Tutorial case study B (Antonio's map)

Parent topic: User Manual and Tutorials

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This case study leads the project geologist through the process of:

- Creating a 3D GeoModeller project (from scratch)
- Creating the 'objects' to be used in the project: geological formations, faults, stratigraphic pile
- Entering geological observations from the field mapping - contacts and orientation data
- Computing the 3D model
- Generating traditional 2D views - maps and sections
- Generating 3D shapes and progressing to web-ready VRML files for interactive 3D display

This tutorial is based on a simple map used in Antonio Guillen's *Introduction to 3D GeoModeller* PowerPoint presentation. It has a simple, layered stratigraphy, some broad folds, and two faults.

In this case study:

Tutorial B1—Getting Started with Case Study B

Parent topic: Tutorial case study B (Antonio's map)

This tutorial is part of Case Study B, last revised December 2005

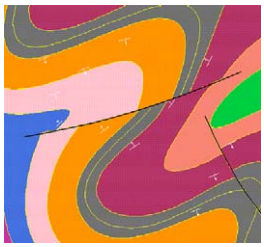
Tutorial B1—Inputs

Parent topic: Tutorial B1—Getting Started with Case Study B

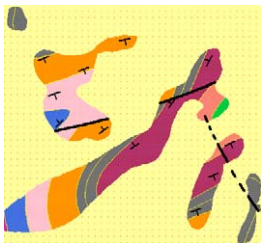
Geology

The geology for this project is available as a 'geological map', in an image file.

Located in directory: **`GeoModeller\tutorial\CaseStudyB\TutorialB1\Data`**
There are two files available



`FieldGeology.jpg`



`FieldGeologyWithCOVER.jpg`

In this tutorial we use the covered geology.

Location

The tutorial gives details of the extents when required.

Stratigraphy

You need to input the stratigraphy for the project area, and also give names to the two faults. The tutorial gives details when required.

B1 Stage 1—Starting the project

Parent topic: Tutorial B1—Getting Started with Case Study B

B1 Stage 1—Steps

1 From the main menu choose **Project > New** OR

From the **Project** toolbar choose **New**

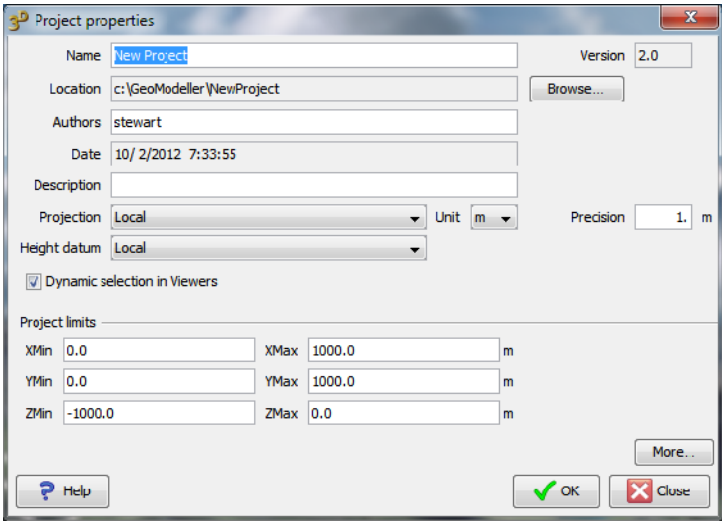
Select the project directory from the file chooser.

2 In the **Project properties** dialog box:

- Give the project a name (**CaseStudyB**) (do not use spaces in the name)
- Define the East, North and Z geographic extents based on the table.

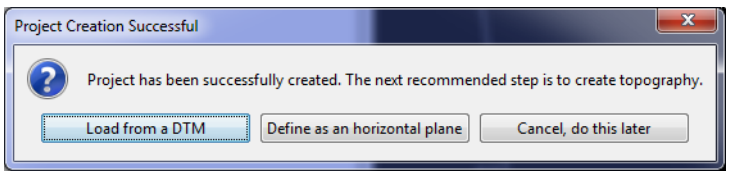
	Minimum	Maximum	Range
East	10 000 (**Xmin**)	14 000 (**Xmax**)	4 000 m
North	20 000 (**Ymin**)	23 700 (**Ymax**)	3 700 m
RL (Z)	–1 000 (**Zmin**)	100 (**Zmax**)	1 100 m

The Z values range between –1000 ('–' for below ground) and 100 ('up in the air', 100 m above ground level).



Choose **OK**.

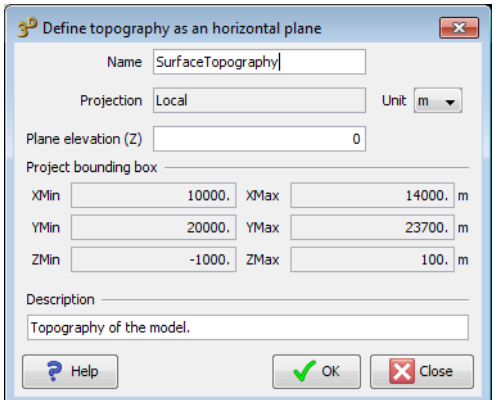
3D GeoModeller displays the **Project creation successful** dialog box.



3 Choose **Define as a horizontal plane**.

For this project, use a 'horizontal topography' at zero elevation.

Give it a name: **`Map_DTM`**.



4 Save the project with a new name and location away from the 3D GeoModeller installation folders.

From the main menu choose **Project > Save As** OR

From the **Project** toolbar choose **Save As** OR
Press CTRL+SHIFT+S.

The 'save as' operation is unusual. When you specify a project name you are actually specifying a folder name. 3D GeoModeller saves the project as an **`*.xml`** (with the same name as the directory) in that directory, along with all associated or referenced files.

Note that a completed version of this tutorial is available as **`GeoModeller\tutorial\CaseStudyB\TutorialB1\Completed_project\TutorialB1.xml`**. Do not overwrite it.

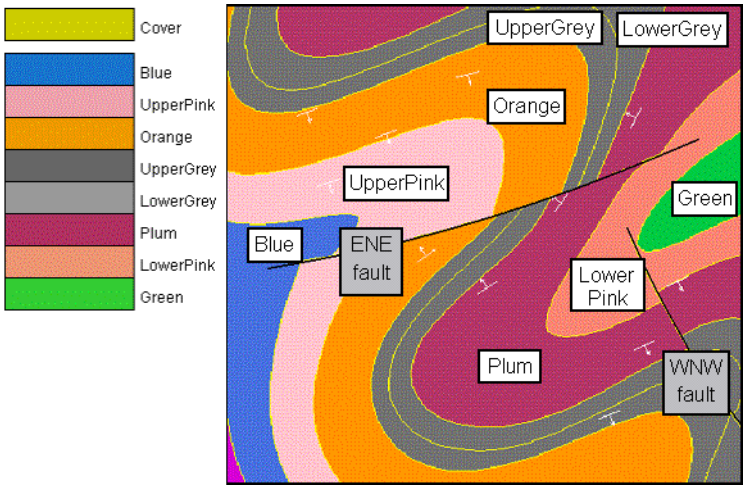
B1 Stage 2—Enter stratigraphy, define stratigraphic order, define onlap or erode

Parent topic: Tutorial B1—Getting Started with Case Study B

In this stage we examine the project geology, and define the stratigraphy, and stratigraphic relationships. Consider the image of project geology (below). Let's assume that the project geologist knows something about the project area, and can make the following decisions:

- Simple, layered stratigraphy, with a common geological history, so the strata can be grouped into a single 'series'.
- 'Green' is known to be the oldest unit.

On the basis of our assumed knowledge of the geology, we need to define the stratigraphic column for the project area. We shall put all strata in one series and add 'Cover'.



B1 Stage 2—Steps

1 From the main menu, select **Geology > Formations: Create-Edit** to create the 'geological formation objects'

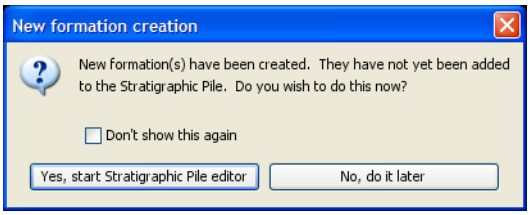
3D GeoModeller displays the **Create-Edit geology formations** dialog box

2 Create a 'formation object' for each of the above geological formations in the project area.

Type the **Name**, assign an appropriate **Colour**, choose **Add**.

When finished, choose **Close**.

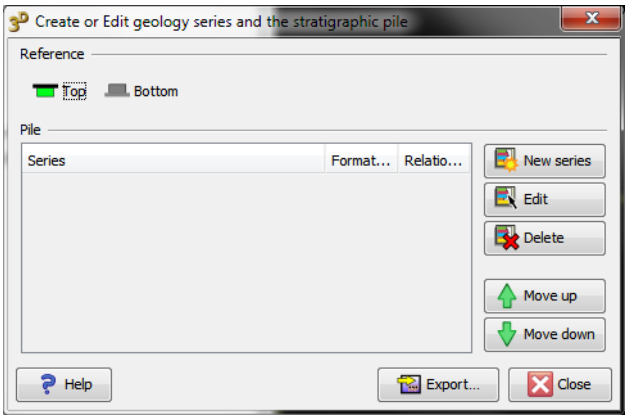
3 When you choose **Close**, 3D GeoModeller may display the **New formation creation** tip box.



Choose **Yes, start Stratigraphic Pile editor**.

If this box does not appear, from the main menu, choose **Stratigraphic pile: Create or edit**.

3D GeoModeller displays the **Create-Edit geology series and the geological pile** dialog box.



Set **Reference (Top-Bottom)** to **Top**.

4 Choose **New Series**.

3D GeoModeller displays the **Create geology series** dialog box.

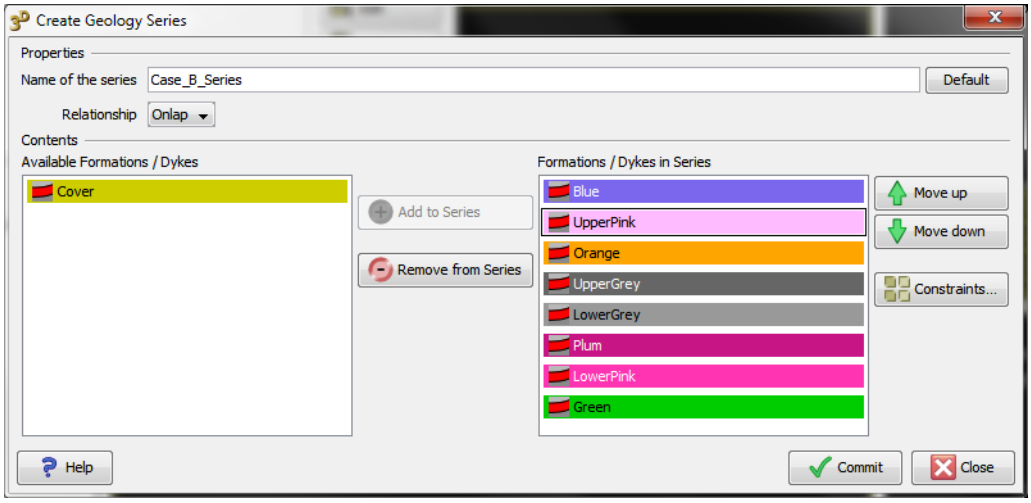
5 Define a first series containing the folded stratigraphy:

Select items in the **Formations** list, and use the across arrow buttons to add formations to the **Series**. You can use the **Move up** and **Move down** to adjust the stratigraphic order—oldest strata at the bottom, and youngest at the top.

Adjust the order to match that listed in the picture above (Green up to Blue).

Set the **Relationship** for this series to **Onlap**.

Name the series `Case_B_Series`.

