

---

## **Noddy Tutorials**

1. Geophysical Response of Plunging Folds
2. Irregular Basins Over Basement Surface
3. Using Alteration Zones in Noddy
4. Remanent Dykes
5. Importing and Exporting Data within Noddy
6. Using Noddy in Exploration Simulations
7. Importing Flight Line Information and Synthetic Surveys
8. Digitizing Information From Maps into Noddy
9. Constraining Event Locations with Known Data





# 1 Table of Contents

<b>1</b>	<b>Table of Contents</b>	<b>3</b>
<b>1</b>	<b>Tutorial 1</b>	<b>5</b>
	Modelling Geophysical Response of Plunging Folds .....	5
	Aim .....	5
	Defining the Base Stratigraphy.....	6
	Previewing an Event .....	9
	Editing the Characteristics of an Event.....	9
	Adding a Scissor Fault .....	10
	Previewing Potential Field Anomalies.....	11
<b>2</b>	<b>Tutorial 2</b>	<b>13</b>
	Irregular Basins Over Basement Structures .....	13
	Aim .....	13
<b>3</b>	<b>Tutorial 3</b>	<b>19</b>
	Using Alteration Zones in Noddy.....	19
	Aim .....	19
<b>4</b>	<b>Tutorial 4</b>	<b>25</b>
	Remanent Dykes.....	25
	Aim .....	25
<b>5</b>	<b>Tutorial 5</b>	<b>29</b>
	Importing and Exporting Data within Noddy.....	29
	Aim .....	29
<b>6</b>	<b>Tutorial 6</b>	<b>33</b>
	Using Noddy for Exploration Simulations.....	33
	Aim .....	33
<b>7</b>	<b>Tutorial 7</b>	<b>37</b>
	Importing Flight Line Positional Information and Generating Synthetic Surveys.....	37
	Aim .....	37
<b>8</b>	<b>Tutorial 8</b>	<b>41</b>
	Digitizing Information from Maps into Noddy .....	41

	Aim .....	41
<b>9</b>	<b>Tutorial 9</b>	<b>47</b>
	Constraining Events Locations to Known Data .....	47
	Aim .....	47

# 1 Tutorial 1

## Modelling Geophysical Response of Plunging Folds

### Aim

In this tutorial we want to compare the differing magnetic signatures of folds with the same outcrop pattern but different plunge directions (North plunging anticlines versus South plunging synclines in this example).

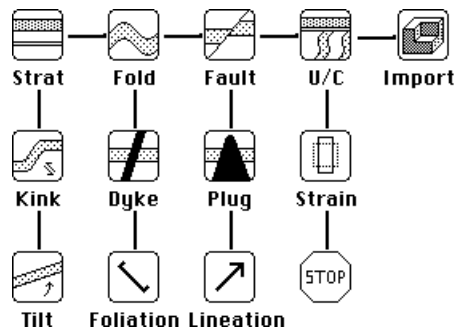
When you first execute Noddy you are presented with three windows:

- The **Toolbar**, which is a small window containing a set of icons for each deformation type
- A History window, into which these deformation events may be placed, edited and moved
- A **Status Bar**, at the bottom of the screen providing status information.

The contents of the **History** window contains the currently defined history, and is thus blank on start up, unless a file called 'DEFAULTS.HIS' is in the same directory as the executable binary.

The Icon Window shape can be cycled between three different shapes by holding the **SHIFT** key down and clicking in the contents of the window or the Pointer icon. This helps users who have smaller screens.

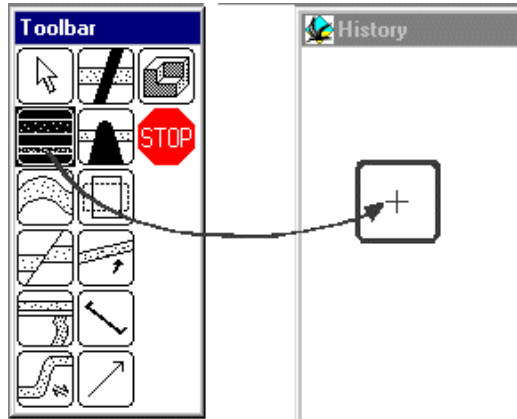
The complete set of icons and their meaning is shown below:



## Defining the Base Stratigraphy

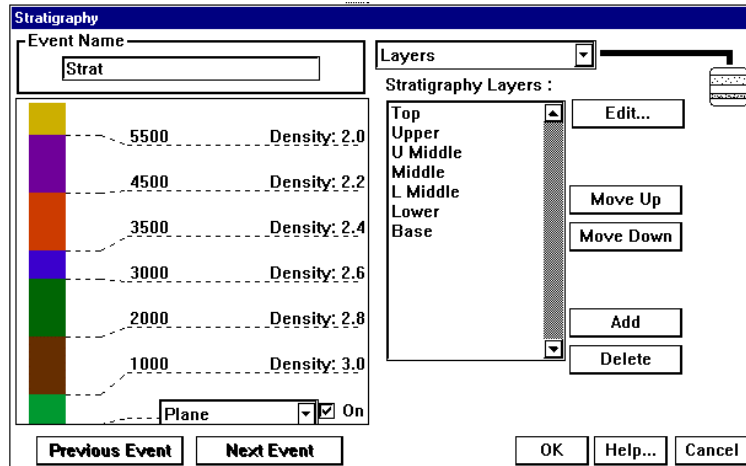


To define the Base Stratigraphy (which must be the first step in the construction of a history, unless a pre-existing history is read in from disk) click once on the Base Stratigraphy icon which will then become highlighted. If you then move the cursor over the History window, a dashed square follows the cursor, and clicking in the History window 'drops' that icon in the window.



*Placing an icon in the History window*

As soon as the icon is dropped, a new window opens up which allows you to define a starting stratigraphy for your model.



*Stratigraphy Summary window*

This window displays a summary of the stratigraphic column on the left hand side, and allows you to edit the stratigraphy on the right hand side.

### Step 1

Click on the name of any one of the stratigraphy layers. Once the name of the layer is highlighted, click the **Delete** button four times to reduce the stratigraphy to three layers.

### Step 2

Double click on the top-most unit name to open up a window that allows you to edit the rock properties for this unit.

The screenshot shows the 'Rock Properties' dialog box. The 'Geology' section has 'Name' set to 'Psammite', 'Alter' checked, 'Width' set to 'Inf.', and 'Height' set to '4800'. The 'Susceptibility' section has 'Anisotropy' unchecked, and 'Magnetic Susceptibility' fields for X (0.0005), Y (0.0000), Z (0.0000), Dip (0), Dip Dir. (0), and Pitch (0). The 'Density' section has 'Density' set to 2.820. The 'Remanence' section has 'Remanence' unchecked, and fields for Declination (0), Inclination (0), and Intensity (0.0000). At the bottom are buttons for 'Define Colour...', 'OK', 'Help...', and 'Cancel'.

*Rock Properties Window*

### Step 3

From the Name list select the rock type **Psammite**, this fills in the relevant rock properties for this rock type. The only area you need to edit is the **Height** of the base of this unit, which should be changed to **4800**. Finally click on **OK**.

### Step 4

Now edit the second unit in the stratigraphy, select the rock type **Basalt**, and change the **Width** value to **500**, and click on **OK**.

### Step 5

For the lowermost unit, select the rock type **Psammite** and click on **OK**.

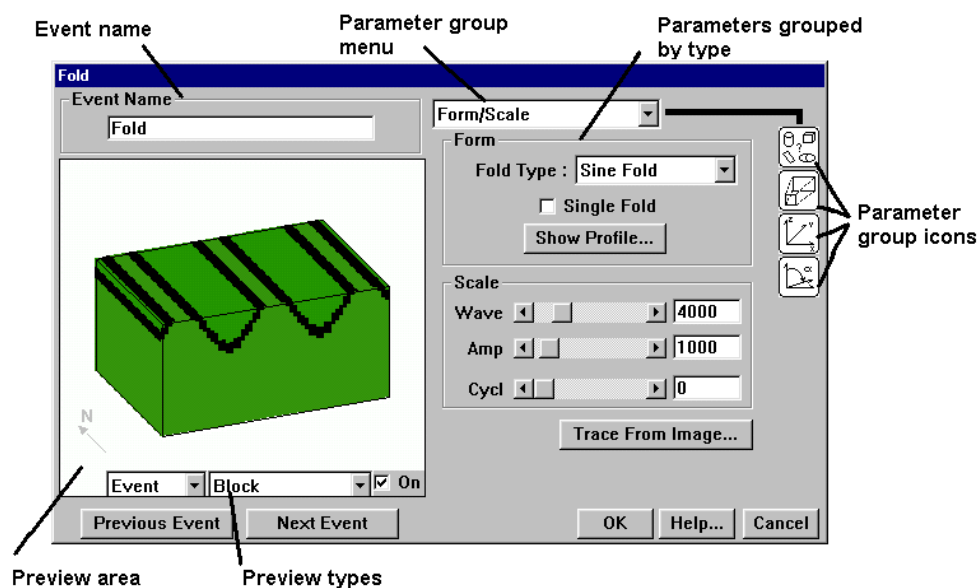
## Step 6

You have now finished defining your stratigraphy, and can click on **OK** from the Stratigraphy window.

### Defining a Deformation Event



Suppose you want to fold this stratigraphy, click on the **Fold** icon, and drop it to the right of the base stratigraphy icon in the History window. This will open up the Fold Definition window, which demonstrates the standard deformation event window capabilities:



*The various groupings and controls for an event edit dialog.*

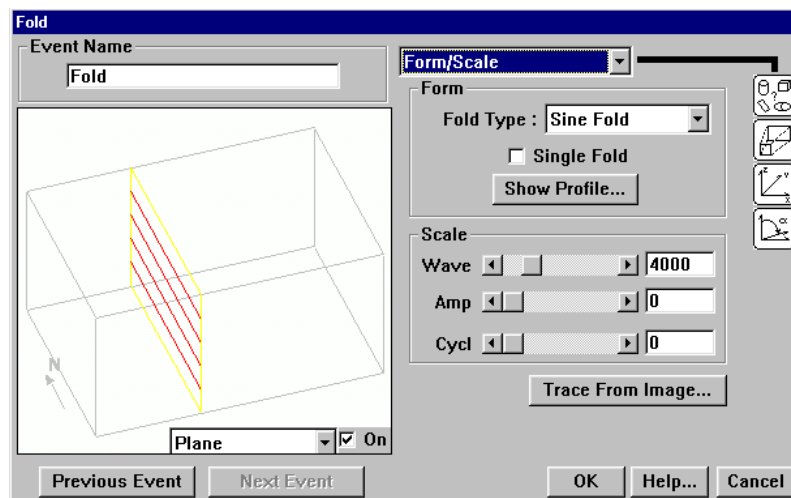
### Tip

If you find your previewed event does not appear as above, it is likely that the size of your block or other settings are not as in the tutorial. After editing the parameters, initial block model etc, use the **File>Read History** option and import the history file, Q1\_START.HIS. This history file brings you to this point of the tutorial.



