

User's Guide

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Overview

Potent combines observed gravity and magnetic data, a geological model, and the calculations and visualisation that relate them into a highly interactive interpretation framework. When using *Potent* you would typically:

- Import observed values from one or more datasets (for example a multi-component aeromagnetic dataset and a regional gravity dataset);
- Use *Potent*'s graphical and numerical editing tools to set up a geological model as a set of discrete solid bodies such as ellipsoids, dykes and layers.
- Use forward and inversion modelling to calculate the field (or fields, if you are using more than one dataset, or more than one component) due to the model;
- Use various visualisation methods to compare the observed and calculated fields in order to assess the validity of your model.

See also: [Getting Started with Potent](#).

Basics

- Conventions
- Units
- Field components
- Licensing
- Running Potent
- Menus
- Tools
- Coordinate Axes
- Features of Potent Dialog Boxes

Conventions

The following conventions are used in this document:

- For brevity, a command from a menu might be referred to as Menu | Command, with a link to the relevant command. For example, "to load observations, click [Observations | Import](#)".
- The names of dialog box elements are written in bold type.
- The names of programs, such as *Potent* and *Intrepid* are written in italics.

Units

Distances are given in metres.

Magnetisation is given in **Amps/metre** (= 1000 * oersted).

Magnetic vector **components** are given in **nanotesla** (nT).

Magnetic tensor **components** are given in **nanotesla/metre** (nT/m).

The following options for units are determined by settings in the **Preferences** dialog box (which also contains information about conversion factors):

Magnetic susceptibility is given in either **SI** units or **cgs** units.

Gravitational vector **components** are given in **milligal** (mgal) or **micrometre/sec²** (um/s²).

Gravitational tensor **components** are given in **microgal /metre** (ugal/m) or **Eotvos**.

If your observations are not in one of the required units they may be scaled on input by setting the scaling factor in the **Observations | Options - Channels** dialog box.

Field components

When you **import** or **make** observations you can specify up to six field components, chosen from the following list:

| Label | Description |
|---------|--|
| TMI | Total magnetic intensity |
| MAGX | X (east) magnetic vector component |
| MAGY | Y (north) magnetic vector component |
| MAGZ | Z (up) magnetic vector component |
| TMI_DZ | First vertical derivative of TMI ⁽¹⁾ |
| HMI | Total horizontal magnetic intensity |
| MAGANAL | Magnetic analytic signal |
| GRVX | X (east) gravity vector component |
| GRVY | Y (north) gravity vector component |
| GRVZ | -Z (down) gravity vector component |
| MAGXX | XX magnetic gradient (tensor) component |
| MAGXY | XY magnetic gradient (tensor) component |
| MAGXZ | XZ magnetic gradient (tensor) component |
| MAGYY | YY magnetic gradient (tensor) component |
| MAGYZ | YZ magnetic gradient (tensor) component |
| MAGZZ | ZZ magnetic gradient (tensor) component ⁽¹⁾ |
| GRVXX | XX gravity gradient (tensor) component |
| GRVXY | XY gravity gradient (tensor) component |
| GRVXZ | XZ gravity gradient (tensor) component |
| GRVYY | YY gravity gradient (tensor) component |

| | |
|-------|--|
| GRVYZ | YZ gravity gradient (tensor) component |
| GRVZZ | ZZ gravity gradient (tensor) component |
| GR1 | Rotationally invariant tensor component 1 ⁽²⁾ |
| GR2 | Rotationally invariant tensor component 2 ⁽²⁾ |

(1) By default Potent assumes the vertical gradient is measured over a distance that is small compared with the survey dimensions. For detailed ground work (for example) where sensors may be separated by one metre or more consider using the **TMI & Mz sensor spacing** command in the **Observations** menu.

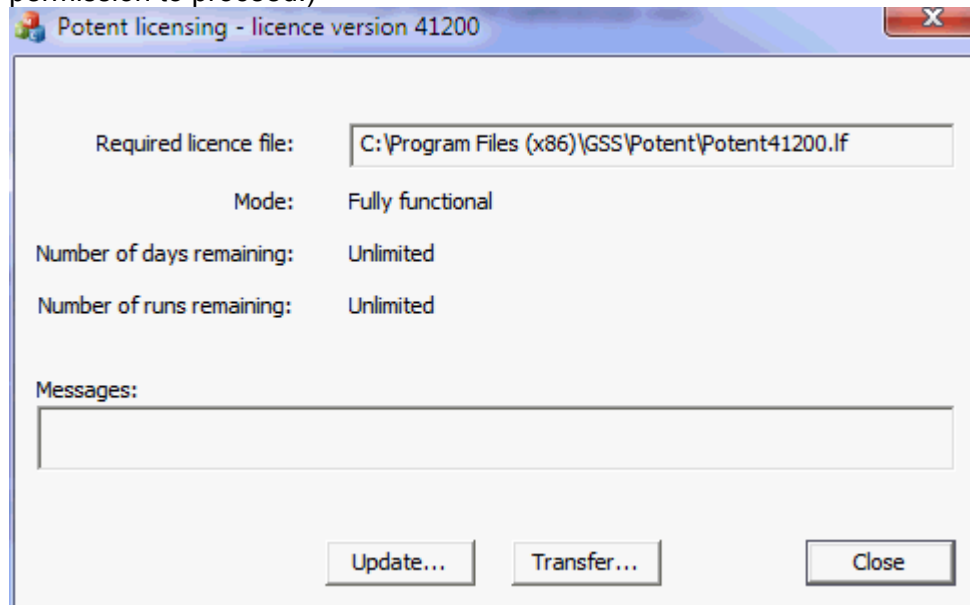
(2) These are the rotationally invariant gravity tensor components described by **Pederson & Rasmussen**.

Licensing

Potent licence information is stored in encrypted form in a licence file that is located in the Potent installation directory. The name of the file is version-dependent; for example the licence file for Potent v4.12.02 is "Potent41200.If". (Notice that the numeric version codes are not necessarily the same.) It is essential that Potent finds this file during its start-up procedure.

Licence manipulation is done through a stand-alone process that is accessed through the **Potent licensing** command in the **GSS** group in the Windows **Start** menu. By default a shortcut to this command is also placed on the Desktop.

(If you are running Windows Vista or later then User Account Control will prompt you for permission to proceed.)



Notice that the licence file version is included in the window title.

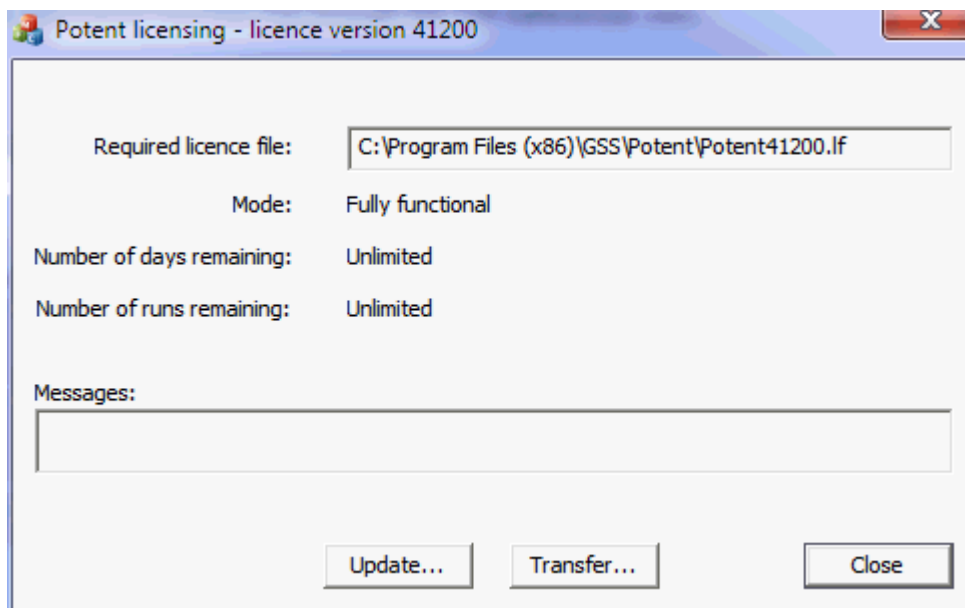
See also:

[Updating the licence](#)

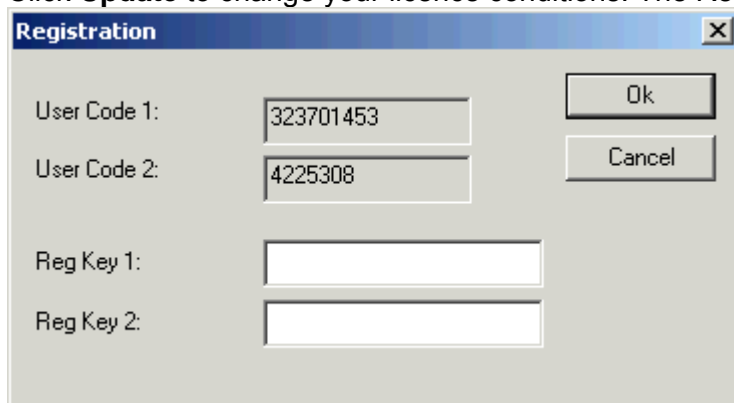
[Transferring the licence to another computer](#)

Updating the licence

You may update your licence from the Windows **Start** menu by running the **Potent licensing** command from the **GSS** group.



Click **Update** to change your licence conditions. The Registration dialog box is displayed:



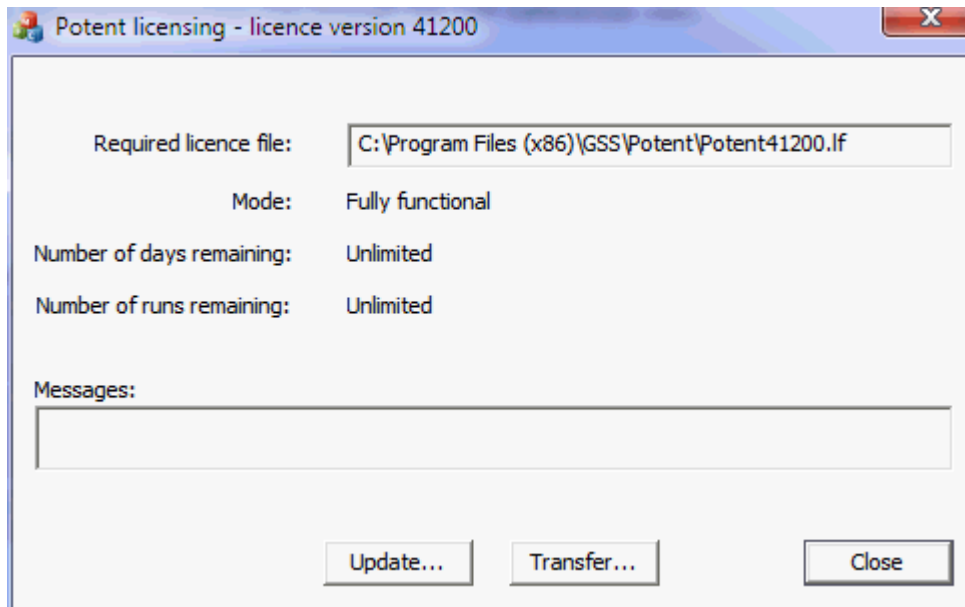
(In order to change your licence conditions you must have already made arrangements with **GSS**.)

1. Send the User Codes to **GSS**. (You may close this dialog box and continue using Potent while you wait for the response.)
2. When you receive the response, re-open this dialog box and enter the received Reg Key codes. (Reg Key 2 often is blank.) Click **OK** to update the licence.

(When you re-open the dialog box you might find that User Code 1 is different to that which you originally sent to GSS. However, the returned Reg Key codes are nevertheless valid. User Code 2 is a form of machine identifier and should not change unless you make substantial hardware or operating system changes to your computer.)

Transferring the licence to another computer

There are two ways to transfer your licence to another computer. In each case, use the **Potent licensing** command from the **GSS** group in the Windows **Start** menu.



Exchange of codes with GSS

1. Click **Update** in the **Potent licensing** dialog box on the licensed machine and send the User Codes 1 and 2 to **GSS**. We will send a code to de-activate its licence. Make a note of the confirmation code number that is displayed when the codes have been entered.
2. Click **Update** in the **Potent licensing** dialog box on the unlicensed machine and send the User Codes 1 and 2 to **GSS**. You should also send the “un-license message” from the previous step to confirm that the un-license function has worked OK on the original machine. We will send a code to activate the licence on the unlicensed machine.

This procedure can be inconvenient, especially for non-Australian users due to the time difference between Australia and much of the rest of the world. Instead, consider using the “transfer file” method” as described next.

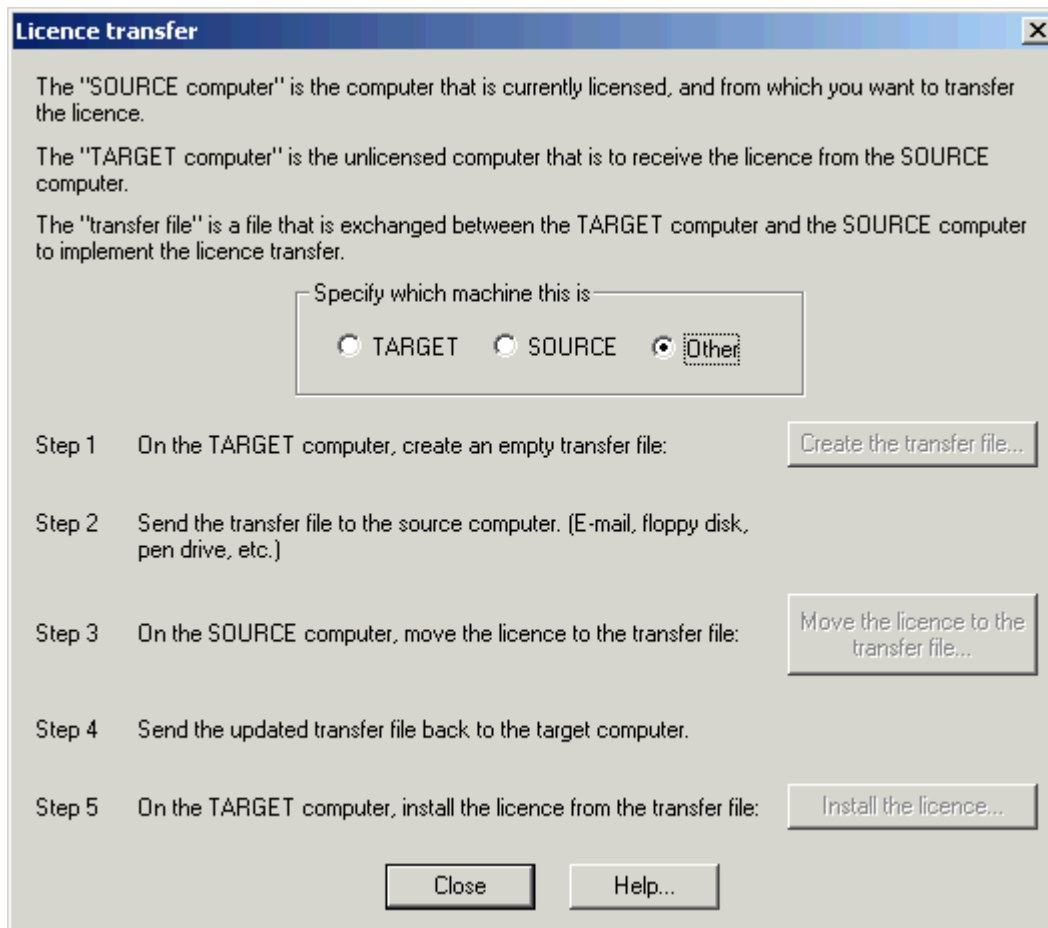
Exchange of a “transfer file”

Note: *This procedure does not work for time-limited licences.*

You can move a licence from a licensed computer (the *source computer*) to an unlicensed computer (the *target computer*) without the assistance of **GSS** by using a file (the *transfer file*) to carry the licence information. On each computer, click **Transfer** in the **Potent licensing** dialog box. The sequence of operations is:

1. On the target computer (currently unlicensed) create an empty transfer file.
2. Send the transfer file to the source (currently licensed) computer.
3. On the source computer, move the licence to the transfer file. The source computer becomes unlicensed.
4. Send the transfer file back to the target computer.
5. Load the licence from the transfer file. The target computer is now licensed.

This strategy is implemented through the **Licence transfer** dialog box:



Use the dialog box on both target and source machines to implement the transfer.

Running *Potent*

Running *Potent* from Windows

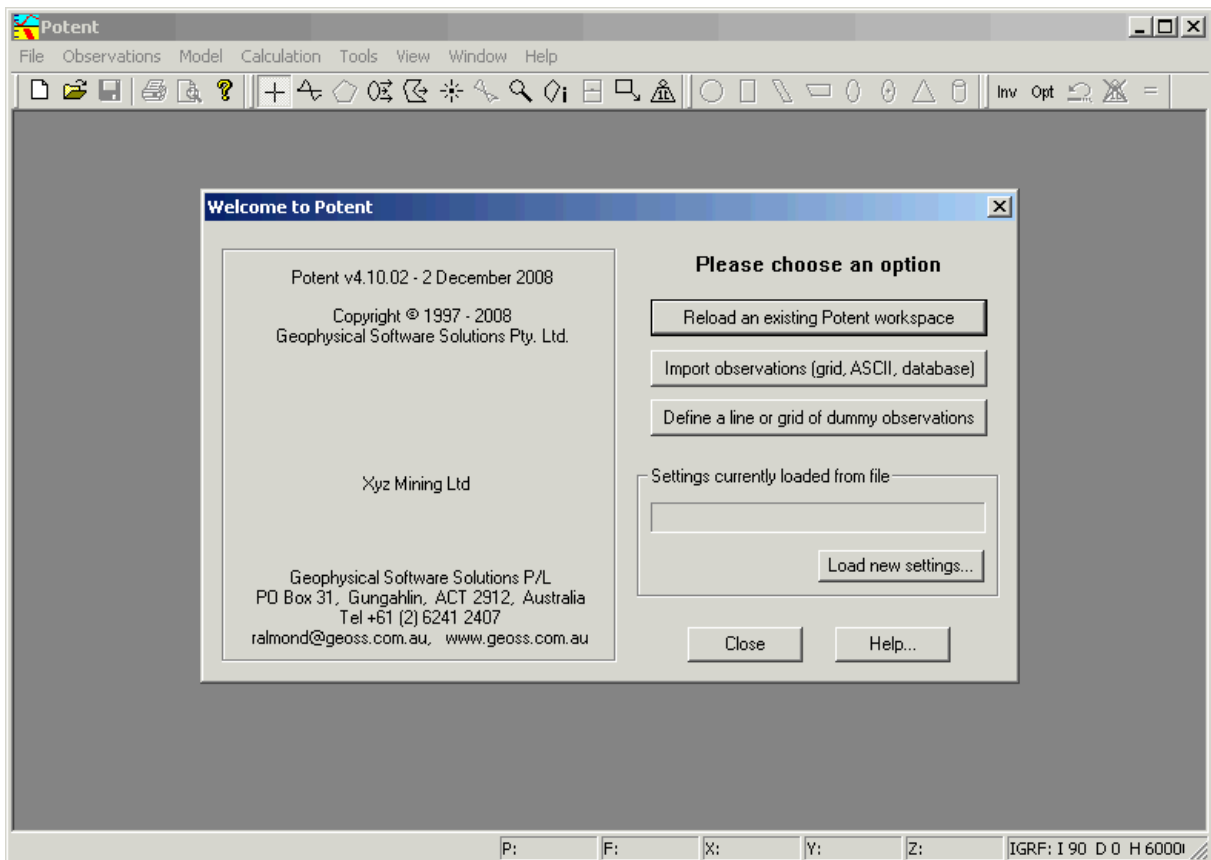
Running *Potent* from Oasis montaj

Running *Potent* from Windows

Potent is designed to run under Windows XP or higher (e.g. Vista or Windows 7).

The *Potent* executable file is POTENT.EXE, which by default will be located in the directory "C:\PROGRAM FILES\POTENT".

The simplest way to run the program is to execute this file in any of the usual Windows ways; desktop icon, **Start** menu or command line.



In this case you are presented with the **Welcome** dialog box.

If you specify a **workspace** file as a command-line argument then *Potent* will not display the **Welcome** dialog box, but will instead immediately load the workspace file.

You can automatically **load a settings file** if you provide its name as a command-line argument, preceded by “-i”. For example, “*potent -igrav.ini*” would run *Potent* and load the settings file “*grav.ini*”. In this case the welcome dialog is still displayed, and the name of the settings file is displayed in the **Settings currently loaded from file** box.

Running Potent from Oasis montaj

Potent can be run automatically from Geosoft’s *Oasis montaj* environment using one of several custom **GX** applications, which are provided as part of the *Potent* installation package. The GXs are:

potentmark – Run *Potent* with observations extracted from a marked section of a database profile.

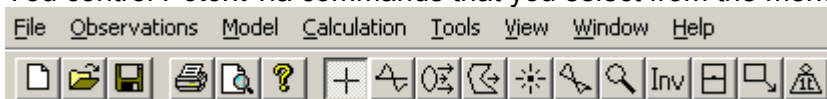
potentprof – Run *Potent* with observations extracted from a section (profile) drawn on a grid.

potentwind – Extract from a database those observations that lie within a polygonal area drawn on a map and run *Potent* with these observations loaded.

In order to activate the GXs you must place them in *Oasis montaj*’s GX subdirectory. The menu file *potent.omn* must be placed in *Oasis montaj*’s OMN subdirectory. When you run *Oasis montaj* you will need to load the *potent.omn* file using the **Load menu** command from the **GX** menu. This procedure is described in the file *ReadMeGeosoft.txt* that is installed in the Geosoft sub-folder of the *Potent* installation folder.

Menus

You control *Potent* via commands that you select from the menu bar.















Several of the more commonly used commands are also available from toolbars, as described in [Toolbars](#) in the Reference Manual.

Refer to the [Reference manual](#) for information about individual commands.

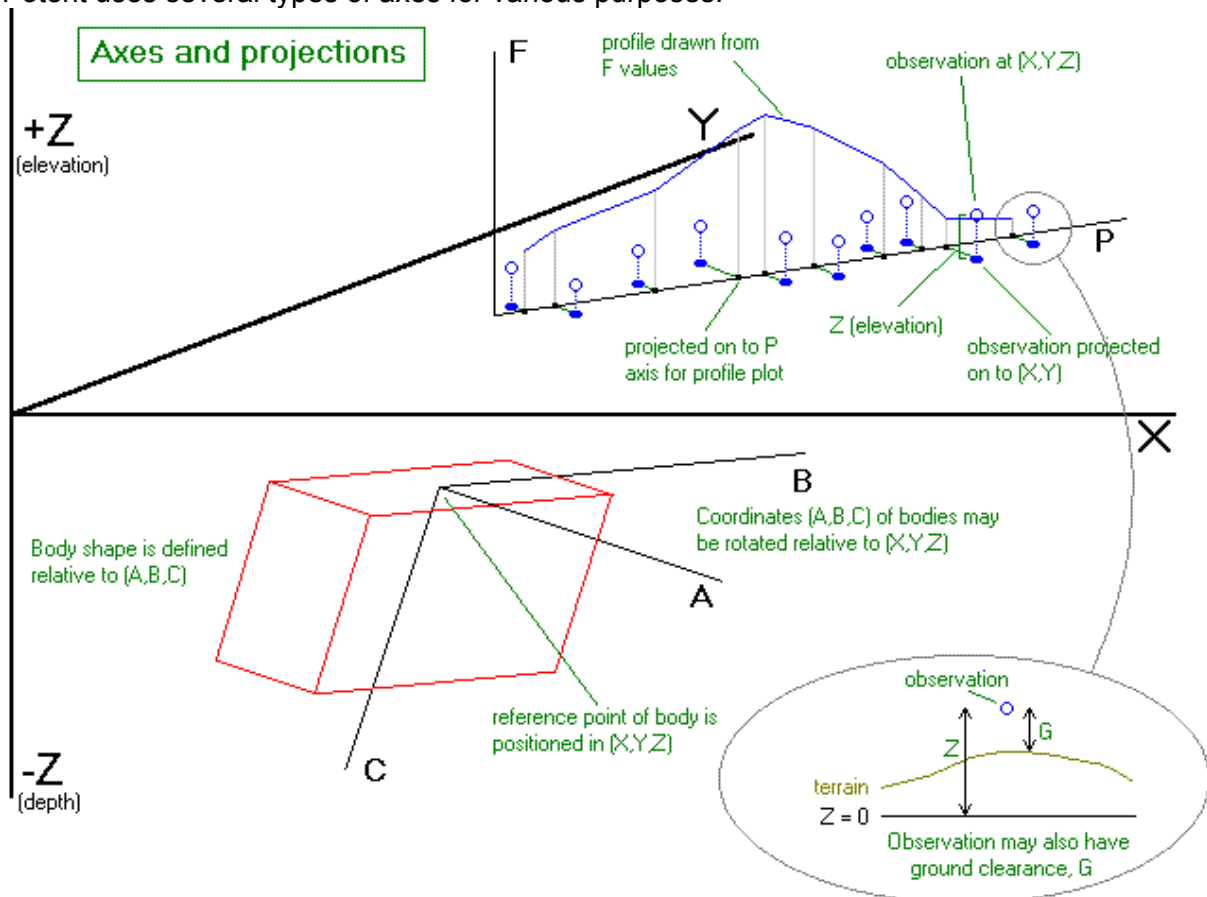
Tools

Several *Potent* functions are controlled by “tools”. You select a tool either by choosing the required option from the Tools menu, or by clicking the equivalent button on the Toolbar. When a tool is active the cursor takes on the shape depicted on the toolbar button. The tools are:

- The **Default tool**, .
- The **Make subset tool (box)**, .
- The **Make subset tool (polygon)**, .
- The **Move Body tool**, .
- The **Body Shape tool**, .
- The **Delete Observation tool**, .
- The **Regional tool**, .
- The **Zoom tool**, .
- The **Invert tool**, .
- The **Define window tool**, .
- The **Locate backdrop image tool**, .
- The **Set inversion weights tool**, .

Coordinate Axes

Potent uses several types of axes for various purposes.



Observations and **model** are positioned relative to axes (X,Y,Z) where Z, the elevation of the observation, is directed vertically upwards. The depth (or rather depth-below-datum) therefore corresponds to -Z. An optional ground clearance value (G) allows Potent to display an estimate of terrain.

The X and Y axes define a horizontal reference surface. You will generally find it convenient to choose coordinates so that true north corresponds to +Y and east to +X.

A third horizontal axis P is defined in the (X,Y) plane. This is the **profile** axis onto which observations are projected in order to display them in profile form. The origin of the P axis is the projection onto it of the first observation of the profile. Each profile line that is displayed on a **plan** is the P axis for that profile.

The field axis F also is directed vertically upwards from the (X,Y) plane. It is used for plotting observed and calculated field values when they are displayed in profile form.

The **shape of a body** is defined in its own coordinate system (A,B,C), in which (0,0,0) is the reference point about which the body is defined. The position of the body is defined as the (X,Y,Z) coordinates of its reference point.

