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Chapter 3

Advanced Framework Construction

Topics Covered in this Chapter

The following topics are covered in this chapter:

- Optimizing grid cell resolution
- Working with horizon cleaning distance
- Constructing fault networks
- Using advanced framework editing tools
- Editing source data to refine frameworks

Overview: Using Advanced Tools to Construct Frameworks

In this chapter, you will review some of the advanced tools used in framework construction. Thus far, map construction in your framework has resulted in the addition of horizons, tops, and faults to your existing framework in a mapping environment that is fairly automatic. In conditions with few faults and surfaces, framework construction can be largely automated. However, automation is not efficacious when default parameters and automatic offsetting results are not optimized for the data. To produce consistently useful results you must learn how to adjust framework construction parameters and apply framework editing tools.

When you possess the material in this chapter you will have a strong background in the theory and practical application of framework parameterization and editing. You will use geophysical and geological interpretation tools to edit original input data to affect changes and improvements to the final framework.

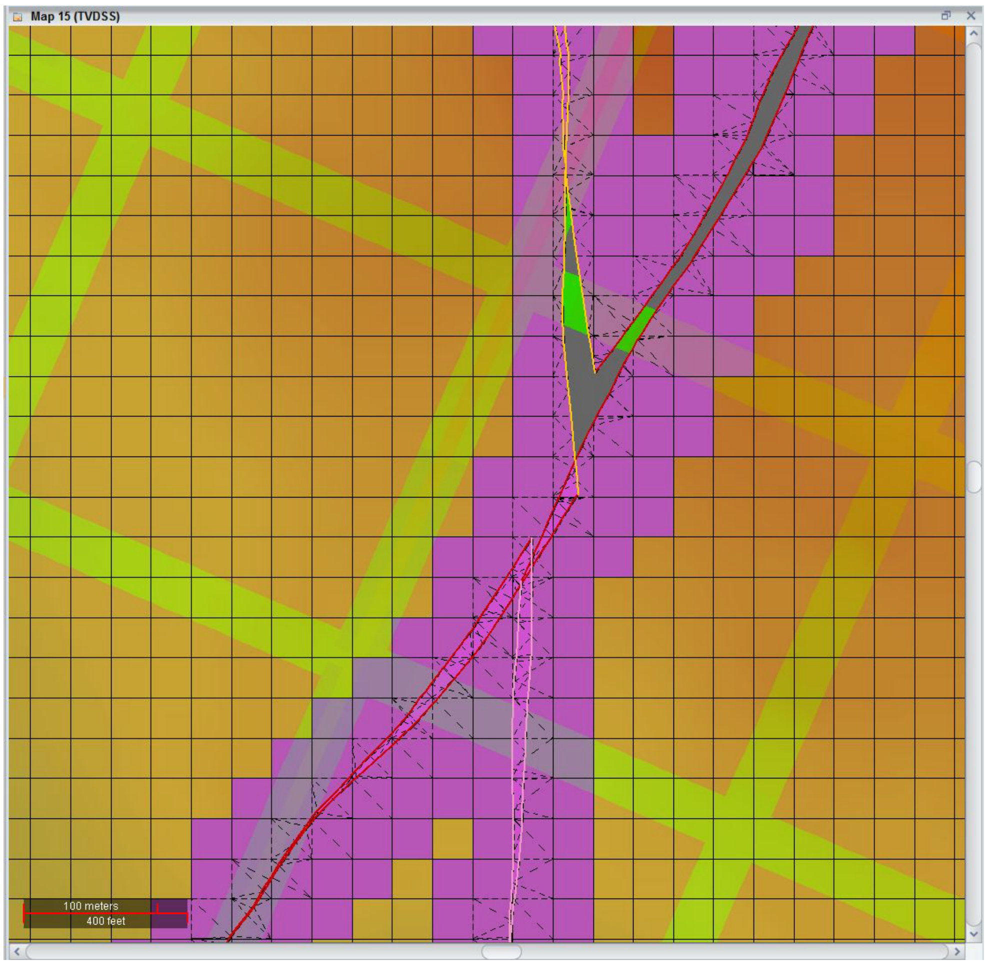
Optimizing Grid Resolution

To achieve the best fault-offsetting results, you must find an optimal grid resolution that balances gridding performance and resolution of the smallest geologic features. In this next section, you will compare different cell sizes to determine which one is most reasonable to achieve speedy results and resolution of your narrowest faults.

As a rule of thumb, your cell size should be roughly $1/5^{th}$ the width of the smallest structure you want to resolve. The smallest fault block in this dataset is about 300 m wide (for this measurement you use a measuring tool in DecisionSpace). This means your cell size should be 60 m.