## Previewing an Event

To get other views of the effect of this event on the pre-existing geology (in this case the base stratigraphy), select **Plane** from the Preview type menu. A plane of the fold axis should now be drawn in the preview space. The **Block** option provides a fast method of viewing the resultant event geology for that event. Other available options apart from this single event are the entire **History** (up until this event), or the **Full** history that details all events defined irrespective of the position of this event in the overall history. (The cube size in the preview calculation is 60% of the size specified in the Block View Options setting, to speed up the result). In this particular example the block has dimensions 10x10x5 km and the upper-south-west corner has coordinates -1000,0,3500.



*Fold control dialog with plane preview setting.*

## Editing the Characteristics of an Event

To alter the wavelength of this (cylindrical) fold, move the Wave scroll bar, and notice how the preview updates automatically.

### Tip

Automatic updating of previews can be disabled by clicking on the **On** button in the lower right hand corner of the preview window.

Reset the fold wavelength to 4000 and then click on the **OK** button. You might like to save this history now, by selecting Save History from the File menu.

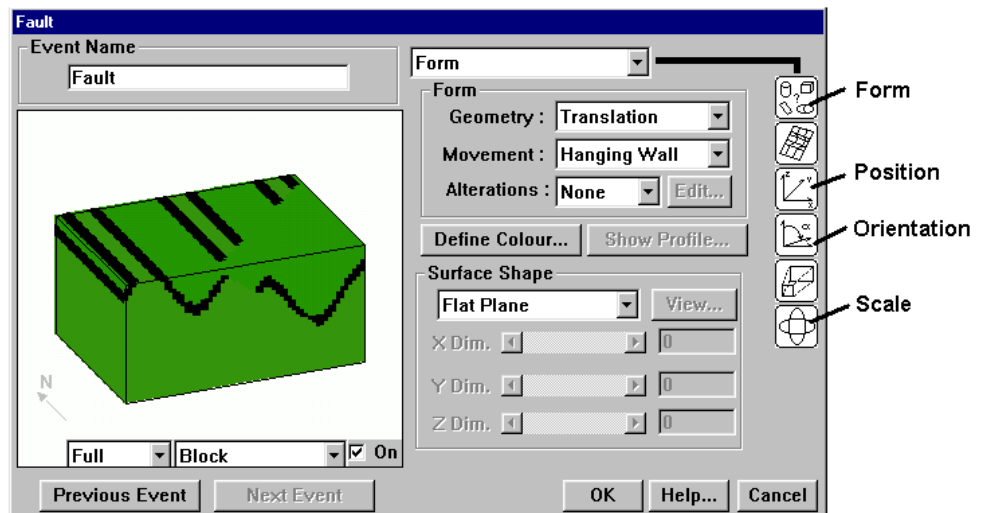
## Adding a Scissor Fault



Now we add a scissor fault so that we simultaneously rotate one block towards the North and the other towards the South (this gives a North and South plunging folds in one model).

To add a fault, click on the Fault icon from the Toolbar, and drop it to the right of the Fold Icon in the History window. A Fault definition window will open up, and we can select the Block Preview menu item again. We can now choose between **Event**, **History** or **Full** Block Previews, by selecting from the timing menu list which has appeared to the left of the Preview Type menu.

**Event** timing shows only the effect of this one event on the Base Stratigraphy; **History** timing shows the history up to and including the event currently being edited, and **Full** timing shows the effect of all events. In this case Full and History blocks have the same effect as this is the youngest event, as we are currently editing the youngest event.



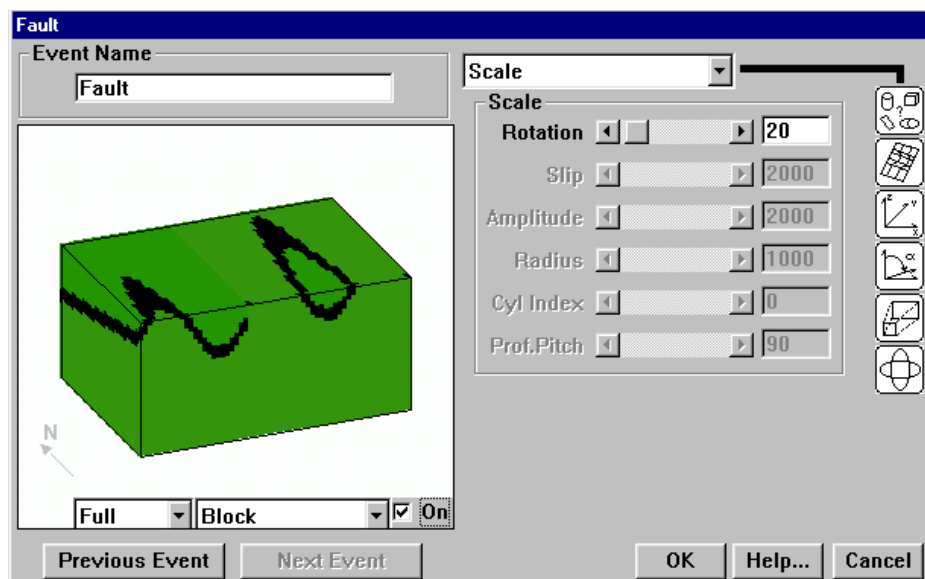
Change the following parameters so that you have a model with North and South plunging folds. If you have a slow machine, turn off the automatic preview mode (the **On** button in the lower right hand corner of the preview window).

```

Form:Geometry      Rotation
Form:Movement      Both
Orientation:Dip     Direction  90
Orientation:Dip     90
Position:XYZ        4000,-2000,-15000
Scale:Rotation      20°

```

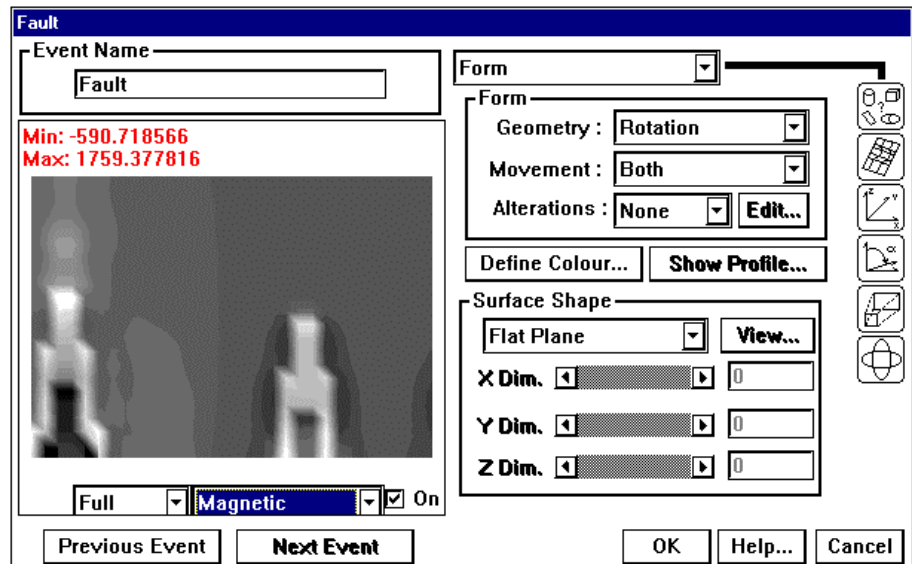
Your model should now have a north plunging anticline in the west and a south plunging syncline in the east, different structures, but the same outcrop pattern.



*Final folded and scissor faulted stratigraphy.*

## Previewing Potential Field Anomalies

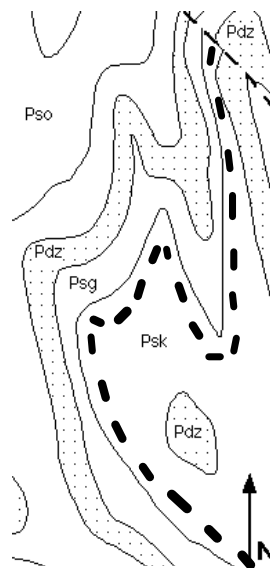
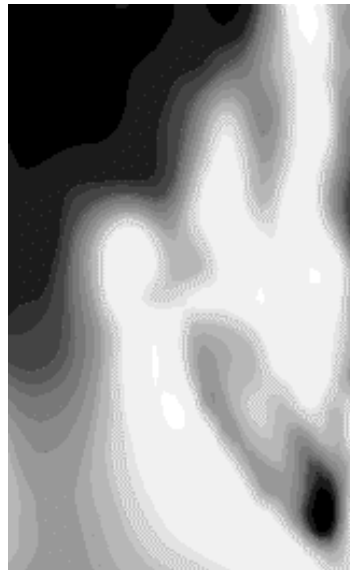
Just as geological models may be previewed, the gravity and magnetic images may also be previewed by selecting, for example, Magnetics from the Preview type menu. This will now calculate the magnetic anomaly associated with the currently defined geology (depending on the choice of Event/History/Full in that menu).



*Magnetic response of plunging anticline.*

Notice the ‘tail’ which occurs on the anomaly associated with the North plunging anticline.

Look at the magnetic signatures below seen to the east of Golden Dyke Dome (magnetic unit is shown as thick dashed line). Based on your previous modelling what is the structure here?