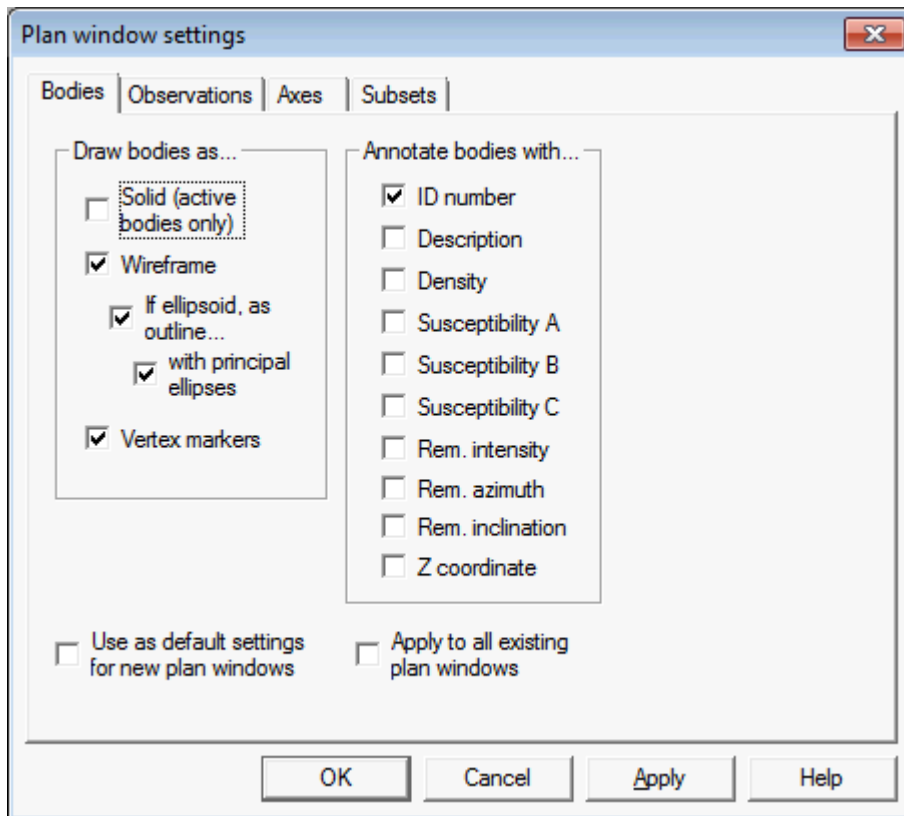
Features of *Potent* Dialog Boxes

- Apply to all existing plan/profile windows
- Use as default settings for new plan/profile windows
- Adjusting numeric values
- "Invert" checkboxes

Apply to all existing plan/profile windows

Potent dialog boxes that pertain to plan or profile windows generally have a check box labelled **Apply to all existing plan windows** or **Apply to all existing profile windows**, depending on which type of window the dialog box is associated with. If you check this check box, then click **OK** or **Apply**, the settings in the dialog box will be applied to all existing plan or profile windows *for the current dataset*.

For example, suppose you were working with a regional gravity dataset and an aeromagnetic dataset and chose the **Window | Options** command when a plan view of the *gravity* dataset was active. If you configured the resulting dialog box as shown in the following picture, then clicking the **Apply** button would cause all plan windows of the *gravity* dataset to display bodies as wireframe, annotated with their ID number and description. Any plan windows of the *aeromagnetic* dataset would be unaffected.

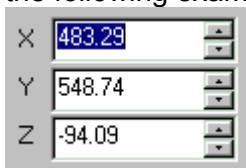


Use as default settings for new plan/profile windows

Potent dialog boxes that pertain to plan or profile windows generally have a check box labelled **Use as default settings for new plan windows** or **Use as default settings for new profile windows**, depending on which type of window the dialog box is associated with. If you check this check box, then click **OK** or **Apply**, the settings in the dialog box will be applied to any further plan or profile windows that might be created for the *current dataset*. The *current dataset* proviso has the same significance as for the **Apply to all existing plan/profile windows** option.

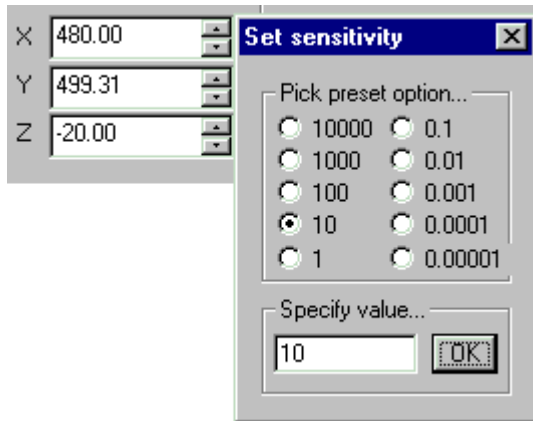
Adjusting numeric values

In *Potent* dialog boxes you set numeric values using edit controls such as those contained in the following example.



You can enter a numeric value either by typing the number or by clicking on the small arrows (“spinners”) to the right of the number field. To cope with floating point numbers, a spinner’s sensitivity to mouse clicks is user-definable, and is set by clicking the right mouse button on either of the spinner arrows.

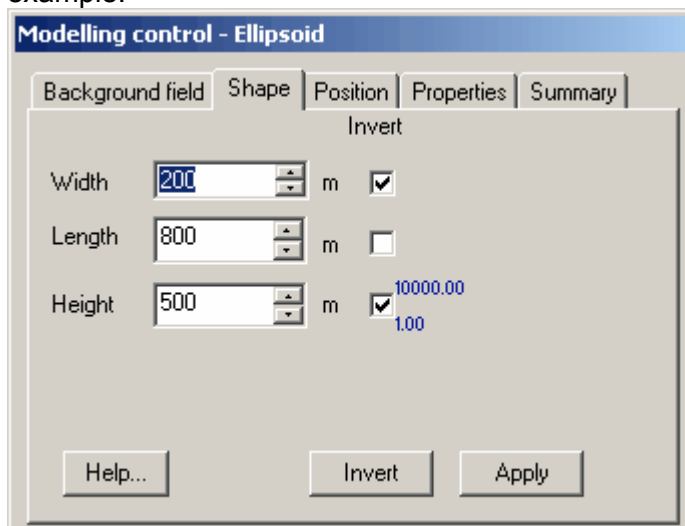
In the next example the user clicked the right mouse button on the spinner attached to the X edit control, for which the sensitivity was 10 (metres per click).



The sensitivity can be set to any of the pre-set values in the dialog box, or to a user-defined value. If you choose a pre-set value the dialog closes as soon as the associated radio button is clicked. Otherwise you must click **OK** to exit the dialog box.

"Invert" checkboxes

When doing **inversion modelling** you specify the parameters that you want the inversion to change by checking an associated **Invert** check box in the appropriate dialog box, as in this example.



In this case the **Height** parameter will be allowed to vary in the range 1m to 10000m. Refer to the **Invert flag** topic in the Glossary for details.

Working with Observations

Commands for working with observations are located in the **Observations menu**.

- What is an 'observation'?
- Importing observations
- Working with large datasets
- Regional field
- Dummy observations
- Datasets
- Subsets
- Exporting observations

What is an 'observation'?

An observation is a point in 3D space at which one or more values have been measured. An observation can contain some or all of the following values:

X, Y - Horizontal coordinates, in metres. These are often map grid coordinates. At least one of X or Y must be provided. An undefined value is set to zero.

Z - Height of the observation, in metres. This is relative to an arbitrary datum of your choice. If not defined it is set to zero.

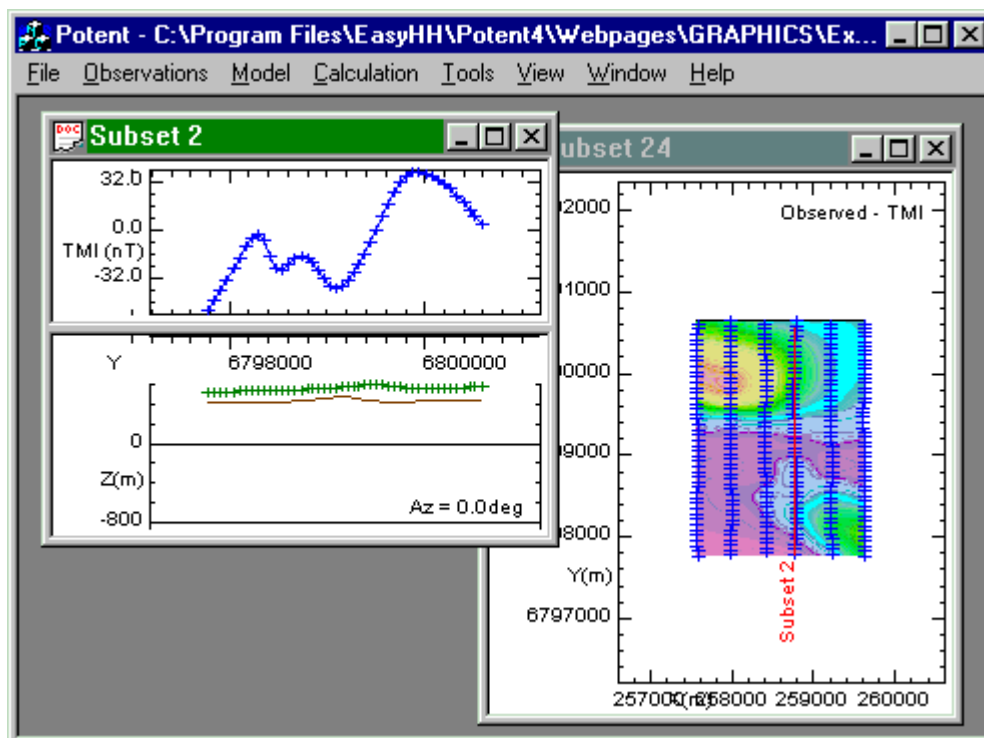
G - Ground clearance, in metres. This can be, for example, the height of the stinger or towed bird above the ground in the case of an airborne survey, or the water depth in the case of a marine gravity survey. If not defined it is set to zero.

F1..F6 - Up to six observed field values. These can be any combination of gravity and magnetic vector and tensor components, as well as the total magnetic intensity (TMI), horizontal magnetic intensity, the vertical gradient of TMI, and the magnetic analytic signal. At least one field value must be defined. Undefined values are ignored. (i.e. they are not merely set to zero; they do not feature in the modelling process at all.)

An observation serves two purposes:

- It provides a point at which one or more field values have been observed and can be displayed.
- It provides the spatial (X,Y,Z) coordinates at which *Potent* will calculate the field due to the model.

This example shows observed TMI data from a small fragment of an airborne survey. The observed values are depicted as an image and as a single N-S profile (labelled "Subset 2" on the plan). The observations are represented as blue crosses on the plan. In the profile window the blue crosses in the top pane represent the observed field values (TMI in this case). The bottom pane is used to depict the subsurface. The green crosses mark the actual position of the observation platform (the aircraft in this case). The line below the green crosses represents the topography, and has been generated by subtracting the ground clearance (radar altimeter) from the true (GPS) height.

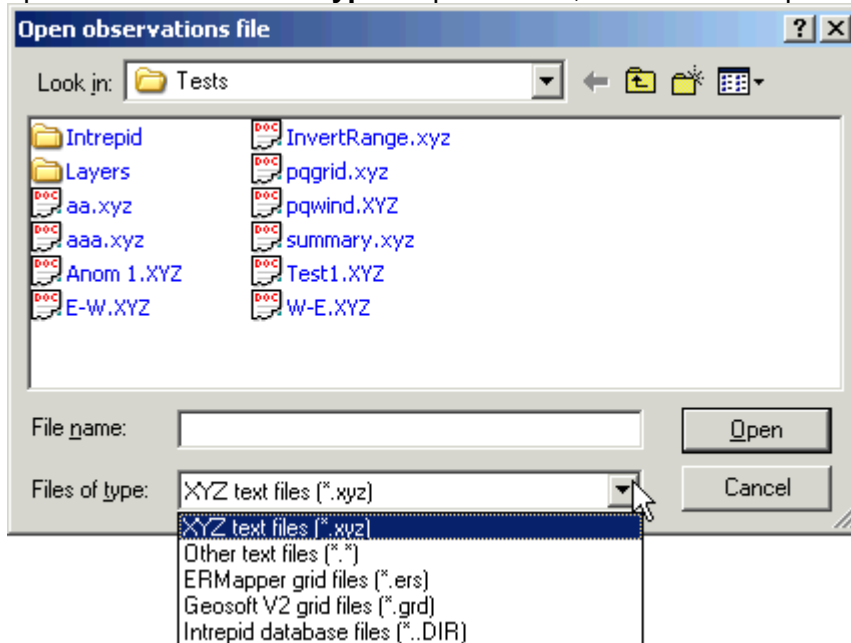


See also: [Coordinate axes](#)

Importing observations

You can import observations either as point-located data in which each value has an explicit set of (X,Y,Z) coordinates, or as gridded data in which case location is inferred from the grid geometry.

To import observations, click **Observations | Import**. This displays the standard Windows file-open dialog box. To specify the type of file that you are opening, select the appropriate option from the **Files of type** drop-down list, as in this example.

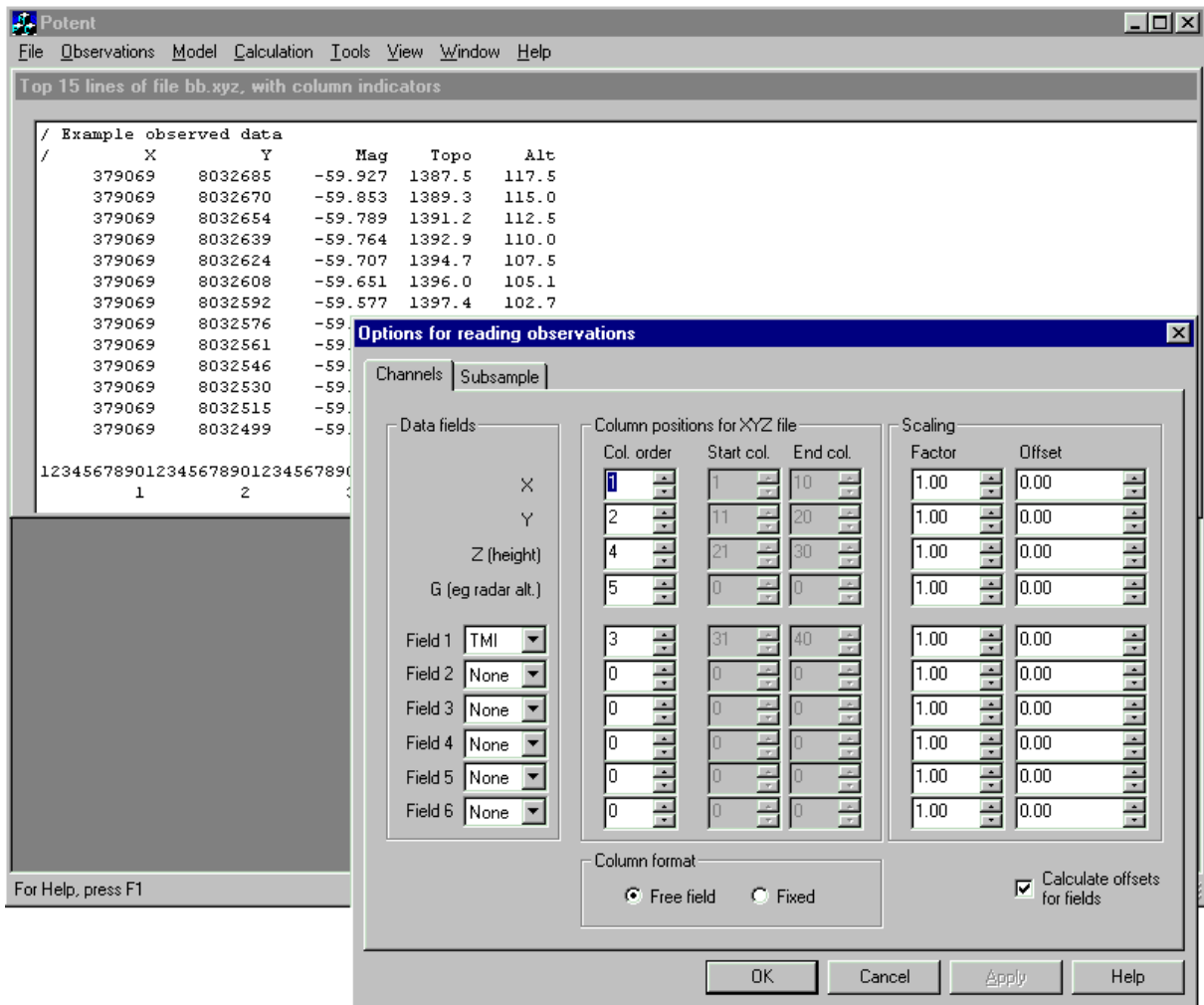


What follows depends on the type of file you specify:

- Importing from text files
- Importing from XYZ files
- Importing grids
- Importing from an Intrepid database

Importing from text files

Potent will look for data either in the form of columns delimited by spaces, tabs or commas (“free field” format), or as specific column ranges (“Fixed” format). You will be presented with a screen similar to this:



Potent lists the first few lines of the file and displays a dialog box that allows you to specify such things as the column position of the various fields. (Refer to the [Observations | Import](#) command for information about the dialog box.)

Note how in the above example the entries in the **Col. order** field in the dialog box reflect the actual columns suggested by the comment in the second line of the data file.

Lines in the data file starting with a “/” are ignored, unless it is the first line, in which case *Potent* uses it as the title for the **dataset**.

Importing from XYZ files

An XYZ file is a special kind of **text file** in which records starting with the word “Line”, or just “Li”, (not case-sensitive) signify the start of groups of data. These groups typically are flight lines, but can be used to represent other groupings such as drill holes or seismic traverses. In *Potent* terminology these lines become **subsets**. Predefining subsets in this way can greatly reduce the amount of work you need to do to visualise your data.

The following data file fragment illustrates the structure.

```

/ Example XYZ dataset
Line - 10
81654.9  48530.5  64.0  -2.05903  0.0
81895.8  48526.0  60.0  -2.46707  0.0
82137.5  48526.5  61.0  -2.51412  0.0
82380.2  48531.5  62.0  -2.43267  0.0
82622.9  48536.5  62.0  -2.03777  0.0
82865.1  48538.0  65.0   0.72153  0.0
83107.0  48529.5  62.0   8.77075  0.0

```

```

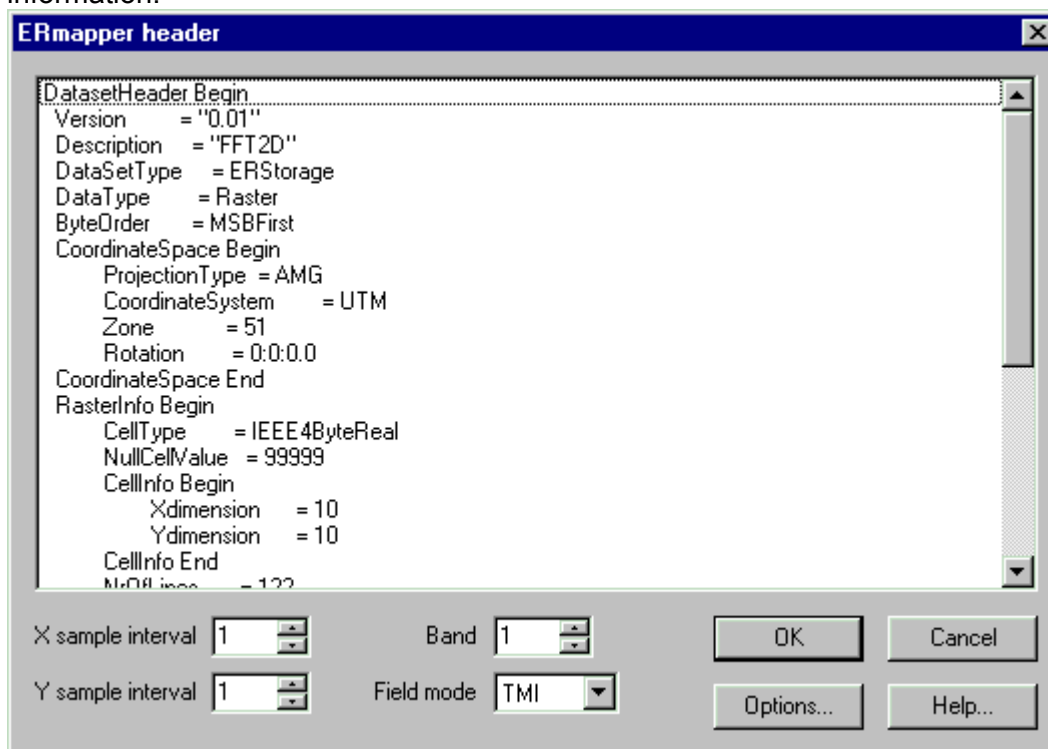
83346.9  48513.5  63.0  12.46111  0.0
83586.1  48498.0  64.0   4.37469  0.0
83823.4  48494.5  69.0  -0.35134  0.0
84058.6  48503.0  67.0  -1.12474  0.0
Line - 11
81384.2  48157.5  62.0  -0.37795  0.0
81628.5  48152.0  55.0  -0.74641  0.0
81872.8  48147.0  56.0  -1.08649  0.0
82116.7  48140.0  59.0  -1.44244  0.0
82358.1  48129.0  57.0  -1.97771  0.0
82597.5  48119.0  60.0  -2.81819  0.0
82885.4  48112.5  63.0  -4.29837  0.0
83174.9  48112.0  62.0  -5.61973  0.0
83416.3  48111.5  60.6  -5.52356  0.0
83703.7  48108.0  63.0  -3.86073  0.0
83942.3  48105.5  61.6  -2.31774  0.0
Line - 12
83253.6  47913.0  62.0  -3.91867  0.0
83271.6  48112.0  60.0  -5.79582  0.0
83319.9  48112.0  60.0  -5.76798  0.0
83310.6  48342.5  61.2  -1.90934  0.0
83346.9  48513.5  63.0  12.46111  0.0
83299.0  48517.0  63.0  12.98701  0.0

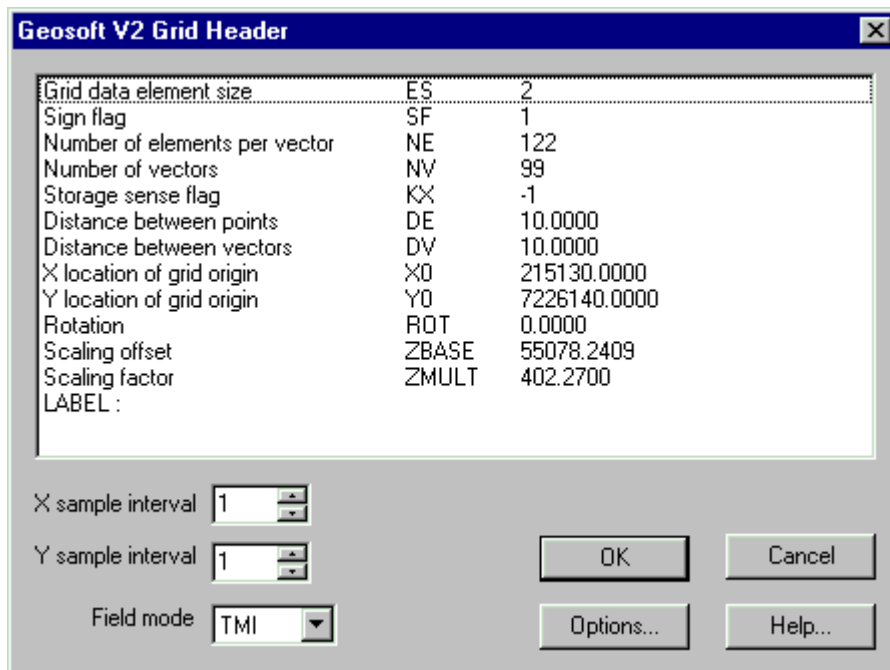
```

A *subset* is created automatically for each "Line" record in the XYZ file.

Importing grids

Potent recognises Geosoft v2 and ER Mapper grid files. (Compressed Geosoft grids are not supported.) When you import a grid file the appropriate header is displayed for your information:





It is important to understand that internally *Potent* represents each grid point as a normal (X,Y,Z,F) observation point, just as though it had been read from an ASCII file. This provides greater versatility for modelling but means that you will probably have to sub-sample large grids in order to avoid running out of memory and CPU performance. For example a grid of 1000 rows by 1000 columns would become 1 million observation points within *Potent*. Even with high-end hardware this would probably exceed your machine's memory capacity, and also would result in poor calculation performance in some situations.

The dialog boxes for each type of grid allow you to sub-sample by column (X) or row (Y). We suggest you use sub-sampling to keep the number of imported observations to less than 250,000. However, there is no inherent limit apart from those imposed by machine memory and the performance issues just mentioned.

Importing from an Intrepid database

Observations can be imported directly from an *Intrepid* database. Refer to the description of the *Observations Import* command in the Reference Manual for details.

Working with large datasets

Although *Potent* imposes no specific limit on the number of observation points that can be input, performance will degrade if too much data is loaded. The point at which this will become a problem depends on two main considerations:

- 1 Your hardware. Obviously, the more memory you have in your computer and the faster its processor, the more able it will be to handle a large amount of data.
- 2 How you use your data within *Potent*. This is less obvious. As long as an observation is merely being displayed, such as when you plot observation locations in a Plan window (even if you superimpose an image or contours of the observed field) then, with 2012 hardware, *Potent* can handle several hundred thousand observations with no problems. However, as soon as you ask *Potent* to calculate the model field at an observation point, the memory requirement for that observation increases dramatically, and in direct proportion to the number of bodies in the model.

This means that (if a model is present) there is a memory overhead for points that are displayed in profile windows if the calculated or residual field profiles are displayed, and on Plan windows if images of the calculated or residual fields are

displayed.

This section describes features of *Potent* that you can use to facilitate working with large datasets.

Load only the observations you need

Aeromagnetic data, for example, is typically oversampled. When reading XYZ data using the **Observations | Import** command, use the **Observations | Options | Subsample** dialog box to thin out observations along line and across line.

Reduce the amount of calculation

Potent calculates the field due to the model at observation points that are visible in non-minimised windows. Therefore minimising windows that have long profiles, or images of the calculated or residual field, will cause the remaining windows to update faster. The profiles and images in the minimised windows will be recalculated when they are restored.

Switch off automatic recalculation

Consider unchecking the **Calculation | Automatic** command, so that *Potent* only calculates the field due to the model when you click **Calculation | Recalculate now**. This can be particularly useful if you are using the **Body Shape** tool to set up a complex layered model, otherwise the field is recalculated whenever a body vertex is dragged.

Use the Window Observations tool

If you have a large dataset that contains a number of relatively small anomalies that you want to model in detail, consider using the following strategy:

- 1 Load the data for the entire area using a high level of **subsampling**. For example, if the dataset consists of 10 million observation points, then reading only every 20th point along line, and every 5th line, would reduce the number of points to around 100,000 while still providing a reasonable overview of the observed field.
- 2 Display the observed field image of this thinned data.
- 3 Use this image as a guide to using the **Window observations** tool to pick out the individual anomalies and load them with a lesser degree of subsampling.
- 4 When doing any **inversion modelling** remember to minimise the “overview” plan window, otherwise *Potent* will attempt to fit the model to the field over the entire survey area, rather than just the local anomaly.

Use Oasis montaj

Geosoft's Oasis montaj environment is well suited to displaying large datasets. If you have access to *Oasis montaj* consider running *Potent* via one of several custom **GX** applications. See “**Running Potent from Oasis montaj**” for more information.