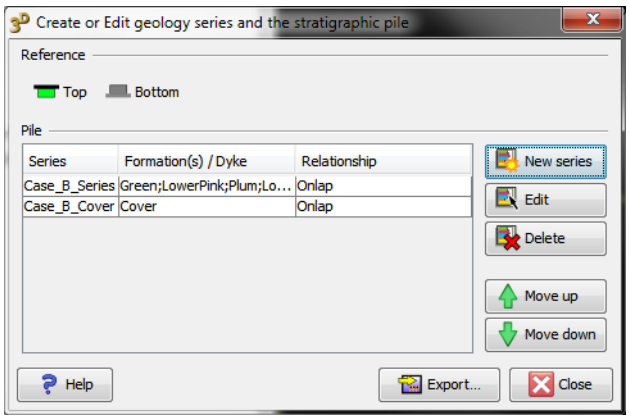


Choose **Commit**.

6 Define a second series containing the unit 'Cover', also with **Relationship** = Onlap. Call it `Case_B_Cover`.

Choose **Commit** and then **Close**.

Return to the **Create-Edit geology series and the geological pile** dialog box.



7 Check the stratigraphic order of the series.

Use **Move up** and **Move down** to adjust the stratigraphic order so that the oldest series (`Case_B_Series`) is at the bottom.

Choose **Close** when finished.

8 *Save your project.*

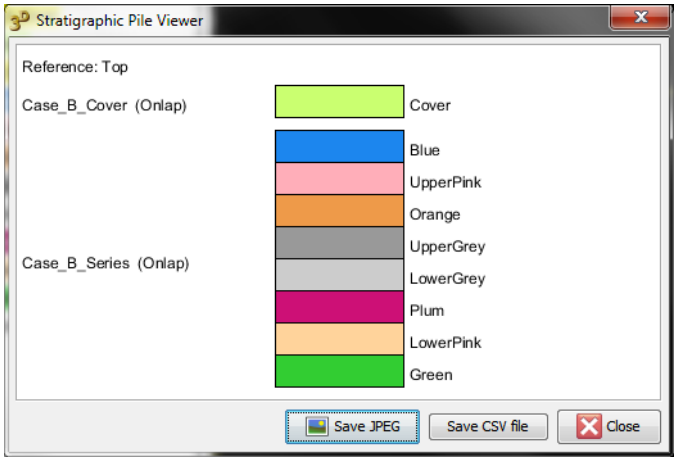
From the main menu choose **Project > Save** OR

From the **Project** toolbar choose **Save** OR
Press CTRL+S.

B1 Stage 2—Other activities

You can view the stratigraphic pile, check the order of series, and check the order of formations within series.

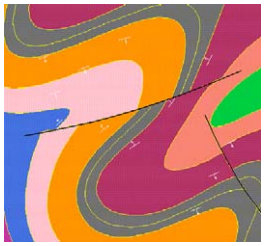
From the main menu choose **Geology > Stratigraphic Pile: Visualise**.



B1 Stage 3—Enter faults, define fault-strata relationship, define fault-fault relationship

Parent topic: Tutorial B1—Getting Started with Case Study B

In the geology map there are two faults, called ENE and WNW. In this stage we specify them in the project.



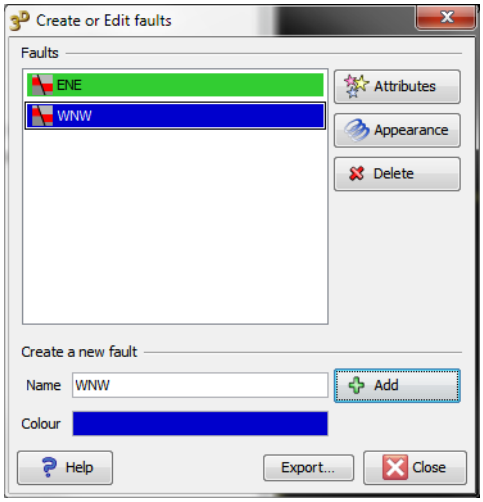
B1 Stage 3—Steps

1 Create an object for each fault. From the main menu, choose **Geology > Faults: Create or Edit**. 3D GeoModeller displays the Create-Edit faults dialog box.

2 Create a fault object each of the two faults in the project area.

Name	Colour
ENE	Green
WNW	Blue

Input the **Name**, assign an appropriate **Colour**, choose **Add**.



When finished, choose **Close**.

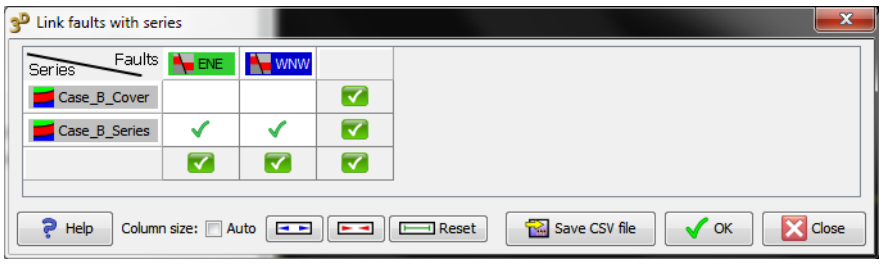
3 When you select **Close** you may be prompted to start the 'link faults with series editor'. Choose **'Yes, start link Faults With Series editor'**. If the dialog does not appear start the editor from the main menu. Choose **Geology > Faults: Link faults with series**.

3D GeoModeller will display the **Link faults with series** dialog box.

4 You can specify that faults affect some series within the stratigraphic pile, but have no impact on other series. Define the series-fault relationships.

Check the cells in the table so that 'Case_B_Series' is linked with both the ENE and WNW faults.

Do not link the Case_B_Cover series to the faults.



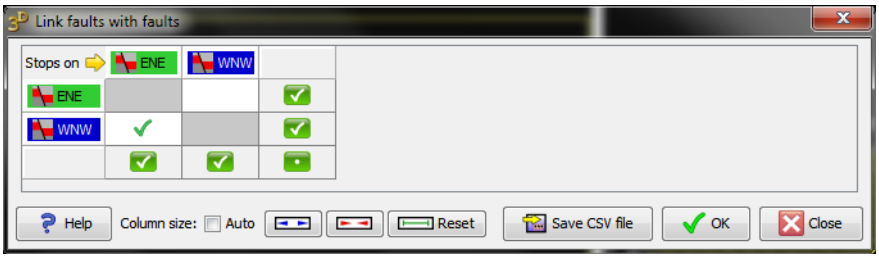
Choose **OK**.

5 You can define a fault as 'stopping on' some other fault. Define the 'fault-fault relationship'.

From the main menu, choose **Geology > Faults: Link faults with faults**.

3D GeoModeller dsplays the **Link faults with faults** dialog box.

Check the boxes to specify that the WNW fault 'stops on' the ENE fault.



Choose **OK**.

6 Save your project.

B1 Stage 4—Import geology image

Parent topic: Tutorial B1—Getting Started with Case Study B

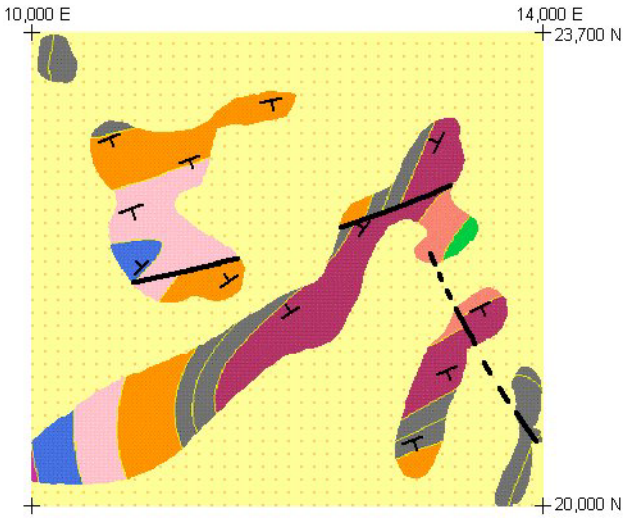
There are several ways to input geological observations.

We shall simulate going into the field to make geological observations by importing a geological map with cover. There are extensive areas of cover, but some bedrock geology is exposed and able to be mapped.

After import we shall georegister the image so that it corresponds with the project.

The image has four registration points for aligning with the project. We only need to use three of them.

Registration point	X coordinate (East)	Y coordinate (North)
Top left	10000	23700
Top right	14000	23700
Bottom right	14000	20000

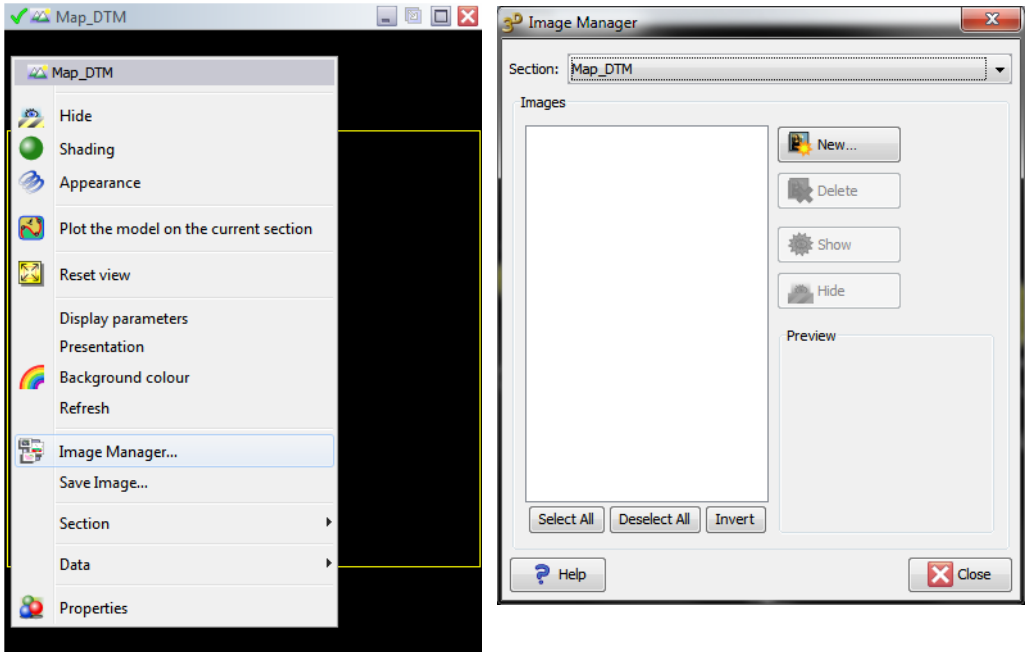


B1 Stage 4—Steps

1 In the **2D Viewer** select **Map_DTM**.

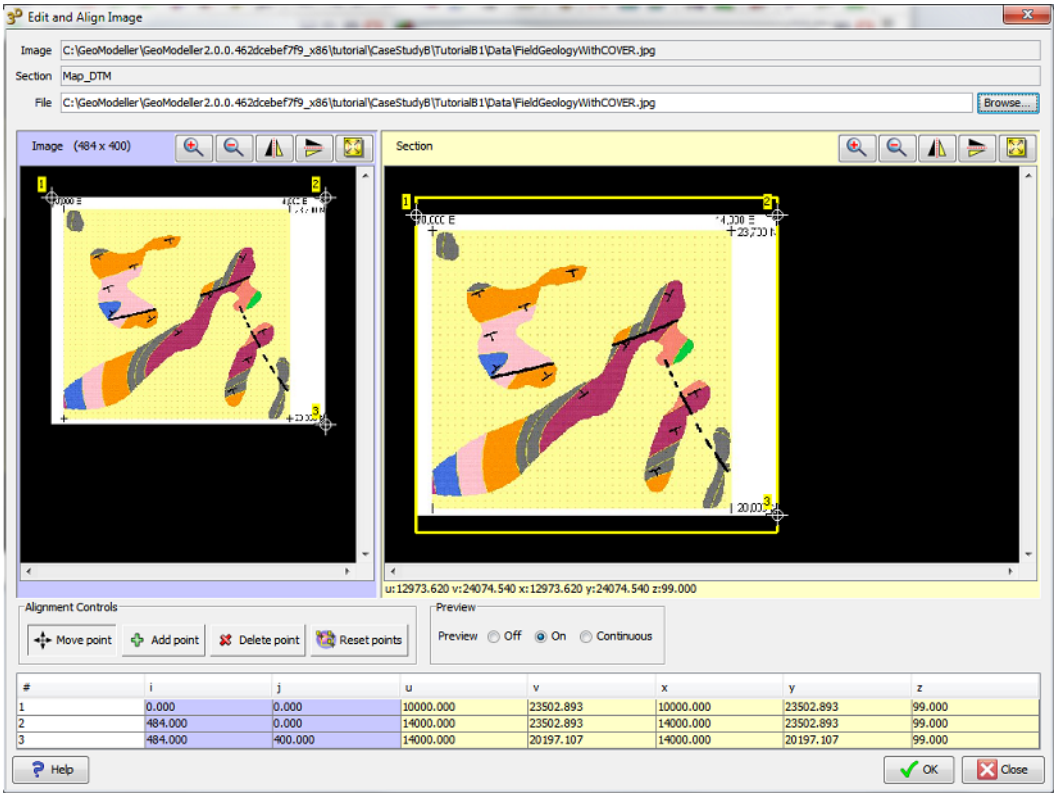
From the **Map_DTM** shortcut menu choose **Image manager**.