## 2

# Tutorial 2

## Irregular Basins Over Basement Structures

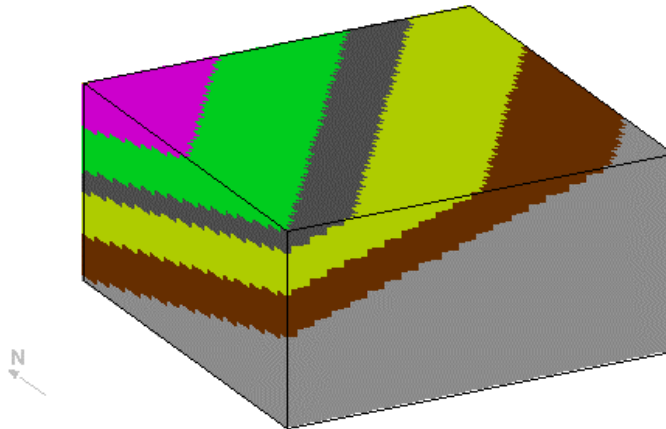
### Aim

This tutorial demonstrates how you can import pre-existing geological interpretations from geometric modelling packages such as MicroStation, Vulcan, GOCAD, Micromine etc. In this particular example you will import a triangulated unconformity surface from Vulcan (in DXF format).



### Step 1

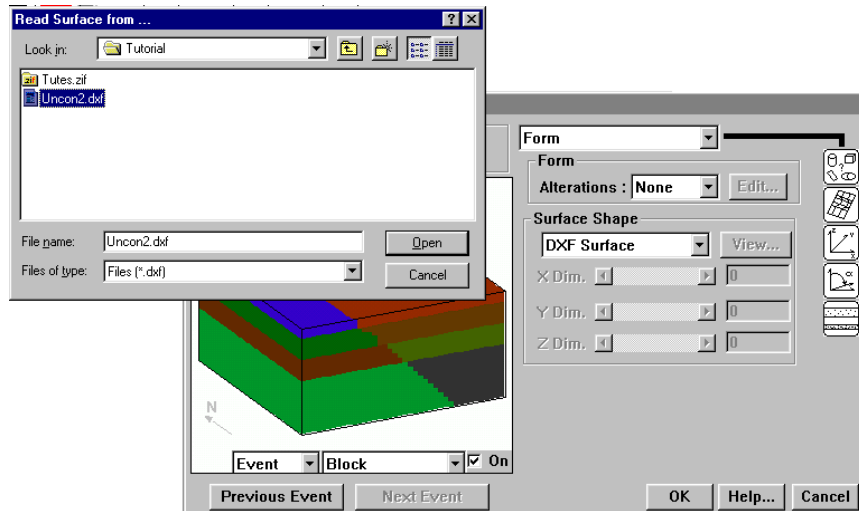
In order to set up a pre-unconformity geology, select Read History from the File menu, and select the file **Q2.HIS** (click on **Overwrite** when the time comes) which creates a default stratigraphy with a default Tilt event. This produces a block diagram that looks something like this:



### Step 2

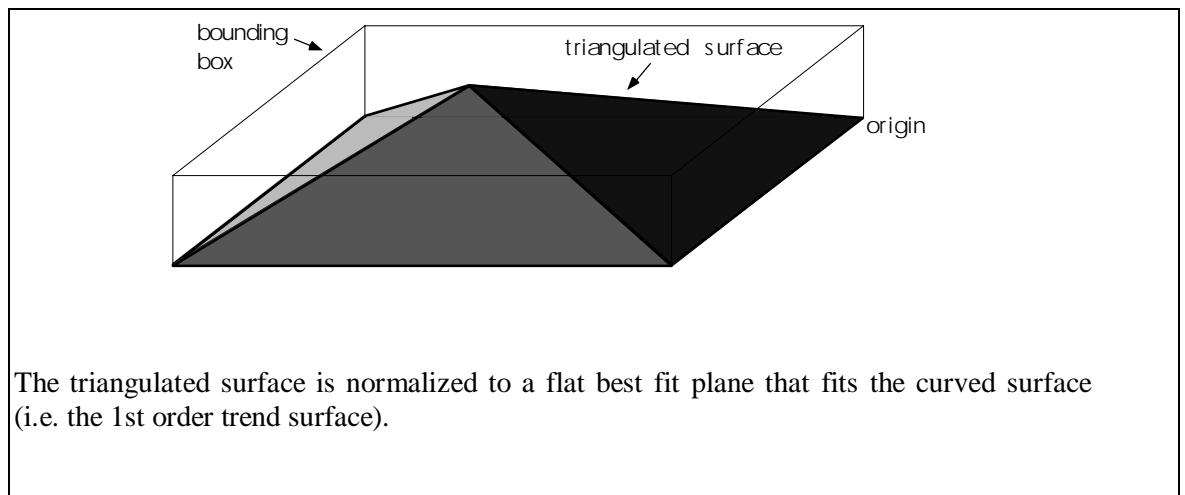


Add an unconformity event to the History window. The Unconformity Event Definition window contains many types of parameters, first of all concentrate on the **Surface Shape** group box.

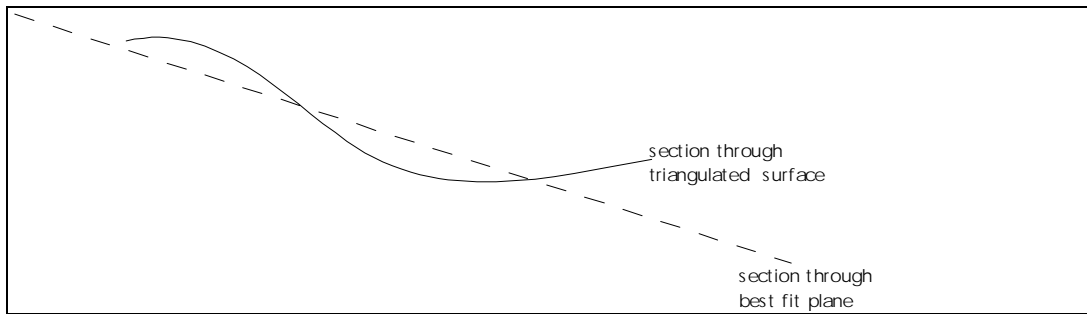


*Defining a DXF surface file from the Surface Shape option.*

In order to change from a flat unconformity surface to one defined by triangulation, select **DXF Surface** (instead of **Flat Plane**) from the Menu list button. Now select the file **UNCON2.DXF** . At this point the actual X, Y and Z dimensions of the bounding box (see below) for the surface will be automatically filled into the X, Y and Z dimensions area.



The triangulated surface is normalized to a flat best fit plane that fits the curved surface (i.e. the 1st order trend surface).



A view of the topography of the surface projected onto the best fit plane can be obtained by clicking on the **View** button. High points are bright, and low points are dark. Note that the topography of this surface has been defined to be a minimum around the edge of the defined area, because the triangulated surface has to merge with a flat plane outside the defined area.



*Mapped surface of DXF plane.*



On the assumption that you actually want a generally horizontal unconformity surface, switch to the Orientation Group Box, and set the **Dip** to  $0^\circ$  and **Dip Direction** to  $0^\circ$ .

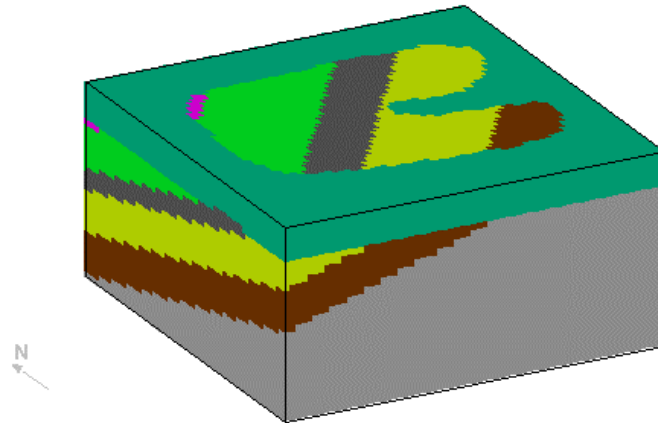
The origin of DXF surfaces in Noddy is defined to be the lower North-East corner of the bounding box, so in order for the unconformity to occur within the default block volume, set the **X Position** parameter in the Position group box to **9000**, the **Y Position** parameter at **9000** and the **Z Position** to **2500**.



In the Unconformity dialog, click on the Stratigraphy Group Box Icon, delete all the layers but one, and edit the **Density** and **Susceptibility** of this layer to **2.7** and **0.00135** respectively. Finally exit from the **Unconformity** definition window.

### Step 3

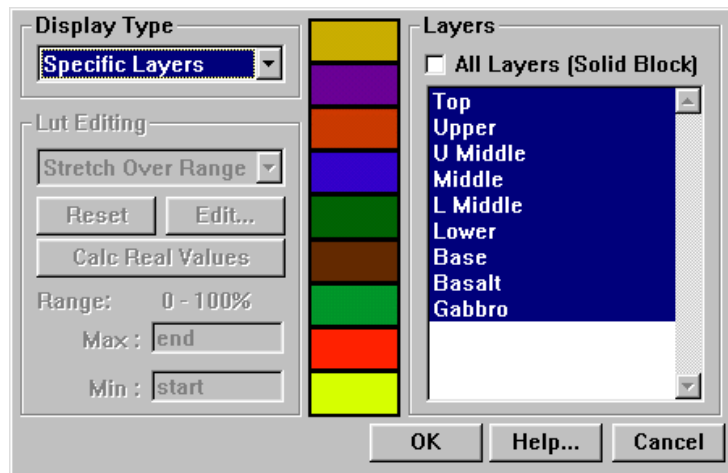
From the Geology menu select Block Diagram. You will be presented with a full resolution block diagram. You should now see tilted strata appearing through a window defined by the unconformity:



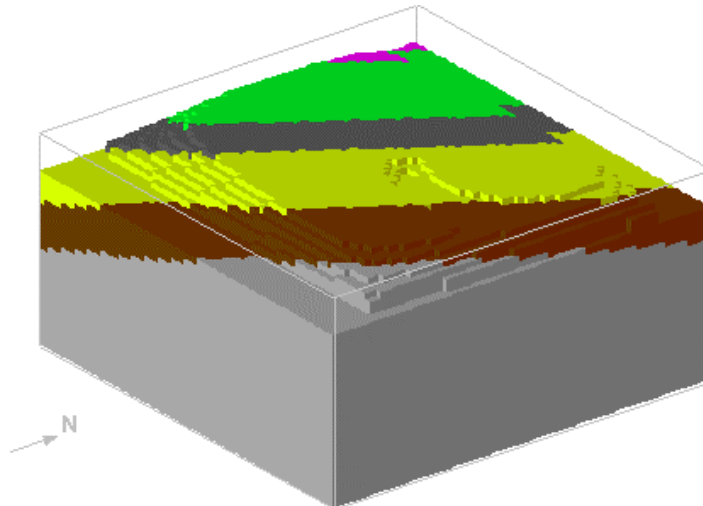
This block diagram is rotatable by dragging the cursor in the window, and scalable by dragging the cursor with the shift key held down.