Regional field

Overview

Removing a regional gradient - tutorial

Overview

This section describes how to use the Regional tool. Refer to the **Regional tool** section of the Reference Manual for detailed information about tool specifics.

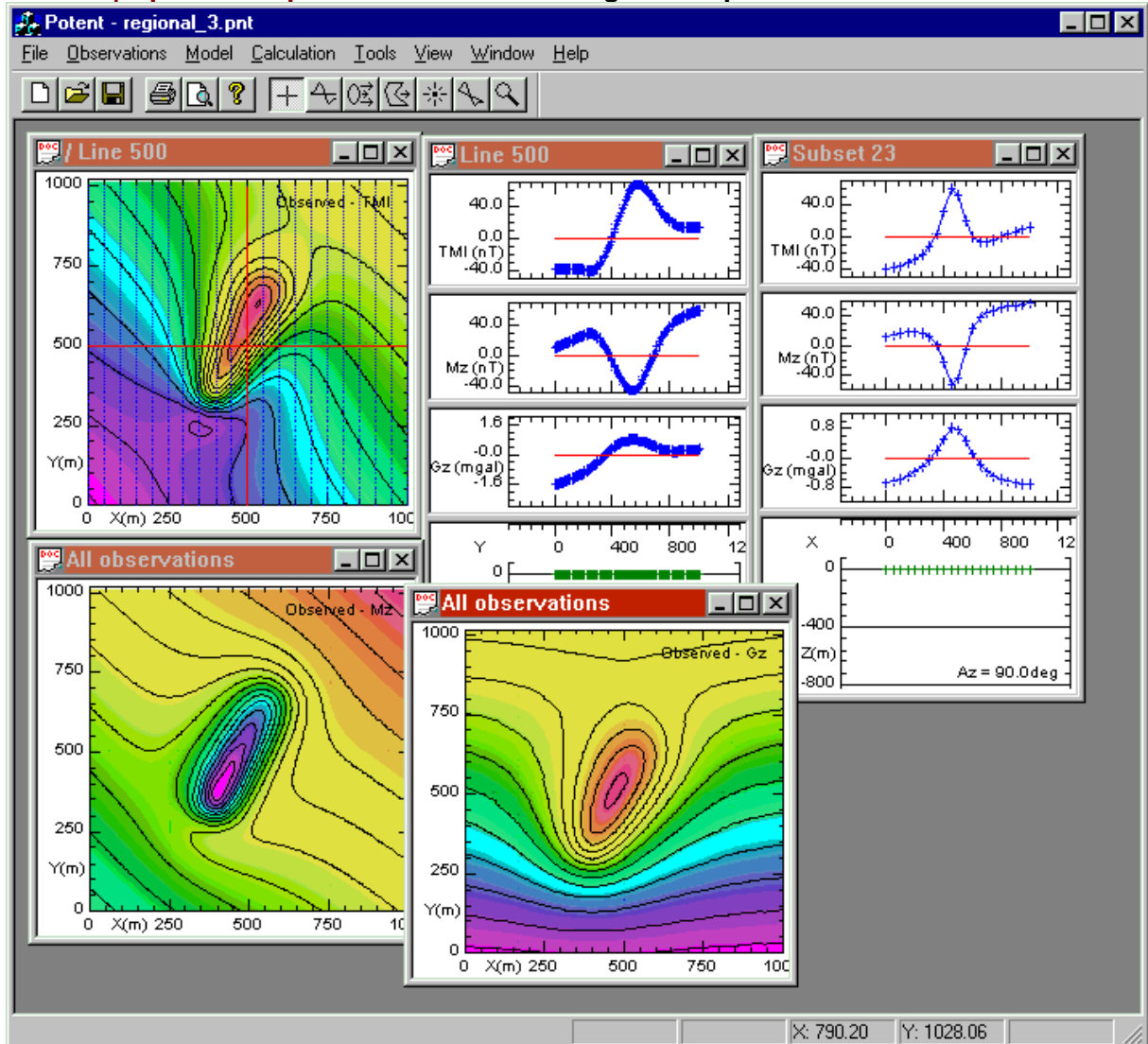
Observed values often have a regional background field superimposed on anomalies of interest. Such a background field might arise from deep sources that produce long-period anomalies that are of no interest in the context of your interpretation, or might be a constant offset deliberately introduced during the processing of the raw data. We shall refer to this background field as the “regional” field. Whatever the actual cause of the “regional” field it is necessary to remove it before effective modelling can be performed.

Potent allows you to remove the background field as a polynomial surface with a maximum degree of two. Although it is straightforward to generate higher degree surfaces, they carry the danger of introducing significant features into your data. We recommend a first-degree surface (an inclined plane) as the safest regional surface that is reasonably versatile as regards the direction of its slope.

Removing a regional gradient - tutorial

The example used in this section is based on the workspace "regional_3.pnt" that should be in your *Potent* installation directory.


1. Click **File | Open workspace** and load the file regional_3.pnt.

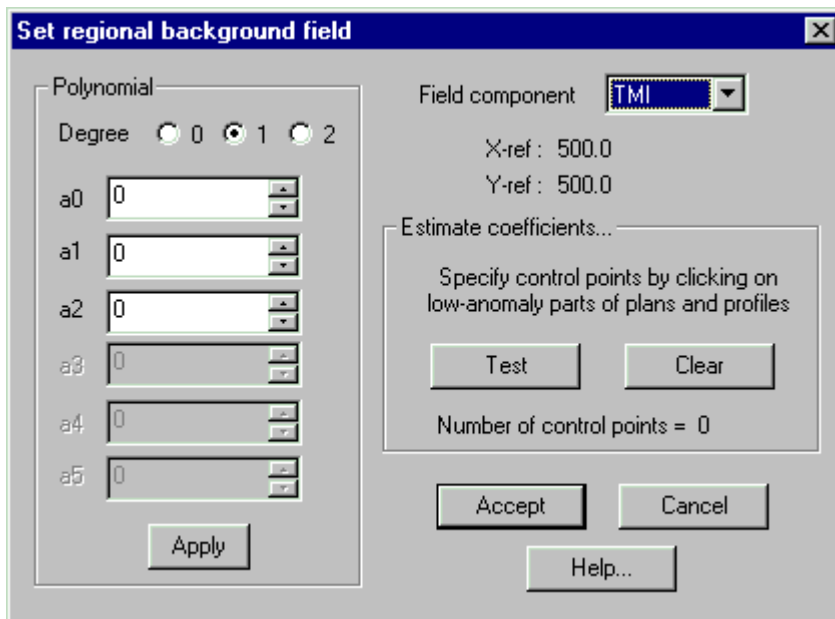


The workspace contains a single (synthetic) dataset consisting of 21 N-S lines. Three components have been observed - TMI, vertical magnetic field (Mz) and gravity (Gz). The three plan windows contain images of the three observed components. Two profile windows show N-S ("Line 500") and E-W ("Subset 23") sections.

The two magnetic components show regional fields trending S-W to N-E. The gravity field shows a N-S gradient.

2. Activate the **regional tool**, either from the toolbar or from the Tools menu.

This changes the cursor to the regional cursor, , and displays the Regional dialog box.

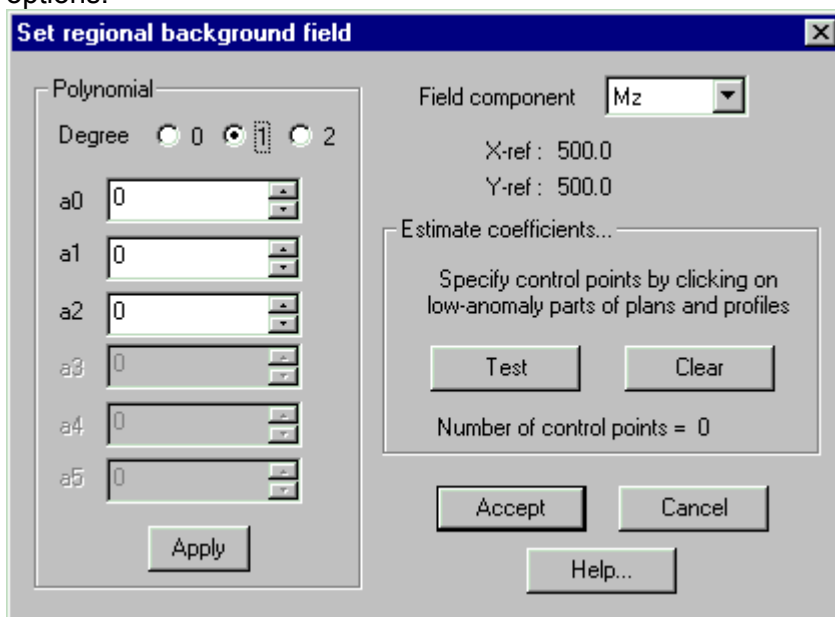


3. Choose a component

The regional must be set separately for each component. We shall start with Mz, so drop down the **Field component** list and click "Mz".

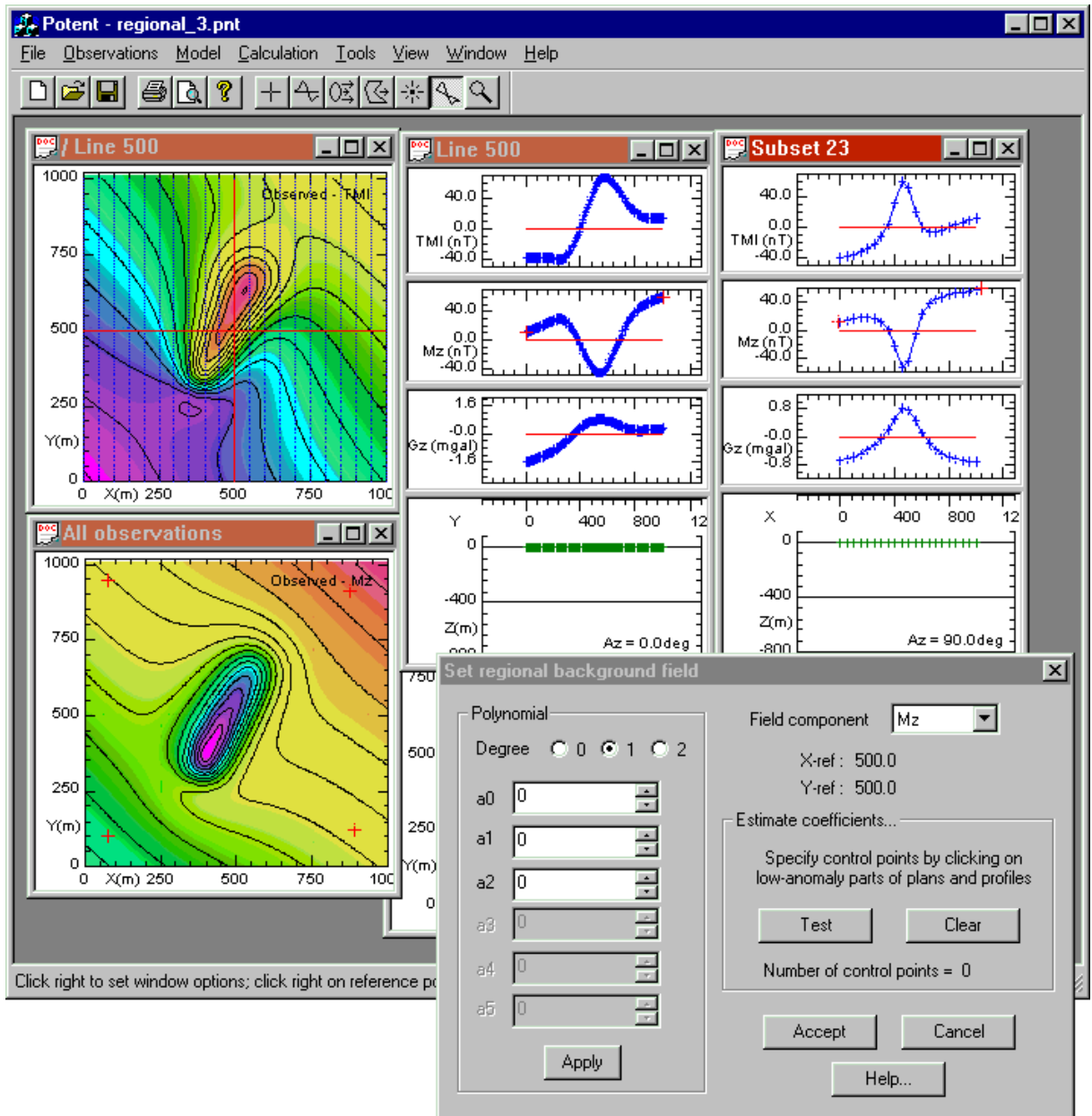
4. Specify a polynomial degree

A first-degree surface seems appropriate in this case, so choose "1" from the **Degree** options.



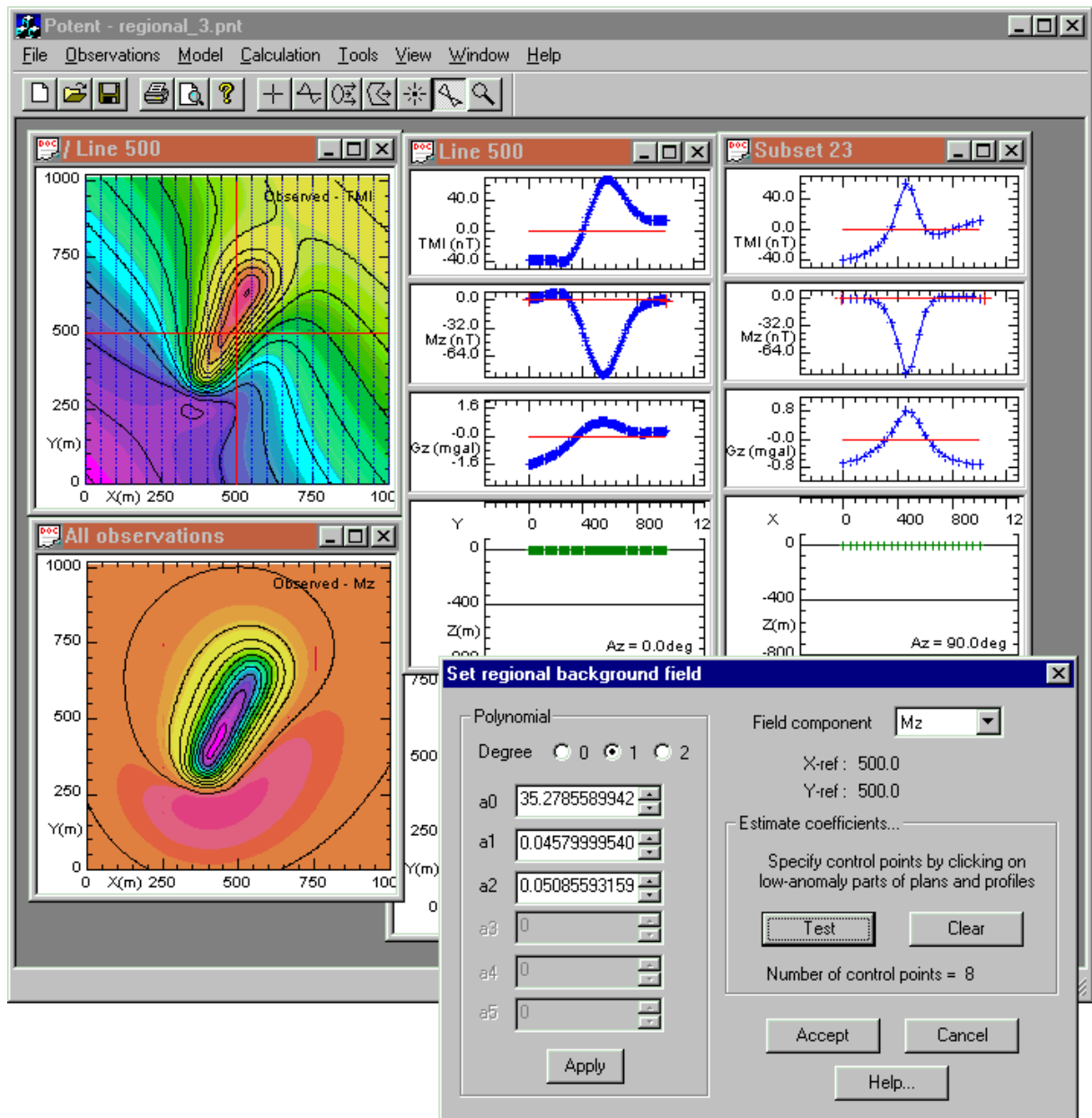
5. Set control points

Control points are used to simplify setting the polynomial coefficients. They are a set of points that *Potent* will fit a polynomial surface to (using root-mean-square minimisation). Keeping the Regional dialog box displayed, click on points on low-anomaly parts of Mz images and/or profiles. (A warning will be sounded if you click on windows or panes not showing the observed Mz field.) In this example we have set a point near each corner of the Mz image, and at each end of the Mz profiles. The control points are marked by red crosses.



6. Create the polynomial surface

Click **Test**. *Potent* calculates a first degree polynomial surface fitted to the control points and updates the Mz image and profiles. The coefficients appear in the a0, a1 and a2 boxes.



7. Fine tune the regional field

In the above example you would probably consider the result to be satisfactory. In a more realistic case you might either:

- Click **Clear** to reset the coefficients, then set new control points to calculate a new set of coefficients.

or...

- Fine tune the regional surface by adjusting the coefficients directly. If you do this using the **spinner buttons** the profiles will be adjusted dynamically. You must click **Apply** to adjust the image. (Before adjusting a1 or a2 you will probably need to reduce the spinner sensitivity by right-clicking the spinner button.)

The **Test** and **Clear** buttons can be used to try various configurations of the surface until a satisfactory one is identified, at which time the **Accept** button is clicked. This creates the polynomial surface as a root-mean-square "best fit" to the points that were identified. This surface will be removed from observed values whenever they are used or displayed.

Dummy observations

Dummy observations are created by the **Observations | Make** command. They are, like normal observations, sets of (X,Y,Z,G,F) values, but with the G and F values set to zero. You can use dummy observations to provide locations at which Potent will calculate the modelled field in situations where there is no actual survey data. This is useful in theoretical model studies, or in educational situations.

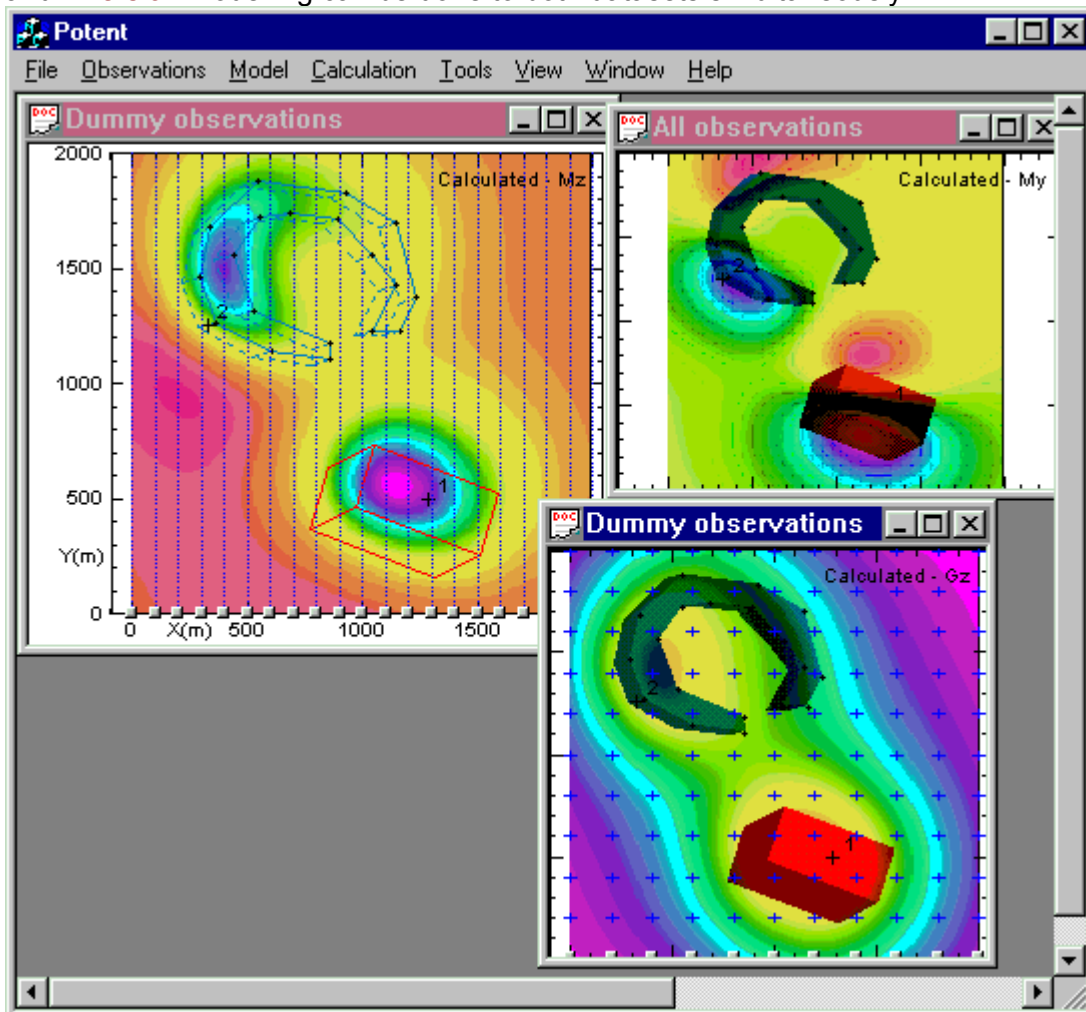
Datasets

When you use the **Observations | Import** command to load a data file the resulting data object within *Potent* is termed a **dataset**. The only limit to the number of datasets that you can have loaded simultaneously is that imposed by machine memory and performance. However, bear in mind that your workspace can quickly become very confused if you have more than three or four datasets open.

If you have loaded 3-component magnetic data from a down-hole survey and then also load the magnetic Z component by a subsequent use of the **Observations | Import** command, then *Potent* will contain two datasets, even though they come from the same source file.

On the other hand, if you load 3-component data for hole DDH001 from file DDH001.XYZ, and then use the **Observations | Merge** command to load 3-component data for hole DDH002 from file DDH002.XYZ, then *Potent* will contain only one dataset. Data from the two files is *merged* into a single dataset.

This (synthetic) example shows an airborne magnetic dataset (top two images) with a gravity dataset (bottom image). Notice that the model is common to both datasets, so that **forward** and **inversion** modelling can be done to both datasets simultaneously.



In order to reduce confusion when you have multiple windows open on multiple datasets, the title bars of all windows of a particular dataset have the same colour. *Potent* automatically

cycles through a set of 6 pre-defined colours as you create datasets either with the **Observations | Import** command or with the **Observations | Make** command. (Note, therefore, that the title bars of *Potent* windows do not take on the colour that is set by Windows' current colour scheme.)

Subsets

Subset buttons

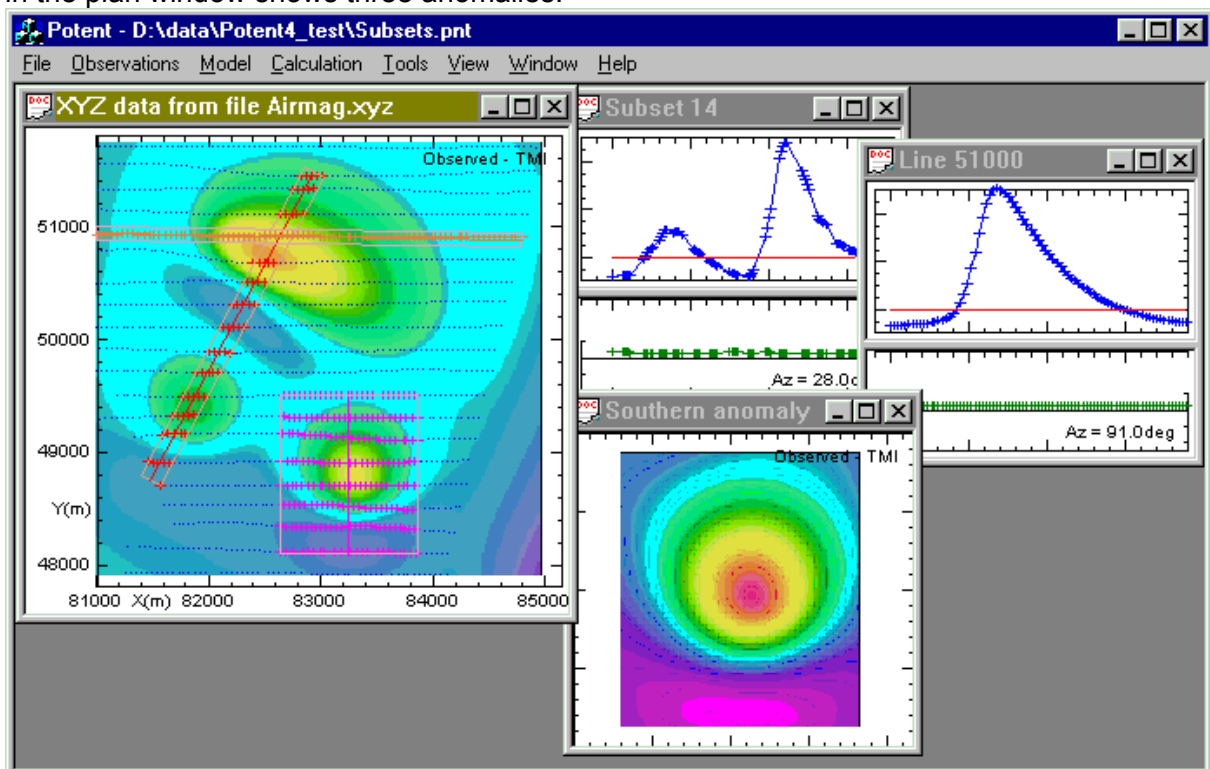
A subset is a sample of **observations** from a particular **dataset**. The subset consists of all the observations that lie within a rectangular or polygonal window. There are three ways to create a subset:

- A subset is automatically created for each line in an **XYZ file**.
- Use the **Subset – box tool** to define the rectangular window that encompasses the observations that you want to include in the subset.
- Use the **Subset – polygon tool** to create a window of arbitrary polygonal shape that encompasses the observations that you want to include in the subset.

Note that when a dataset is opened or created the entire set of observations is automatically assigned to a subset, which is given the title “All observations”. Any other subsets are in addition to this one.

Refer to the **Observations | Subset management** command for more information.

The following example shows a TMI dataset consisting of a number of E-W lines. The image in the plan window shows three anomalies.



Three subsets have been created to view the observations more effectively. The **Plan window | Options command (Subsets tab)** has been used to mark the subsets on the plan in the following ways:

- The observations that belong to the subsets are drawn with small crosses. The non-subset observations are marked by dots.
- The observations of each subset are drawn with their own distinctive colours.
- The “selection rectangles” that were used to identify the sampled observations are drawn in light grey. The centre-lines of the rectangles are drawn in a darker grey. (If

the subset was created using the **Subset – polygon tool** then there is no centre-line. Instead Potent uses the least-squares regression line in the XY plane.)

The windows on the right display the subsets. The subset name is used as the window title. “Line 51000” is the subset that was formed from a narrow E-W rectangle that just bracketed Line 51000. It has been displayed as a profile window.