3D GeoModeller displays the **Image manager**.



2 Choose New. 3D GeoModeller displays the **Edit and align image** dialog box.

Choose Browse and open:
`GeoModeller\tutorial\CaseStudyB\TutorialB1\Data\FieldGeologyWithCOVER.jpg`

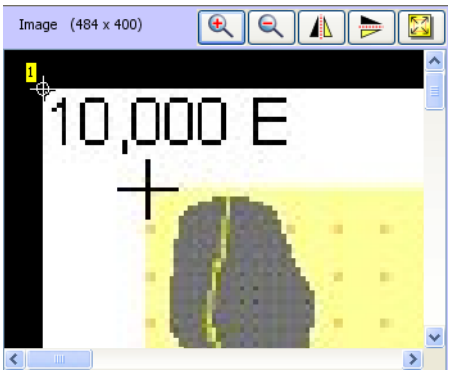


If your image has three or more points for which you know the geographical coordinates, you can use the **Edit and align image** dialog box to georegister the image in your project. After georegistration, each point in the image corresponds to the correct location in the 3D GeoModeller project.

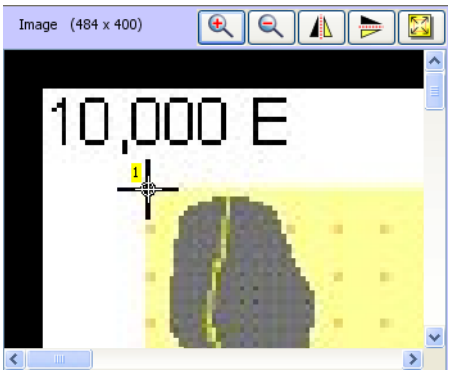
On the left is a copy of the image you have opened. On the right is a copy of the image as registered in the 3D GeoModeller project.

The left panel has three movable alignment points. You will move them to the correspond with the three known registration points in the image.

3 Enlarge the image in the **Image** panel and move the view to the top left corner so that you can see the registration point and alignment point 1.



Drag alignment point 1 to exactly align with the registration point in the image.

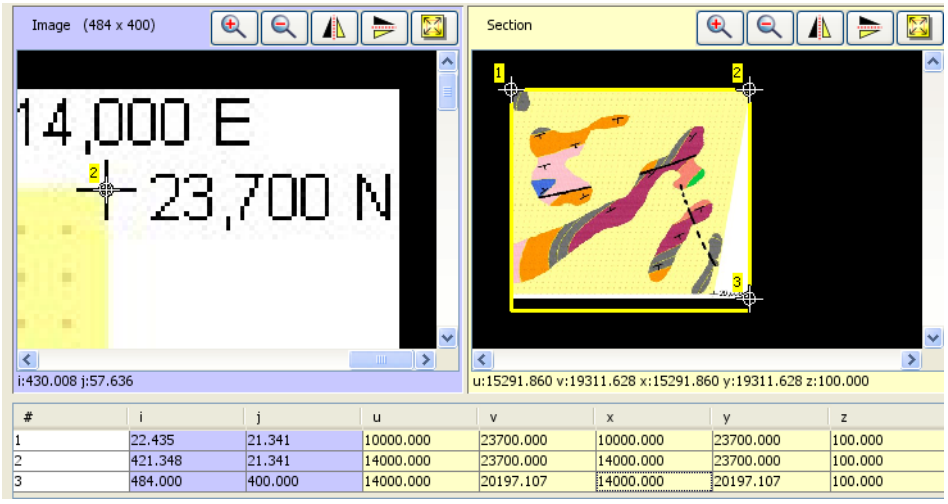


4 Enter the coordinates of this point (10000, 23700) in the table at the bottom of the dialog box as **u** and **v** for alignment point 1.

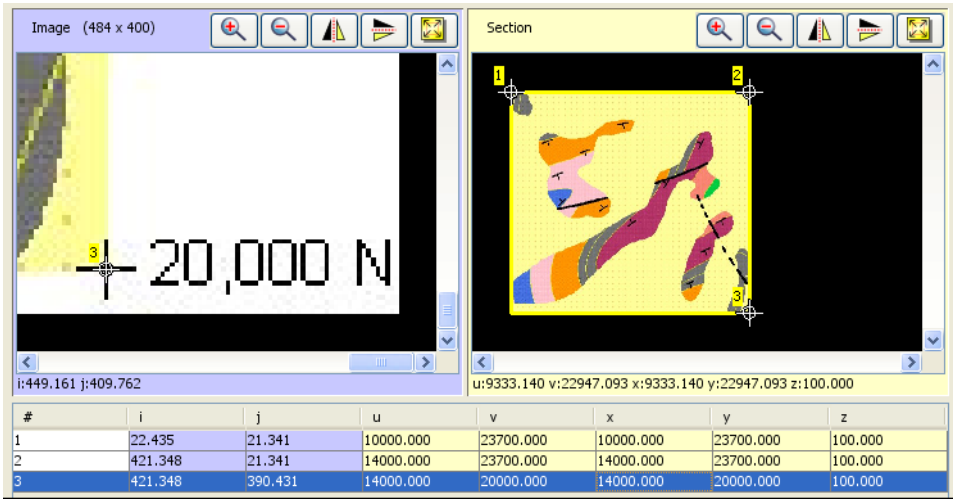
#	i	j	u	v	x	y	z
1	22.435	21.341	10000.000	23700.000	10000.000	23700.000	100.000
2	484.000	0.000	14000.000	23502.893	14000.000	23502.893	100.000
3	484.000	400.000	14000.000	20197.107	14000.000	20197.107	100.000

In the **Section** panel, 3D GeoModeller warps the image to correctly geolocate this point.

5 Repeat steps 3–4 for the top-right and bottom-right registration points, corresponding to alignment points 2 and 3.



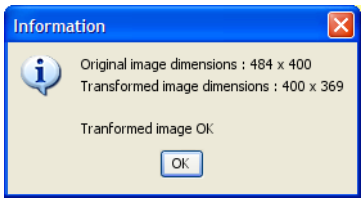
#	i	j	u	v	x	y	z
1	22.435	21.341	10000.000	23700.000	10000.000	23700.000	100.000
2	421.348	21.341	14000.000	23700.000	14000.000	23700.000	100.000
3	484.000	400.000	14000.000	20197.107	14000.000	20197.107	100.000



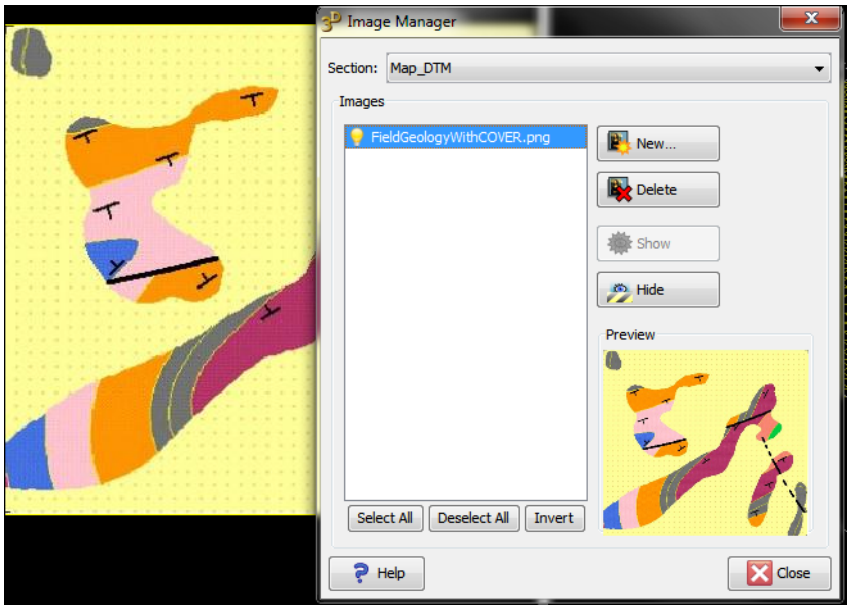
#	i	j	u	v	x	y	z
1	22.435	21.341	10000.000	23700.000	10000.000	23700.000	100.000
2	421.348	21.341	14000.000	23700.000	14000.000	23700.000	100.000
3	421.348	390.431	14000.000	20000.000	14000.000	20000.000	100.000

6 Choose **OK**.

3D GeoModeller reports the final dimension of the part of the image that it is using. Choose **OK**.



3D GeoModeller lists the image in the **Image manager** and displays it in the **2D Viewer** in the **Map_DTM** tab.



If it is not visible, select it in the **Image manager** and choose **Show**.

Close the **Image manager**.

7 Save your project.

Tutorial B2—Input Initial Geological Observations

Parent topic: Tutorial case study B (Antonio's map)

We have finished specifying stratigraphy and faults and imported and georegistered a topography map. Now we are ready to start entering geology observations.

B2 Stage 1—Getting started

You can continue with your version of the project that you completed in Tutorial B1—Getting Started with Case Study B or open the project that we have prepared, ready to start this tutorial.

B2 Stage 1—Steps

1 *Open the completed project from Tutorial B1.*

To use the prepared version:

- Open: **`GeoModeller\tutorial\CaseStudyB\TutorialB1\Completed_project\TutorialB1.xml`**
- Save the project with a new name in the folder you are using for your tutorial data.

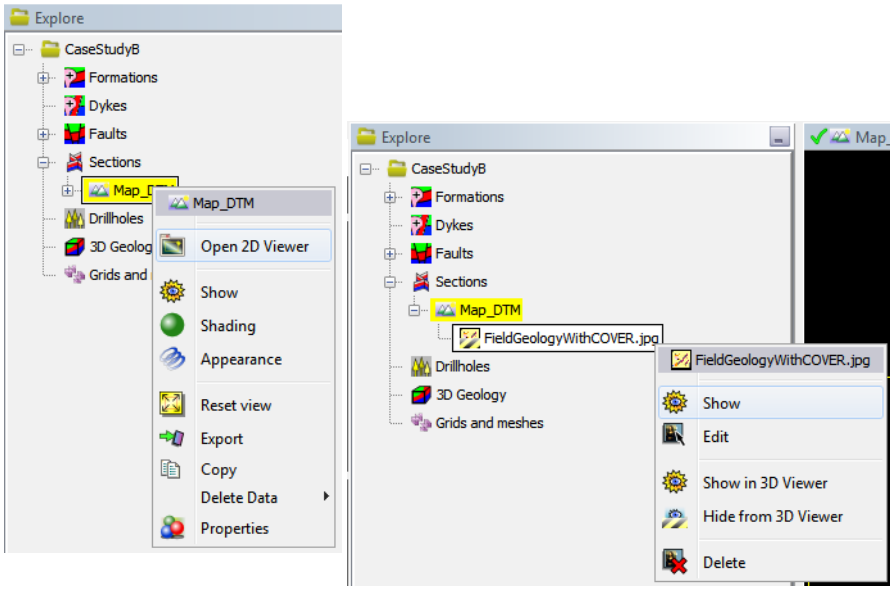
Note that a completed version of this Tutorial B2 is available as **`GeoModeller\tutorial\CaseStudyB\TutorialB2\Completed_project\TutorialB2.xml`**. Do not overwrite it.