To produce a block diagram that shows the geology immediately below the unconformity surface, click in the diagram with the right mouse button. This will bring up a window that allows you to make any of the rock types transparent:





Switch the **Display Type** menu to **Specific Layers**, and select all of the layers except the lowest layer on the list, and then click on **OK**. Click on **OK** and you will then have a block diagram with the rocks above the unconformity made transparent.



#### Step 4

You are now ready to calculate the resulting gravity and magnetics images by selecting **Calculate Anomalies>Anomalies** from the Geophysics menu, this will ask you for a file name for the results of this calculation. Once the calculation is complete both the gravity and magnetics images will be displayed.

### Step 5

The outcrop pattern of the unconformity is clear in parts of the magnetics image, but is unclear in other areas, and is very hard to pick at all in the gravity image. You can enhance the unconformity contact by performing a 1st vertical derivative calculation on the magnetics image. To do this select **Vertical Derivatives->First>Magnetics** from the Geophysics menu and selecting the file name you have just saved, and then typing in a new file name for the 1<sup>st</sup> VD image.

# 3

## Tutorial 3

### Using Alteration Zones in Noddy

#### Aim

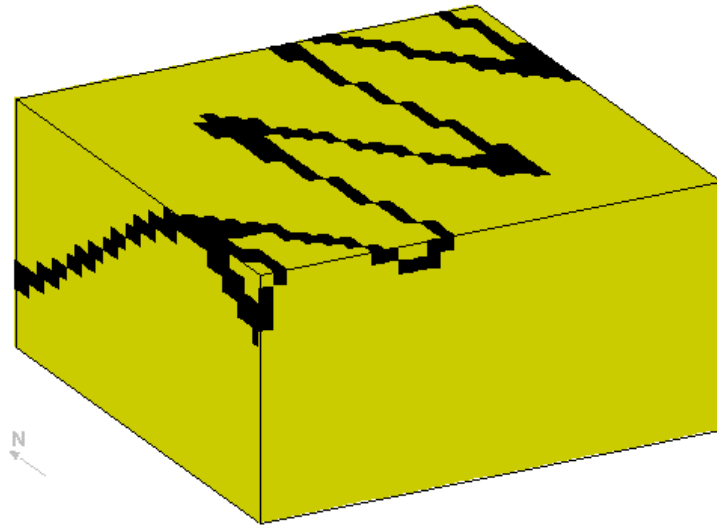
In this tutorial we shall see how two different types of alteration zones may be used in Noddy to simulate contact aureoles around plugs and demagnetization effects next to faults. The alteration zones in Noddy are defined in terms of 1 dimensional profiles as a function of distance from the causative surface and use the same general profile definition tool as faults and folds.

#### Step 1

Commence by reading in **Q3.HIS** which defines a **Base Stratigraphy>Fold >Tilt history**.



This will provide some background for the later events, which should produce a block that looks like this, except with only three layers.



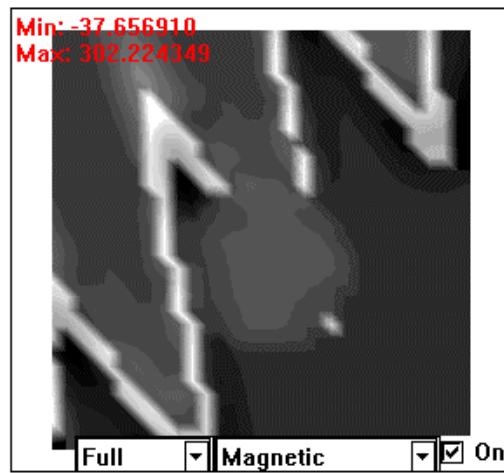
### Step 2



Now emplace a vertical cylindrical plug in the middle of the block. Drop a plug icon in the History window. Set the position of the plug somewhere in the middle of the block, and select a rock type of Porphyry from the Rock Property Database list, which will give the plug a susceptibility of  $1.7 \times 10^{-4}$ . (The rock property database may be edited by selecting Edit Rock Database... from the Tools menu).

### Step 3

Look at the magnetic preview, just to see what the result looks like without alteration zones:



### Step 4

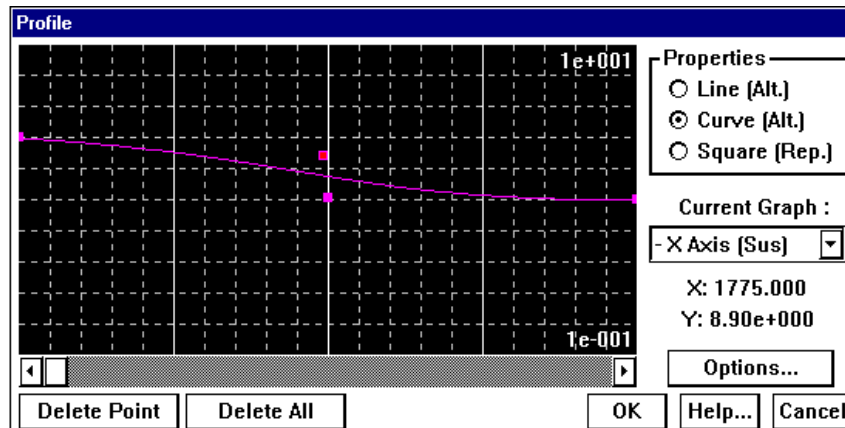
Define the metamorphic aureole around this plug by clicking off the **On** button in the preview window. Change the alteration type to **Both**, and click on the **Edit** button.

You will now be presented with an Alteration Profile Definition window, that allows you to change the alteration profiles for each geophysical rock property individually. For this example just worry about the bulk magnetic susceptibility (when there is no anisotropy this is the **X Axis (Sus)** value). Select this parameter from the **Current Graph:** list.

### Step 5

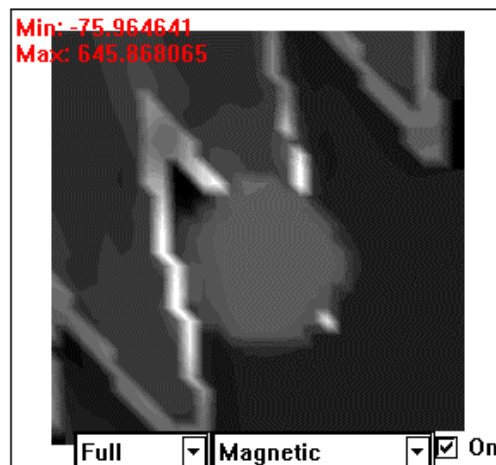
Define the scaling parameters for this profile by clicking on the **Options** button. Set the **Alteration Distance** to **2000**, the **Min Scale Factor** to **-1** and the **Max**

**Scale Factor** to **+1**, that is the width of the metamorphic aureole is 2000 m, and the y axis on the profile plot will vary between  $10^{-1}$  to  $10^{+1}$  (as a log scale). Now click on **OK** to return to the profile definition window, and set the **Profile Type** to **Curve (Alt)**, which means all susceptibility values within 2000 m are the product of the original value and the alteration values defined by the profile settings. Now draw a profile, such as the one shown below ranging between 2.0 on the left (at the plug country rock boundary) and 1.0 on the right (2000m away from the plug):



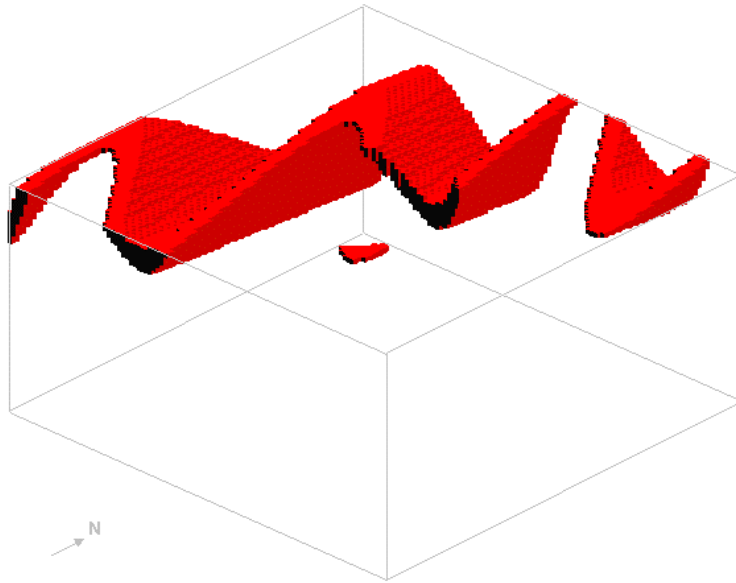
*Defining the metamorphic aureole in a Profile Window.*

and preview the geophysical response again (by clicking on the **On** button), which should now look something like this:



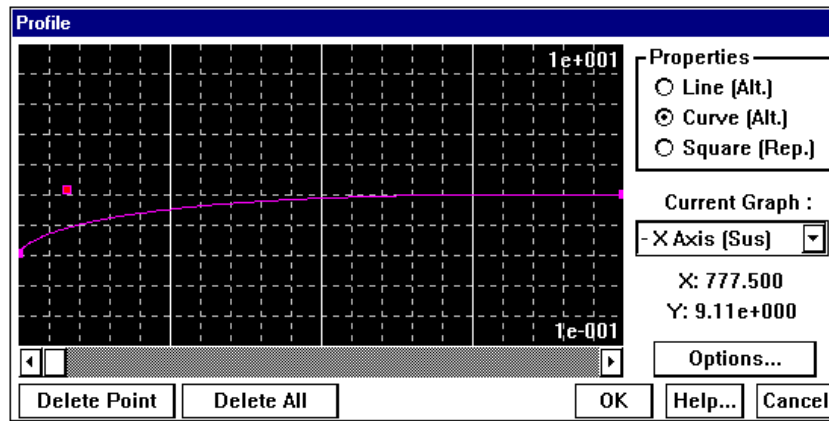
### Step 6

You can also make a block diagram showing only the Basalt layer. Select the **Geology>Block Diagram** option, and then right click in the image. Choose the **Select Layers** option from the **Display Type**, and then select only the **Basalt** layer from the **Layers** list, then click on **OK**, which produces a block like this:



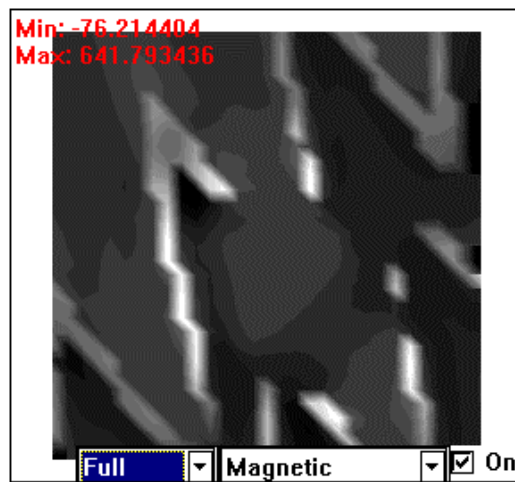
### Step 7

Add a fault event. For the fault, set the **Alteration Type** to **Both**, and **Edit** the profile, setting for **X Axis (Sus)** (in the **Options** window) the **Alteration Distance** to **1000** and the **Min Scale Factor** to **-1** and the **Max Scale Factor** to **1**. In the Profile window, set the Profile Type to **Curved (Alt)** and draw a profile like this, that is, make the fault demagnetize the rocks close to it.

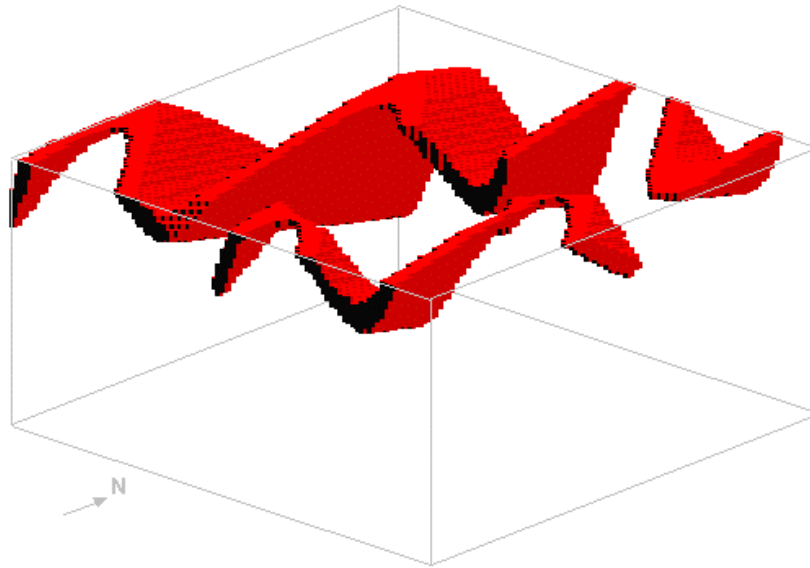


*Susceptibility control profile away from the plug.*

The resulting geophysical image should now look something like this:



The block diagram now looks like this:





# 4 Tutorial 4

## Remanent Dykes

### Aim

This tutorial demonstrates the effects of remanent magnetization when the remanence is defined in a pre-folding and post-folding environment.

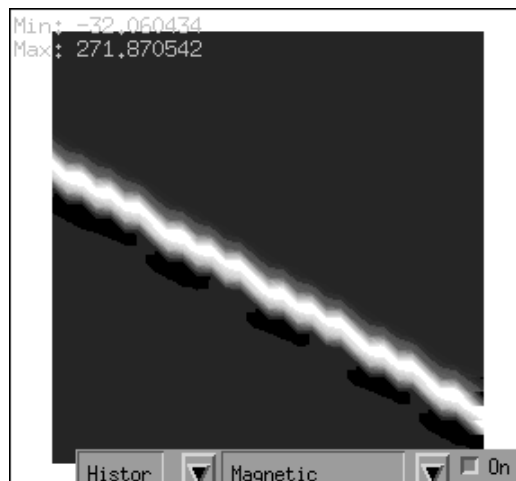
### Step 1

Select New History from the File menu (and then select User Defaults), then set up a Base Stratigraphy with one layer with a susceptibility of 0.

### Step 2

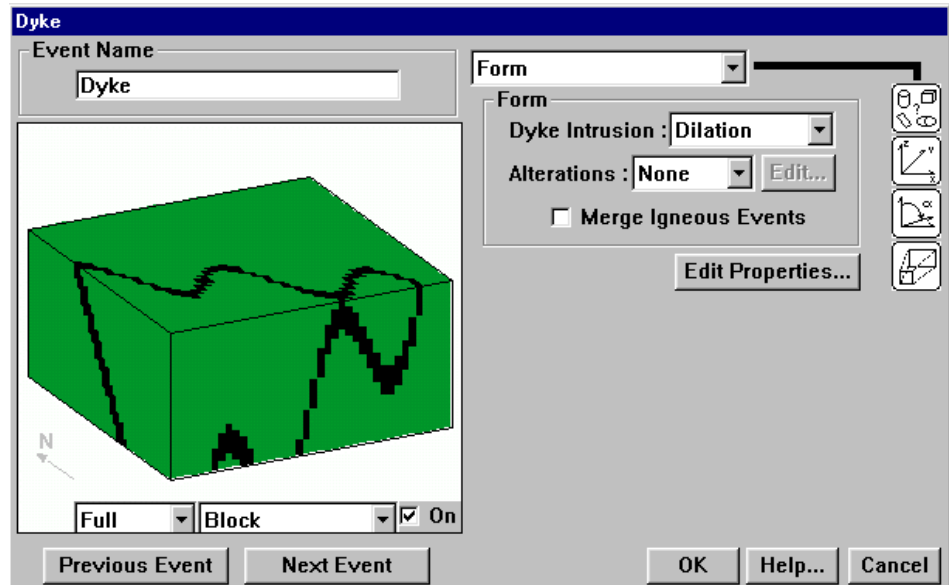
Put in a dyke with the following parameters, and view the magnetic field in the preview:

X	4000.00
Y	3000.00
Z	4000.00
Dip Direction	210.00
Dip	60.00
Pitch	90.00
Width	500.00
Magnetic Susceptibility	0.001

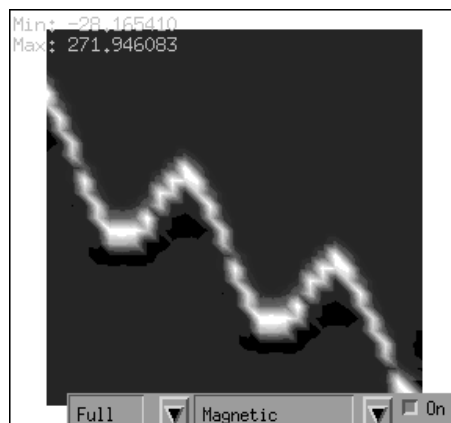


### Step 3

Next put in a default fold except for an **Amplitude** of **2000** m and re-calculate the magnetic field.



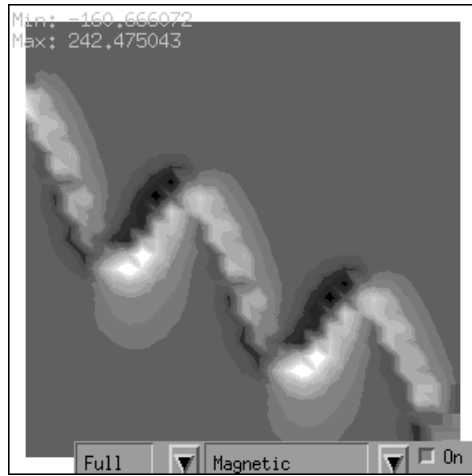
*Defining a fold with a dyke.*



### Step 4

Now change the magnetic properties of the dyke by turning on remanence for the dyke (first click on **Edit Properties** in the **Form** parameters area) with the following values and re-calculate the magnetic field.

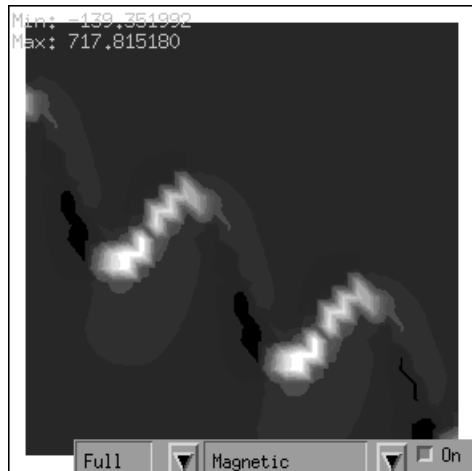
Inclination	23.00
Declination	135.00
Strength	100



*Recomputed magnetic response with remanence.*

### Step 5

Finally go to the **Edit>Geophysics Survey Options** and click on **Deformable Remanence** (so that the remanent vectors are folded) and re-calculate the magnetic field.



*Deformed remanence field.*



# 5

## Tutorial 5

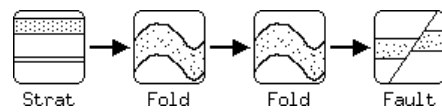
### Importing and Exporting Data within Noddy

#### Aim

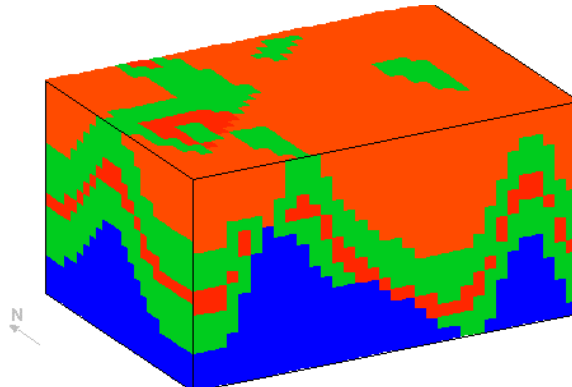
This tutorial shows some of the current import/export capabilities for transferring geological information to and from Noddy.