“Subset 14” is the SSW-NNE profile that takes a cluster of observations from each of the lines it crosses. It has been displayed as a profile window, on which you can see the clustering of the observations from each line. For the purpose of displaying the profile, each of the observations is projected on to the centre-line of the selection rectangle.

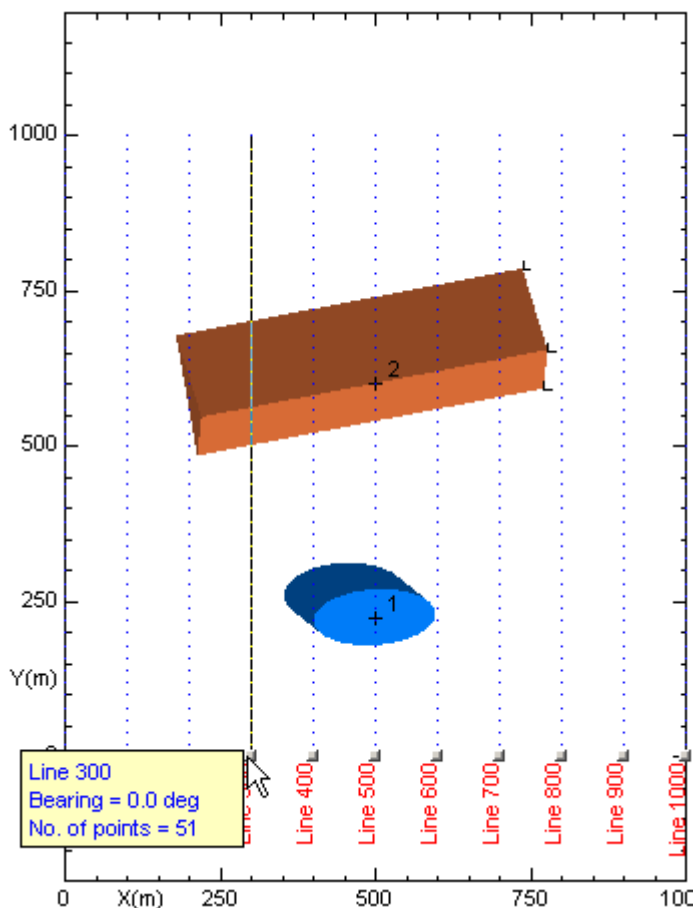
The subset named “Southern anomaly” used a much wider selection rectangle and so has been displayed in a plan window. The image shows the anomaly in more detail and at a greater colour stretch.

Note that once a subset has been created it can be displayed in any number of windows of any type by using the **Observations | Subset management** command.

See also - [Why is the observed field profile spiky?](#)

Subset buttons

On Plan windows a subset may have a small button at the end of its centre-line. In this example, which uses observations imported from an XYZ file, there is a subset button at the southern end of each subset



The presence of these buttons is an option in the **Plan window | Options command (Subsets tab)**.

Subset buttons have several uses:

- Hover the cursor over the button to display information about the subset (as shown for Line 300 in the example shown above).
- Left-click on a button to create a profile window for the subset.
- Hold down SHIFT and left-click on a button to create a plan window for the subset.

- Hold down CTRL and left-click on a button to create a down-hole window for the subset.
- Right-click on a button to display the **Subset attributes** dialog box.

Exporting observations

You can export **observations** belonging to one or more **subsets** to an ASCII file.

- Click **Observations | Save subset(s) as**.
- In the file dialog, click **Options** to specify how you want the observations to be saved and which subsets you want to be included. Click **Open** when done.
- Specify a name for the new file. Click **OK** when done.

There are several reasons that you might want to export observations:

- The output file might be a more manageable size, as it contains only the data belonging to that **subset** (which might be a small fraction of the size of the original dataset).
- The output file can contain observed values that have had the regional background field removed. After you have set up a suitable background field (using the **Tools | Regional** command), you might want to save the “regional-removed” observations for future use.
- You can include the calculated field in the output file so that it is available to other programs.

Working with the model

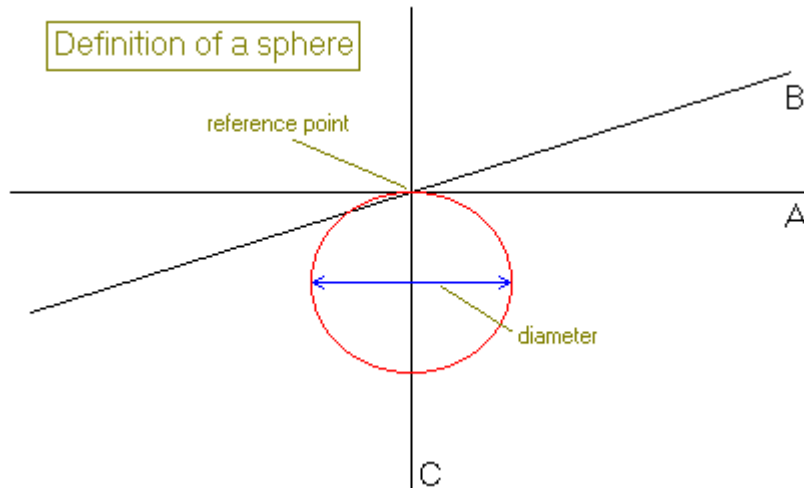
A *Potent* model consists of one or more discrete bodies. For example, you might use an ellipsoidal body to represent a lenticular orebody, or a polygonal prism body to represent a single stratum in a stratigraphic model. (*Potent* has several features aimed at facilitating work with layered models, such as are used in petroleum exploration. Refer to **Working with stratigraphic models** for details.)

Types of body
 Body attributes
 Editing a body graphically
 Editing a body numerically
 Calculating the field due to the model
 Forward modelling
 Inversion modelling
 Calculation algorithms

Types of body

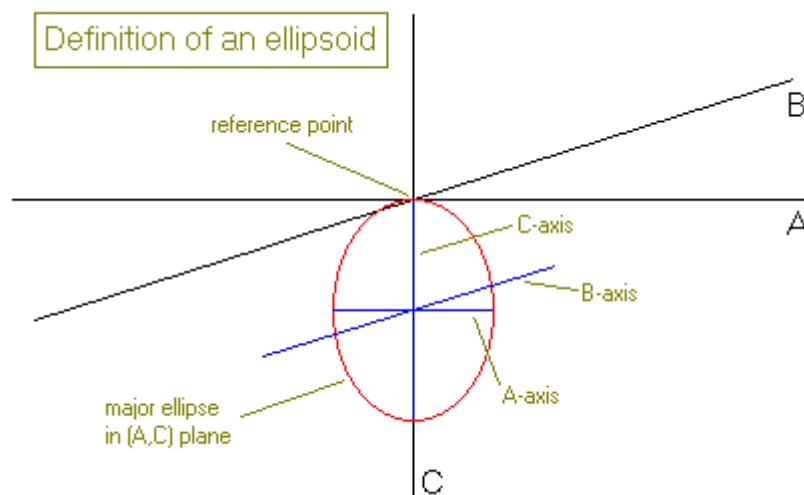
Sphere
 Ellipsoid
 Lens
 Rectangular prism
 Cylinder
 Polygonal prism
 Dyke
 Slab

Sphere



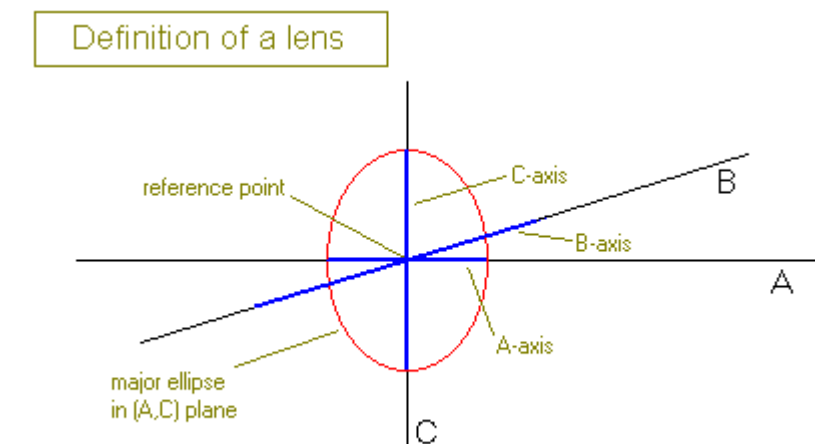
See also - [Edit Body Shape](#) in the Reference document

Ellipsoid



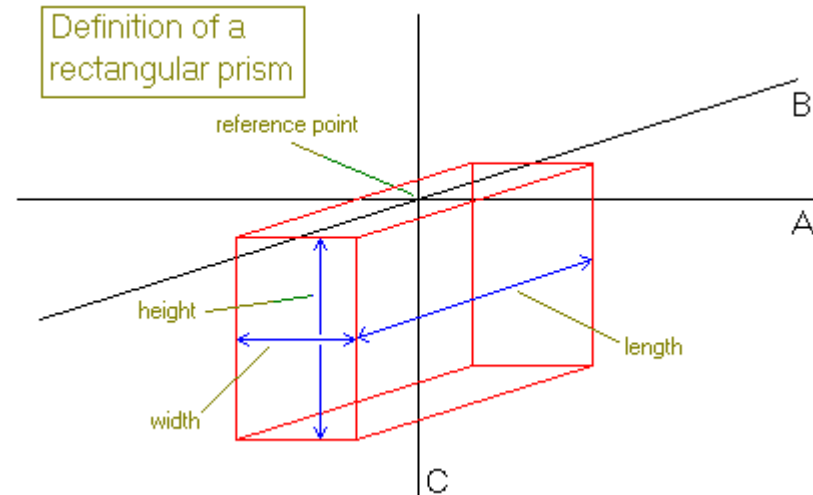
See also - [Edit Body Shape](#) in the Reference document

Lens



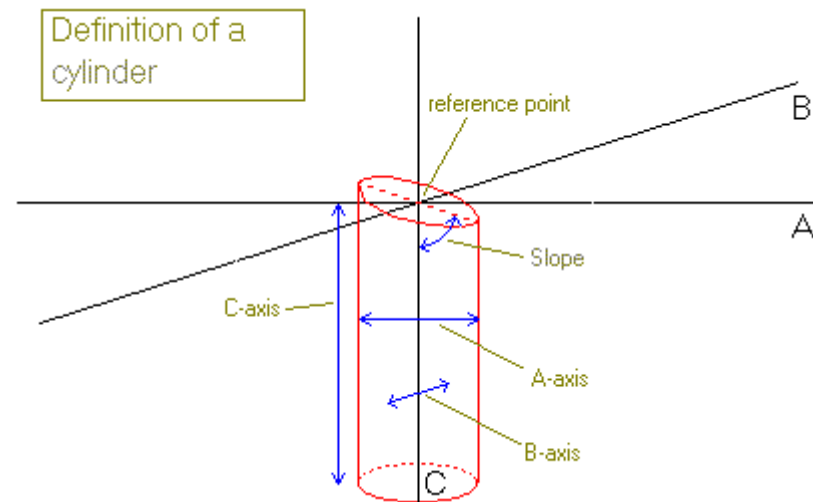
A lens is identical to an ellipsoid apart from the fact that its **reference point** is at its centre, rather than at the top. This means it pivots about its centre, not its top, when it is rotated. See also - [Edit Body Shape](#) in the Reference document

Rectangular prism



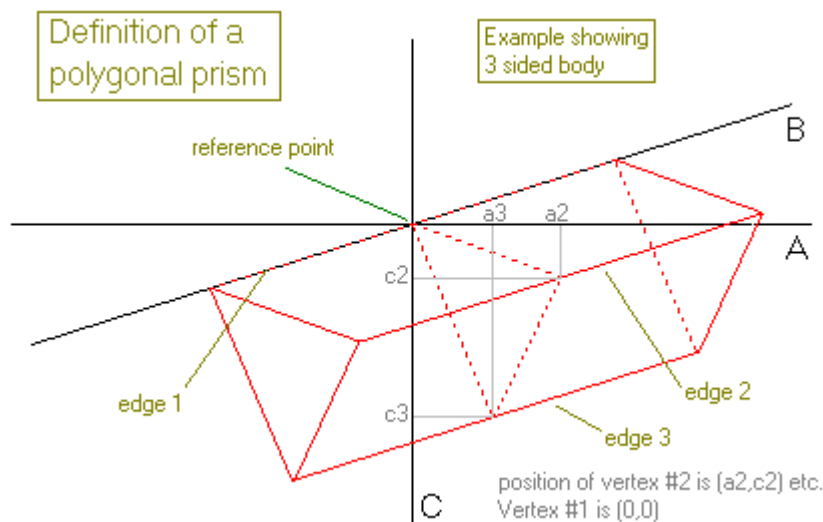
See also - [Edit Body Shape](#) in the Reference document

Cylinder



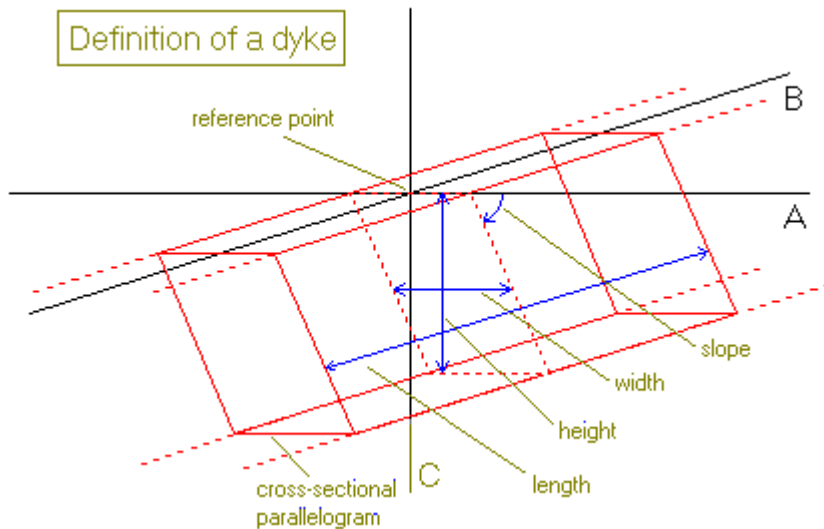
See also - [Edit Body Shape](#) in the Reference document

Polygonal prism



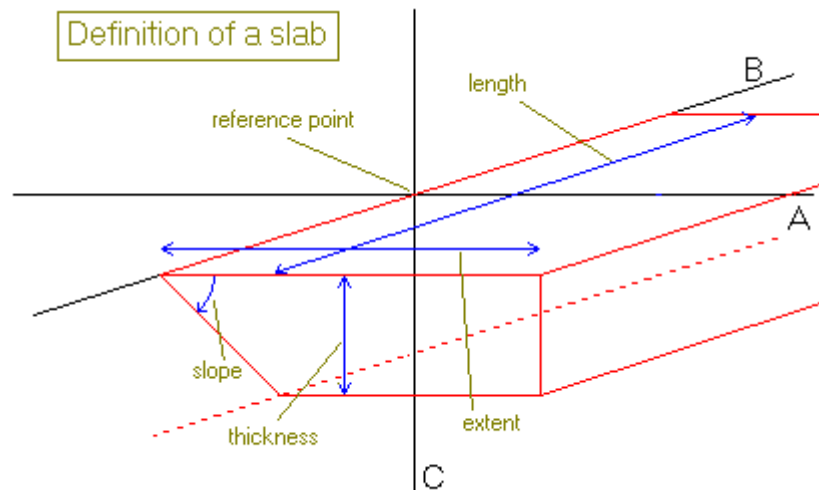
See also - [Edit Body Shape](#) in the Reference document

Dyke



See also - [Edit Body Shape](#) in the Reference document

Slab



See also - [Edit Body Shape](#) in the Reference document

Body attributes

- General
- Position
- Physical properties
- Body Shape

Body attributes - General

The [Edit Body | General](#) dialog allows you to set attributes of the body such as **status**, annotation and colour. Note that when you first create a body you must set its status to Active if you want its field to be calculated.

Body attributes - Position

Set the position of a body either graphically using the [Move Body](#) tool, or numerically using the [Edit body | Position](#) dialog box (as described in [Editing a body numerically](#)).

The position of a body is set by specifying the position and orientation of its (A,B,C) axes on the (X,Y,Z) axes. A body may have up to three degrees of rotational freedom - strike, dip and plunge. When all three are equal to zero degrees, the (A,B,C) axes are parallel to the (X,Y,Z) axes. From this starting position a body may be rotated as follows:

The body is rotated CLOCKWISE through the **strike** angle about its +C axis;
The body is rotated CLOCKWISE through an angle of **dip** degrees about its +B axis.
The body is rotated ANTI-CLOCKWISE through the **plunge** angle about its +A axis.
If +Y is directed to the north and the body's strike is along its +B axis then this rotation scheme can give strike, dip and plunge angles that are similar to their conventional geological definitions. However, this depends on the relative proportion of the body dimensions.

You can visualise the rotation scheme by creating a 3-D rectangular prism type body and then observing its changing orientation when it is subjected to various rotations.

Body attributes - Physical properties

The parameters that define physical properties are set using the **physical properties** dialog box.

If you are doing gravity modelling, then you must set the density to an appropriate value. Units are tonnes/m³ (which is numerically identical to gms/cc). As *Potent* calculates gravity anomalies, you would usually enter the density contrast rather than the true density.

However, if you use the **Model | Background physical properties** command to set a background density, then you enter the true density in the dialog box. (In this case, *Potent* subtracts the background density from the body density when doing calculations.)

When doing magnetic modelling you can set susceptibility (isotropic or anisotropic, making approximate allowance for demagnetisation) as well as remanent magnetisation. All units are SI, as indicated by the dialog box text.

Body Shape

The body types used by *Potent* are distinguished by their shapes.

The shape of a body is defined in terms of its own (A,B,C) **coordinate system** (see for example Clark et al, 1986). The origin of (A,B,C) is the "reference point" of the body, as it is the point around which the body is defined.

See also - **Types of body**, and **Edit Body Shape** in the Reference document

Editing a body graphically

There are two ways of editing a body graphically:

- Use the **Move Body tool** to drag the entire body around on any plan or profile window.
- Use the **Body Shape tool** to adjust the position of individual vertices of bodies that have a polygonal cross-section. These are the **polygonal prism**, the **dyke** and the **slab**.

Editing a body numerically

You can edit the properties of a body numerically in either of two ways:

- Click **Model | Edit model** and select the body from the list in the resulting dialog box.
- Position the cursor over the small cross that marks the reference point of the body (any window will do) and click the right mouse button.

In each case *Potent* displays the **Body properties** tabbed dialog box, which allows you to edit every attribute of a body.

Calculating the field due to the model

When the **Calculation | Automatic** menu option is checked, *Potent* automatically calculates the field due to the model in response to changes you make to the model. Recalculation is done in response to the following events:

- A body is dragged with the mouse and dropped in a new position.
- A vertex of a **polygonal prism**, **dyke** or **slab** is dragged with the mouse and dropped in a new position.

- The inducing field is changed using the **Model | Inducing field** command (in the case of magnetic field components).
- The OK or Apply button is clicked in the **Model | Edit model** dialog box.
- A minimised profile window is restored, and the model has changed since it was minimised.

When the **Calculation | Automatic** menu option is **not** checked, the field due to the model is calculated only when you click **Calculation | Recalculate now**.

Forward modelling

Forward modelling takes place when you manually adjust model parameters in order to improve the fit between the observed field and the calculated field due to your model. You adjust model parameters either by dragging with the mouse (using the **Move Body tool** or the **Body Shape tool**) or by using the **Edit body** dialog box.

When forward modelling, *Potent* calculates the field according to the following scheme:

- The field due to altered bodies is calculated for observations that are visible in profile windows (i.e. minimised profile windows are ignored). If the observation is contained in more than one profile window, its associated field is calculated only once. This means that there is no calculation overhead in having multiple profile windows visible for a particular subset – all the calculations will be done for the first one, and the results used by the remaining ones.
- When **any** change is made to the model (even, for example, a single parameter of one body), the field due to the **entire** model is calculated at observations that are visible in any plan windows that have an image of the **calculated** or **residual** field displayed. (i.e. minimised plan windows are ignored). The calculations are repeated for each such visible plan window. Therefore there is a calculation overhead associated with having multiple plan windows visible if they contain images of the calculated or residual field. This overhead becomes large if the plan windows contain many observations. Work around the problem by keeping the windows minimised, and restoring them only when you want to see the images.

Inversion modelling

During inversion modelling, *Potent* automatically adjusts nominated model parameters so as to improve the fit between the observed and calculated fields.

Refer to the **tutorial** in the *Getting Started* document for a simple inversion example.

Steps for inversion modelling are:

- 1 Set up your observations and model as described in **Working with Observations** and **Working with the model**. Try to obtain a reasonable match between observed and calculated fields.
- 2 Edit each body of the model and set the **invert flag** associated with each parameter that you want the inversion to optimise. (When setting the Invert flag you also have the opportunity to set a range within which the value will be allowed to vary.) For **polygonal bodies** you will probably choose to use the **Invert tool** to set up inversion on body vertices.
- 3 Open windows that contain only the observations that you want to be used as data during the inversion. Minimise any other windows to suppress their involvement in the inversion process. The open windows can be any combination of plans and profiles from any of the datasets you have open. For example, you could invert on regional gravity data concurrently with aeromagnetic TMI data. It is immaterial whether or not a plan window has an image displayed. (In fact it is advisable not to have an image of the calculated field displayed as it would be recalculated at each inversion iteration.)
- 4 Consider using the **Inversion weights** tool to set the relative importance of sections of observations.

- 5 Click "**Calculation | Invert options**". Use the first page to set the maximum number of iterations. There is one other page for each dataset you have open. Use these pages to nominate those channels that you want to be involved in the inversion. You can also set weights that specify the relative importance of each channel. For example if you have gravity data with peak anomaly amplitude of 10mgal and a TMI dataset with amplitude 1000nT you might want to set the relative importance of the gravity channel to 100 to compensate for the numerical discrepancy in the anomaly sizes when the inversion algorithm is calculating the RMS error.
- 6 Click **Calculation | Invert**. The inversion proceeds until: 1) convergence stops, 2) the specified number of iterations is reached, 3) you press the Esc key.

Potent imposes no limit on the number of parameters (NP) or observation points (NV) that are used during inversion. However, remember that memory usage is approximately proportional to NP*NV, and that inversion time is approximately proportional to NP*NP.

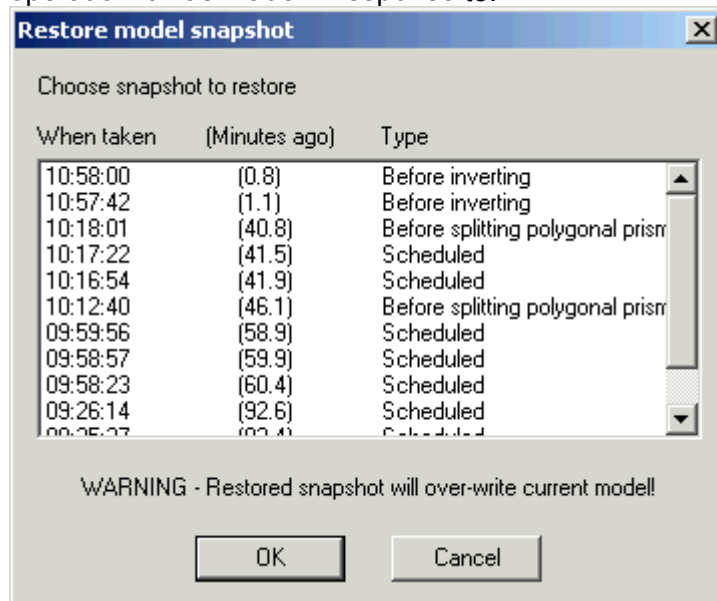
Undoing changes to the model – snapshots

Potent does not have an explicit "Undo" command; such a feature is impracticable due to the complexity of changes that can be applied to the model. Instead there is a "snapshot" feature. A snapshot is simply a copy of the model.

Potent saves snapshots under various circumstances. You can quickly revert to an earlier version of your model by using the **Restore from snapshot** command. A snapshot is taken in the following situations:

- Time based snapshots are enabled and a specified number of minutes has elapsed since the previous snapshot. (The snapshot will be taken the next time the model changes.) The **Preferences** command provides options for controlling time based snapshots.
- The **Save snapshot** command in the Model menu is clicked.
- An inversion is about to start.
- A polygonal prism is about to be split.
- Two polygonal prisms are about to be merged.
- A new model is about to be loaded (**Model | Open** command).

Up to 100 snapshots may be saved. The **Restore from snapshot** command lists all available snapshots. Each snapshot has information about when it was taken, and what type of operation it was made in response to.



Calculation algorithms

The gravity and magnetic calculations for the 2D versions of slab, dyke, and polygonal prism are all based on the well-known and readily derivable formulas for the anomalies due to a semi-infinite slab. See for example [Grant and West \(1965\)](#). Field values calculated inside the bodies are not valid.

The gravity calculation for the sphere uses the fact that the gravitational effect at external points is equal to that of a point of the same mass located at its centre. The magnetic calculation for the sphere uses the fact that the magnetic effect at external points is equal to that of a point dipole of the same magnetic moment located at its centre. The demagnetisation effect is calculated using the correction formula described in [Emerson, et al \(1985\)](#). Field calculations are valid both outside and inside the sphere.

The gravity and magnetic calculations for the ellipsoid use the formulas given by [Clark, et al \(1986\)](#) for the case in which all axes are of different lengths. If the length of any axis is within 1% of the length of another then temporary length adjustments of 1% are applied to make all axes lengths different for the purpose of calculation. The demagnetisation effect is calculated using the correction formula given in the same paper. Field calculations are valid both outside and inside the ellipsoid.

The rectangular prism is a special case of a finite-length polygonal prism (see below). A formula for its gravitational effect is given by [Nagy \(1966\)](#). The formula for the magnetic effect of a 3D rectangular prism was derived along lines similar to those of [Bhattacharyya \(1964\)](#). Approximate demagnetisation corrections are calculated using the formula given by [Emerson, et al \(1985\) \(p65\)](#). Field values calculated inside the body are not valid.

The field due to the cylinder is approximated by that of a series of juxtaposed rectangular prisms. Approximate demagnetisation corrections are calculated using the same formula used for the rectangular prism. The validity of the approximation is not known, but it is assumed that using the correction produces results that are more accurate than would be obtained if demagnetisation were ignored completely. Field values calculated inside the body are not valid.

The gravity calculations for 3D versions of the slab, dyke, and polygonal prism use the formula of [Cady \(1980\)](#) for the component of the field normal to the axis of the prism. The field calculation is exact at any point external to the prism. If the prism has non-zero plunge or the dip is not 90 degrees then the other two gravitational components are calculated using numerical integrations. This increases calculation time considerably. Field values calculated inside the bodies are not valid.

To our knowledge there is no formula in the literature for the magnetic effect of a finite length polygonal prism at an arbitrary point external to it. The formula of [Shuey and Pasquale \(1973\)](#) is valid only in the plane of symmetry of the prism and so is inadequate for Potent's 3D approach. Instead the calculation has been programmed in two stages. Firstly, two orthogonal field components normal to the axis of the prism (the A and C components) are calculated using formulas derived along the same lines as that given by [Cady \(1980\)](#) for the gravity case. The component along the axis of the prism (ie. along the B axis) cannot, we believe, be expressed analytically and so is evaluated using a numerical integration. The demagnetisation effect is taken as zero. Field values calculated inside the body are not valid. Gradients and tensor components are calculated using a simple numerical differentiation. The field is calculated at the usual place, then recalculated at a position displaced slightly in the direction of the required gradient. The two values are then divided by the shift in distance to give the gradient. This strategy clearly can become inaccurate when the field gradient is not uniform, such as when a body is near to a the observation point at which the calculation is taking place. Such inaccuracies usually appear as spikes in the calculated field profiles, and so are obvious to the user.

