	76.52	70.83	68.37
67.97	70.37	74.66	76.97	76.01	72.43	67.63	64.87
64.95	64.92	71.92	72.02	70.33	65.57	65.24	62.13
61.75	75.75	77.70	78.26	76.30	73.69	69.87	68.30
67.89	68.01	71.71	73.49	73.82	73.44	72.25	70.22
68.18	66.08	63.09	61.11	2.80	2.00		

147 2.650

-50.00	4.00	6.00	8.00	10.00	12.00	14.00	16.00
18.00	20.00	22.00	24.00	26.00	28.00	30.00	32.00
34.00	36.00	38.00	40.00	42.00	44.00	46.00	48.00
50.00	52.00	54.00	56.00	58.00	60.00	62.00	64.00

66.00	68.00	70.00	72.00	74.00	76.00	78.00	80.00
82.00	84.00	86.00	88.00	90.00	92.00	94.00	96.00
98.00	100.00	102.00	104.00	106.00	108.00	110.00	112.00
114.00	116.00	118.00	120.00	122.00	124.00	126.00	128.00
130.00	132.00	134.00	136.00	138.00	140.00	142.00	144.00
146.00	146.00	144.00	142.00	140.00	138.00	136.00	134.00
132.00	130.00	128.00	126.00	124.00	122.00	120.00	118.00
116.00	114.00	112.00	110.00	108.00	106.00	104.00	102.00
100.00	98.00	96.00	94.00	92.00	90.00	88.00	86.00
84.00	82.00	80.00	78.00	76.00	74.00	72.00	70.00
68.00	66.00	64.00	62.00	60.00	58.00	56.00	54.00
52.00	50.00	48.00	46.00	44.00	42.00	40.00	38.00
36.00	34.00	32.00	30.00	28.00	26.00	24.00	22.00
20.00	18.00	16.00	14.00	12.00	10.00	8.00	6.00
4.00	-50.00	-50.00	2.80	61.11	63.09	66.08	68.18
70.22	72.25	73.44	73.82	73.49	71.71	68.01	67.89
68.30	69.87	73.69	76.30	78.26	77.70	75.75	61.75
62.13	65.24	65.57	70.33	72.02	71.92	64.92	64.95
64.87	67.63	72.43	76.01	76.97	74.66	70.37	67.97
68.37	70.83	76.52	83.79	89.00	91.31	88.32	83.65
78.79	71.70	68.33	67.60	67.44	67.74	68.16	68.92
69.66	71.78	85.28	88.77	91.02	87.52	67.25	65.12
57.01	54.68	53.06	51.55	50.28	47.03	43.02	40.41
38.92	39.12	41.32	46.33	47.87	42.42	40.89	40.12
41.90	45.03	48.56	50.39	52.06	53.23	54.91	56.92
65.42	67.66	87.70	91.17	89.00	84.04	71.55	69.53
68.79	68.12	67.68	67.45	67.42	68.25	71.58	81.82
90.16	98.88	101.75	97.48	89.68	74.84	73.28	73.33
73.30	73.21	79.94	82.38	82.89	79.40	74.14	69.18
64.75	64.95	76.78	77.42	76.27	65.18	65.03	61.64
61.82	81.08	82.47	82.68	81.66	79.18	73.32	71.80
71.39	71.56	74.18	75.60	76.20	76.10	75.43	73.99
72.23	70.19	68.12	65.83	3.50	2.80		
76	2.700						

-50.00	4.00	6.00	8.00	10.00	12.00	14.00	16.00
18.00	20.00	22.00	24.00	26.00	28.00	30.00	32.00
34.00	36.00	38.00	40.00	42.00	44.00	46.00	48.00
50.00	52.00	54.00	56.00	58.00	60.00	62.00	64.00
66.00	68.00	70.00	72.00	74.00	76.00	78.00	80.00
82.00	84.00	86.00	88.00	90.00	92.00	94.00	96.00
98.00	100.00	102.00	104.00	106.00	108.00	110.00	112.00
114.00	116.00	118.00	120.00	122.00	124.00	126.00	128.00
130.00	132.00	134.00	136.00	138.00	140.00	142.00	144.00
146.00	146.00	-50.00	-50.00	3.50	65.83	68.12	70.19
72.23	73.99	75.43	76.10	76.20	75.60	74.18	71.56
71.39	71.80	73.32	79.18	81.66	82.68	82.47	81.08
61.82	61.64	65.03	65.18	76.27	77.42	76.78	64.95
64.75	69.18	74.14	79.40	82.89	82.38	79.94	73.21
73.30	73.33	73.28	74.84	89.68	97.48	101.75	98.88
90.16	81.82	71.58	68.25	67.42	67.45	67.68	68.12
68.79	69.53	71.55	84.04	89.00	91.17	87.70	67.66
65.42	56.92	54.91	53.23	52.06	50.39	48.56	45.03

41.90 40.12 40.89 42.42 47.87 95.00 95.00 3.50

COMPUTED GRAVITY ANOMALY VALUES (IN MILLIGAL)

0.000	6745.746
2.000	6815.712
4.000	6861.620
6.000	6898.097
8.000	6929.663
10.000	6957.944
12.000	6983.666
14.000	7007.222
16.000	7028.849
18.000	7048.706
20.000	7066.908
22.000	7083.539
24.000	7098.666
26.000	7112.345
28.000	7124.626
30.000	7135.537
32.000	7145.114
34.000	7153.380
36.000	7160.356
38.000	7166.056
40.000	7170.493
42.000	7173.684
44.000	7175.626
46.000	7176.325
48.000	7175.785
50.000	7173.999
52.000	7170.970
54.000	7166.687
56.000	7161.138
58.000	7154.318
60.000	7146.215
62.000	7136.806
64.000	7126.073
66.000	7114.002
68.000	7100.565
70.000	7085.736
72.000	7069.484
74.000	7051.779
76.000	7032.579
78.000	7011.847
80.000	6989.538
82.000	6965.604
84.000	6939.985
86.000	6912.623
88.000	6883.448
90.000	6852.391
92.000	6819.370
94.000	6784.298
96.000	6747.075

98.000	6707.600
100.000	6665.755
102.000	6621.418
104.000	6574.448
106.000	6524.702
108.000	6472.010
110.000	6416.181
112.000	6357.022
114.000	6294.302
116.000	6227.758
118.000	6157.105
120.000	6082.012
122.000	6002.096
124.000	5916.918
126.000	5825.964
128.000	5728.624
130.000	5624.154
132.000	5511.640
134.000	5389.917
136.000	5257.445
138.000	5112.070
140.000	4950.559
142.000	4767.437
144.000	4551.202
146.000	4248.235
148.000	3944.983
150.000	3727.874
152.000	3543.301
154.000	3379.773
156.000	3231.839
158.000	3096.287
160.000	2970.996
162.000	2854.454
164.000	2745.529
166.000	2643.337
168.000	2547.170
170.000	2456.444
172.000	2370.666
174.000	2289.423
176.000	2212.353
178.000	2139.136
180.000	2069.499
182.000	2003.191
184.000	1939.989
186.000	1879.693