#### Step 1

Read in a simple history (**Q5.HIS**) that shows a refolded-fold followed by a normal fault.



Look at a block diagram of the geology.



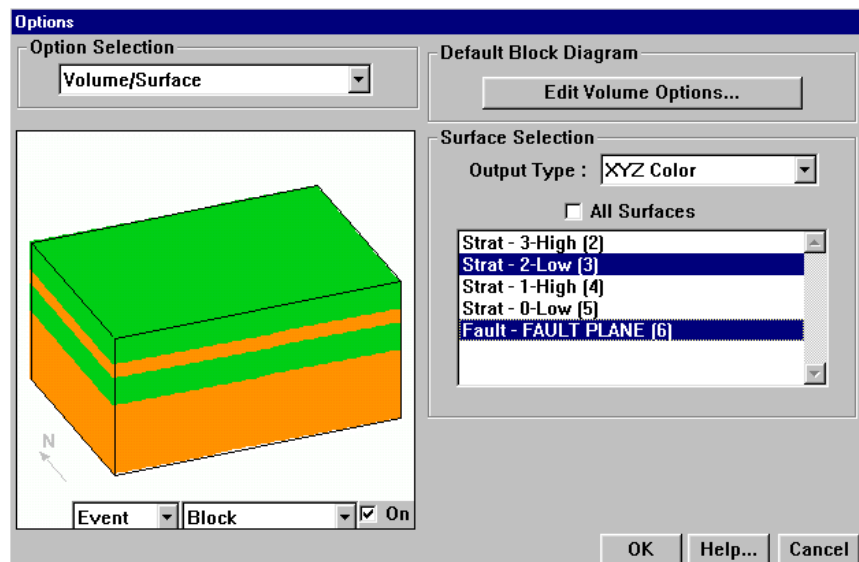
Make a map of the top surface of the block by selecting **Geology>Map>Lines**, and click on the map to show the local orientation of bedding, this should help to explain the outcrop patterns.



Map created from imported history file.

## Step 2

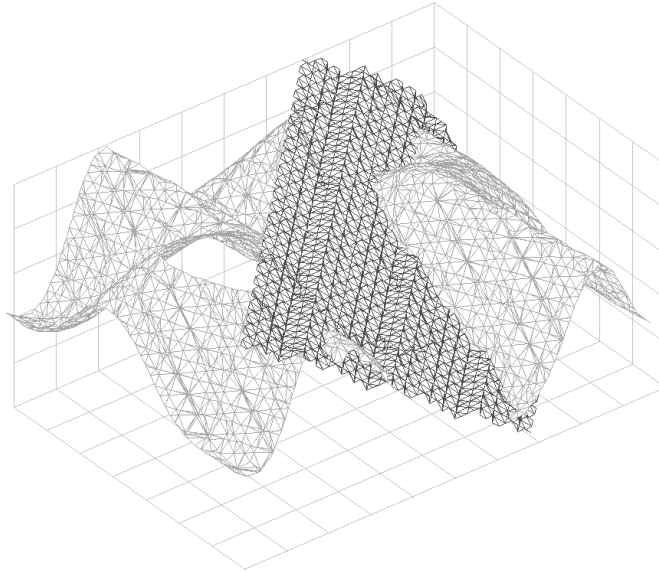
Select the Volume/Surface Options window, and turn off Surface Selection:All Surfaces. Select only the 2-Low and Fault Plane surfaces.



Exit from this window.

## Step 3

Select 3D Triangulation from the Geology menu and you should get a view of two intersecting triangulated surfaces:



*3D Triangulation of surfaces.*

Go back to the Volume/Surface Options window and change the Surface Selection:Output Type to File (DXF 3D Faces)

Select 3D Triangulation again from the Geology menu. This time the triangulation of the two surfaces will be saved out to file as in 3D DXF format (using 3D faces rather than polylines in this case to describe the triangular facets).

#### **Step 4**

You can also export this geology as a voxel model in a number of different formats: as a Noddy Block Model format file; as a Raw Voxel model (tab delimited ASCII); or as a Tabulated Column format model which specifies the location of each voxel.

#### **Step 5**

Only the Noddy format files can be directly read back in for further calculation of geophysical anomalies or deformation, although Vulcan 'regularized block model' format models can be converted into Noddy format models via the **Tools>Import Block>Vulcan** menu option.





# 6 Tutorial 6

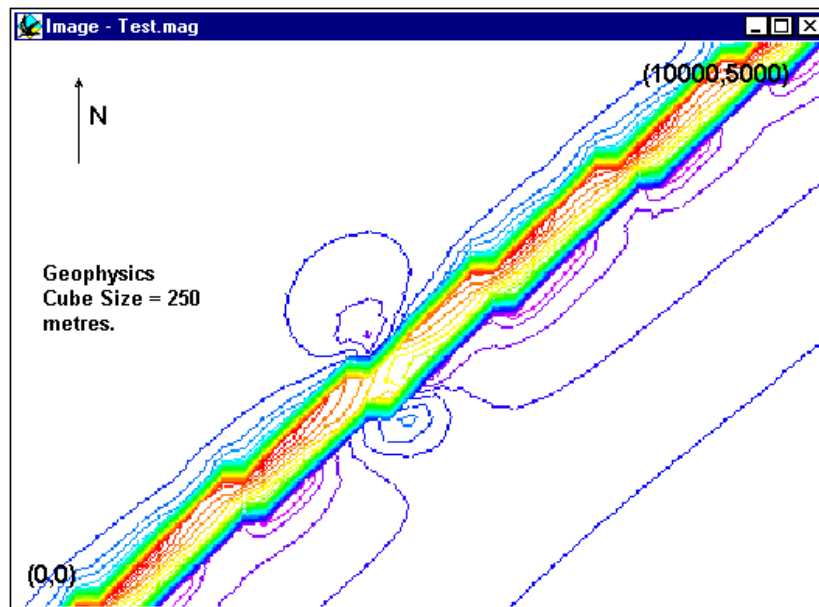
## Using Noddy for Exploration Simulations

### Aim

In this example we provide a simple exploration scenario that allows a drilling program to be developed.

You are provided with an aeromag image (80 m flight height) called **BORE.MAG** of a regional survey over a dyke that has elsewhere been associated with mineralization. You have graciously been provided with enough funds to finance 5000 metres worth of drilling, but due to the inflexibility of the new computerized order forms you can only drill holes in 500 m increments.

Can you find the ore body?



*Initial contoured display of magnetic data.*

**Step 1**

Load in the history file **Q6.HIS** that contains the scenario you will be using.

**WARNING**

---

Do not look at the details of the history, since the object of the tutorial is to locate the mineralization from the geophysics results!

---

**Step 2**

Display the magnetics data using the **Geophysics>Display Image>Magnetics** option. Select the **BORE.MAG** dataset. The display of the data may initially be in monochrome. To display the image in colour, position the cursor in the window and click the right button. Alter the Image Type to **Pseudocolour** and select **OK**.

**Step 3**

Use the **Geology->Borehole>Import>3D** menu to load 500, 1500 or 2000 m drill holes (named 500.XYZ, 1500.XYZ etc). These files are simply 3 column XYZ ASCII lists of drill hole position (Z is positive up).

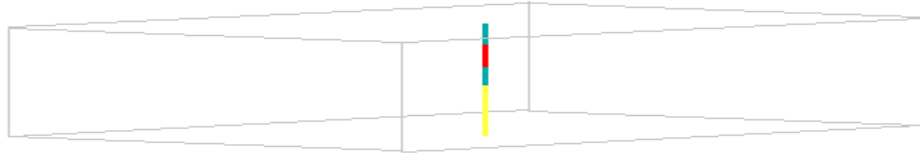
After you have loaded a file, it will allow you to select which columns contain X, Y and Z values and what offset to apply to the data. Don't touch the column settings.

Locate the borehole collar X,Y values by positioning the cursor in the magnetics image and nominating an exploration drill site with X, Y positions provided in the status bar. To position the drill holes (which all nominally start at a location of 0,0,0) apply an offset to the X and Y values.

The three rock types present are:

Yellow	background sediments
Blue	basalt dyke
Red	mineralization

You will be shown a 3D visualization of the drill hole with colours representing the three rock types present. Once you find the red mineralization, you have successfully located the mineralization.



All drill holes are vertical, and only record the geology at the XYZ positions used.

Each subsequent drill hole is added to the same display as long as you keep that figure open.

It is probably wise to record on a piece of paper the X,Y locations of the drill hole collars so that you can design your drilling program.

### **Answer**

To confirm the position of the mineralization (ONLY after you have completed your successful drilling), select the **Geology>Block Diagram** option and then select only the Mineralization for display. Use the right mouse button to click in the display and select Specific Layers. When coupled with the location of the Plug item in the history, the position of the mineralization will be revealed.



# 7

## Tutorial 7

### Importing Flight Line Positional Information and Generating Synthetic Surveys

#### Aim

In this tutorial we see how to calculate geophysical profiles at pre-defined positions. The profile positions are taken from a ModelVision export file, and allow us to compare the results from ModelVision and Noddy for the same model.

#### Step 1

Open up the **MVTEST.HIS** file, which contains a NS vertical dyke in a empty background. Look at a block diagram to see the dyke, and then go to the menu **Geophysics>XYZ Point Data->Import from File**, and select the file **MV\_LINE.GEO** (a Geosoft format file from ModelVision, which originally had a .DAT suffix when exported).

This will bring up a window that allows the user to select which columns to use for X, Y and Z data, and to add an offset to these values. In this case select **None** from the **Z Column** list since a comparison with the ModelVision results can then be created. Unless draped surveys are specified, the Z value will be calculated from the **Calculation Altitude** height from the top of the block as defined in the Geophysics Options window. A small window showing the first 5 lines of the file is provided as a check.

All the specified X,Y,Z locations must be within the area specified for calculation in the Geophysics Options window, otherwise an error message will appear. Any lines of text that do not start with a valid number will be assumed to be a comment.