The magnetic Analytic Signal AS is calculated from the formula

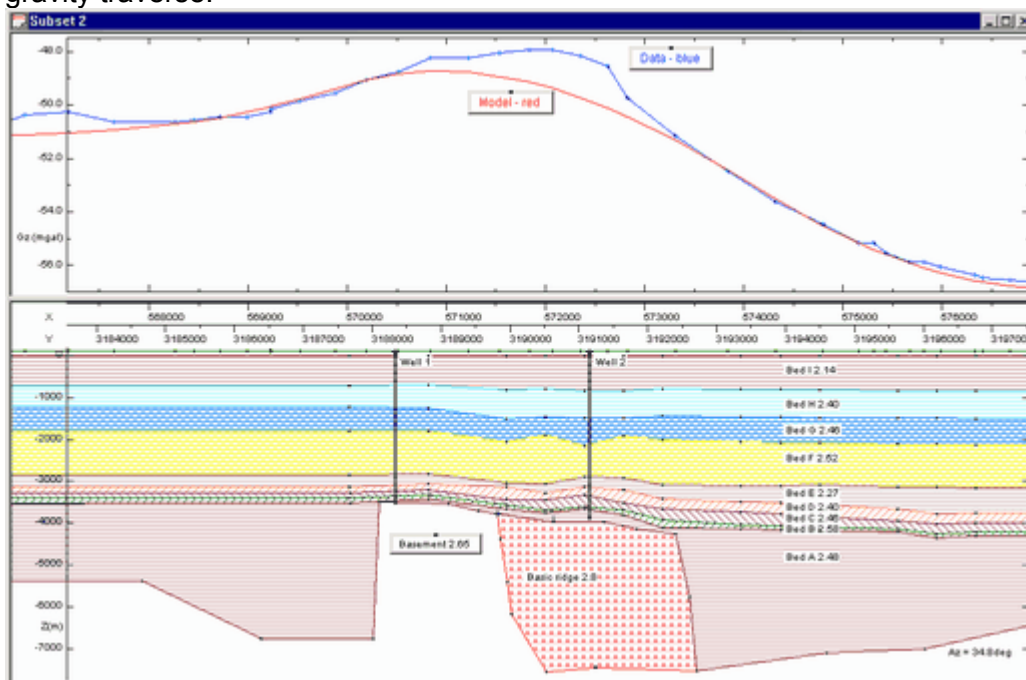
$$AS(x, y, z) = \sqrt{\left(\frac{\partial T}{\partial x}\right)^2 + \left(\frac{\partial T}{\partial y}\right)^2 + \left(\frac{\partial T}{\partial z}\right)^2}$$

where T is the calculated TMI at (x, y, z). (See, for example, [Paine et al \(2001\)](#)).

Working with stratigraphic models

Potent was originally designed as a tool for modelling gravity and magnetic data in a mineral exploration context. That is why the model is constructed from discrete bodies such as ellipsoids and prisms, which are well suited for representing orebodies and “blocky” geological structures.

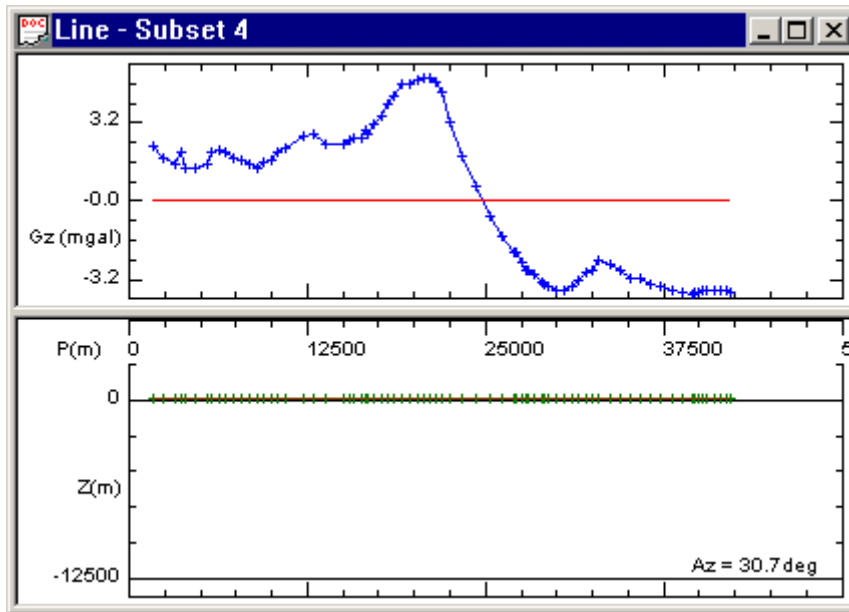
However, several *Potent* releases have introduced features that are aimed at facilitating the type of stratigraphic modelling that is used in petroleum exploration, as in this example of a gravity traverse:



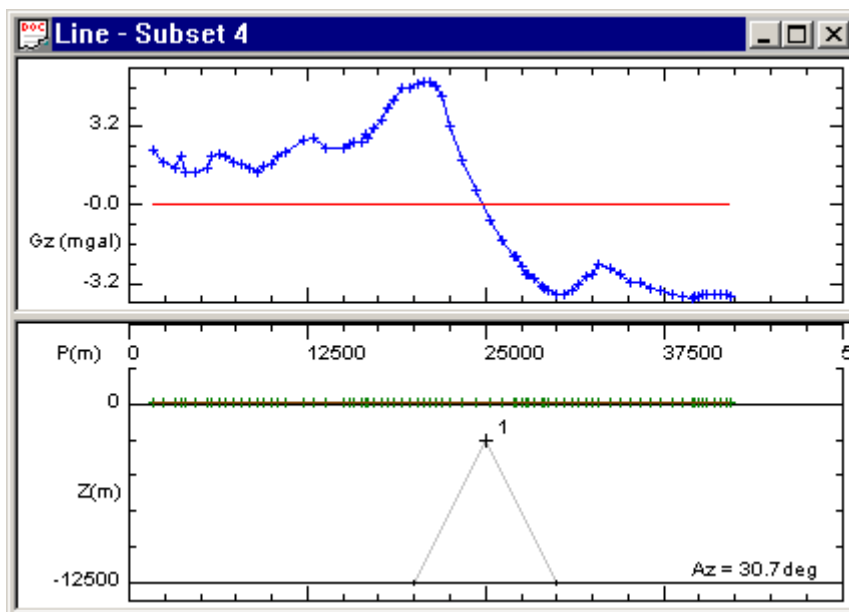
In *Potent* a stratigraphic model typically consists of several juxtaposed **polygonal prisms** bodies. In the example shown above each layer is a polygonal prism.

If you have a digitised stratigraphic section you might consider using the **Model | Import as interfaces** command, which provides a rapid, interactive way of setting up a complex model. Alternatively, such a model could be set up along the following lines:

- 1 **Import your data** and create a single **profile window**. Consider minimising the **plan window**.

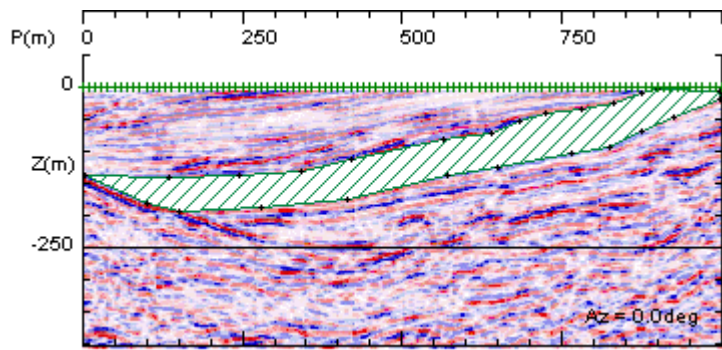


- 2 Create a **polygonal prism** body. (**Model | Create | Polygonal prism** menu command.) The newly created body has a triangular cross-section (the simplest polygon) and is positioned near the centre of the cross-section pane.

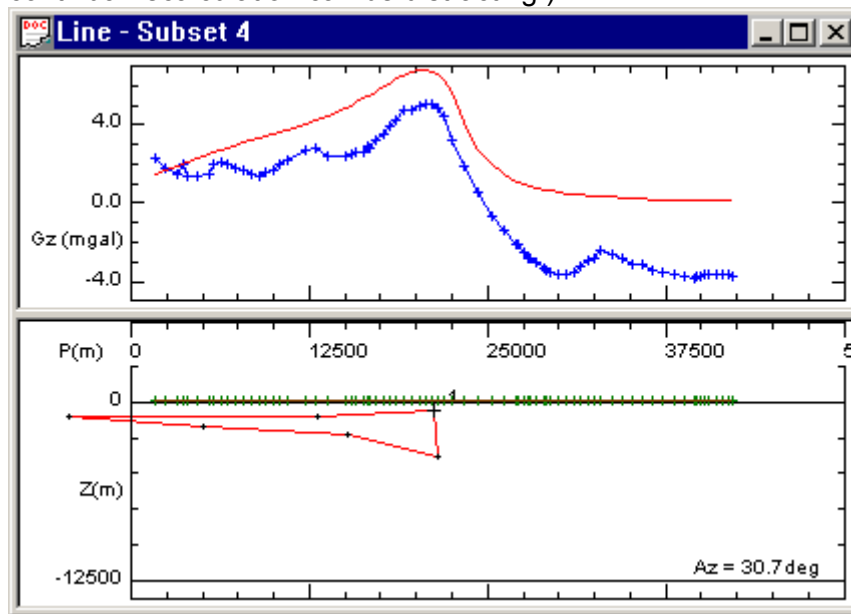


The body is created with infinite strike extent ("2D"). Use the **Shape** tab of the **Edit body** dialog box to change this to a finite length if required (but remember that this will increase calculation time substantially). You can also use the **Edit body** dialog box to set the physical properties of the body, as well as attributes such as Description, Colour and Fill Pattern.

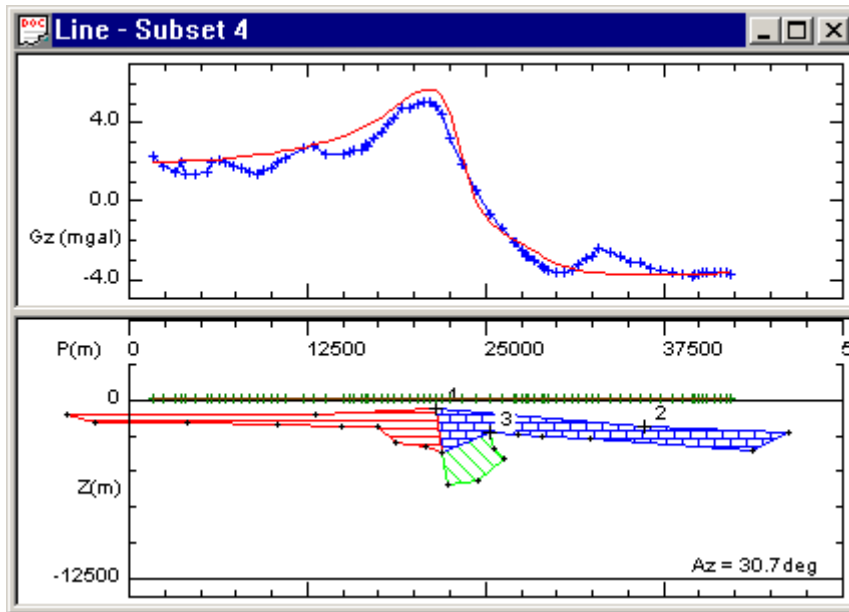
- 3 Consider unchecking the **Calculation | Automatic** menu command so that the calculated field is not updated every time you edit a polygon vertex. You can click **Calculation | Recalculate now** to update the calculated field as required.
- 4 Consider adding a **backdrop image** such as a seismic section, to use as a guide when drawing your model.



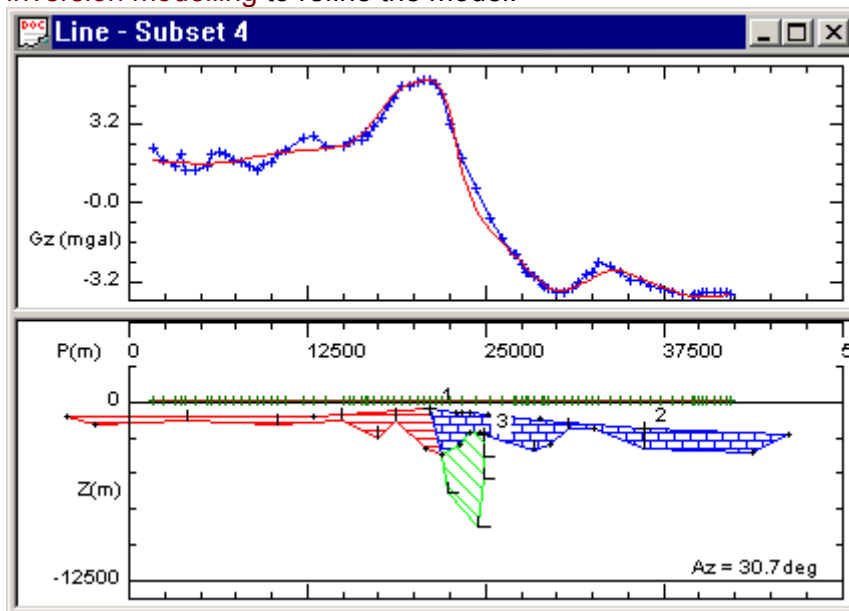
- 5 Use the **Body shape** tool to create a suitable shape. (You may or may not make the body **Active**. If you do, the calculated field will change as you edit the body, but the continual recalculation can be distracting.)



- 6 Create the next body, either by choosing the **Model | Create | Polygonal prism** menu command again, or by cloning the previous body using **Clone** button in the **Edit model** dialog box.
- 7 Edit this body as before, but in this case you might want to connect vertices to form interfaces between bodies, as described in the description of the **Body shape** tool.
- 8 Continue adding polygonal bodies as required, and forward model (maintaining geological plausibility) so that the calculated field approximates the observed field.



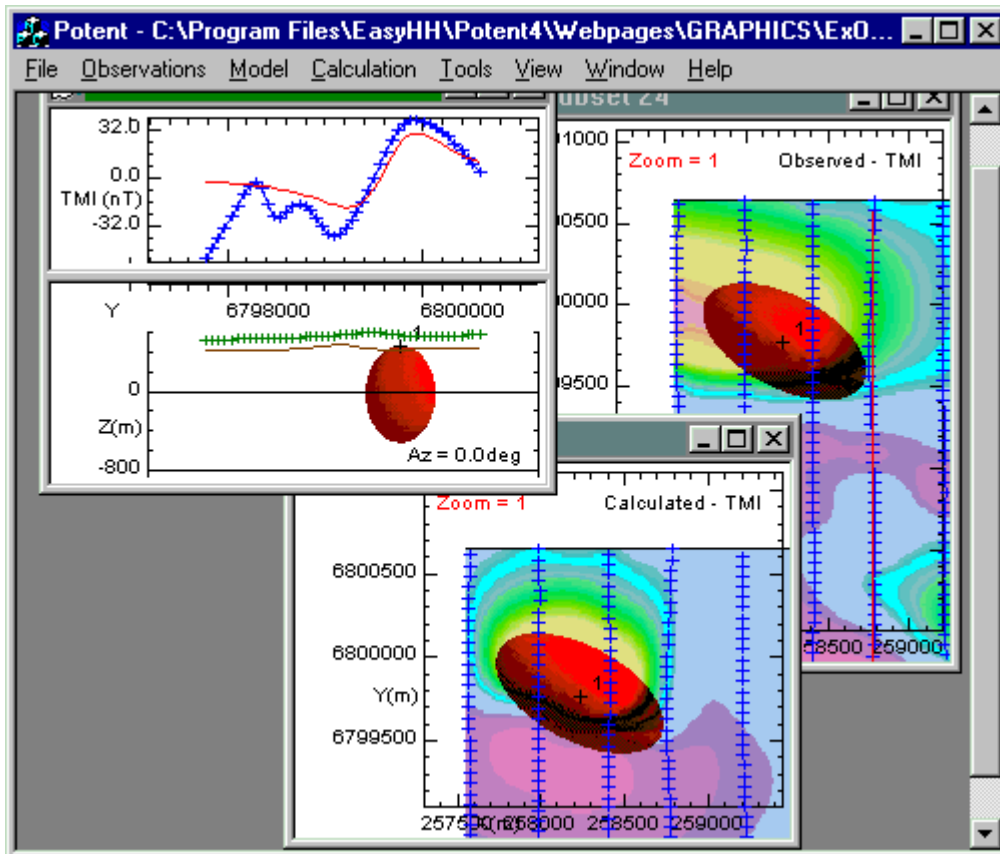
- 9 Use the **Polygon inversion** tool to set up inversion on chosen vertices, then use **inversion modelling** to refine the model.



Visualisation

Potent allows you to display observations and model in **plan windows** and **profile windows**. In the following example two plan windows give an overview of the observations and model, while a single profile window gives a more detailed view of one of the traverses in cross-section form.

Bodies can be displayed either as solid-rendered (using OpenGL, as in the example) or wireframe. Wireframe is faster to display, and avoids graphics card problems that can exist with OpenGL.



Refer to the following topics for more information:

- Plan windows
- Profile windows
- Down-hole windows
- Viewing in 3D

Plan windows

A plan window displays a “bird’s eye” view of your model and observed data.

When you first create a dataset (using the [Observations | Import](#) or [Observations | Make](#) command) the observations are displayed in a special plan window referred to as the **main plan**. This window “owns” the dataset. It can be closed only by closing the entire dataset, using the [Observations | Close dataset](#) command.

After the main plan window has been created automatically, you can create further plan windows for a dataset in two ways:

- Use the [Subset tool](#) to create a plan window for a new **subset**;
- Use the [Observations | Subset management](#) command to create a new plan window for an existing **subset**.

See also - [Plan window settings](#) and [Plan window scales](#) dialog boxes;

Profile windows

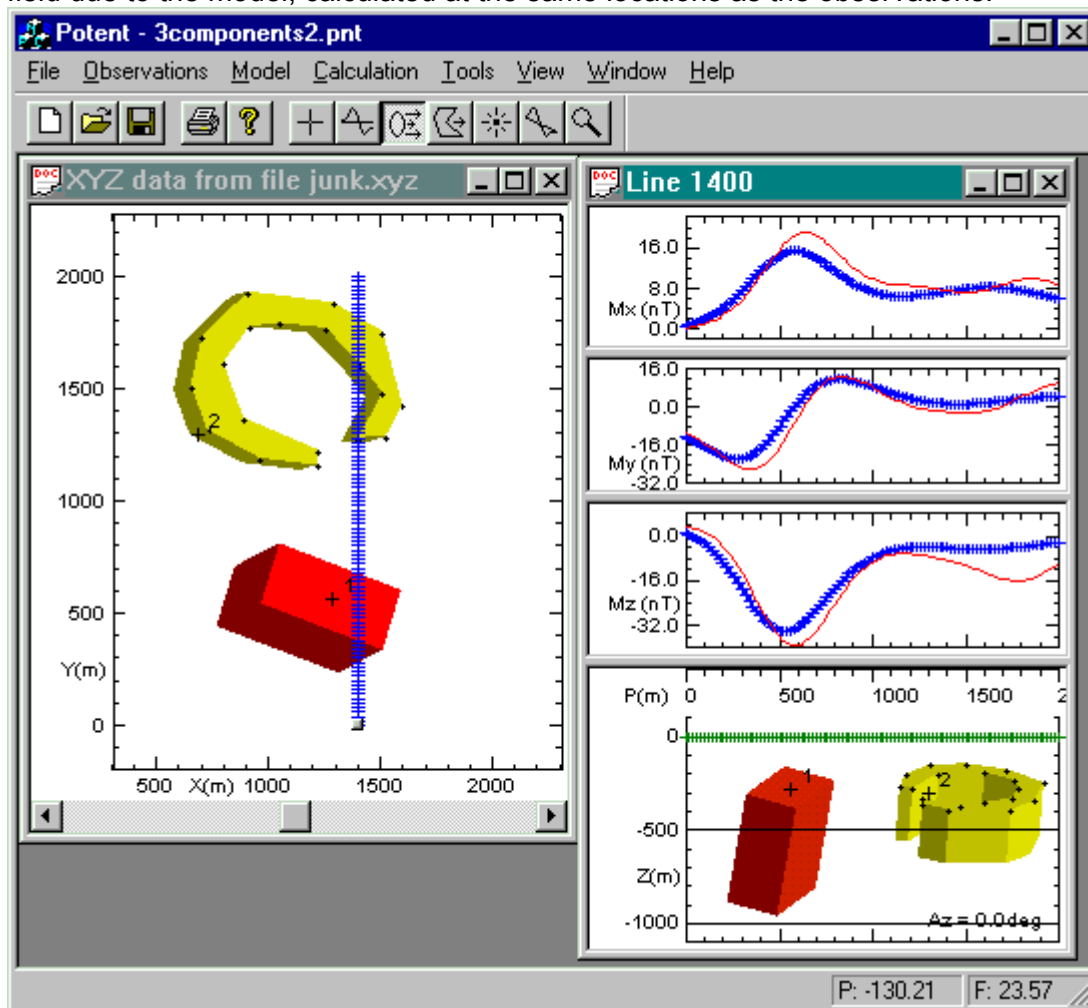
A profile window displays a cross-section of your model and observed values.

You can create profile windows for a dataset in two ways:

- Use the [Subset tool](#) to create a profile window for a new **subset**;
- Use the [Observations | Subset management](#) command to create a new profile window for an existing **subset**.

A profile window is a “split” window that is divided into two or more “panes”, which can be resized relative to each other using standard Windows functionality. There is always a single **cross-section pane**, as well as one **profile pane** for each component in the observed data.

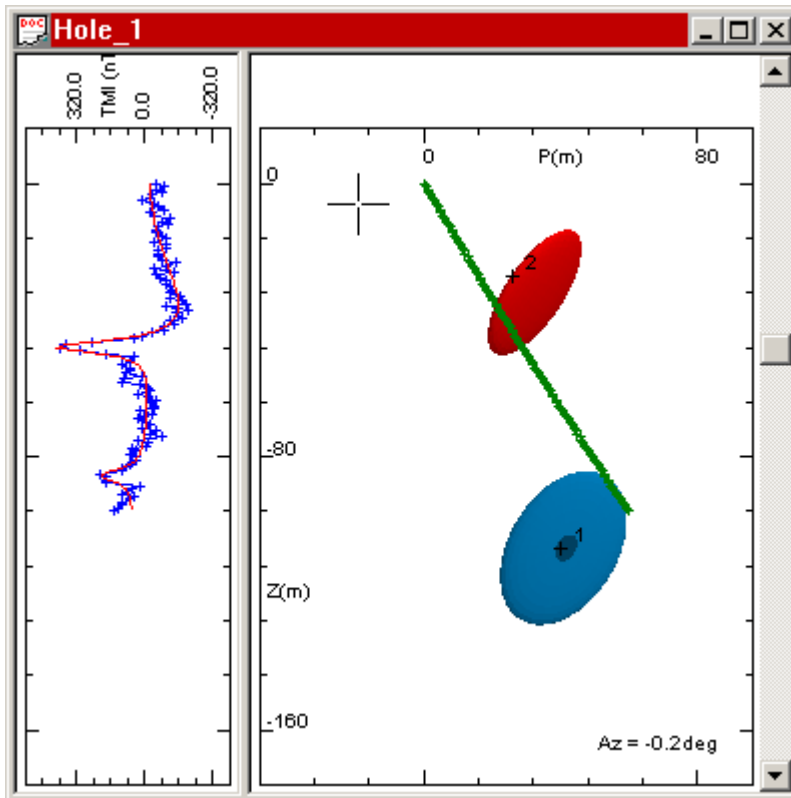
The following example shows a profile window (on the right) that depicts three-component data taken from a single N-S traverse (shown in plan view on the left). The bottom pane shows the model (two bodies, rendered as solid objects) and the observation locations (green crosses, zero elevation in this case). The three top panes show the three magnetic components. The blue crosses are the observed values, while the red line represents the field due to the model, calculated at the same locations as the observations.



See also - [Profile window settings](#) and [Profile window scales](#) dialog boxes.

Down-hole windows

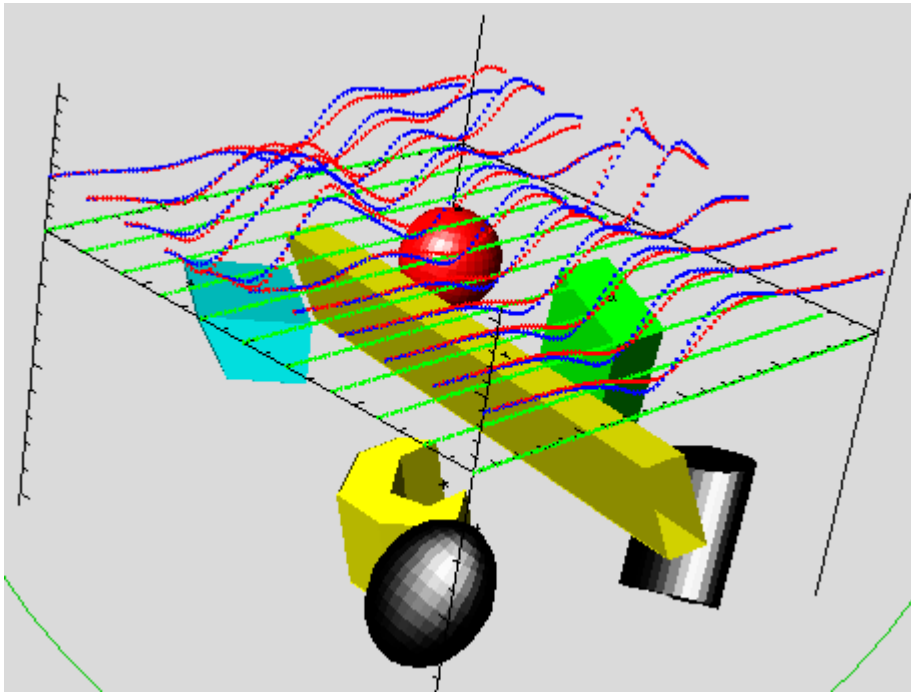
A down-hole window is similar to a [profile window](#) except that the profiles are plotted vertically, as in this example.