The exercises to follow explore concepts and tools necessary to achieve optimum framework results. The exercises will include a review of:

- The concepts and workflows related to adjusting grid cell size and horizon cleaning distance to achieve optimum surface resolution in the vicinity of closely spaced faults
- The concepts and workflows required to manually adjust fault-to-fault network relationships
- The tools available to edit fault-surface intersections in *Section*, *Map*, and *Cube* views



Exercise 3.1: Modeling the Interpretation

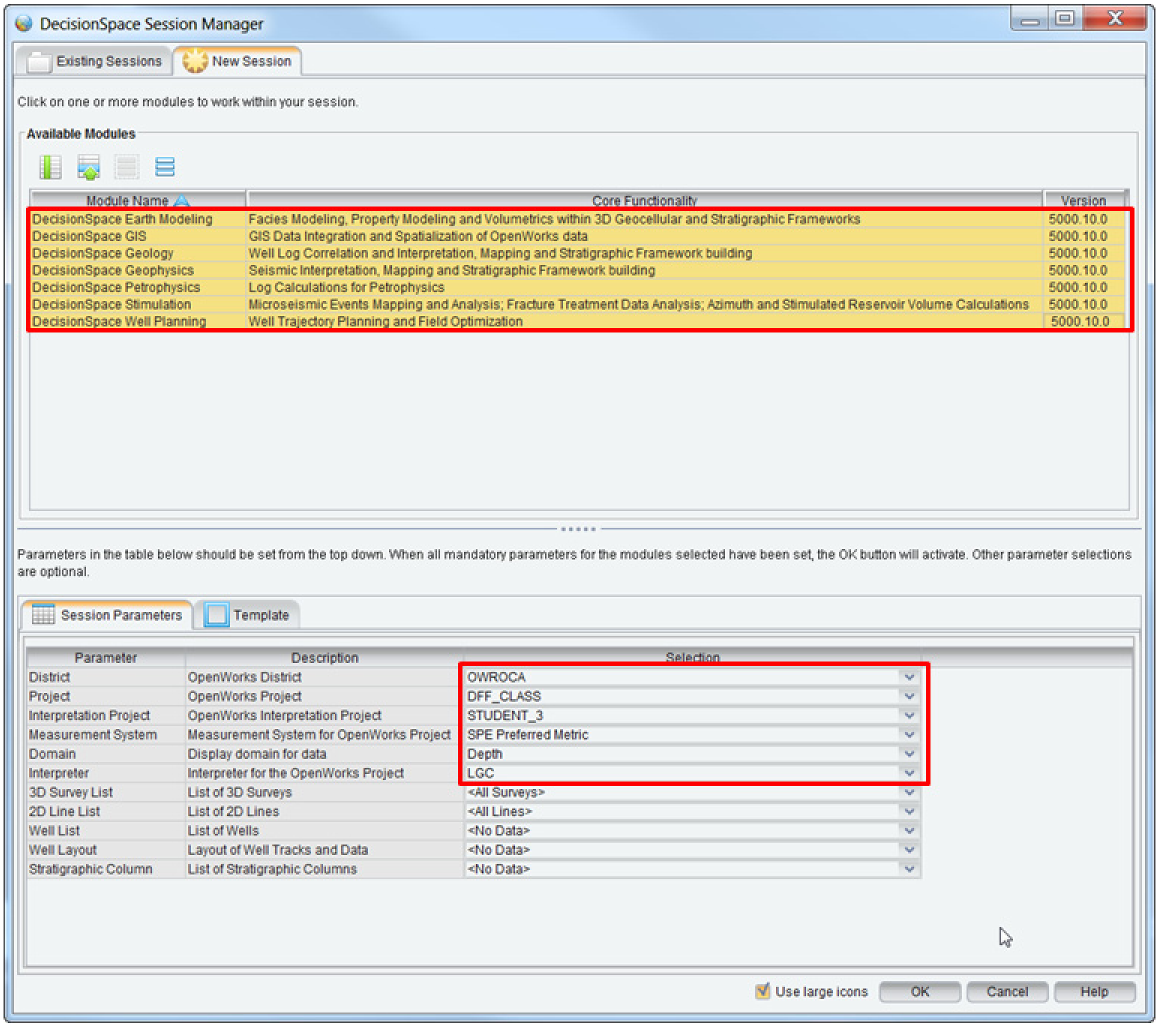
In this exercise, you will work with the surface modeling and editing tools available in Dynamic Frameworks to Fill.

So far in this course, you have constructed a simple framework by adding horizons, well picks, and faults. Now you will add additional faults and horizons to construct a more complex framework; you will validate this model and refine it manually using the advanced framework editing tools.

You will also review best practice workflows for optimizing grid resolution (cell size) and horizon cleaning distance. This will enable you to produce the best fault-offsetting results, particularly in narrow fault blocks. You will also manually edit the intersections of faults and surfaces. These tools rely on the concept of framework updatability and illustrate how changes in the database affect framework geometries.

1. Launch DecisionSpace. Load session **Chapter3_AdvancedFWConstruction_Part1**. If your session opens correctly, skip to Step 5.