2 *(If not already showing) Open* ***Map_DTM*** *in the* ***2D Viewer*** *and display the geology map image.*

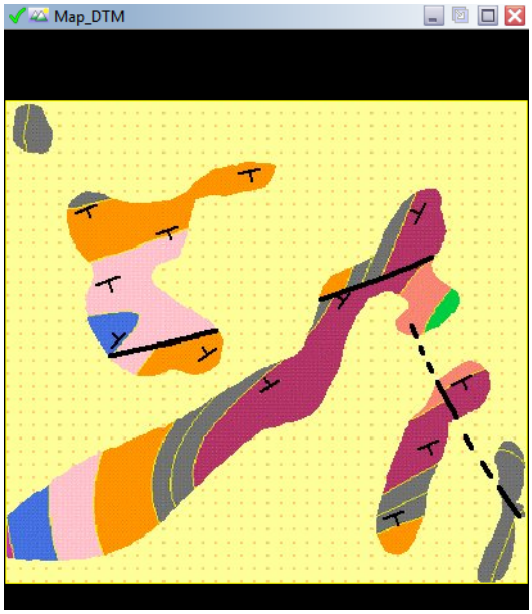
(If the ***Map_DTM*** *tab is not visible)* In the **Explorer** tree, expand **Sections** and select **Map_DTM**.

From the shortcut menu, choose **Open 2D viewer**. 3D GeoModeller displays the section in the **2D Viewer**.

(If the topography image is not showing) In **Map_DTM** in the **2D Viewer**, from the shortcut menu choose the image name to show or hide it OR
Press PAGEUP or PAGEDOWN to show, and END to hide.



Now we can start recording observations of the geology, and so begin building the 3D geological model of this project area.



B2 Stage 2—Enter geological contact points from map view

The process has two basic steps, repeated for each set of data:

- Enter a point (or a set of points)
- Assign those points to a specified geological horizon (in this project, as contact points for the top of a formation).

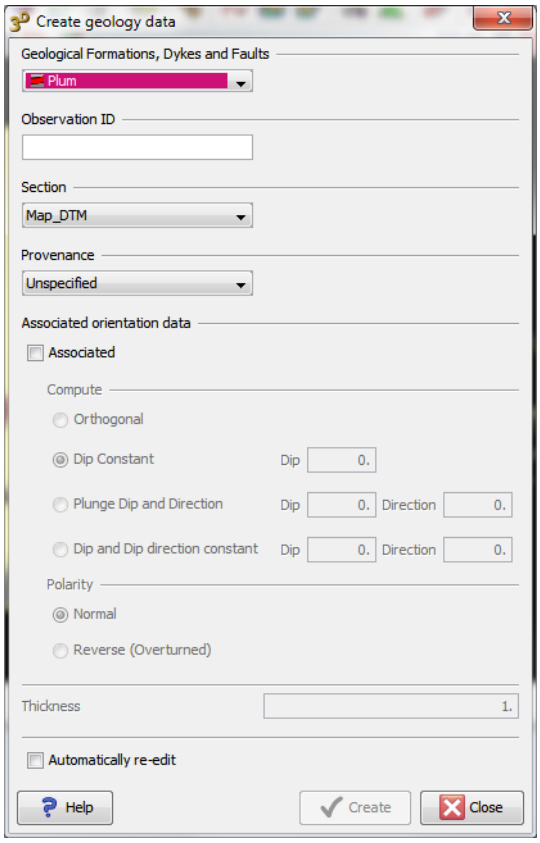
Recall that we set up stratigraphic pile for this project with reference to the tops of formations. This means, for example, that if we make a geological observation on the contact at the top of formation Plum, we assign it to that formation (Plum), and not to the overlying formation.

B2 Stage 2—Steps

1 From the main menu choose **Geology > 2D structural > Create geology data** OR

In the **Structural** toolbar, choose **Create geology data** . OR
Press CTRL+G.

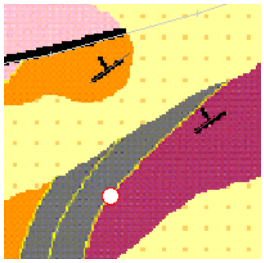
The **Create geology data** dialog box appears.



2 From the **2D Viewer** toolbar, choose **Create** .

3 From the **Points list editor** toolbar choose **Delete all Points** to erase any existing contents of the Points List.

4 In **Map_DTM** in the **2D Viewer**, click the contact at the top of formation Plum, as shown in the picture.



5 In the **Create geology data** dialog box, in **Geological formations and fonts**, select Plum.

6 Choose **Create**.

3D GeoModeller has now recorded this point as a geological observation in section **Map_DTM**, assigned as a contact point at the top of formation Plum.

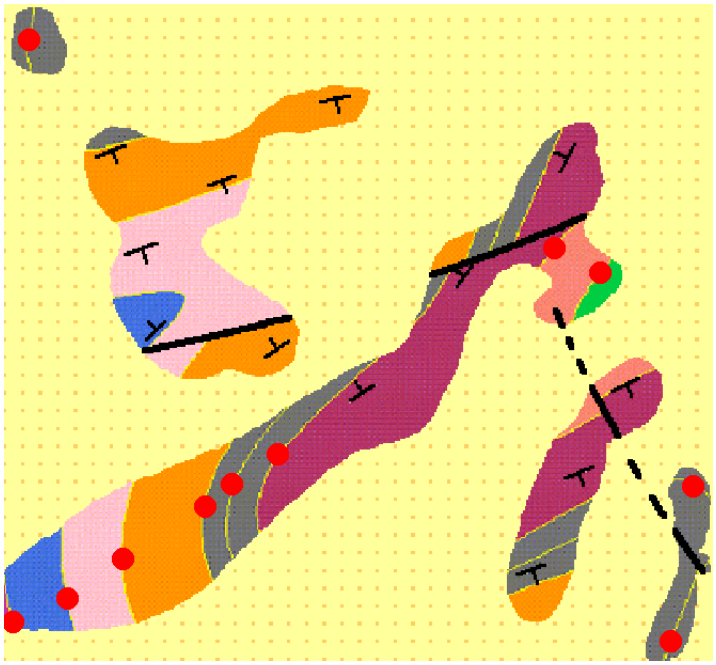
7 Save your project

8 Add more geological observations using the same steps, each time assigning the selected point to the correct geological formation in the stratigraphic pile. Add the eleven points suggested in the map shown here. This is a bare minimum of points—just one or two points per geological formation.

The points shown in the illustration are all, of course, on the contact surfaces of formations. Use your understanding of the stratigraphic pile to ensure that you assign each point to the 'top' of the 'underlying' formation in each case.

If you can't easily distinguish the two shades of grey, you may 'cheat' by looking at the geological map without the cover at the beginning of this case study.

Repeat steps 3–7 for each point.



9 Close the **Create geology data** dialog box.

B2 Stage 2—Discussion

If you tried to 'compute' the model at this point, there would be nothing to compute! Why? In fact, it would be possible to 'fit-a-surface' through this minimal number of points. Without any orientation data, however, it is not possible to decide which side is 'up' and which is 'down'.

Therefore, GeoModeller will not compute a solution where there is no orientation data. You must have at least one point of orientation data to determine 'facing'.

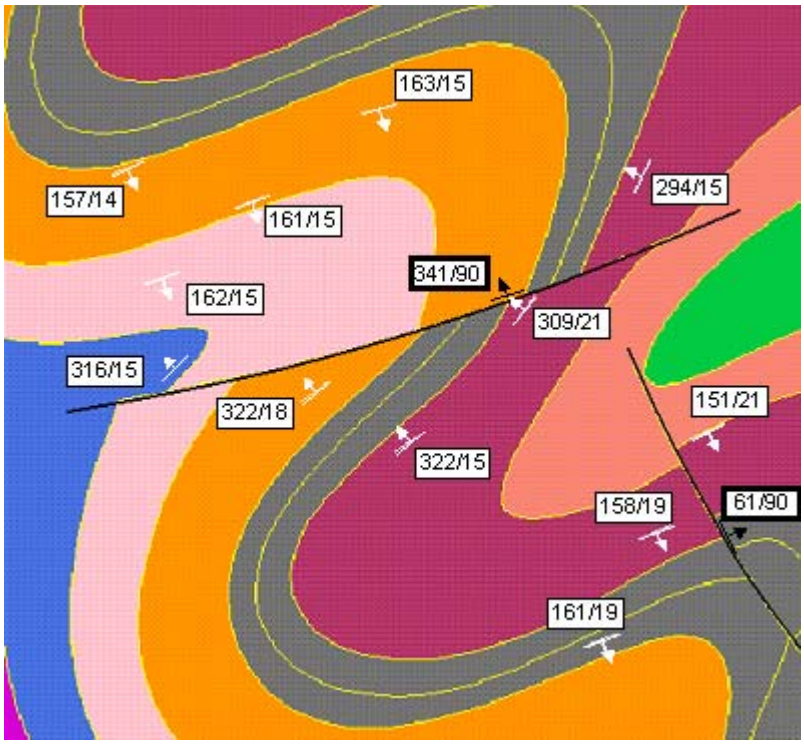
B2 Stage 3—Enter orientation data from the map view

Entering orientation data is similar to entering contact points, but you must also enter the correct azimuth and inclination values.

Our project geologist has made the following strike and dip observations:

- Twelve, related to the strata (shown in white below)
- Two, indicating that the two faults are vertical (shown in black with thicker border below)

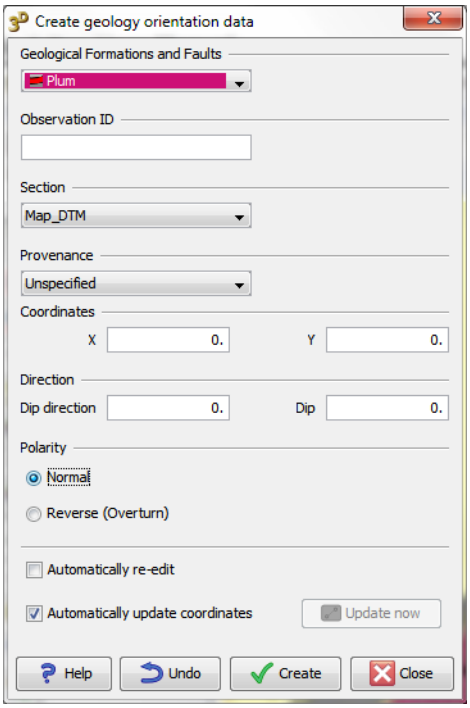
The geologist has recorded the data as vector directions. 3D GeoModeller also uses this convention. The azimuth direction is measured from North as per convention. The dip value can be thought of as 'dip of the strata down from horizontal', but equally it can be thought of as defining a 'facing vector', having an angle measured 'from vertical' in the direction of the specified dip direction.



B2 Stage 3—Steps

1 From the **Structural** toolbar, choose **Create orientation data** .

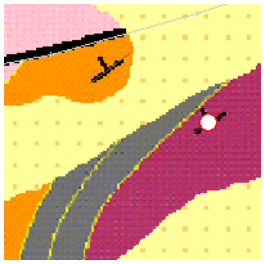
In the **Create geology orientation data** dialog box, check **Automatically update coordinates**.



2 From the **2D Viewer** toolbar, choose **Create** OR press C.

3 From the **Points list editor** toolbar choose **Delete all Points** to erase any existing contents of the Points List.