**XYZ Conversion**

**Parameter Mapping**

X Coord. Column: 1 X Offset: 0

Y Coord. Column: 2 Y Offset: -1000

Z Coord. Column: None Z Offset: 0

Geosoft Single Line File - exported by Model Vision!

Line:LS\_SYN3I

EAST	NRTH	MAG	MOD	GRAV	MODI
0.000	0.000	0.419	0.744I		
10.000	0.000	0.548	0.756I		
20.000	0.000	0.697	0.768I		

Buttons: OK, Help..., Cancel

*Conversion of Geosoft line file.*

## Step 2

Once the desired columns and offsets have been applied, click on **OK** and a new window will appear that allows you to save the newly created data. This file may then be viewed with a text editor or spreadsheet package, and will contain the new gravity and magnetic data at the desired locations.

## Step 3

As a separate tutorial, we can also generate a synthetic survey over this area using the **Geophysics>XYZ Point Data>Generate** menu option. You are presented with a window that allows you to alter the survey specifications:

**XYZ Generation**

**Start Position**

X: 0

Y: 0

Alt: 400

**Area Dimensions**

Along Lines: 8000

Across Lines: 10000

**Orientation**

Declination: 90

**Spacing Between**

Lines: 500

Points: 50

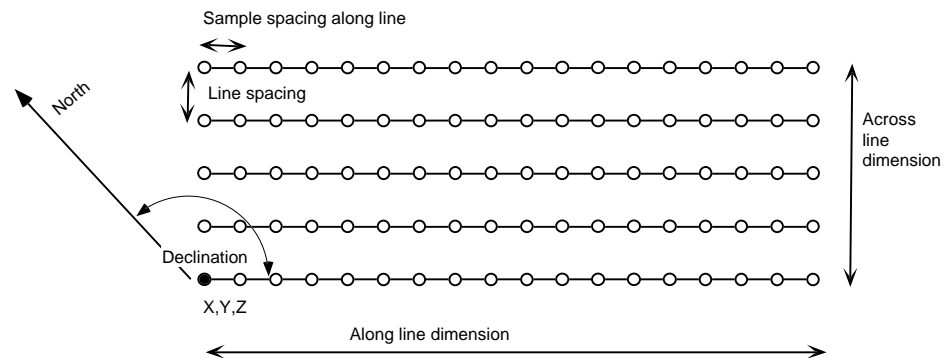
**Type of File**

Geological  Geophysical

Buttons: OK, Help..., Cancel

*Dialog to create synthetic observation points.*

The Position, Orientation and Area Dimensions parameters are defined according to the figure below:



#### Step 4

You can create either a rock property table for each X,Y position on the top of the block (if you select **Geological** as the **Type of File**) or the total field values at those positions (if you select **Geophysical**).

The geology file you create can have any extents, and will look something like this:

```
Noddy Geological Point Description
VERSION=6.01          LINES=420          ANICALC=1 REMCAL=1
```

X	Y	Z	DENS	SUSX	SUSY	SUSZ	DECL	AZI	STR	DIP	DDIR	PITCH	NAME
0.0	0.0	5000.0	5.0	0.0	0.0	0.0	30.0	30.0	0.0	90.0	90.0	0.0	Gabbro
50.0	0.0	5000.0	5.0	0.0	0.0	0.0	30.0	30.0	0.0	90.0	90.0	0.0	Gabbro
100.0	0.0	5000.0	5.0	0.0	0.0	0.0	30.0	30.0	0.0	90.0	90.0	0.0	Gabbro
150.0	0.0	5000.0	5.0	0.0	0.0	0.0	30.0	30.0	0.0	90.0	90.0	0.0	Gabbro
200.0	0.0	5000.0	5.0	0.0	0.0	0.0	30.0	30.0	0.0	90.0	90.0	0.0	Gabbro
250.0	0.0	5000.0	5.0	0.0	0.0	0.0	30.0	30.0	0.0	90.0	90.0	0.0	Gabbro
300.0	0.0	5000.0	5.0	0.0	0.0	0.0	30.0	30.0	0.0	90.0	90.0	0.0	Gabbro

The geophysics file must contain X,Y locations within the area selected from the **Edit>Geophysics Survey Options** window, and will look something like this:

```
Noddy Geophysical Point Data
VERSION=6.0  LINE=402
```

---

X	Y	Z	GRAV	MAG
0.000000	0.000000	0.000000	0.000000	-77.483611
50.000000	0.000000	0.000000	0.000000	-77.483611
100.000000	0.000000	0.000000	0.000000	-65.381012
150.000000	0.000000	0.000000	0.000000	-65.381012
200.000000	0.000000	0.000000	0.000000	-65.381012
250.000000	0.000000	0.000000	0.000000	-65.381012
300.000000	0.000000	0.000000	0.000000	-78.514437
350.000000	0.000000	0.000000	0.000000	-78.514437
400.000000	0.000000	0.000000	0.000000	-78.514437
450.000000	0.000000	0.000000	0.000000	-78.514437
500.000000	0.000000	0.000000	0.000000	-80.658351
550.000000	0.000000	0.000000	0.000000	-80.658351
600.000000	0.000000	0.000000	0.000000	-80.658351
650.000000	0.000000	0.000000	0.000000	-80.658351
700.000000	0.000000	0.000000	0.000000	-80.225422
750.000000	0.000000	0.000000	0.000000	-80.225422
800.000000	0.000000	0.000000	0.000000	-80.225422
850.000000	0.000000	0.000000	0.000000	-80.225422
900.000000	0.000000	0.000000	0.000000	-80.282955
950.000000	0.000000	0.000000	0.000000	-80.282955



# 8 Tutorial 8

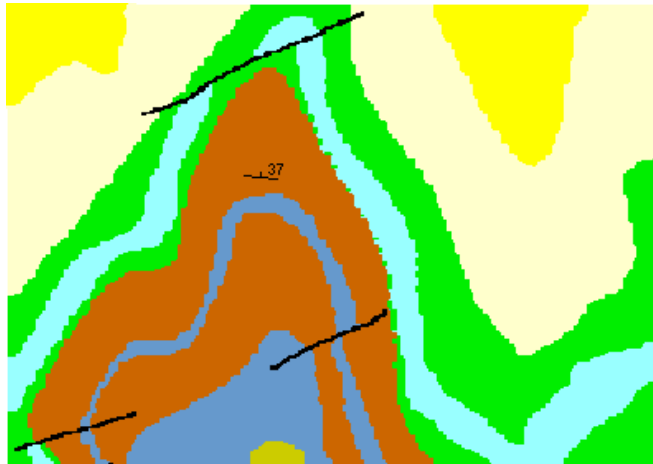
## Digitizing Information from Maps into Noddy

### Aim

This tutorial demonstrates the ability to trace geological features directly from geological maps and sections or from geophysical images. In this example we will trace a fold profile and a fault position from a scanned geological map.

### Step 1

Load in a copy of a map which is in .BMP format, by selecting Read Picture from the file menu, and choose the file **FOLDEX.BMP** . This shows the area to be modelled, and can be kept open as a reference.



*Bitmap of FOLDEX.BMP file.*

### Step 2

In order to simplify the process, let us limit ourselves to a stratigraphy with just three layers, retaining just the pale blue layer as the marker layer. Use heights of 4500 and 5000 for the top and base of the middle (pale blue) layer.

### Step 3

To create a fold that matches the map we need to consider two pieces of information, the fold profile and the plunge of the fold. First let us create the fold, by placing a fold icon in the history window, and select to the Form/Scale group boxes.

Form/Scale

Form

Fold Type : User Defined

Single Fold

Show Profile...

Scale

Wave 9875

Amp 2500

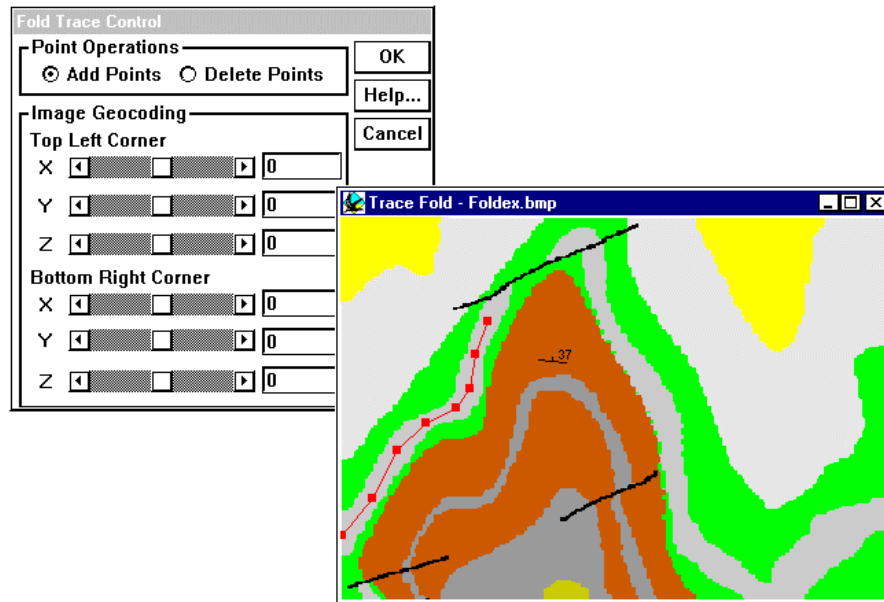
Cycl 0

Trace From Image...

*Entry parameters of the fold event.*

#### Step 4

Click on the **Trace From Image...** button, and select the FOLDEX.BMP file. You will now be presented with two windows: a Fold Trace Control window, that controls editing and the scaling of the window, and the Trace Fold window, which contains the image underlay. First type in the coordinates of the top left (0,7000,5000) and bottom right (10000,0,5000) of the image.