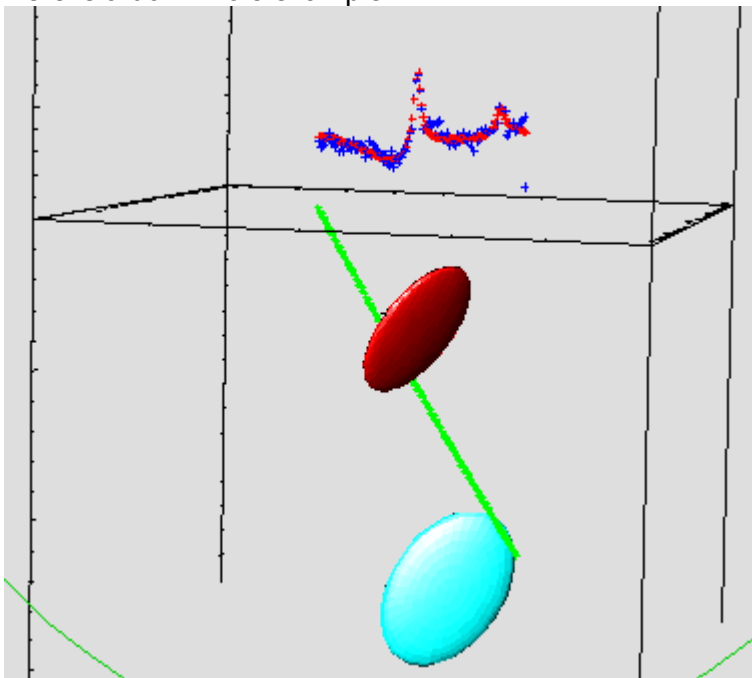
In a down-hole window the cross-section pane is on the right, and there are up to six profile panes on the left (one for each observed field component). Refer to the description of the [profile window](#) for further details.

Viewing in 3D

You can use the [Model | Export as DXF file](#) command to export model and observations to a 3D DXF file, which can then be viewed by a number of third-party viewers (including several “free” ones). The following examples were generated using Autodesk’s Volo View Express (since superseded by DWG TrueView). In each case the picture shows model, observation points (green), observed field (blue) and calculated field (red). This synthetic example, which includes all body geometries, demonstrates the type of output available:



Here is a down-hole example:

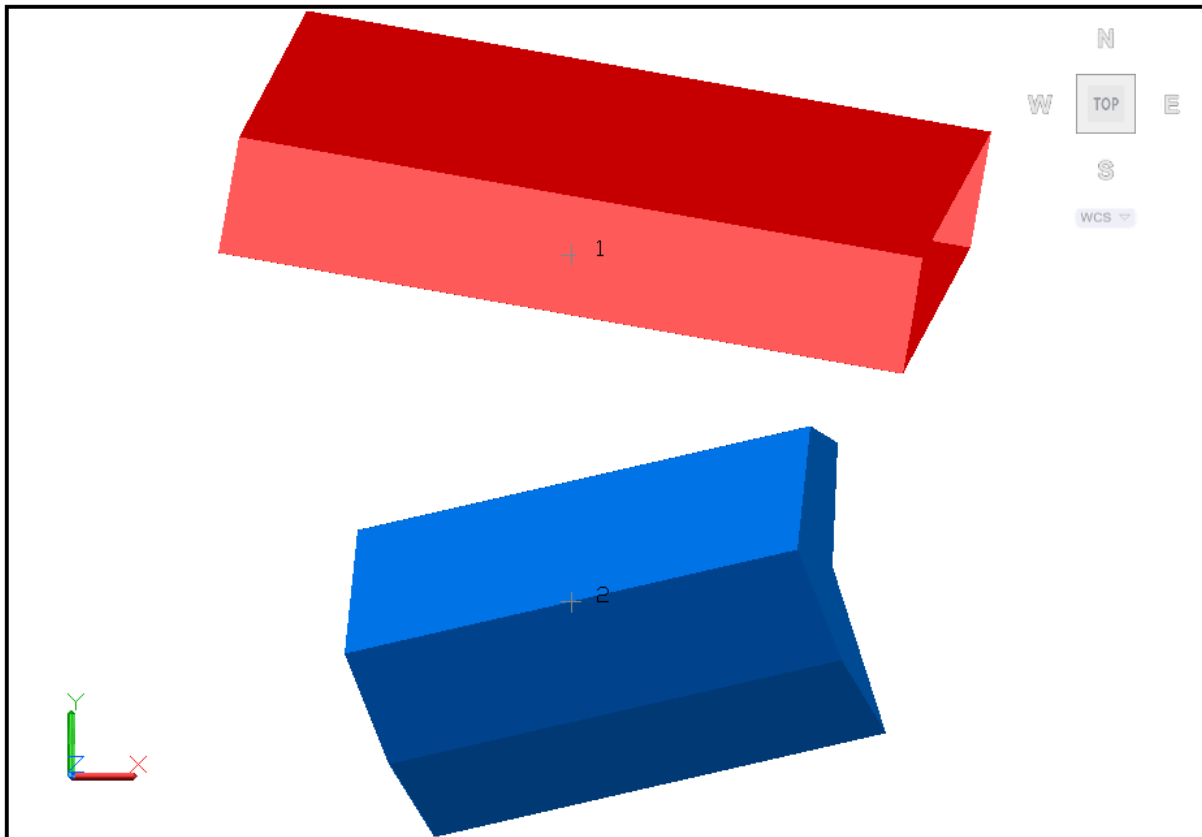


See also: [Representing 2D bodies in a 3D DXF file](#).

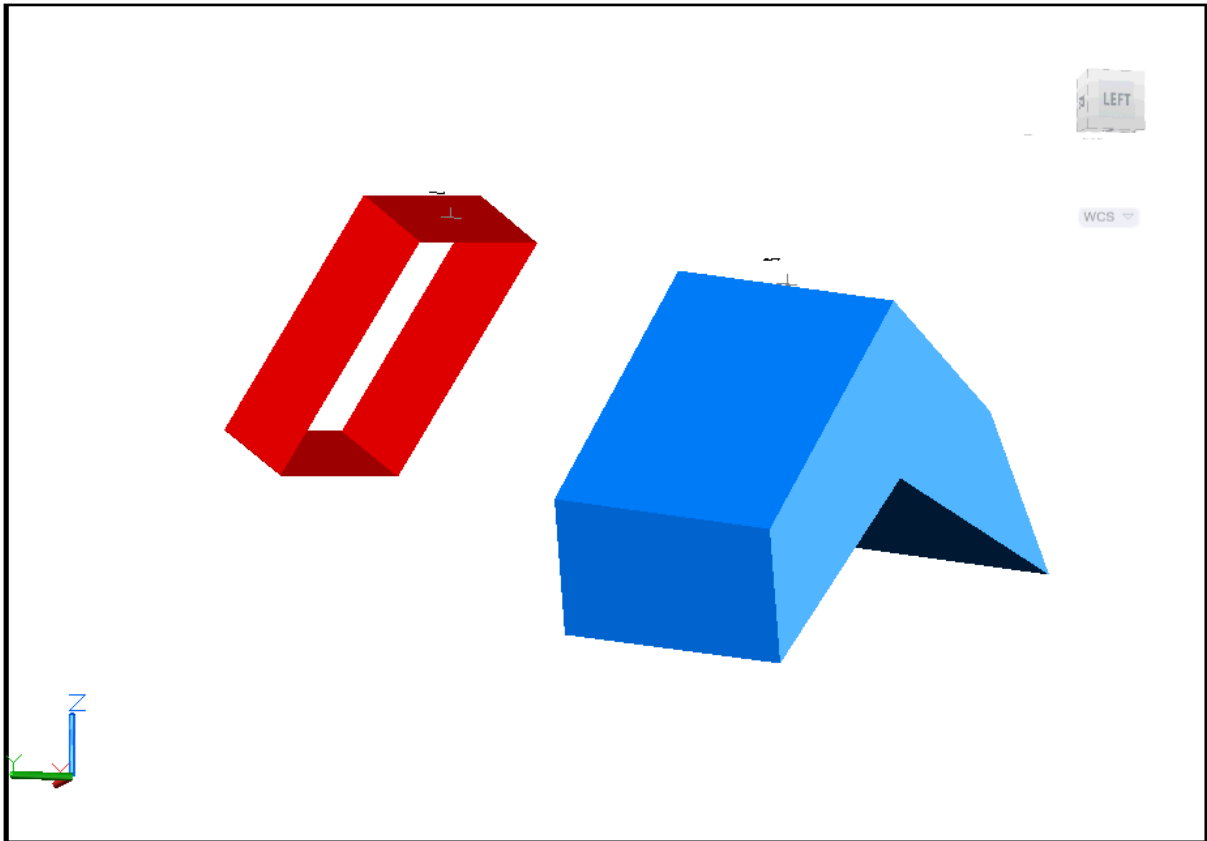
Representing 2D bodies in a 3D DXF file

The following images were displayed using AutoCAD's free DXF viewer, DWG TrueView 2013. They show 3D DXF views of a Potent model.

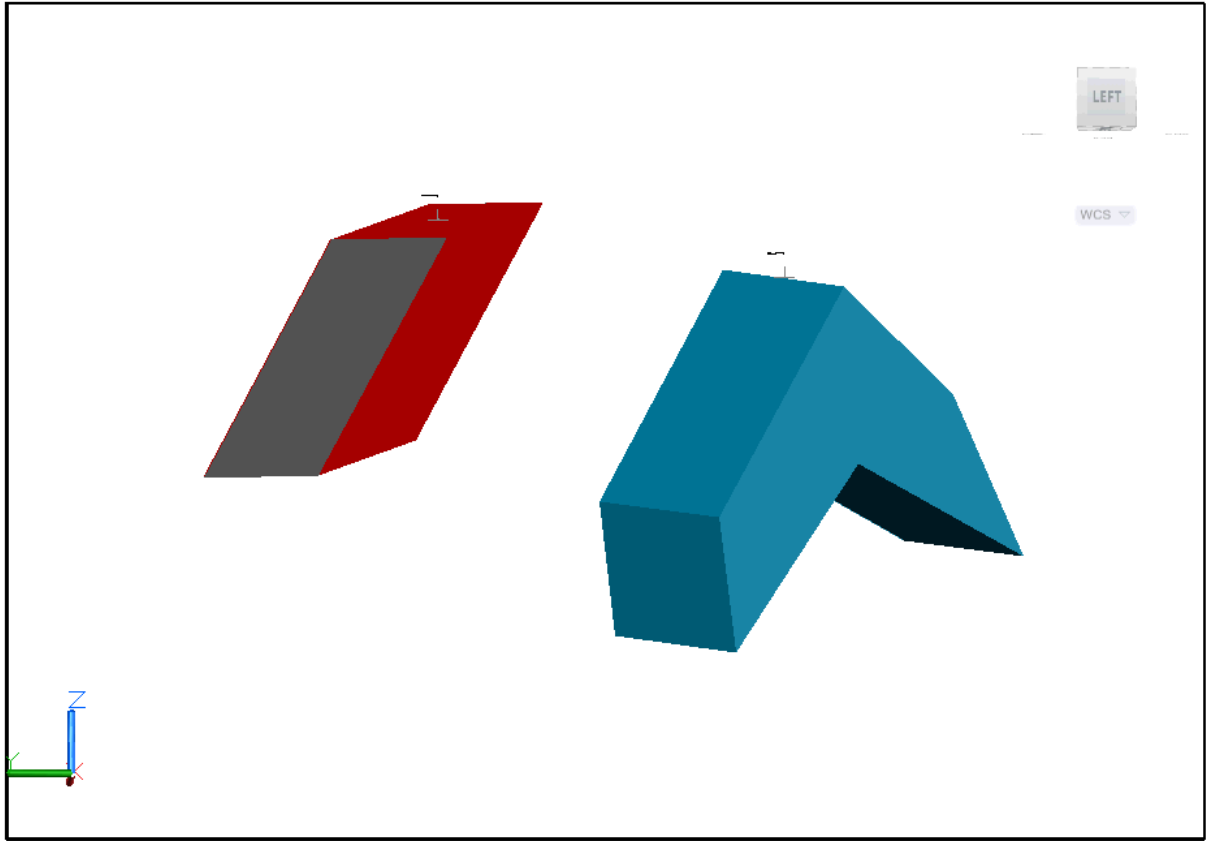
The blue body is a finite length polygonal prism. All its faces (including the ends) are included in the 3D representation.



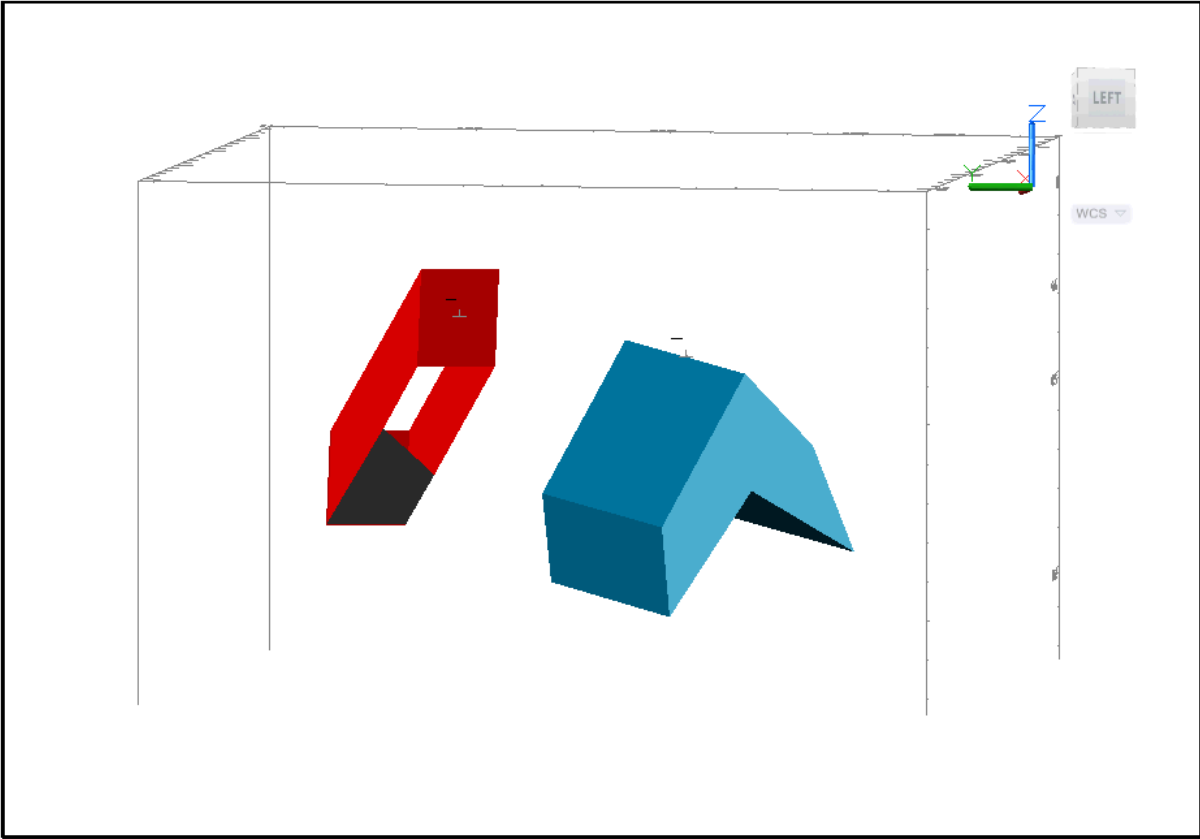
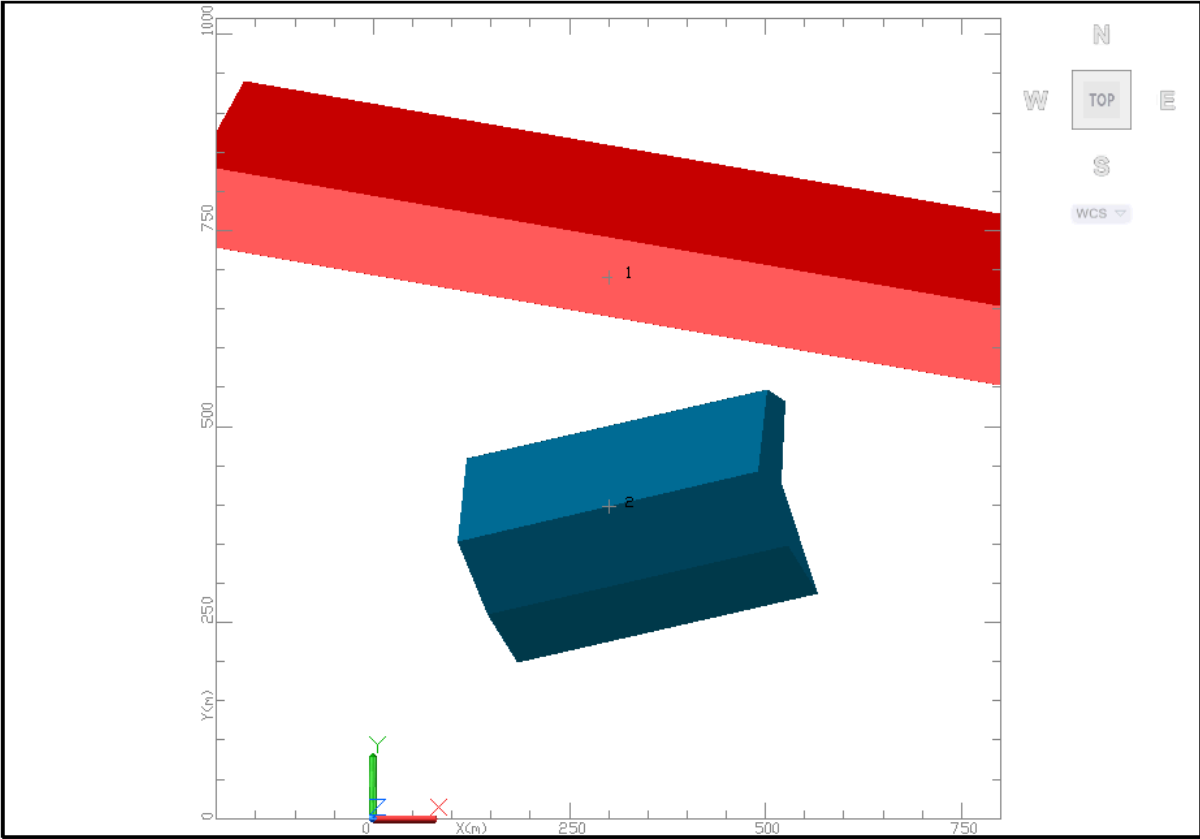
The red body is a **2D** (i.e. infinite strike length) **dyke** (a special case of a polygonal prism). The user has chosen to draw only 600m of its length by using the **2D drawn length** command. Prior to Potent v4.14 the ends were not included in the 3D representation. This gave the body a “hollow tube” effect, which was intended to provide a visual cue that the body was actually infinite in length. However the hollow effect was distracting under some viewpoints, as in the following example. If there were several such bodies then the effect became confusing.

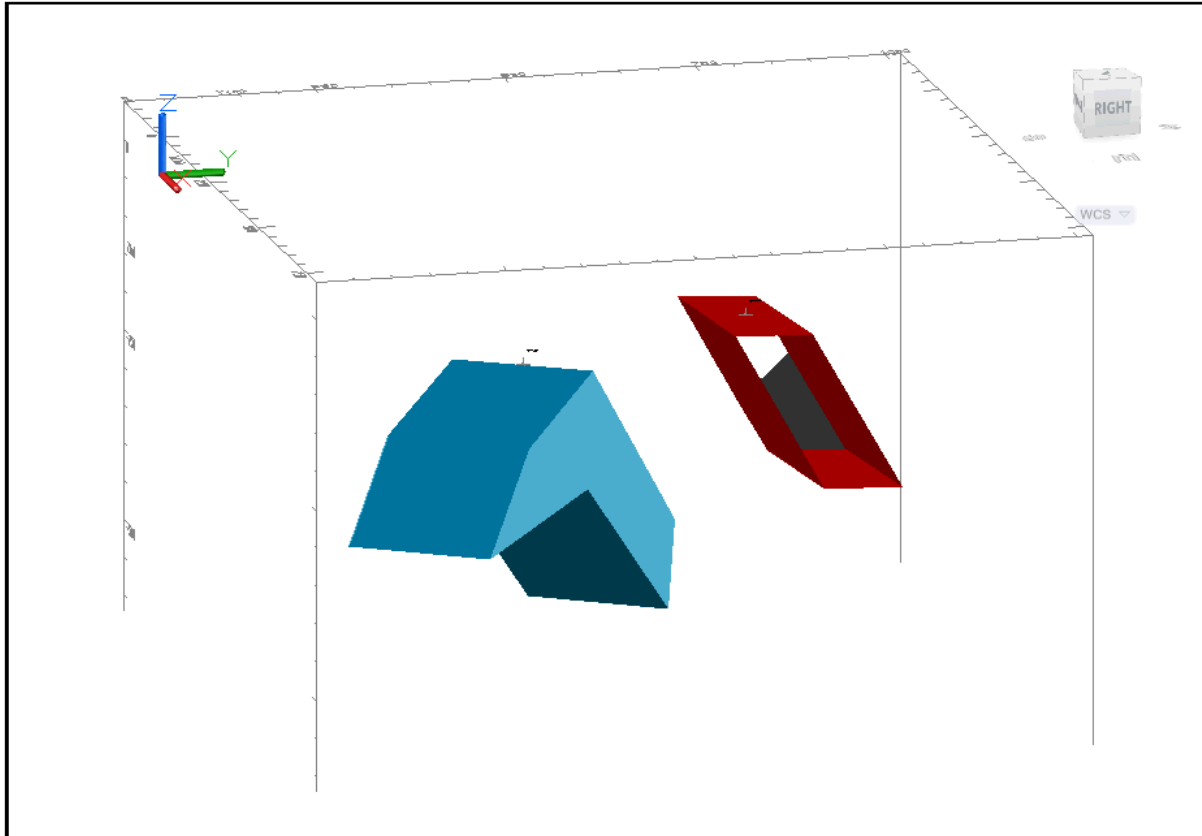


As of release v4.14 Potent closes the ends of 2D bodies with grey faces when creating a 3D DXF file, as in this example. The red body is shown to be 2D by its grey end. (The blue body is genuinely of finite length as evinced by its coloured ends.)



Note: If the representation of the 2D body extends outside the viewing rectangle then the hollow representation is used where truncation occurs. In this example, which shows three different views of the same model) the coordinate axes have been included for clarity. The red body is fully clipped to the axis plane at its eastern end and partially clipped to the west. At the west the part of the grey end face is included where there is no clipping.



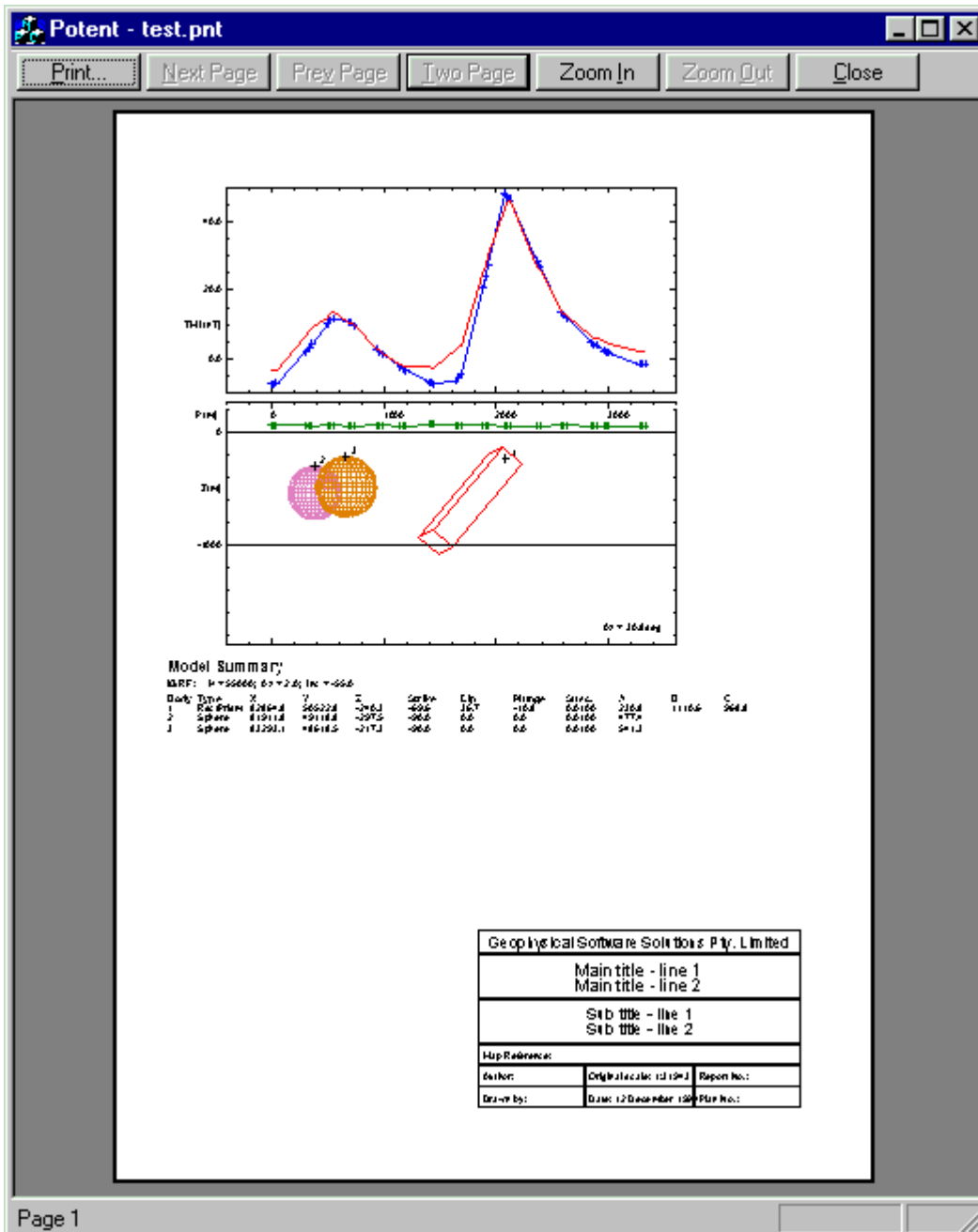


Printing

The following commands support printed output of the active window:

- File | Print
- File | Page setup
- File | Print preview
- File | Page layout

The first three perform the usual Windows print functions. The **File | Page layout** command allows you to control the scale, printed model information, and title block information. This Print Preview example shows the general effect that is obtained. (Note that, due to OpenGL issues, bodies are always drawn as wireframe when printing.)



Some line thicknesses can be set using the **Edit body – General** and **Profile window settings** dialog boxes.