4 In **Map_DTM** in the **2D Viewer**, click the one of the points where strike and dip have been recorded (For the one shown, values are: 322 and 15).



Observe that the coordinates of the point appear in the **Create geology orientation data** dialog box.

5 In the **Create geology orientation data** dialog box:

- For **Geology formations and faults**, select Plum.
- Enter **Dip direction**: 322.
- Enter **Dip**: 15.
- Choose **Apply**.

This point has now been recorded as 'an orientation observation in section Map_DTM, assigned to unit Plum, with a specified (x, y) location, and specified azimuth and dip values.

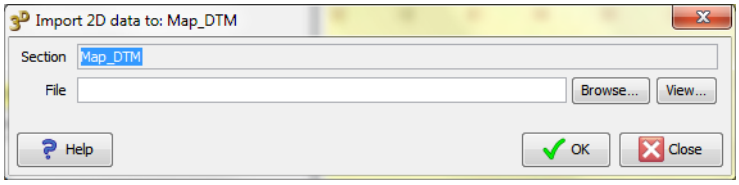
6 Save your project.

7 Repeat steps 3–6 for the rest of the points shown in the picture at the beginning of this stage of the tutorial (shown in white in this tutorial, but in black in the image that you have imported to the project). Each time, assign the selected point to the correct geological formation in the stratigraphic pile, and enter the required azimuth and dip values.

Ignore, for now, the points defining the fault attitude (shown in black in this tutorial, but not shown in the image).

Alternatively: You can import the 13 orientation points from a data file supplied:
`GeoModeller\tutorial\CaseStudyB\TutorialB2\Data\Orientation_B2.data`

From the main menu choose **Import > Import 2D data**.



Choose **Browse**, open the file and choose **OK**.

8 Close the **Create geology orientation data** dialog box.

B2 Stage 3—Further optional activities

Now that you have entered geology contact observations and some orientation data defined, 3D GeoModeller can compute and plot the model.

1 From the main menu choose **Model > Compute** OR

From the **Model** toolbar choose OR
Press CTRL+M.

Use these settings:

- **Sections to take into account**: **All**
- **Series to interpolate**: **All**

Choose **OK**.

2 Select **Map_DTM** tab in the **2D Viewer**.

3 From the main menu choose, choose **Model > Plot the model settings** OR

From the **Model** toolbar, choose **Plot the model settings** OR
Pess CTRL+D.

Set the parameters:

- Check **Show fill** and clear **Show lines**.
- Use default values for the other parameters.

Choose **OK**.

Your results will have something in common with the images provided, but there is more work to do. We need to specify the faults.

B2 Stage 3—Discussion

Orientation Data in 3D GeoModeller

Orientations are essentially facings (orthogonal to the geological surface, in the direction of stratigraphic younging).

It is important to record orientations with the correct sense of 'up'; if some of the orientation data for a formation are incorrectly assigned an upside down facing, then 3D GeoModeller's computation of the potential (or surface) for that formation could be quite convoluted!

From a topological viewpoint, every surface in 3D GeoModeller has up and down sides. Therefore, even faults and intrusives must have at least one piece of orientation data to define this direction.

B2 Stage 4—Entering fault data

In this stage you enter fault contact points and orientation data

B2 Stage 4—Steps

1 *Create contact data for the two faults.*

Use the same steps as you used for geological contacts in B2 Stage 2—Enter geological contact points from map view.

In Stage 2, you clicked only one point before assigning it to a formation. In this step you click several points and assign them all to a fault. Before you start,

choose **Create** (C) and clear the points list.

Click a few points along the ENE fault (the almost horizontal one in the centre of teh image) and assign those points to the ENE Fault.

Repeat for the WNW Fault.

2 Save your project.

3 *Enter the two fault orientation points, one for each fault.*

Referring to the data in the picture at the start of this tutorial, and using the same steps as you used for geological orientation data in B2 Stage 3—Enter orientation data from the map view, enter the two orientation points for the two faults.

Note: If you imported the orientation data instead of entering it (in B2 Stage 3—Enter orientation data from the map view), omit this step. You have already imported your orientation data.

4 Save your project.

5 Check that the series–fault and fault–fault relationships are in the same state that you specified in B1 Stage 3—Enter faults, define fault-strata relationship, define fault-fault relationship. in Tutorial B1—Getting Started with Case Study B

B2 Stage 4—Discussion

While it is important to correctly record the attitude of a fault in 3D space (in this case, vertical), the choice of facing direction for these faults is arbitrary.

It does not matter whether the ENE Fault 'faces' north or south.

3D GeoModeller requires that each surface to be computed has at least one piece of orientation data. Where you do not supply orientation data, 3D GeoModeller does not compute a solution and, in the model, the feature will not exist.

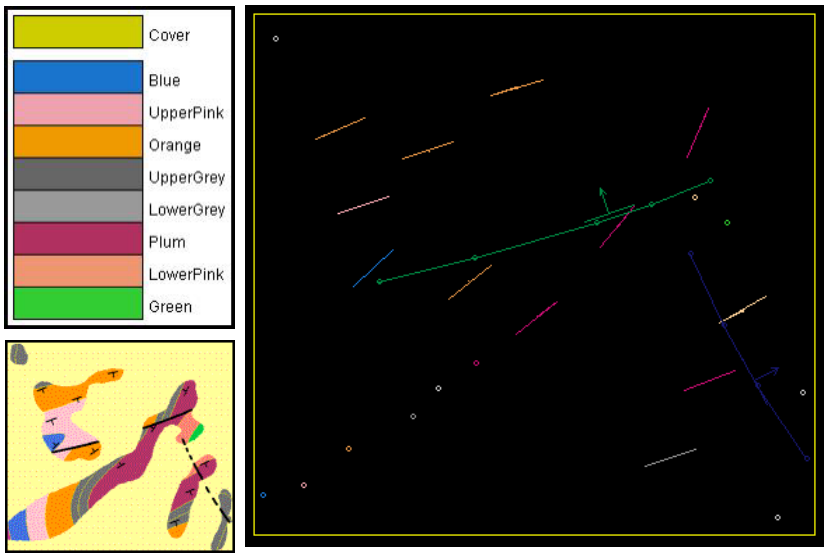
Tutorial B3—Compute the Model and Draw a Geology Map

Parent topic: Tutorial case study B (Antonio's map)

We have already created the project, and completed stratigraphy and faults. In Tutorial B2—Input Initial Geological Observations we completed all of the simple data entry. We are now ready to compute the model and view 3D results.

At this point we have a very minimalist geological mapping project:

- Project East, North & Z extents defined.
- Topography defined
- Stratigraphy units defined, and ordered in a stratigraphic pile, and grouped into 'series'
- Two faults defined
- Some minimalist geological mapping recorded in the Map_DTM section view.
- Eleven geological contact points - about one per unit
- A handful of contact points defining the location of two faults
- Fourteen orientation data points for selected geology and the two faults



We are ready to 'compute the model' and see what is achieved with this minimalist mapping work!

B3 Stage 1—Getting started and computing the model

You can continue with your version of the project that you completed in Tutorial B2—Input Initial Geological Observations or open the project that we have prepared, ready to start this tutorial.

B3 Stage 1—Steps

1 *Open the completed project from Tutorial B2.*

To use the prepared version:

- Open: **`GeoModeller\tutorial\CaseStudyB\TutorialB2\Completed_project\TutorialB2.xml`**
- Save the project with a new name in the folder you are using for your tutorial data.

Note that a completed version of this Tutorial B3 is available as **`GeoModeller\tutorial\CaseStudyB\TutorialB3\Completed_project\TutorialB3.xml`**. Do not overwrite it.

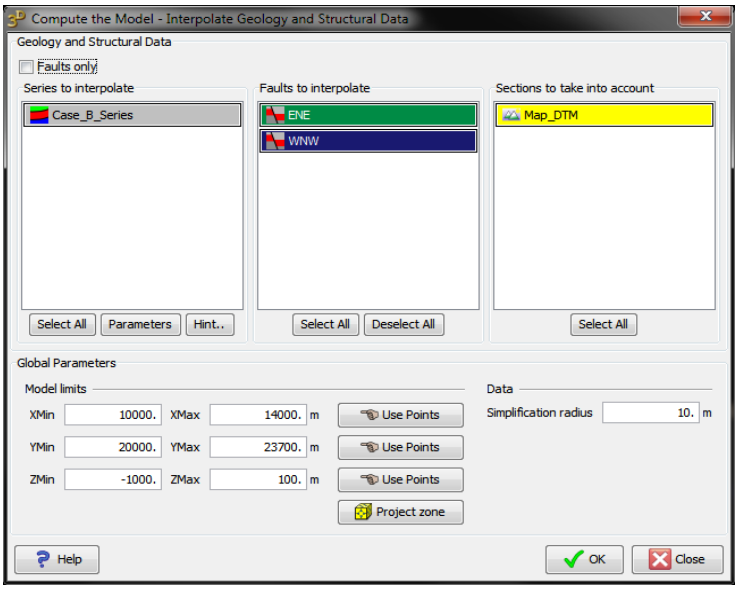
B3 Stage 2—Computing the model

When 3D GeoModeller computes the model it produces a set of equations from which it can render pictures of the model.

B3 Stage 2—Steps

1 From the main menu choose **Model > Compute** OR

From the **Model** toolbar choose OR
Press CTRL+M.



In the **Compute the model** dialog box, set parameters as follows:

Use these settings:

- **Sections to take into account**: **All**
- **Series to interpolate**: **All**

Choose **OK**.

2 Save your project.

B3 Stage 3—Plotting the model

At this point 3D GeoModeller has computed a model, but the model is simply a set of equations.

We now want to draw a map of the geology of this project area, based on the computed 3D model. We draw the map in the Map_DTM map view section.

Every map and section is drawn by 'interrogating the model'. 3D GeoModeller defines an (x, y) mesh across the section view. For each mesh node at point P (x, y, z) 3D GeoModeller asks the model 'what are you ?'. The answer is one of the geological formations, such as 'Green', or 'Plum'.

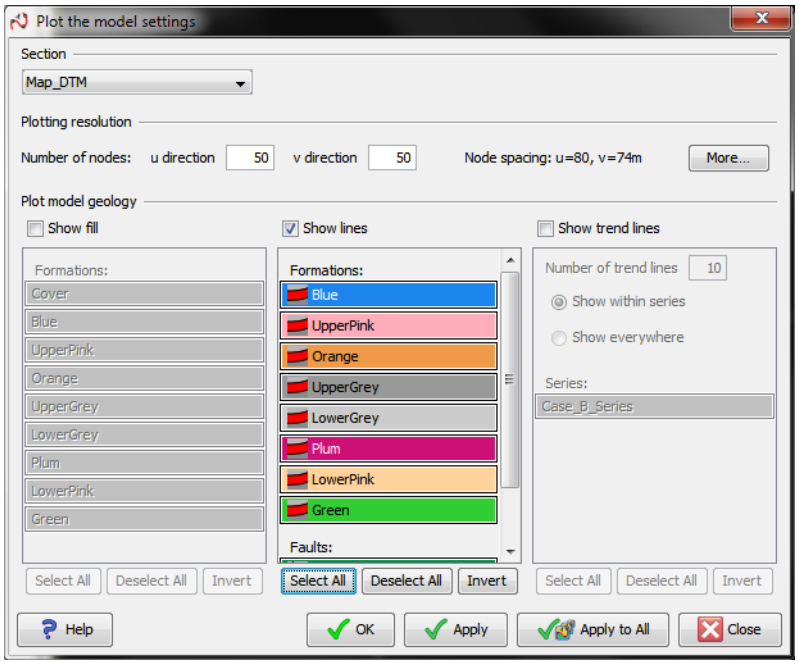
Using this information as a starting framework, 3D GeoModeller further interrogates the model to deduce where it should draw formation contact lines.