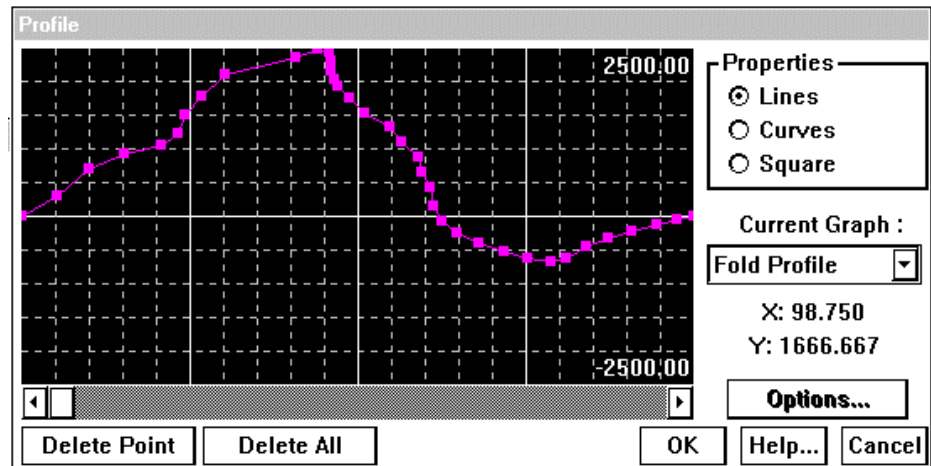


*Tracing the fold outline.*

Start digitizing the fold profile using the light blue layer as a guide. Profile points will show up as red squares connected by red lines. (The profile will always project onto the X axis without overlaps, so if your profile did not, you would have to rotate the image prior to digitizing). Extra points may be added as long as the **Add Points** control is set. To remove unwanted points select **Delete Points** and then click on the point you want to remove. Existing points may be moved around by dragging. Once you have finished the profile click **OK** in the **Fold Trace Control** window (don't close the **Trace Fold** window!).

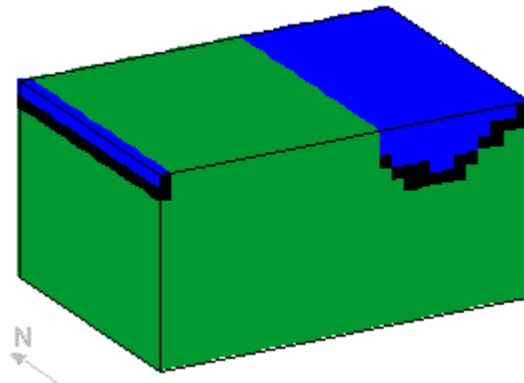
### Step 5

Now confirm that the profile looks OK by clicking on the **Show Profile** button, that allows further editing of the profile if desired.



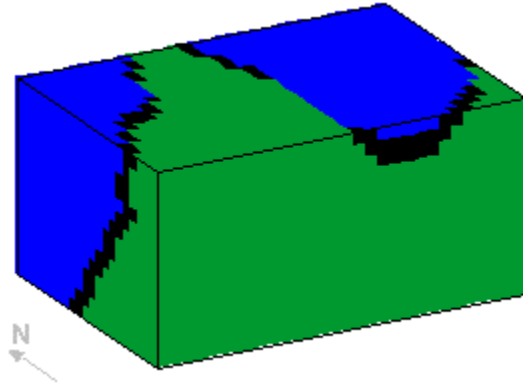
*Profile of digitised fold.*

The amplitude and wavelength of the fold will be automatically calculated based on the map corner coordinates, however in our case the amplitude will have to be adjusted later, because the fold plunge has not yet been taken into account (or you can calculate the true amplitude now from the plunge according to  $true\ amplitude = apparent\ amplitude * \cos(dip)$ ). You may observe the overall block geology by changing the preview to the History mode, or by making a block diagram, although you will probably find that not all of the folded layer fits in the block.



### Step 6

Now we use the dip information from the fold hinge to tilt the entire block  $37^\circ$  around an east-west axis. You may observe the overall block geology by changing the preview to the History mode, or by making a block diagram.



---

**Note**

Use a Tilt event to rotate the stratigraphy.

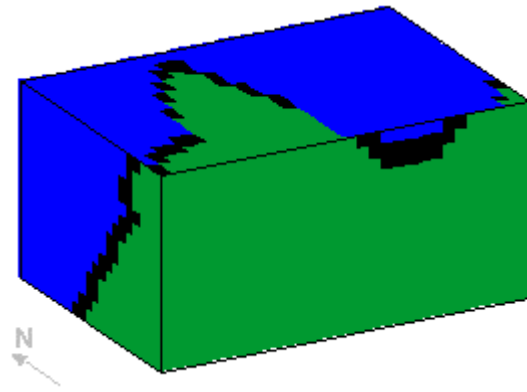
---

**Step 7**

Now you can add an event to model the fault that cuts the north end of the fold. Notice that the fault offsets the west limb of the fold but does not offset the right limb. These are several ways we can explain this in Noddy: with an elliptical fault (where the slip vector magnitude varies with position), with an oblique slip translational fault, or with a rotational fault (where both magnitude and orientation vary with position).

In either case we can use the **Trace From Image...** function to place the fault in the correct position and also with the correct orientation. With the Fault tracing option, only two points can be digitized, the first point provides the origin for the fault, and the second point controls the orientation. For elliptical and rotational faults the position of the first control point is therefore crucial, as it defines the centre of the ellipsoid and the rotation axis position respectively. If you are having trouble placing the fault, you can also use the **Define XYZ** position menu which appears when you create a **Map view** of the geology.

In the block below is an elliptical fault with a horizontal slip vector to achieve the variation in offset of the two limbs.



# 9

## Tutorial 9

### Constraining Events Locations to Known Data

#### Aim

In this example we demonstrate how to use an existing magnetic dataset to constrain the position and geometry of the Noddy events.

#### Step 1

First we need to be able to read in the pre-existing magnetic data. In order to do this we convert a raw ASCII grid file into a Noddy .MAG file for further use. Select **Tools>Import Image>Column** You will then be presented with a window that allows you to open a .GEO file (**DATA.GEO**). This is a multi-column ASCII file with Northings, Eastings and Magnetics data values. You will need to define which columns relate to X, Y and Z directions (you may need to transpose easting and northing).

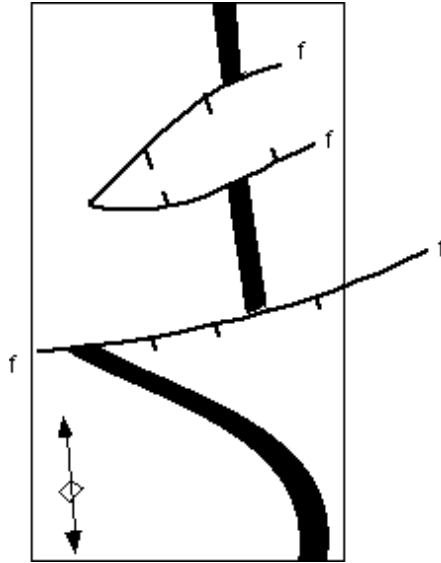
While importing, Noddy creates a new .MAG image file. Call this file **DATA.MAG**.

#### Step 2

Next we need to identify this newly created data as a reference image for the modelling. First change the Geophysics Scale to 2 in the Project Options window (this keeps the image to a reasonable size. Then select **File>Load Reference Images>Magnetics** and load in the image **DATA.MAG**. This will then be displayed in a window as a normal geophysics image that may be viewed as a raster or colour contour image, have profiles drawn etc.

#### Step 3

Now load in a history file called **Q9.HIS** in which has been created a model that will be used to try to simulate the folded fault block located at 5000,5000. This history provides the stratigraphy and the late folding event which are both obvious in the geology map below, but leaves the early faulting up to you. First of all create a block diagram to have a look at the model as it stands.



#### Step 4

To create the fault select a fault icon from the Toolbar and place it between the Base Stratigraphy and the Fold icons in the History window. The fault definition window will open up. You need to decide what type of fault explains the fault block geometry seen in the magnetics. Try putting in a Translational normal fault dipping 60 to 180, and position it at 5000, 5000, 5000.

In the preview window you should now see this fault plane. In order to see the effect of this fault on the Base Stratigraphy alone (i.e. without the later folding) select **Block** from the menu at the lower right of the Preview area. This shows the south (hanging wall) block sliding off into oblivion. In order to see the combined effect of the faulting and folding, select **Full** from the left menu in the Preview area.

You can now also preview the magnetic anomaly image for this geology, by selecting **Magnetics** from the right menu in the Preview area. This creates a full magnetics calculation for a cube size 5/3 times cube size defined in the **Edit>Block Options** window, and provides the range of TMI values present in the area.



### Step 5

This fault accounts for some of the fault block behaviour, but does not explain the narrowing of the block to the West. This suggests that perhaps we need a fault that has a slip vector that decays to the West. You can achieve this by selecting **Elliptical Fault** from the **Form>Geometry** menu in the fault definition window. Since elliptical faults have a narrow extent, it is not at first obvious where the fault is in the **Full:Block** preview.

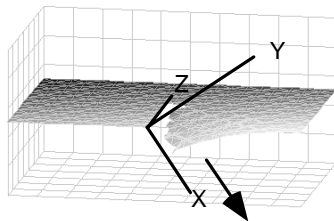


To make the fault more obvious, increase the **Ellipsoid Axis** dimensions (click on the Ellipsoidal Scale icon to bring up the relevant parameters) until it appears in the preview.

#### Note

If the refresh rate of the preview is too slow, disable it by clicking on the **On** button in the lower right hand corner of the preview area, and turn it on when you next want to see the block.

These axes define the ellipsoidal volume within which there will be slipped rock, with X parallel to the slip direction in the fault plane, Z perpendicular to the slip direction in the fault plane, and Y normal to the fault plane.



The X,Y,Z position now defines the centre of the ellipsoid (which the fault passes through).

### Step 6

Once the Elliptical fault is quite large, you should be able to see the fault block in the Preview window again. As a check that the magnetics are starting to look reasonable, and also to see the relationship between the magnetics and the geology, select Magnetic and Map from the right menu in the preview area. Now exit from the Fault definition window and calculate a full magnetics image.

### Step 7

We can produce a composite image to check on the exact placement and orientation of the fault. To do this select **Geophysics>Difference With Reference>Magnetics** and reload in the newly created .MAG file. The resulting image is the reference image subtracted from the model image. Both the model and fault positions show up quite clearly in this image, so repositioning and re-orienting the fault becomes quite simple. This difference image is also available in the Preview window, but is much smaller and harder to deal with. Once the fault is positioned and oriented correctly, you can start to worry about the Ellipsoid Axis dimensions so that the shape of the fault block matches the observed data.