Working with workspaces

Potent allows you to save your entire session for later use. The commands are

- **File | Open workspace**
- **File | Save workspace**
- **File | Save workspace as**

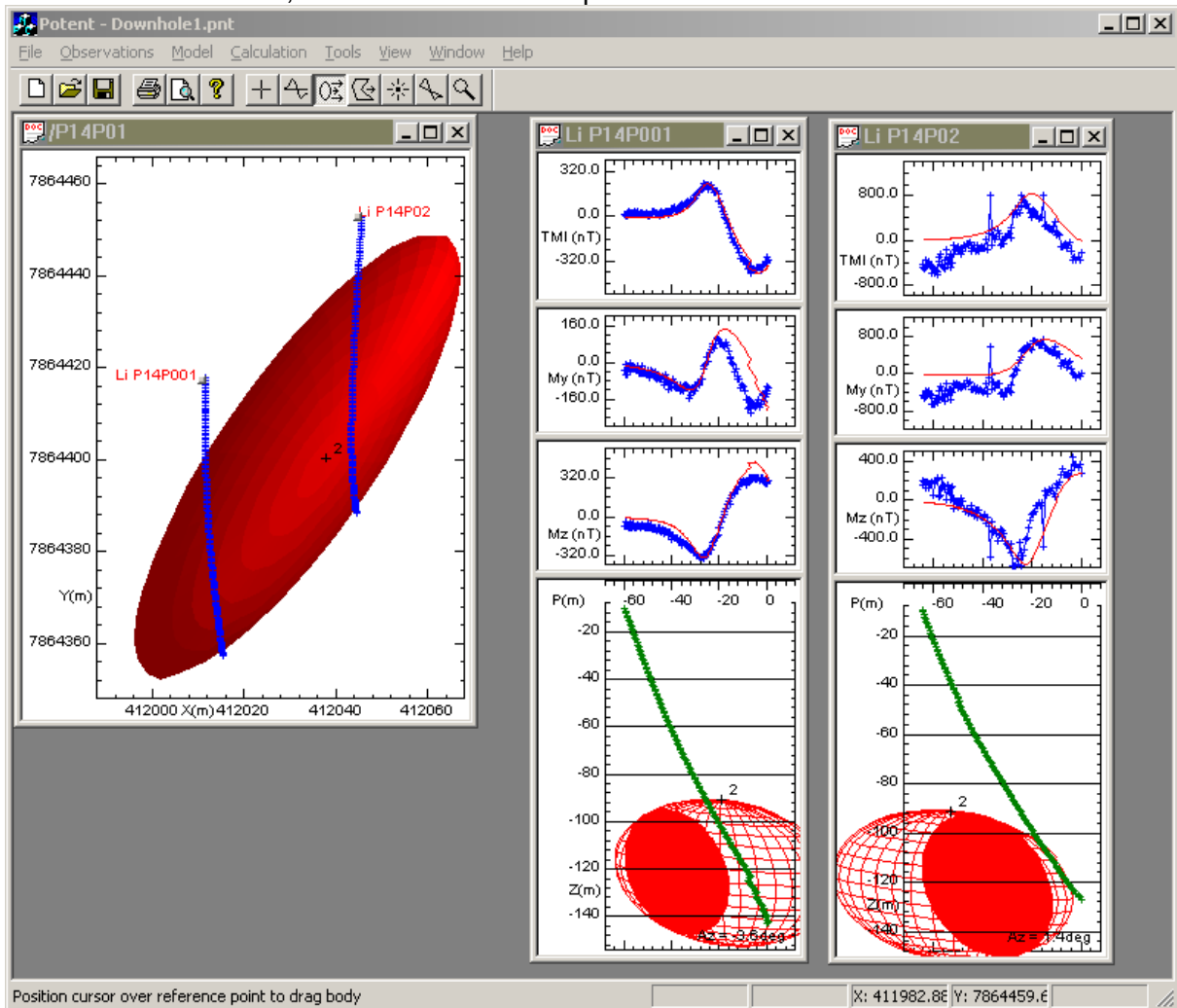
By default, Potent workspace files have the extension “.PNT”.

Working with down-hole data

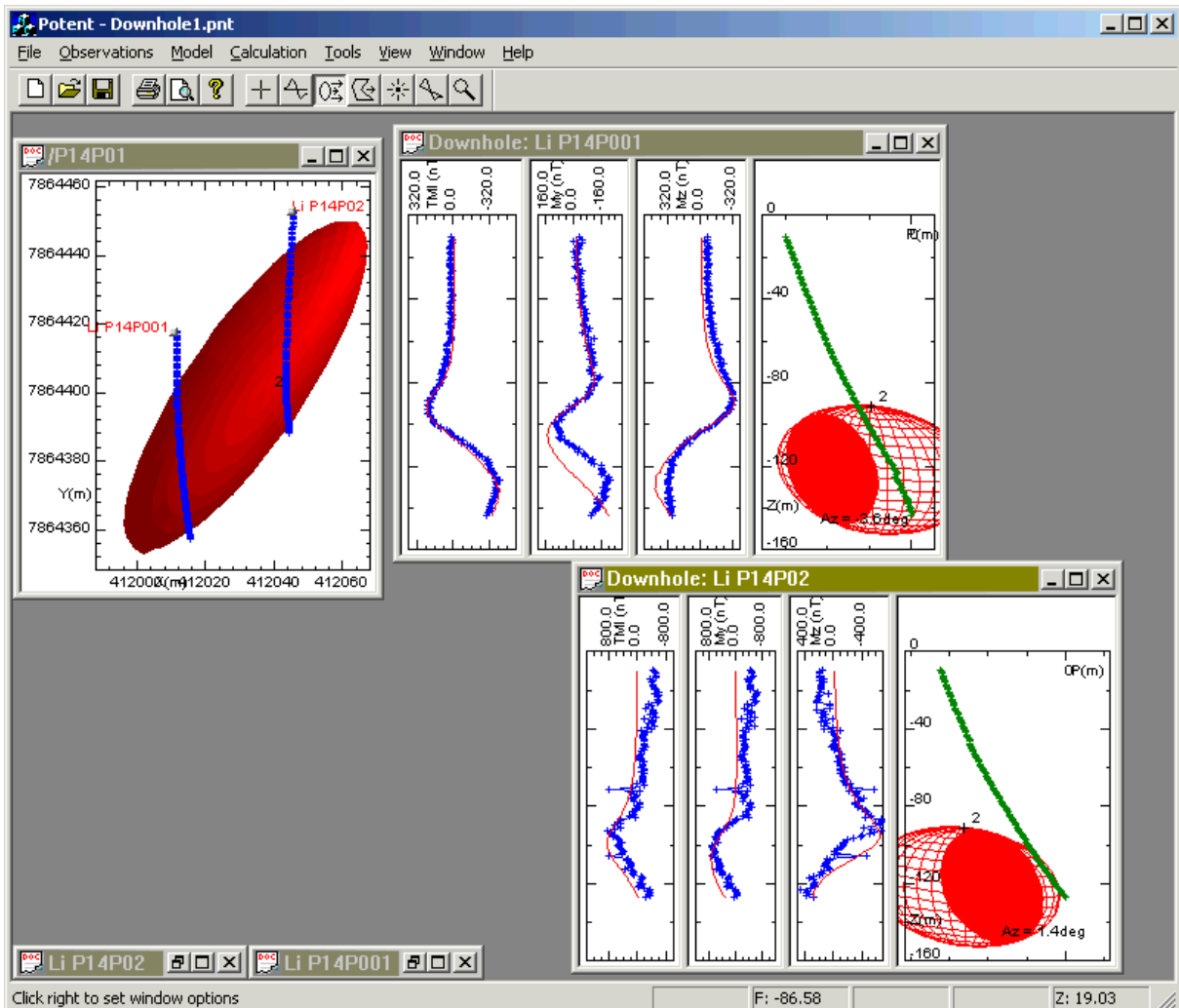
(Thanks to Giants Reef Mining Ltd. for permission to present the following data from their Rising Star prospect near Tennant Creek, Northern Territory, Australia.)

As it is designed to operate in a 3-dimensional space, Potent can model single or multiple component down-hole data just as easily as above-surface data. If the inclination of the hole

is less than approximately 60 degrees from the horizontal then you can simply use profiles in the same way as for above-surface data. The main difference is that the profile windows will tend to be tall and thin, as shown in this example.



Alternatively, you can use "Down-hole" windows, which place the profiles vertically. The down-hole representation is optional in the example above, but is essential when the hole is nearly vertical. (With a vertical hole, horizontal profiles plot the observed values compressed into a single spike.) The following graphic shows the same data using down-hole windows:



Here are some comments pertaining to the real-life example shown in the above graphics:

- The Plan window (left) shows the surface expression of the observation points in the two drill holes (which were drilled from south to north.) An ellipsoidal body has been used to represent a lenticular orebody.
- The green crosses in the two Profile windows are the height of the observations (displayed using the **Cross-section** page of the **Profile window settings** dialog box). As this is down-hole data, the crosses follow the path of the drill hole.
- Multi-channel magnetic data were acquired down the hole. Each of the profile windows show traces for the Mz (vertical), My (North) and Total (TMI) magnetic components.
- The ellipsoidal body is drawn in wireframe form in the profile windows. Superimposed on this is the cross-section of the body in the plane of the profile window. The distance between the track of the drill hole (green crosses) and the body cross-section (solid red ellipse) is the measure of how close the drill-hole was to the interpreted target.

Creating a down-hole window

Create a down-hole window in a similar way to a profile window. Use any of the following methods:

- Use the **Subset tool** to drag a line across the observations as displayed on the plan. Then click **Create Subset And Open A Down-hole Window** on the **Create Subset** dialog box.
- If the observations for the hole have an associated subset button (e.g. if they came from an XYZ file), then hold down the Ctrl key and click the button.

- From the "Data subsets summary" dialog box (**Observations | Subset management**), highlight the subset that contains the required observations then click **Down-hole**.

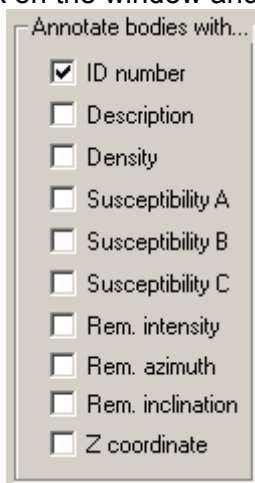
Annotating your output

Potent provides two ways of annotating windows with descriptive text. The first is automatic, and allows you to quickly label a body with such things as its ID, description and various physical properties. The second method is more versatile and allows you to add descriptive text anywhere in a window.

- **Annotating with the body properties**
- **Free-format annotation boxes**

Annotating with the body properties

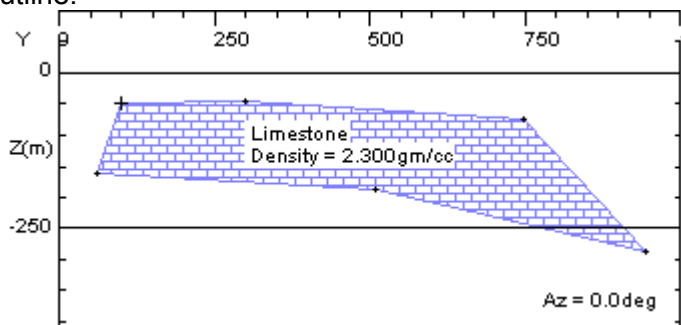
The **Bodies page** of the **Plan window settings** dialog box and the **Cross-section page** of the **Profile window settings** dialog box each has an **Annotate bodies with...** group. (Right click on the window and click **Options** on the popup menu.)



By default only the body ID is enabled, giving a body annotation similar to this example:

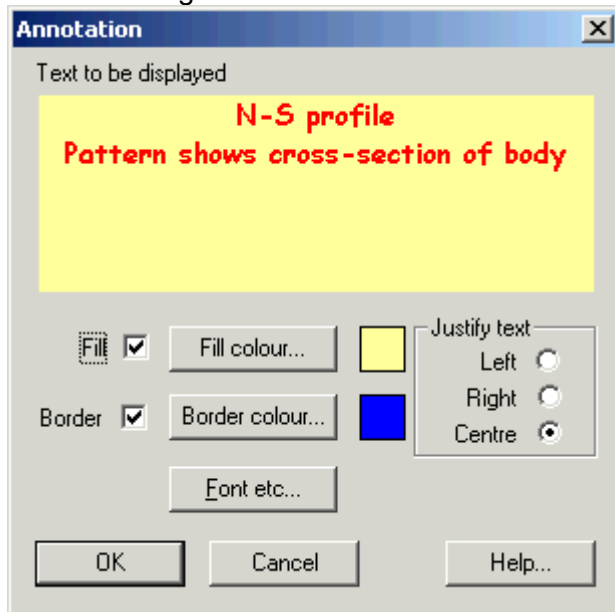


To suppress the annotation for a particular body, uncheck the **Show annotation** box in the **General** page of the **Edit body** dialog box. The **General** page also allows you to specify an offset at which the annotation will be drawn for the body. In this example the ID number has been suppressed and the annotation shifted from the top left corner to the central part of the body outline:

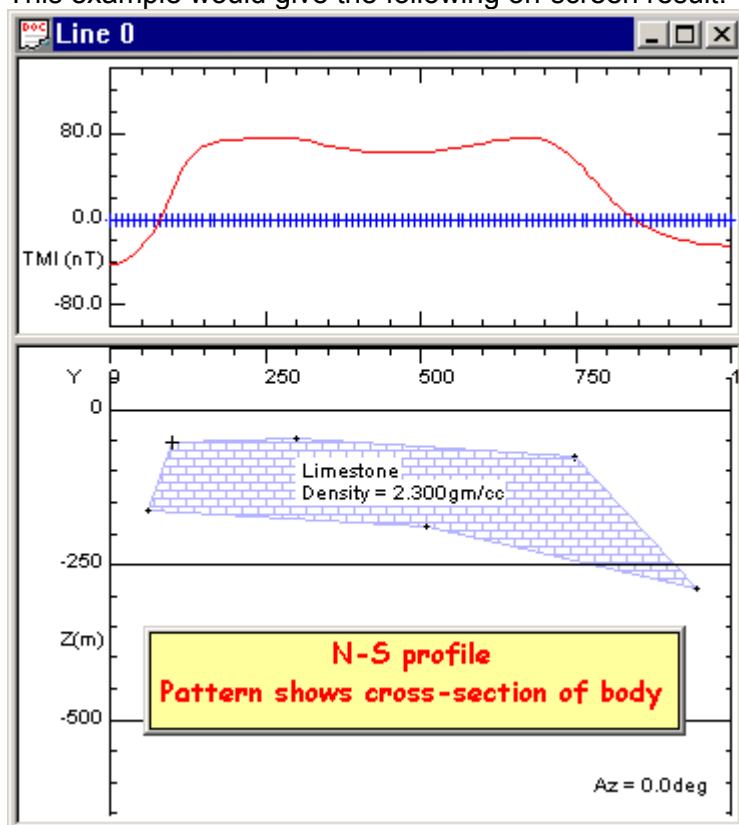


Free-format annotation boxes

You can place a text box anywhere in a window. Right click in the required window and click **Annotation...** from the pop-up menu. The **Annotation** dialog box allows you to enter the text and formatting for the annotation box.



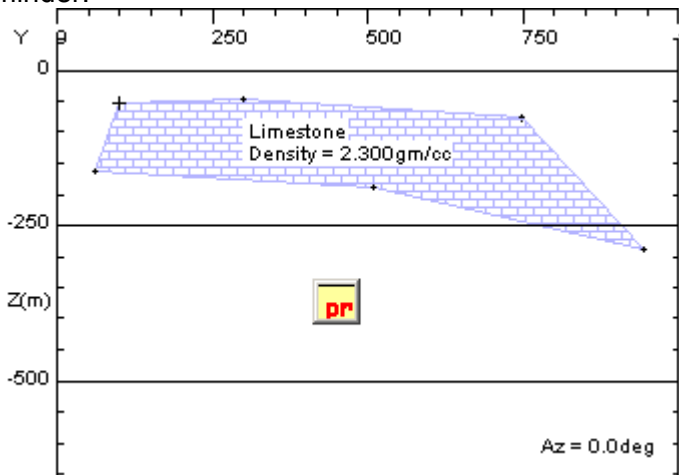
This example would give the following on-screen result:



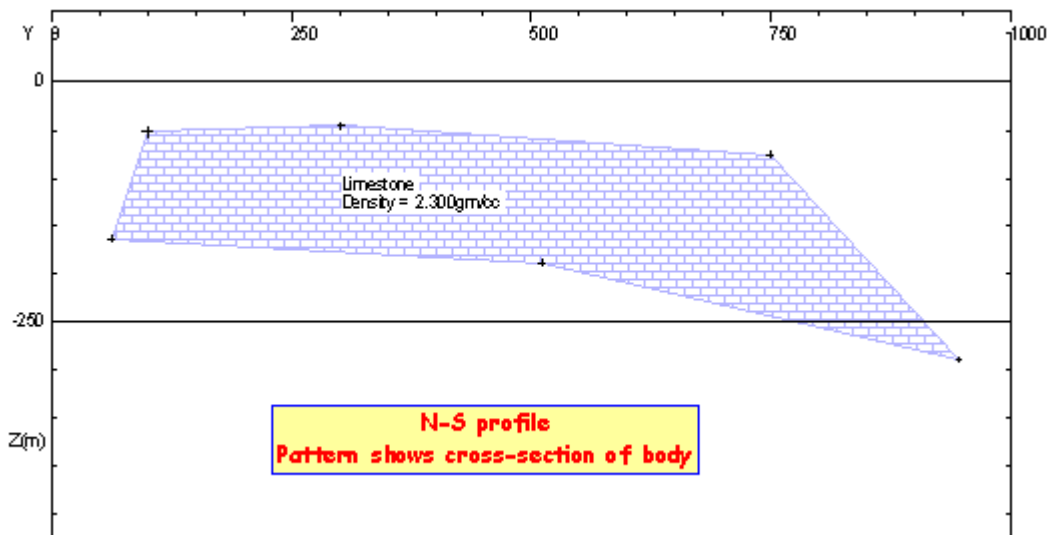
Note that the border is visible only on printed output. Use Print Preview to check what the eventual effect will be.

You can drag the annotation box to any position on the screen. You can also resize it. However, on printed and metafile output the box is automatically resized to the minimum rectangle that can contain the specified text. Therefore you don't need to make the on-screen box large enough to display all the text if you are interested only in printed or metafile output.

For example, if you want to annotate your printed output prominently, but leave the on-screen working area reasonably clear, you might resize the box so that it is still visible as a reminder:



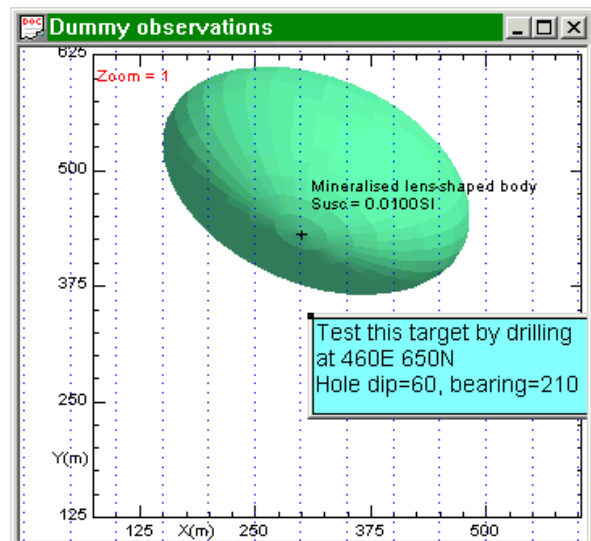
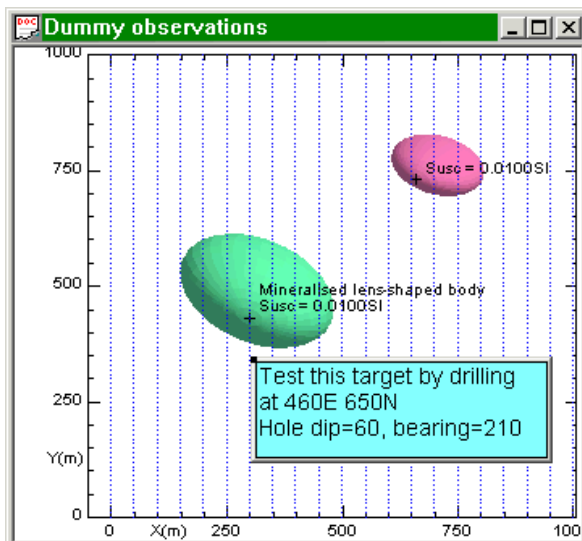
Print Preview shows how the printed output will appear:



- How an annotation box is positioned
- Editing and deleting an annotation box
- Hiding annotation boxes

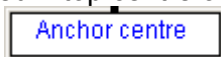
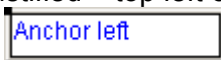
How an annotation box is positioned

An annotation box is generally associated with something in the window. For example it might contain information relating to a body. Therefore if the window is scaled or scrolled, the annotation should stay in the same place relative to the axes. In this example the “anchor point” is the top left corner of the annotation box (and is marked by a small black square in the frame). When the plan window is scaled the position of the anchor point within the window changes, but it retains the same (X, Y) coordinates:



The anchor point is marked by a small black square on the top of the annotation box frame. Its position depends on the text justification, as follows

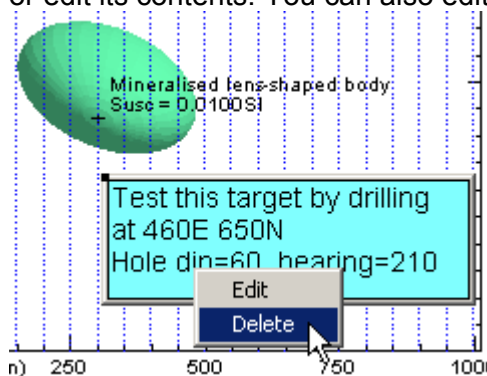
- Left justified – top left of the frame
- Centred – top centre of the frame
- Right justified – top right of the frame



Return to **Free-format annotation boxes**.

Editing and deleting an annotation box

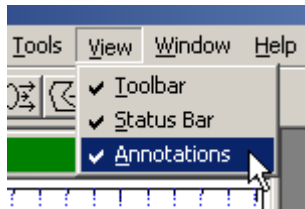
Right click on an annotation box to display a pop-up menu that allows you to delete the box or edit its contents. You can also edit the contents by double-clicking the box.



Return to **Free-format annotation boxes**.

Hiding annotation boxes

On the **View** menu click **Annotations** to toggle the display of annotation boxes.



Return to **Free-format annotation boxes**.

Glossary

2D
3D
Active dataset
Active window
Body
Body Status
Current dataset
Dataset
Dummy observations
Geosoft
GX
IGRF
Intrepid
Inversion
Invert flag
Main plan
Model
Oasis montaj
Observation
Polygonal prism body types
Popup menu
Predefined subset
Reference point
Spinners
Subset
TMI
Tool
Vertex
Visualisation
Workspace
XYZ file

2D

In Potent the term "2D", or "2-dimensional", is used for any body that has infinite strike length.

These can be the **polygonal prism**, the **dyke** and the **slab**. You make these bodies 2D by setting their strike length (B axis) to 0 (which *Potent* takes as infinity).

3D

In Potent the term "3D", or "3-dimensional", is used for any body that is finite in all three spatial dimensions. The **Sphere**, **Ellipsoid**, **Lens**, **Rectangular prism**, and **Cylinder** are always 3-dimensional. The **polygonal prism**, the **dyke** and the **slab** are 3 dimensional when their strike lengths are finite.

The use of the term "2.5-dimensional" to refer to a body that is of finite length but constant cross-section should be restricted to the situation described by [Shuey and Pasquale](#) in which the calculation point is constrained to lie on the plane of symmetry of the prism. All bodies used by Potent are treated as 3-dimensional objects. Calculations are valid at any point external to the bodies.

The term "2.75D" is an abomination that is not used in this documentation.

Active dataset

The active **dataset** is the dataset associated with the **active window**.

Active window

The active window is the profile or plan window that has its title bar highlighted. When a *Potent* operation pertains to a particular window, the active window is used.

Body

A **body** is a solid geometrical shape, such as an ellipsoid, that has physical properties appropriate to magnetic and gravitational modelling.

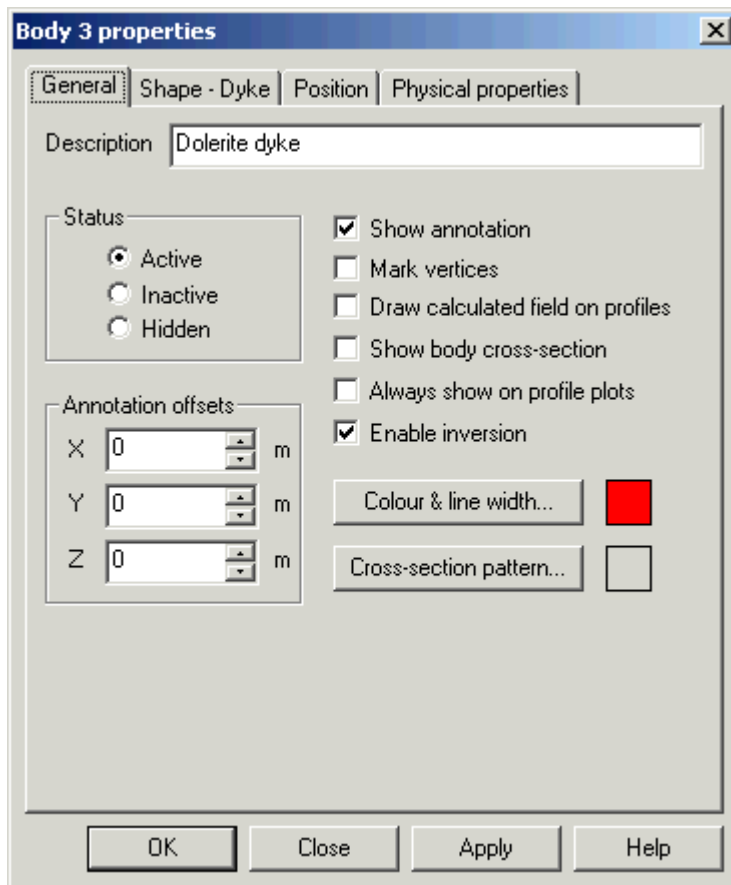
Body Status

The status of a body can be Active, Inactive or Hidden.

- Active – The body contributes to the calculated field of the model. It is drawn in the colour assigned to it in the **Edit body | General** dialog box.
- Inactive – The body does not contribute to the calculated field of the model. It is drawn as wireframe in light grey.
- Hidden – The body does not contribute to the calculated field of the model. It is not drawn in any windows. It can be edited only by selecting it using the **Model | Edit model** command.

Compact Edit body dialog box

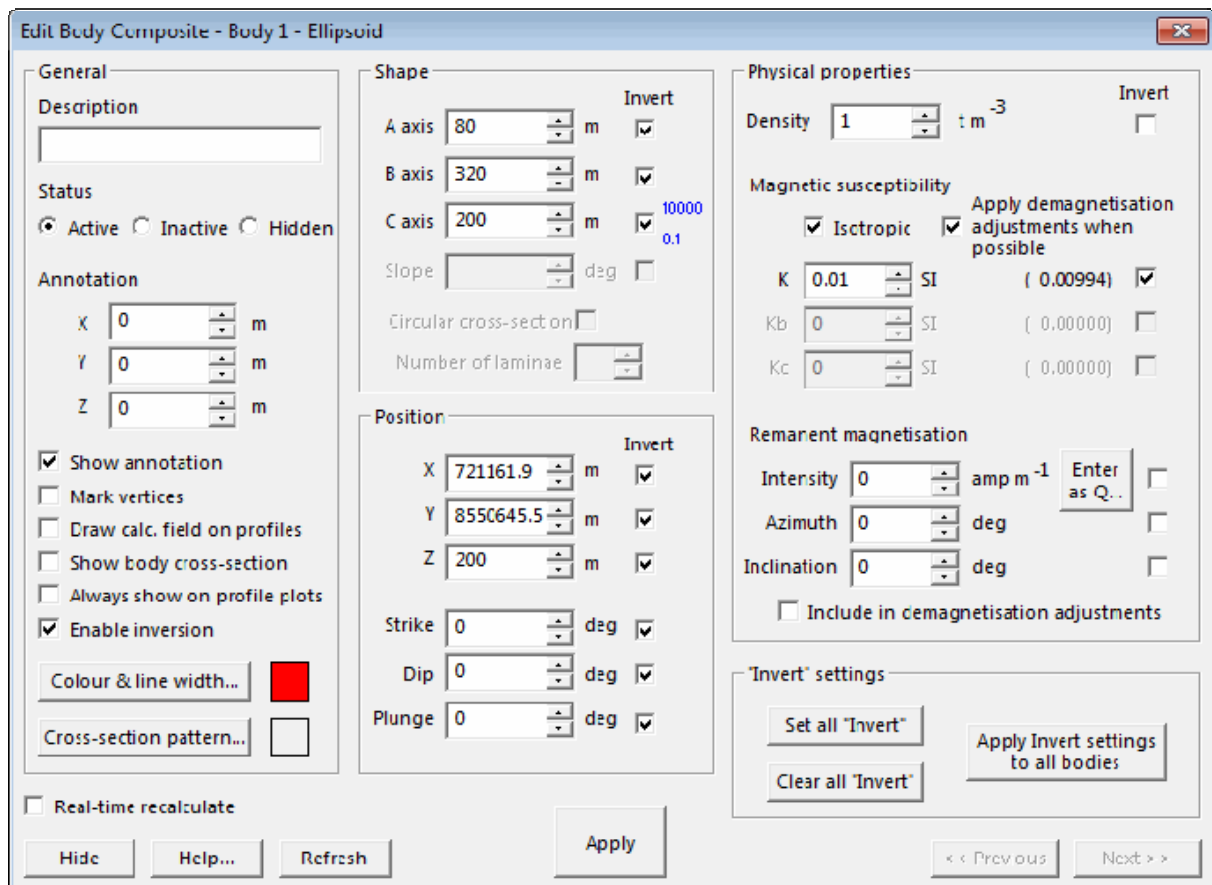
This is a tabbed **Edit body** dialog box that can be used to change the parameters of a body. Other Potent controls cannot be accessed while the compact dialog box is open.