The fine-ness or coarseness of this 'mesh' will impact upon the quality of the rendered output. It also impacts upon the speed of rendering.

B3 Stage 3—Steps

1 Select **Map_DTM** tab in the **2D Viewer**.

2 From the main menu choose, choose **Model > Plot the model settings** OR
From the **Model** toolbar, choose **Plot the model settings** OR
Pess CTRL+D.

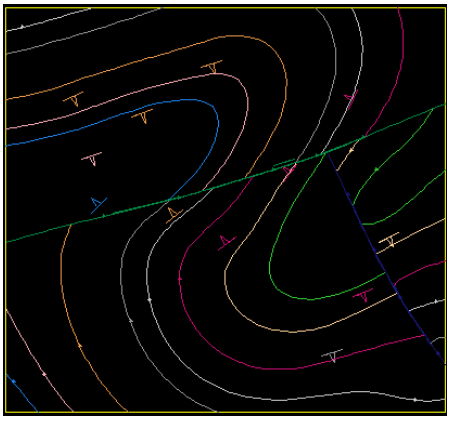


In the **Plot the model** dialog box, set the parameters:

- Check **Show lines** and clear **Show fill**.
- Use default values for the other parameters.

Choose **OK**.

3D GeoModeller displays the plotted model.



B3 Stage 3—Discussion and further exploration

In the **Plot the model** dialog box, the 'u point' and 'v point' define the degree of fineness of the mesh used for the initial interrogation of the model.

For this simple model the default values of 50 x 50 are adequate. A model with fine detail might require a finer mesh. Alternatively, for a quick render, select a coarser mesh.

- Experiment with the mesh size (u, v), replotting each time
- Experiment with the layout options. From the shortcut (right click) menu choose **Display parameters**. Turn the various layers of rendered results on and off. If one layer appears to be hidden under another, turn the display of both off and then turn on the one at the back first.
- Experiment with re-plotting the model using **Fill** and **Trend**

  To erase the display of all model (calculated) data from the model, so that only the original data remains:

  From the main menu choose **Model > Erase all model geology** OR
  From the shortcut menu in the **2D Viewer** choose **Erase all model geology** OR

  In the **Model** toolbar choose **Erase all model geology** .

B3 Stage 4—Compute and render: Discussion of result

In this stage we plot the model using lines over the image beneath. We assess its accuracy and discuss.

B3 Stage 4—Steps

Using the instructions in B3 Stage 3—Discussion and further exploration

1 *Erase all model geology*

From the main menu choose **Model > Erase all model geology** OR
From the shortcut menu in the **2D Viewer** choose **Erase all model geology** OR
In the **Model** toolbar choose **Erase all model geology** .

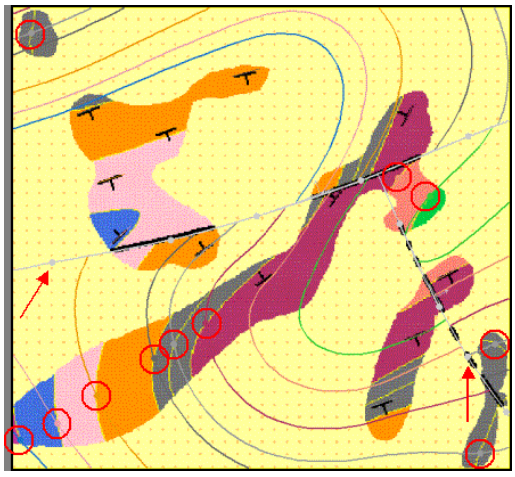
2 *Display the image.*

In **Map_DTM** in the **2D Viewer**, from the shortcut menu choose the image name to show or hide it OR
Press PAGEUP or PAGEDOWN to show, and END to hide.

3 Plot the model with lines.

4 Examine the outcome. Are these results OK?

B3 Stage 4—Discussion



The contact contours do honour the sampled points of geology.

The faults are well delineated by several sample points. These are honoured by the model result.

The orientation data are honoured

The result is not too bad considering the lazy mapping job that we have done! Those few points that have been mapped are honoured accurately. Even with these few points the modelled geology is crudely correct.

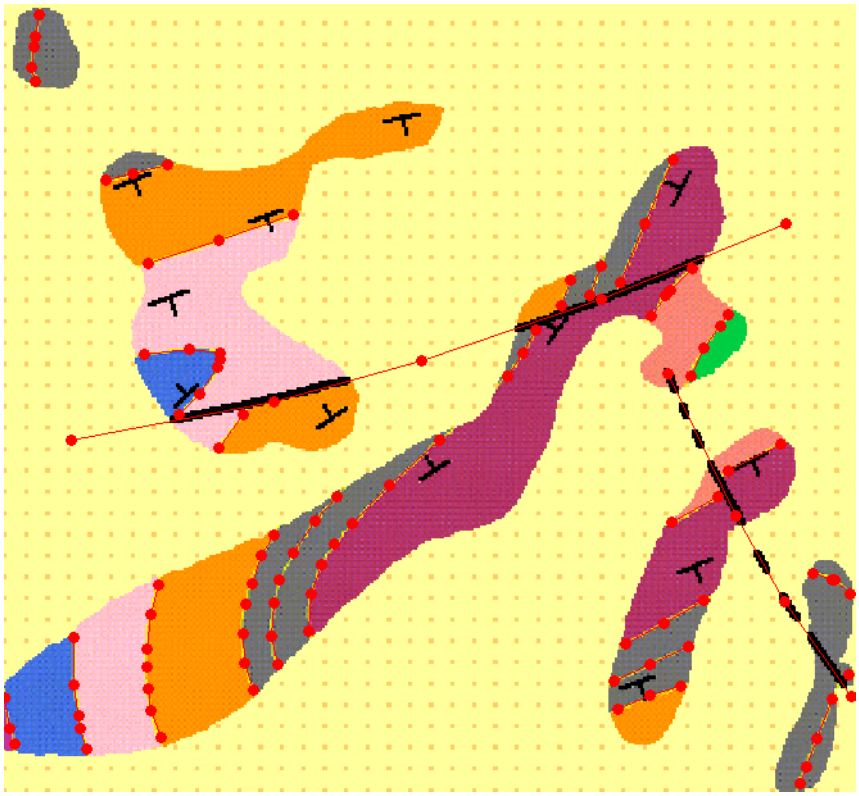
Of course, the model is wrong in many places. We know it's wrong because we can see in the geology image where it has gone wrong.

Can we do a better geological mapping job on this project area?

The faults are well defined—no further work needed!

Orientation data—we've used all the measurements that are available. No more needed.

Geological contacts? Although there is extensive cover, we could still improve our mapping. Taking this tutorial to a logical conclusion, we could end up with a project with many more observations of the geology, as shown in the following diagram.



What can we expect when we compute the revised model? In Tutorial B4—Add Data, Recompute, Redraw the Geology Map

Tutorial B4—Add Data, Recompute, Redraw the Geology Map

Parent topic: Tutorial case study B (Antonio's map)

In this tutorial we add further geological contact data to our project and examine the resulting model for improvement.

B4 Stage 1—Getting started and computing the model

You can continue with your version of the project that you completed in Tutorial B3—Compute the Model and Draw a Geology Map or open the project that we have prepared, ready to start this tutorial.

B4 Stage 1—Steps

1 *Open the completed project from Tutorial B3.*

To use the prepared version:

- Open: **`GeoModeller\tutorial\CaseStudyB\TutorialB3\Completed_project\TutorialB3.xml`**
- Save the project with a new name in the folder you are using for your tutorial data.

Note that a completed version of this Tutorial B4 is available in **`GeoModeller\tutorial\CaseStudyB\TutorialB4\Completed_project\TutorialB4.xml`**. Do not overwrite it.

2 Select **Map_DTM** tab in the **2D Viewer**.

3 Erase all model geology.

4 Hide the image if it is visible.

B4 Stage 2—Importing additional data

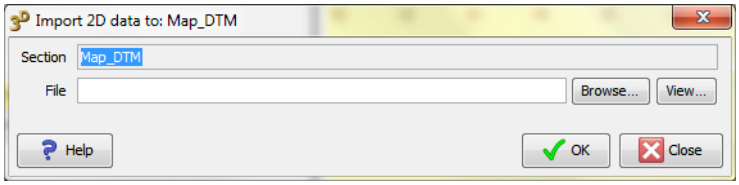
Our geologist has supplied more detailed contact data for the site. The data is in an ASCII file the 3D GeoModeller can import.

B4 Stage 2—Steps

1 Import the data in the file **`GeoModeller\tutorial\CaseStudyB\TutorialB4\Data\TutorialB4.data`**

Select **Map_DTM** tab in the **2D Viewer**.

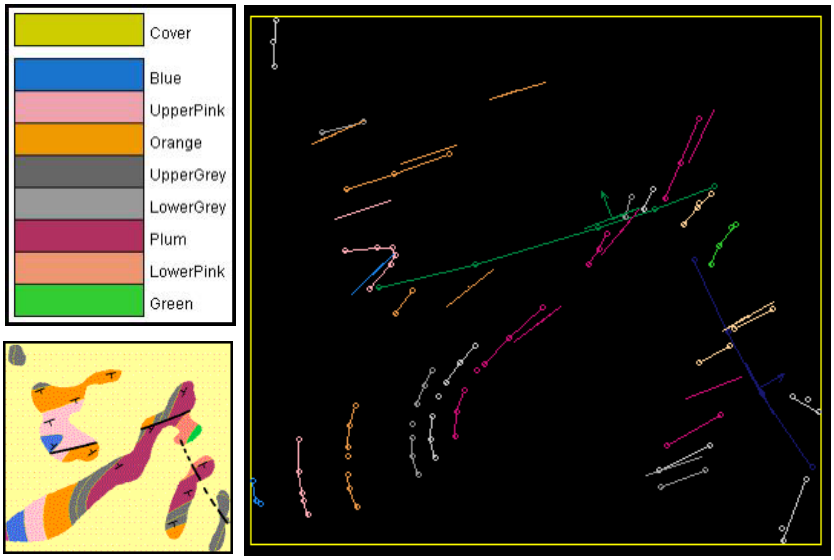
From the main menu choose **Import > Import 2D data**.



Choose **Browse** and open the file.

Choose **OK**.

View the new data in the **Map_DTM** tab of the **2D Viewer**.



B4 Stage 2—Discussion

We now have a more complete geological mapping project.

We have defined all of the basics:

- Project East, North & Z extents
- Topography
- Stratigraphy units, ordered in a stratigraphic pile, and grouped into series
- Two faults
- And fairly complete geological mapping in the Map_DTM section view
- About 100 geological contact points
- Contact points that define the location of two faults
- Fourteen orientation data points for some geology and the two faults

We are ready to recompute the model and see what we have achieved with this more complete geological mapping work.

B4 Stage 2—Recomputing and plotting the model

B4 Stage 2—Steps

Repeat the steps in Tutorial B3—Compute the Model and Draw a Geology Map.

1 *Compute the model with all components selected*

Carry out the steps in B3 Stage 2—Computing the model

2 *Plot the model with lines on Map_DTM section.*

Carry out the steps in B3 Stage 3—Plotting the model

B4 Stage 3—Compute and render, discuss result

In this stage we plot the model using lines with the image beneath. We assess its accuracy and discuss.

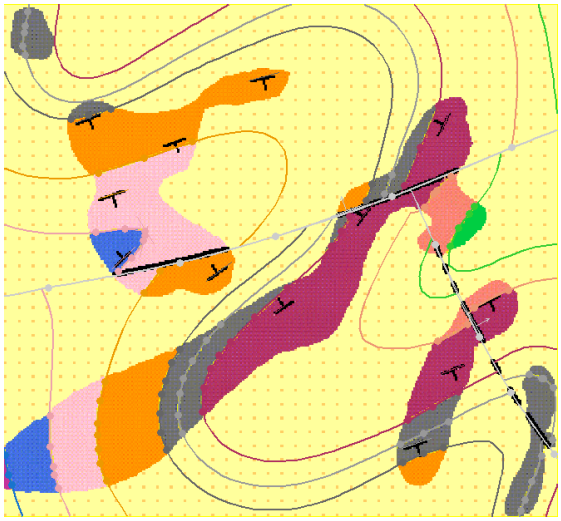
B4 Stage 3—Steps

Using the instructions in B3 Stage 3—Discussion and further exploration

1. Erase all model geology
2. Display the image.
3. Plot the model usig lines.
4. Examine the outcome. Are these results OK?

B4 Stage 3—Discussion

Quality of the model



The model contact lines honour the sampled points of geology.

The model honours the orientation data.

A 3D GeoModeller model cannot claim to be the 'correct answer'! At best, it can only claim to be a model that is 'consistent with the observed geological observations'.

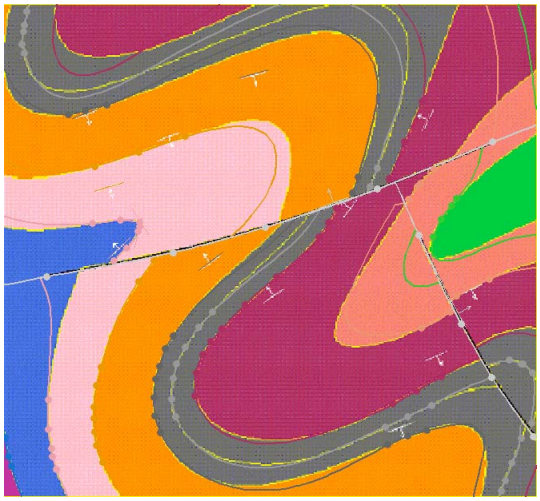
Certainly the model in this case is in good agreement with the exposed (mapped) geology.

A large portion of the map generated above is 'interpolation'. For this project we actually know what is under the cover.

The image without cover

Recall that we have a map without the cover, so we can compare our results with it. The map is in the file **GeoModeller\tutorial\CaseStudyB\TutorialB4\Data\FieldGeology.jpg**

Admittedly this is a simple geology map, with broad predictable folding, but the interpolation from about 20% outcrop has achieved a good result.

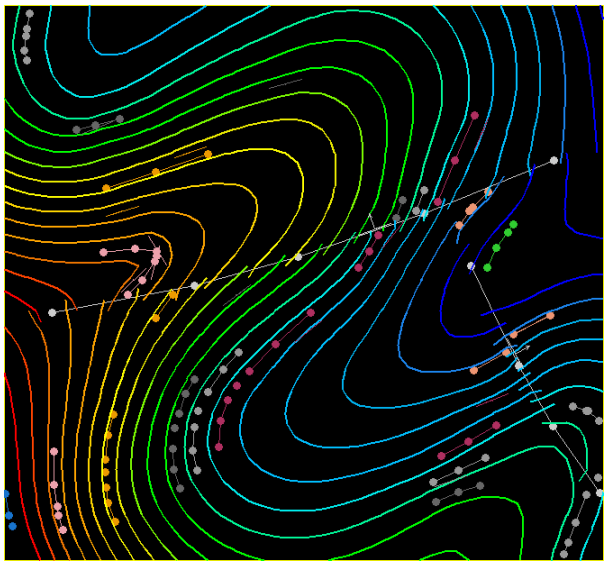


You could import and georegister this image in the project. Use the instructions in B1 Stage 4—Import geology image. Note that, if there are several images in a section, the keystrokes PAGEUP and PAGEDOWN enable you switch between the available images.

Viewing the model with trend lines

The following illustration is of the computed 'potential' for this series (plotted using the **Show trend lines** option. Observe:

- How the iso-potentials honour the orientation data and the trends of the exposed geological contacts, and then
- How they provide the basis for the interpolation of the contacts beneath cover.



Tutorial B5—Cross sections, Shapes and Other Model Products

Parent topic: Tutorial case study B (Antonio's map)

In this tutorial we:

- Create a cross section and view the model in it
- Calculate and export the 3D model in Virtual Reality Modelling Language (VRML) and view it on a web page

B5 Stage 1—Getting started

You can continue with your version of the project that you completed in Tutorial B4—Add Data, Recompute, Redraw the Geology Map or open the project that we have prepared, ready to start this tutorial.

B5 Stage 1—Steps

1 *Open the completed project from Tutorial B4.*

To use the prepared version:

- Open: **`GeoModeller\tutorial\CaseStudyB\TutorialB4\Completed_project\TutorialB4.xml`**
- Save the project with a new name in the folder you are using for your tutorial data.

Note that a completed version of this Tutorial B5 is available in **`GeoModeller\tutorial\CaseStudyB\TutorialB5\Completed_project\TutorialB5.xml`**. Do not overwrite it.

2 Select **Map_DTM** tab in the **2D Viewer**.

B5 Stage 2—Creating the secton and plotting the model in it

We are interested in a diagonal section from the North West corner of Map_DTM.

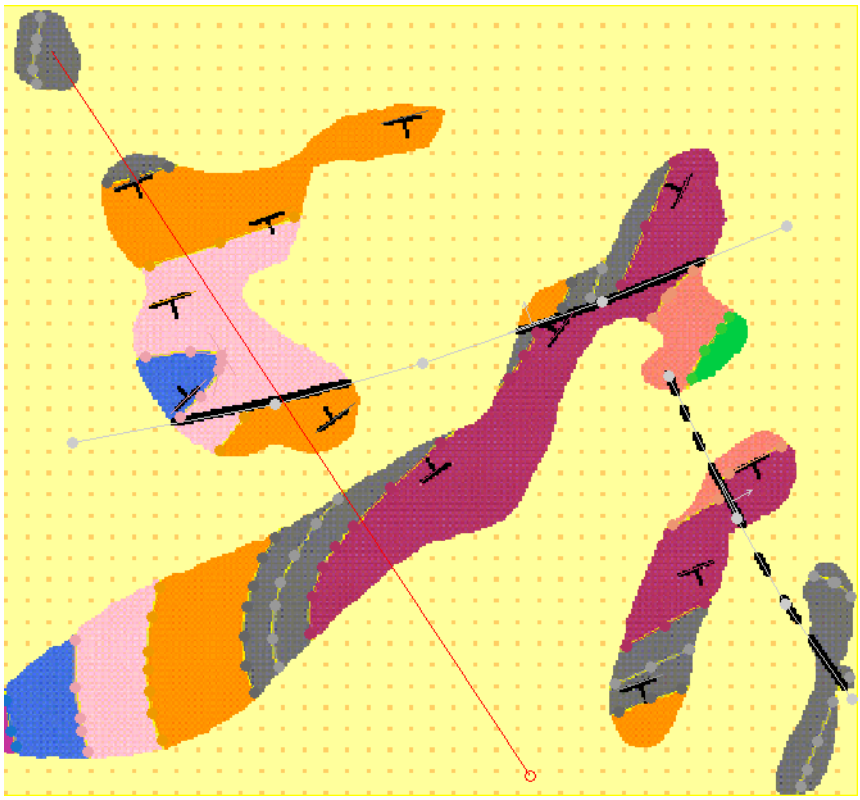
B5 Stage 2—Steps

1 In **Map_DTM** in the **2D Viewer**, display the image of geology with cover.

2 From the **2D Viewer** toolbar, choose **Create** OR press C.

3 From the **Points list editor** toolbar choose **Delete all Points** to erase any existing contents of the Points List.

4 In **Map_DTM** in the **2D Viewer**, click the points corresponding to the ends of the diagonal red line in the folowing diagram

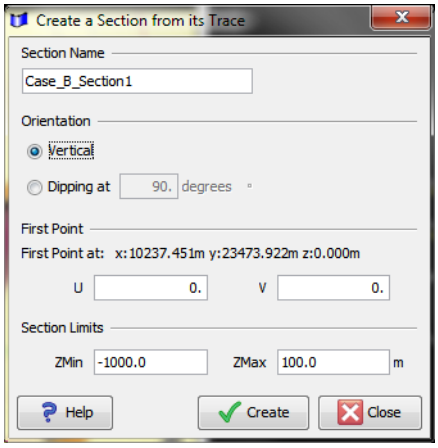


5 *Create the section* `Case_B_Section1` *from the points trace*

Choose menu option **Section > Create a section from its trace** OR

on the **Section** toolbar, choose **Create section from trace** OR choose CTRL+T.

Enter the name `Case_B_Section1`.



Choose **Create** and then **Close.**

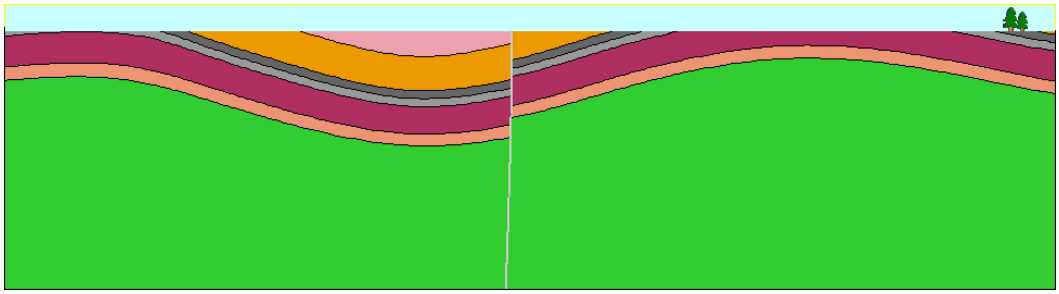
6 *Plot the model using fill in this new section view*

From the main menu choose, choose **Model > Plot the model settings** OR

From the **Model** toolbar, choose **Plot the model settings** OR
Pess CTRL+D.

Check **Show fill** and clear **Show lines**.

Choose **OK**.



7 Save the project.

B5 Stage 3—Generating and exporting 3D shapes

We can generate a set of 3D shapes, defined by triangulated surfaces. Again, the process interrogates the model. We specify a 3D mesh of points that defines the fineness for the triangulation computation.

B5 Stage 3—Steps

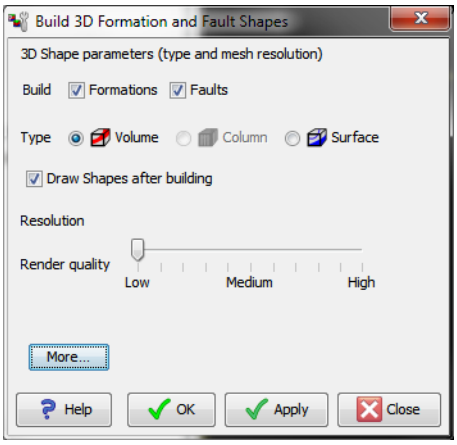
1 Choose main menu **Model > Build 3D formations and faults** OR
In the Model toolbar choose **Build 3D formations and faults**

2 In the **Build 3D formation and fault shapes** dialog box:

Select **Volume**

Select **Anistropic**, with **X**, **Y** and **Z** all set to 50.

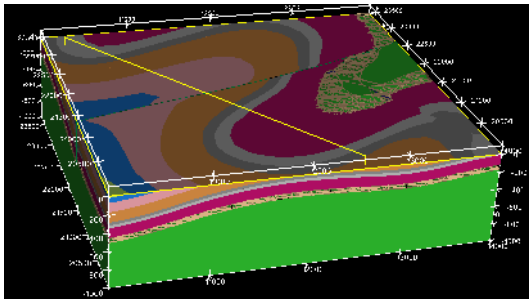
Choose **OK**.



These dimensions yield a 50m x 50m x 50m resolution for this project.