As the compact dialog box has tabbed pages, it takes up less space on the screen than the alternative, the **composite dialog box**.

Composite Edit body dialog box

This is a non-tabbed **Edit body** dialog box that can be used to change the parameters of a body. Other Potent controls can be accessed while the composite dialog box is open. However, it is a large object that is best suited to a large screen or a dual monitor system.



The composite dialog box is the alternative to the **compact edit body dialog box**. It allows you to access all body parameters with a minimum of mouse clicks. You can leave it open on the desktop, as other Potent controls can be accessed while the composite dialog box is displayed.

Current dataset

The current **dataset** is the dataset that has its **observations** displayed in the **active window**.

Dataset

A **dataset** is a self-contained set of observations that has been loaded into *Potent*. For example if you have used the **Observations | Import** command three times to load a ground TMI dataset, some down-hole 3-component magnetic data, and a gravity survey, then these will comprise three datasets within *Potent*.

Dummy observations

Dummy observations are created by the **Observations | Make** command. They are, like normal observations, sets of (X,Y,Z,G,F) values, but with the G and F values set to zero. You can use dummy observations to provide locations at which Potent will calculate the modelled field in situations where there is no actual survey data. This is useful in theoretical model studies, or in educational situations.

Geosoft

Geosoft Inc., Toronto, Canada
www.geosoft.com

See also: **Oasis montaj**.

GSS

This is us, “Geophysical Software Solutions”, the developers of Potent. For help with running Potent, or with licensing issues, please e-mail us at support@geoss.com.au. For full contact details please visit our web-site at www.geoss.com.au and follow the **Contact us** link.

GX

A GX is a program that performs tasks within *Oasis montaj*. In the context of Potent, the GXs are programs you can use from within *Oasis montaj* to collect the required data and then run the Potent application.

IGRF

“International Geomagnetic Reference Field”

You can set the IGRF, or “inducing field”, using the **Model | Inducing field** command.

Intrepid

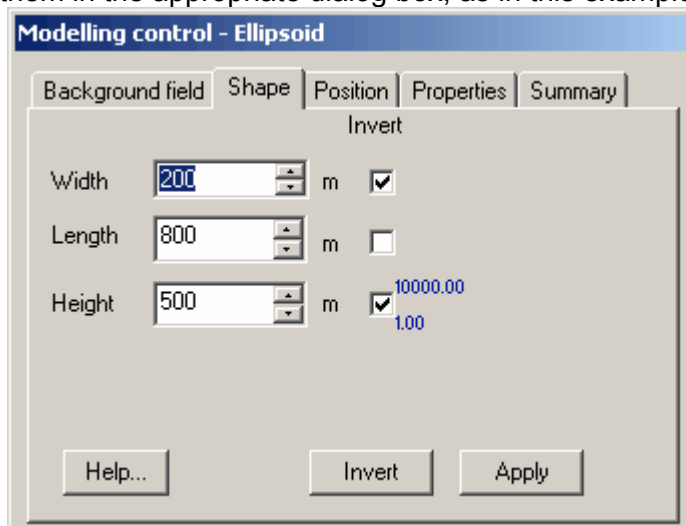
Intrepid consists of a suite of geophysical data processing and interpretation applications developed by **Intrepid Geophysics** of Melbourne, Australia. (Intrepid Geophysics is the trading name of Desmond Fitzgerald & Associates Pty Ltd.)

Inversion

During **Inversion modelling**, *Potent* automatically adjusts nominated model parameters so as to improve the fit between the observed and calculated fields.

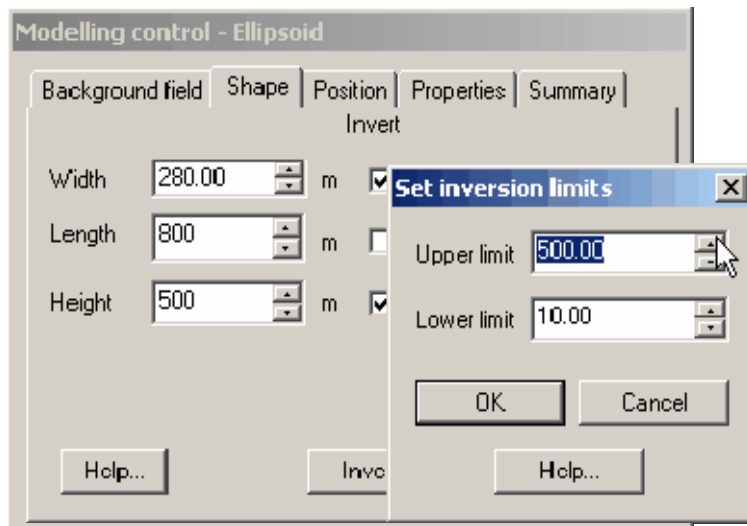
Invert flag

Body parameters that may be altered by the inversion process have an Invert box next to them in the appropriate dialog box, as in this example from PotentQ.



Checking the box sets the invert flag that is associated with the parameter. If an Invert flag is set then the associated parameter will be allowed to change during inversion, otherwise it will be kept fixed. In the above example **Width** and **Height** will be varied during inversion.

Note: Invert flag settings are ignored if the body’s **Enable inversion** box is not checked. Blue numbers to the right of an invert box indicate a range within which the value will be allowed to vary, as shown for **Height** in the above example. Set an inversion range by right-clicking on the Invert box and setting the upper and lower limits in the dialog box, as shown for **Width** in the following example:



Cancel inversion limits by setting the upper and lower values to 0.

Note 1: If the starting value of the parameter is less than the lower limit or greater than the upper limit, then the value is set to the nearer of the two limits when inversion starts.

Note 2: If the starting value of the parameter is equal to either of the limits then it will not change during inversion. Therefore make sure that the starting value is slightly within the specified range.

Main plan

The **main plan** is the **plan window** that is created automatically when you first create a dataset (using the **Observations | Import** or **Observations | Make** command)

Model

The collection of **bodies** that represent a geological structure.

Oasis montaj

Oasis montaj is **Geosoft's** software for mapping and processing geophysical data.

Observation

An **observation** is a point in 3D space at which one or more values have been measured.

Polygonal prism body types

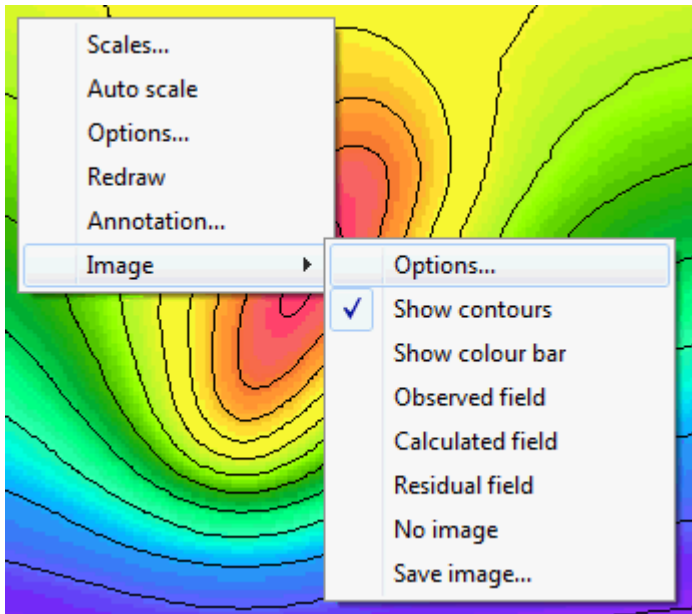
Polygonal prism body types are those derived from the polygonal prism. These are the **polygonal prism**, the **dyke** and the **slab**.

They have some common properties:

- They can be either **2D** or **3D**.
- Their cross-sectional polygons can be edited graphically using the **Tools | Body shape** command.
- Their **Invert flags** can be set graphically using the **Invert** tool.

Popup menu

A local menu of commonly used **Window menu** commands. Display the popup menu by right-clicking the mouse on a plan or profile window.



The **Image** sub-menu is available only if the window is a Plan window, .

Predefined subset

A predefined **subset** is one that was created automatically either from a “Line” record in an **XYZ file**, or as a line created using the **Observations | Make** command.

Reference point

The “reference point” of a **body** is the point about which it is defined. The **position** of a body is the position of its reference point. When a body is rotated, it is rotated about its reference point.

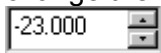
By default, the reference point is marked on plots by a cross and the body number.



See also: **Coordinate axes**.

Spinners

Spinners are small arrows that are attached to numeric edit boxes. Left-click the arrows to change the value. Right-click the arrows to change the sensitivity.



Refer to **Adjusting numeric values** for details.

Subset

A subset is a named sample of observations from a particular **dataset**. The subset consists of all the observations that lie within a rectangular or polygonal window.


See also:

- Subsets**
- Subset – box tool**
- Subset – polygon tool**

TMI

Total magnetic intensity, a quantity commonly measured by magnetometers such as the proton precession magnetometer.

Tool

A tool is a mouse cursor that allows you to perform a particular function. For example the **Move body** tool, , allows you to drag bodies around various windows. See **Tools**.

Vertex

The corner of the front face of a **polygonal body**.

Visualisation

“Visualisation” means the presentation of observations and model in the most appropriate ways. For example, observed data can be displayed as profiles or as images, (or both), depending on the circumstances.

See also: **Visualisation**.

Workspace

The workspace is everything that is contained in the current *Potent* session. Workspaces can be saved and restored as described in **Working with workspaces**.

XYZ file

An XYZ file is an ASCII file that contains observed data in tabular form, interspersed with records that identify flight lines and ties. Refer to **XYZ files** for details.

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Frequently asked questions

- Why is the calculated field profile not smooth?
- Why is the observed field profile spiky?
- Why doesn't inversion seem to work properly?
- How can I export my results to other programs?
- Can I work with different units?
- How do I add an image to a plan window?
- How do I create a cross-section of my data?
- How do I delete a vertex from a polygonal body?
- How do I remove a regional background field from a dataset?

Why is the calculated field profile not smooth?

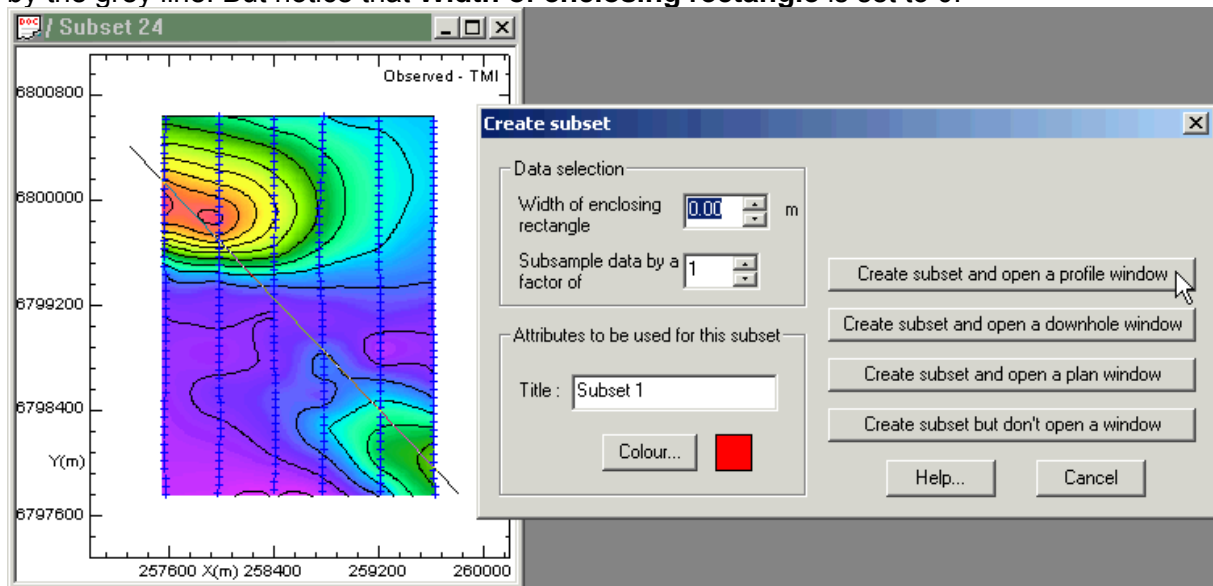
A common source of confusion for new users is the fact that *Potent* calculates the field due to the model at the observation points. If the observation points that constitute the profile are not on a straight line then the calculated field profile usually will not be smooth.

This is a reflection of *Potent's* 3D approach to calculations. In fact, a similar lack of smoothness should be in the observed profile, reflecting the changing relative position of the observation platform and the magnetic sources.

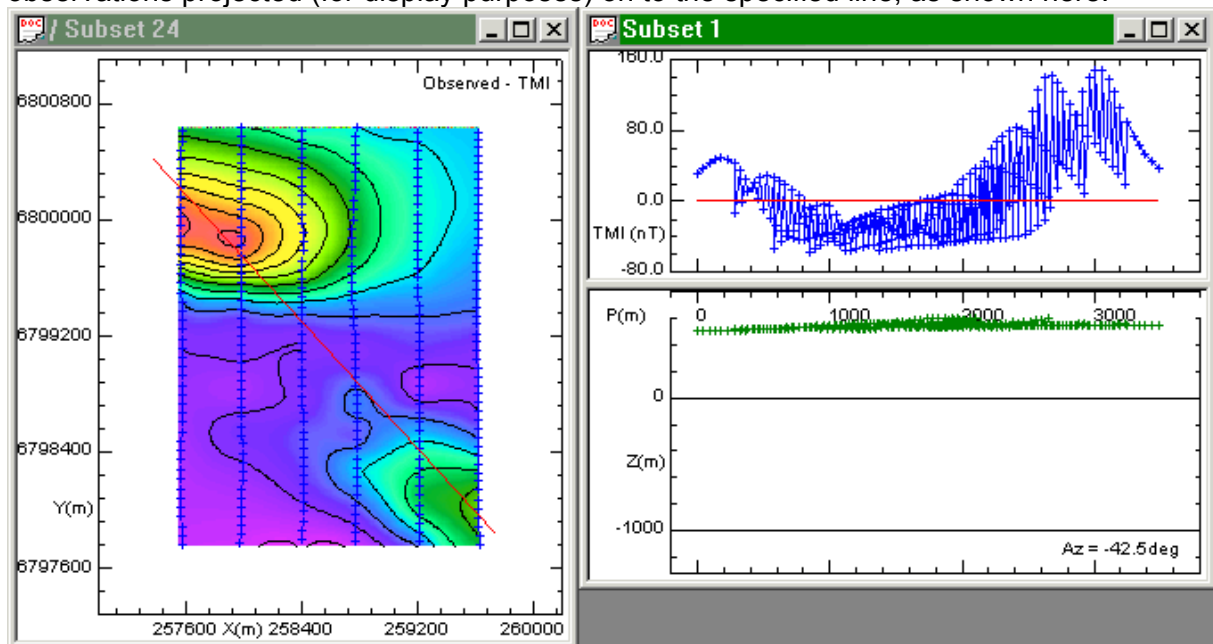
Why is the observed field profile spiky?

If you create a profile using the **Subset tool**, then you must remember to expand the initial selection line into a narrow rectangle.

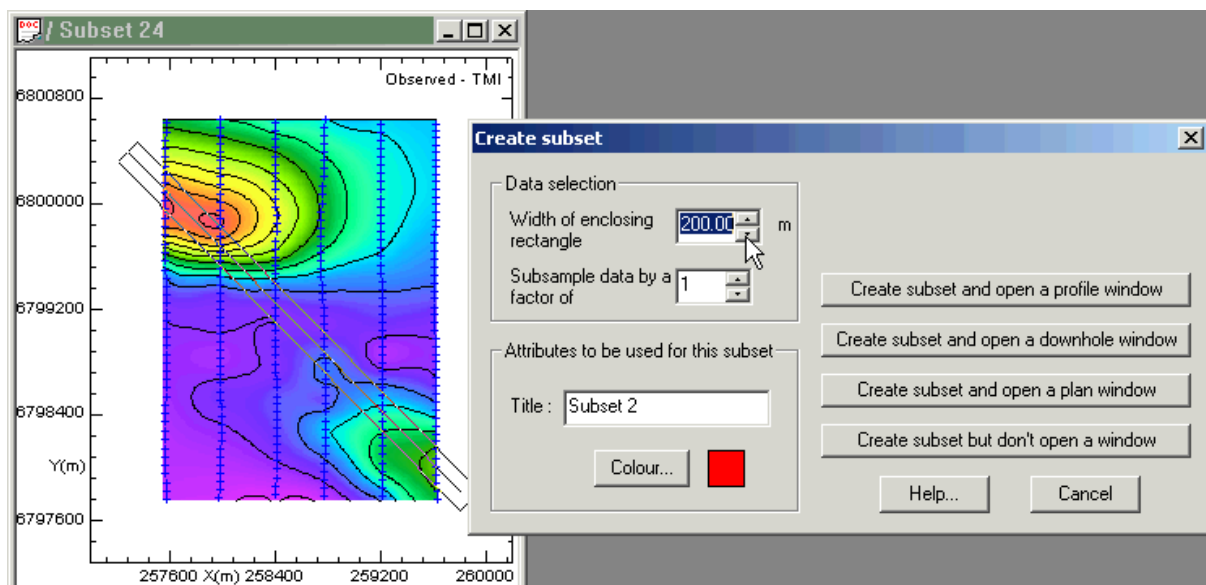
In this example the user wanted a profile section going diagonally across the data, as shown by the grey line. But notice that **Width of enclosing rectangle** is set to 0.



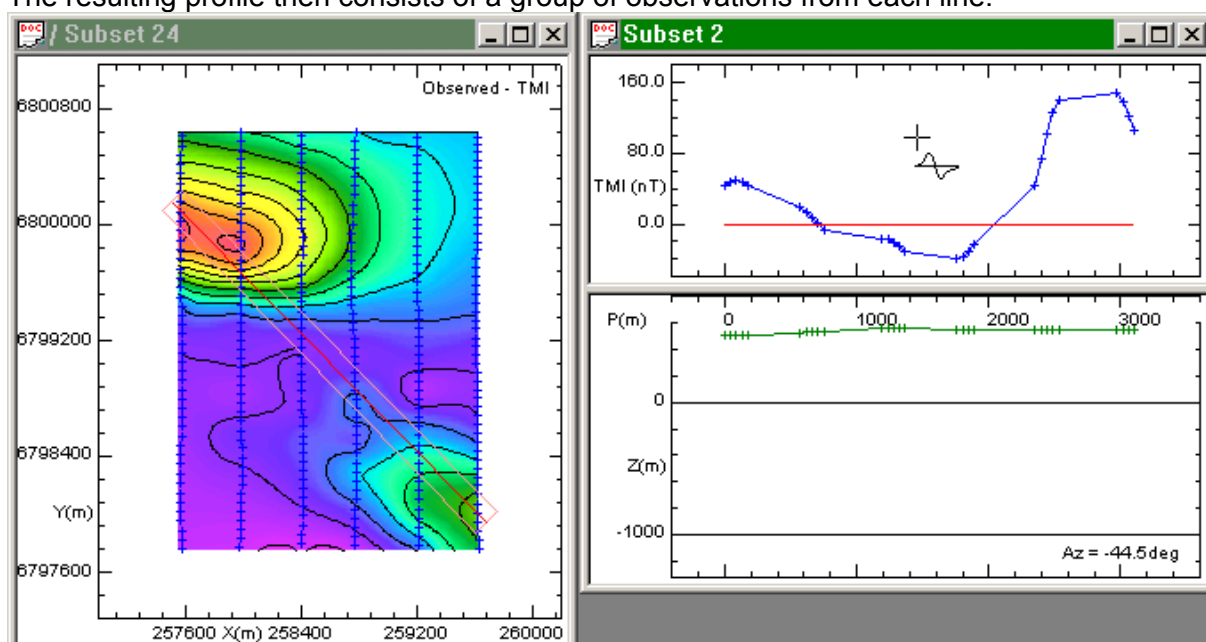
The zero-width line implies “infinite width”, and so the resulting profile contains all the observations projected (for display purposes) on to the specified line, as shown here:



What the user should have done was to expand the line into a narrow rectangle:



The resulting profile then consists of a group of observations from each line:



Why doesn't inversion seem to work properly?

It is important to remember that *Potent* will try to adjust the model parameters so that the calculated field values are similar to the values of the observations that are visible in windows. For example if you wish to model an anomaly that is a small subset of a large dataset, you will generally need to minimise the main Plan window so that only observations that are in the subset are visible. Otherwise *Potent* will attempt to fit the calculated field to all data, not just that belonging to the anomaly.

Review the [Inversion Modelling](#) section to see how to set up inversion.

How can I export my results to other programs?

In the File menu, the [Draw to metafile](#) command allows you to write the contents of any window to a Windows "Enhanced Metafile". By default these files have a ".EMF" extension. The next two commands are available only when a [Plan](#) window is [active](#).

- In the Model menu, you can use the **Export as Geosoft polygon file** command to create a file that can be imported into a Geosoft Oasis montaj map. By default these files have a “.PLY” extension.
- Also in the Model menu, the **Export as DXF file** command allows you to create 2D and 3D files in Autodesk’s Drawing Interchange and File Format, Release 12. By default these files have a “.DXF” extension. DXF files (especially the 2D version) are widely recognised by desktop publishing and GIS applications.

Can I work with different units?

Potent is designed to work with metric units, though there are some exceptions. Values that are not metric can be scaled as they are input. Refer to the **Units** section for details.

How do I add an image to a plan window?

The general way of adding an image is:

- 1 Right-click on the plan window and click **Options** on the **popup menu**.
- 2 On the dialog box, click the **Observations** tab.
- 3 In the **Show image of** group of controls, select the item for which you want to create an image (such as **Observed field**).
- 4 Click **OK**.

The shortcut way to add an image of Observed, Calculated or Residual field is:

- 1 Right-click on the plan window and point to **Image** on the **popup menu**.
- 2 From the **Image** menu, click **Observed field**, **Calculated field** or **Residual field**.

How do I create a cross-section of my data?

Use the **subset tool** to create a narrow selection of your observations.

How do I delete a vertex from a polygonal body?

Using the **Body shape** tool, hold down the CTRL key while clicking the left mouse button on the vertex to be deleted.

How do I remove a regional background field from a dataset?

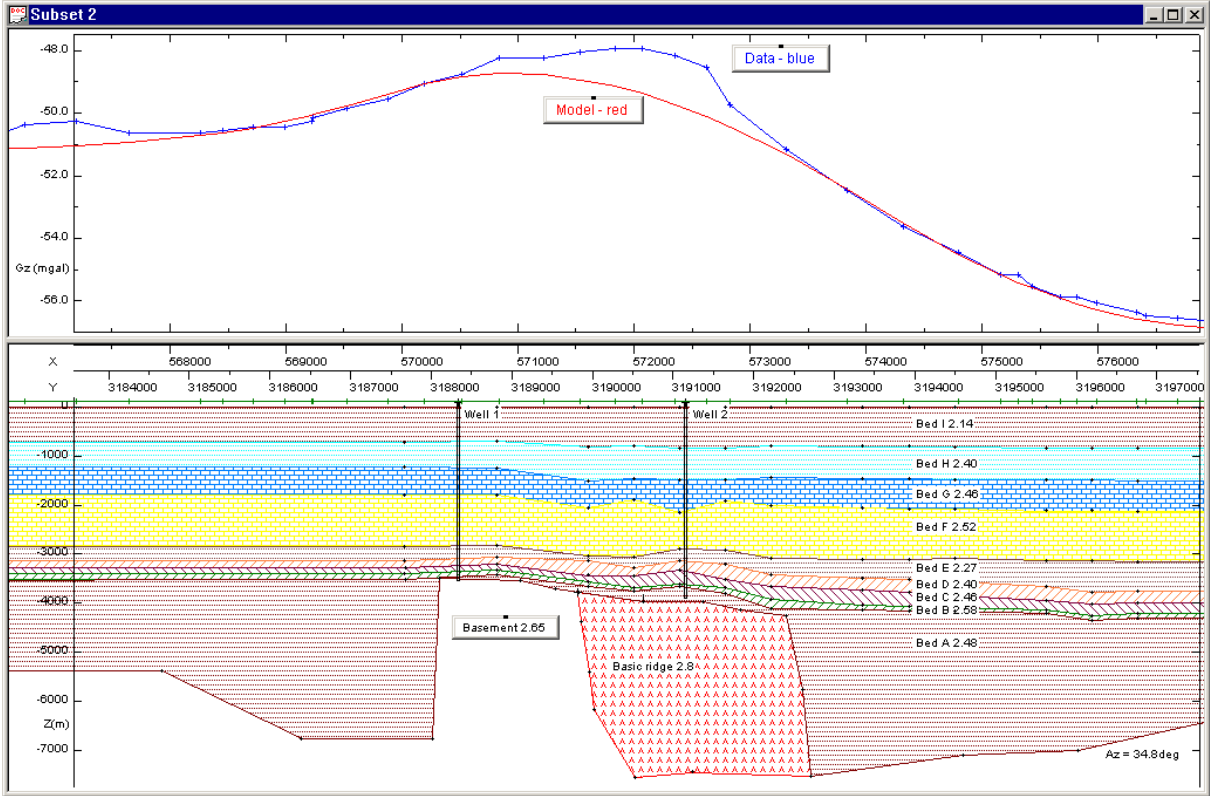
This is described in the **Regional Field** section of **Working with Observations**.

Technical Background

Potent is written in Microsoft Visual C++, using Microsoft Foundation Classes (MFC) for Windows and other high-level functions, and OpenGL for 3D rendering of bodies. The *Potent* executable file is statically linked to the MFC library, so that you do not need to be concerned about having the correct MFC DLL file installed.

Full size graphics

Layered Model



Startup