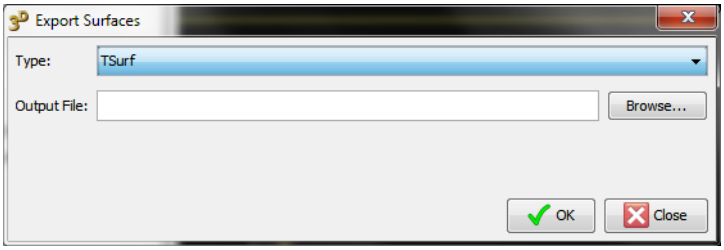
The process takes about three minutes for this simple model on a 2.4 GHz computer with 512 Mb RAM

When finished, 3D GeoModeller displays the results in the **3D Viewer**.

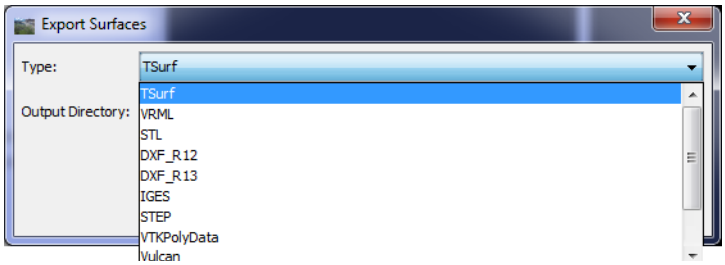


3 Save the project.

4 Choose **Export > 3D Model > Shapes** to bring up the export dialog.



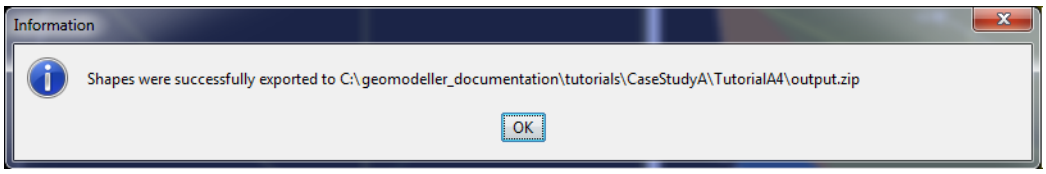
5 Under **Type** select the file format you wish to save the 3D mesh products in.



6 Choose **Browse** to select an output file name or type one in the edited box provided.

NOTE: Most formats will produce several files, one for each unit. In such cases a ZIP file will be created using the name provided.

7 Once the save is complete you will recieve a message dialog indicating where the products have been saved.



8 Navigate to the output directory and extract the contents of the ZIP file to ensure the export was successful.

9 *Export VRML files for interactive 3D display in a web browser*

NOTE: This is for Micrsoft Internet Explorer only.

After building the shapes, we can generate a set of Virtual Reality Modelling Language (VRML) files for interactive web display. The process takes about thirty seconds for this 2.4 MHz PC with 512 Mb RAM.

From the main menu choose **Export > Export 3D model > VRML project website**.

Specify a folder for your files. 3D GeoModeller places a **`.zip`** file in that folder, containing the VRML web pages.

B5 Stage 3—Solutions provided

- We supply a completed version of the VRML website, according to the instructions in this tutorial, in your 3D GeoModeller installation folders. Its path is **`GeoModeller\tutorial\CaseStudyB\TutorialB5\Completed_VRML_Site`**. Do not overwrite these files.
- We also provide a high-resolution resolution version. We generated it from shapes defined with 10 m vertical resolution, and 25 m horizontal resolution. The finer vertical resolution is more suited to the thin layers of this model. You can download this in a **`.zip`** file (**`VRML_10mZ_25mXY_Resolution.zip`**) from the 3D GeoModeller website www.geomodeller.com.

B5 Stage 4—Viewing the VRML web pages

Before viewing the VRML pages, you need to:

- Ensure that you have a VRML viewer plug-in for your browser.
- Unzip the files into folders.

To save time in this exercise, we have generated a relatively coarse-grained (50 m x 50 m) set of shapes. Our output looks OK, but, in a production enviromment, you may require finer definition.

B5 Stage 4—Steps

1 To view the VRML interactive display:

2 If you do not have a VRML viewer, install one on your computer.

We have tested and used the *Blaxxun Contact* VRML plug in for *Microsoft Internet Explorer*. It enables you to view and interact with web-ready VRML files in a standard web browser. You can obtain this from the following download:

- ftp://ftp.intrepid-geophysics.com/pub/geomodeller/vrml/blaxxunContact53.exe

3 Open the **`.zip`** file that 3D GeoModeller created. Unzip it into a folder of your choice. Ensure that the **Use folder names option** is checked.

The VRML site consists of the following files and folders:

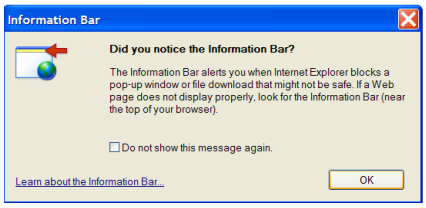
- File **`index.html`** for launching the site
- Folder **`HTML`** with various VRML display control files
- Folder **`VRML`** with the geology shape files

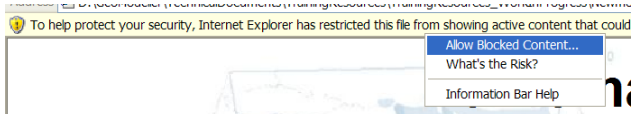
4 Open the file **`index.html`** using *Microsoft Internet Explorer*.

If *Microsoft Internet Explorer* is your default browser, you can just double click **`index.html`**.

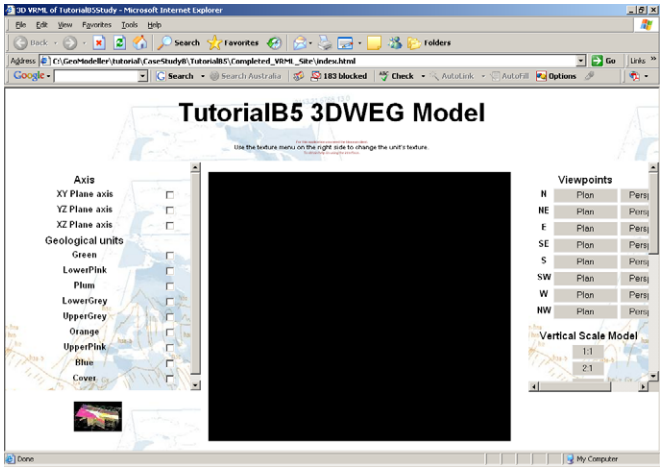
If you have several browsers and *Microsoft Internet Explorer* is not your default browser, use **Open With** from the shortcut (right click) menu in *Windows Explorer* or *My Computer* to launch it.

Depending on your security settings, you may need to allow blocked content. Your browser may display a warning as shown below. Generally you need to right click the **Information Bar** near the top of the window and choose **Allow Blocked Content**. This permits the browser to load the rest of the VRML data.

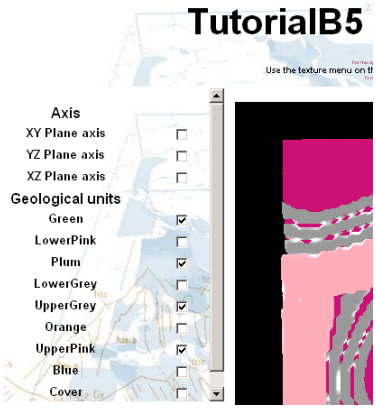




The browser displays the web page with an empty display area.

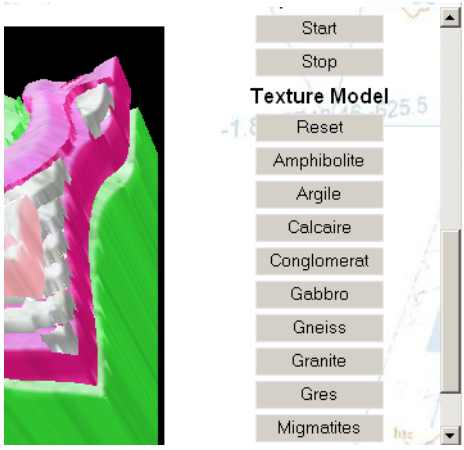


5 Check some or all of the geology formation check boxes on the left side of the screen. You can also check the check boxes for display of axes as a reference frame.



6 When you first view the VRML data, the colours just fill the spaces uniformly, without the shading that gives a 3D illusion. You can apply a texture to each colour region.

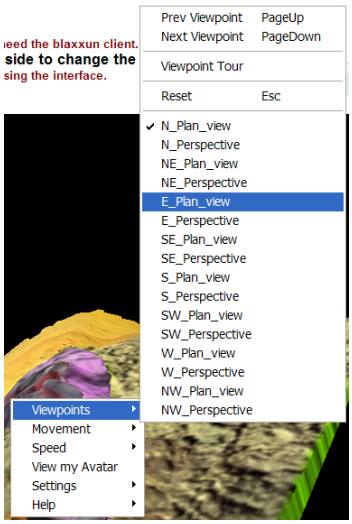
Locate the **Texture Model** buttons in the options on the right side of the window (Scroll down if necessary). To apply a texture to a formation, choose a texture button and then click the formation in the display area.



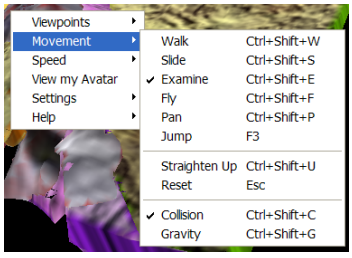
You can rotate, move and reset the display, and change its vertical exaggeration. This tutorial only has room for brief instructions. Consult the *Blaxxun Contact* user manual for full details.

B5 Stage 4—Blaxxun Contact controls

- To select 2D or 3D display, select one of the **Viewpoints** buttons at the right of the display area (scroll to reveal if necessary) OR
  From the display area shortcut (right click) menu, choose **Viewpoints >** and the option you require.



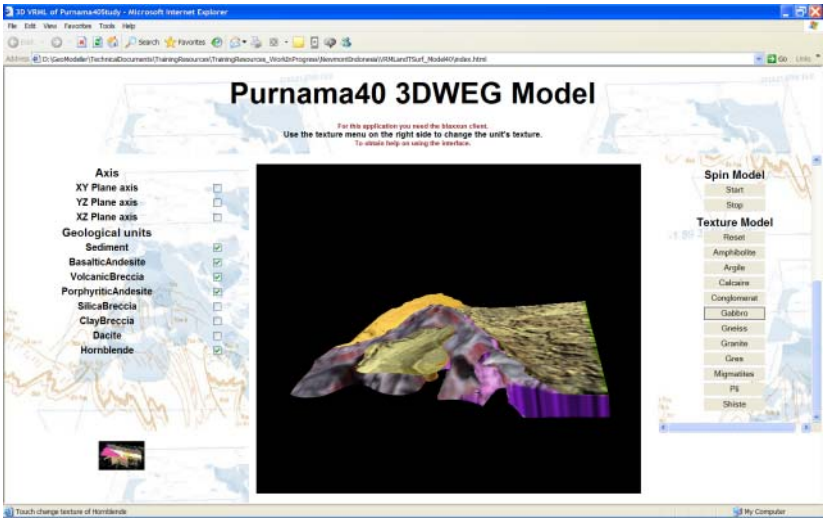
- To change vertical exaggeration: select one of the buttons in **Vertical Scale Model** at the right of the window (scroll to reveal if necessary).
- To rotate the display: from the display area shortcut (right click) menu, choose **Movement > Examine** (or press CTRL+SHIFT+E). Drag with the left mouse button to rotate (mouse pointer shows **E**).



- To move the display: from the display area shortcut (right click) menu, choose **Movement > Slide** (or press CTRL+SHIFT+S). Drag (gently) with the left mouse button in the opposite direction to the desired movement (mouse pointer shows **S**). This may take some practice. If the display disappears, reset it using one of the **Viewpoints** buttons.
- To view the *Blaxxun Contact* on-line help manual: from the from the display area shortcut (right click) menu, choose **Help > Online Manual**. The manual appears in a new window.

There are further options for rotating, panning and zooming in the shortcut (right click) menu.

Here is an illustration of another VRML model display.



You have now successfully completed Tutorial B