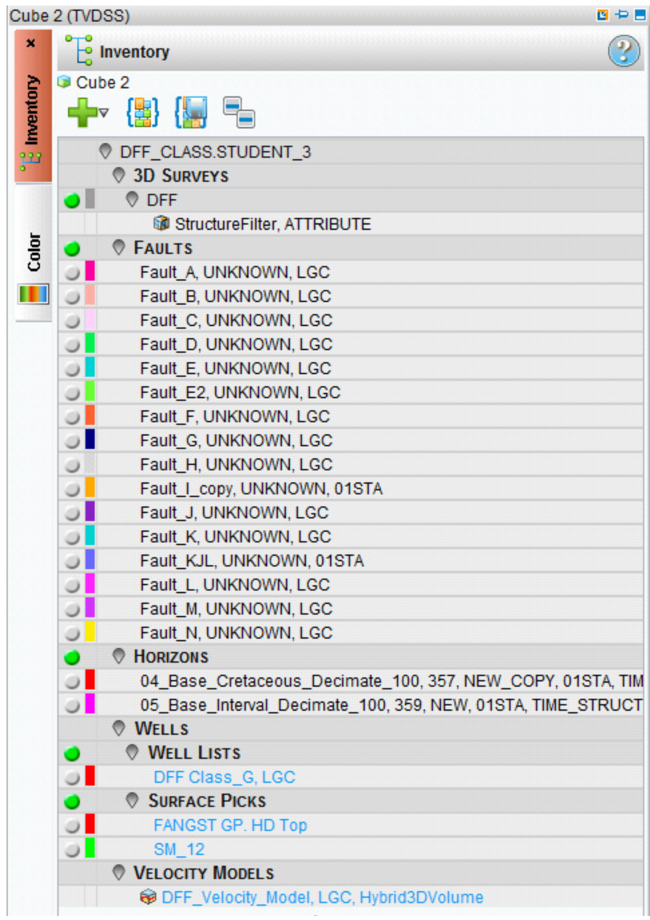
2. If you have trouble loading the session named above, initiate a *New Session* in **Depth**, as shown.



3. In the *Template* tab select **Map/Section/Cube - Triple Tile**. Then click **OK**.

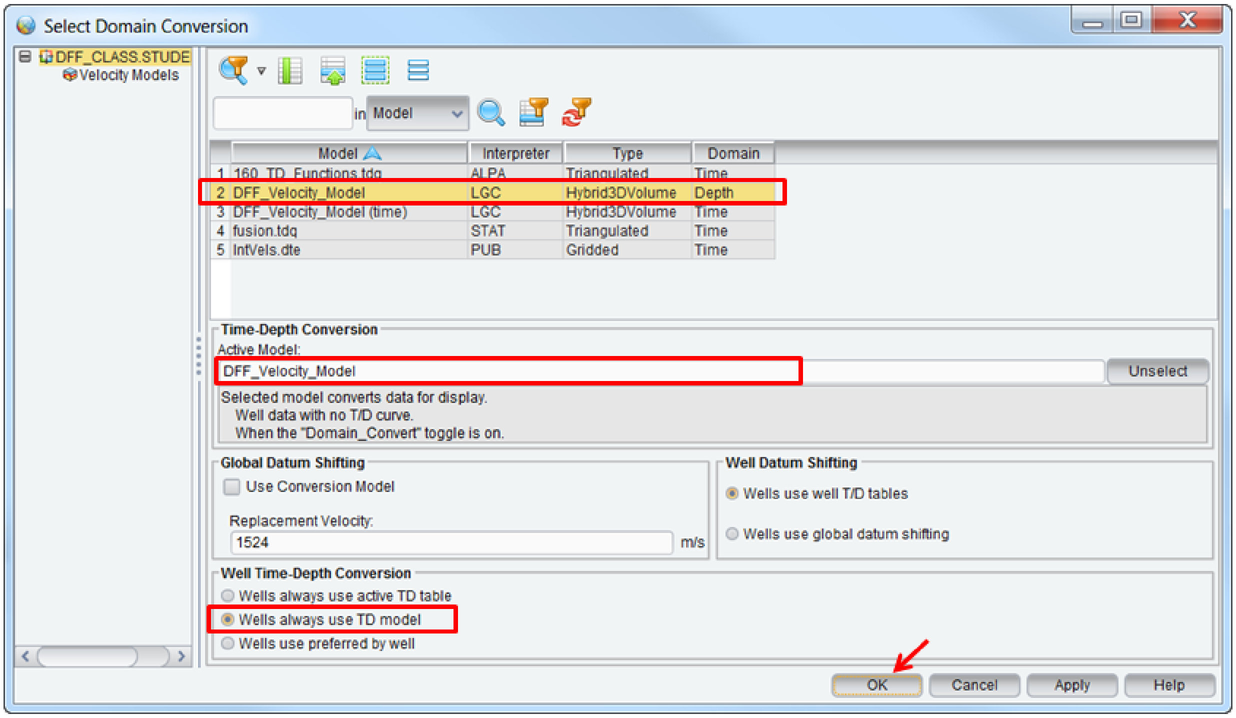
4. Load ISet **DFF_Ch3** from the *Tools* task pane.

   In the *Tools* task-pane, click the **Interpretation Set** ( ) icon. In the *Interpretation Set* task pane, highlight **DFF_Ch3**, and then click the **Load Data to Session** ( ) icon.



5. Confirm that you are using the **DFF_Velocity_Model** velocity model for domain conversion.

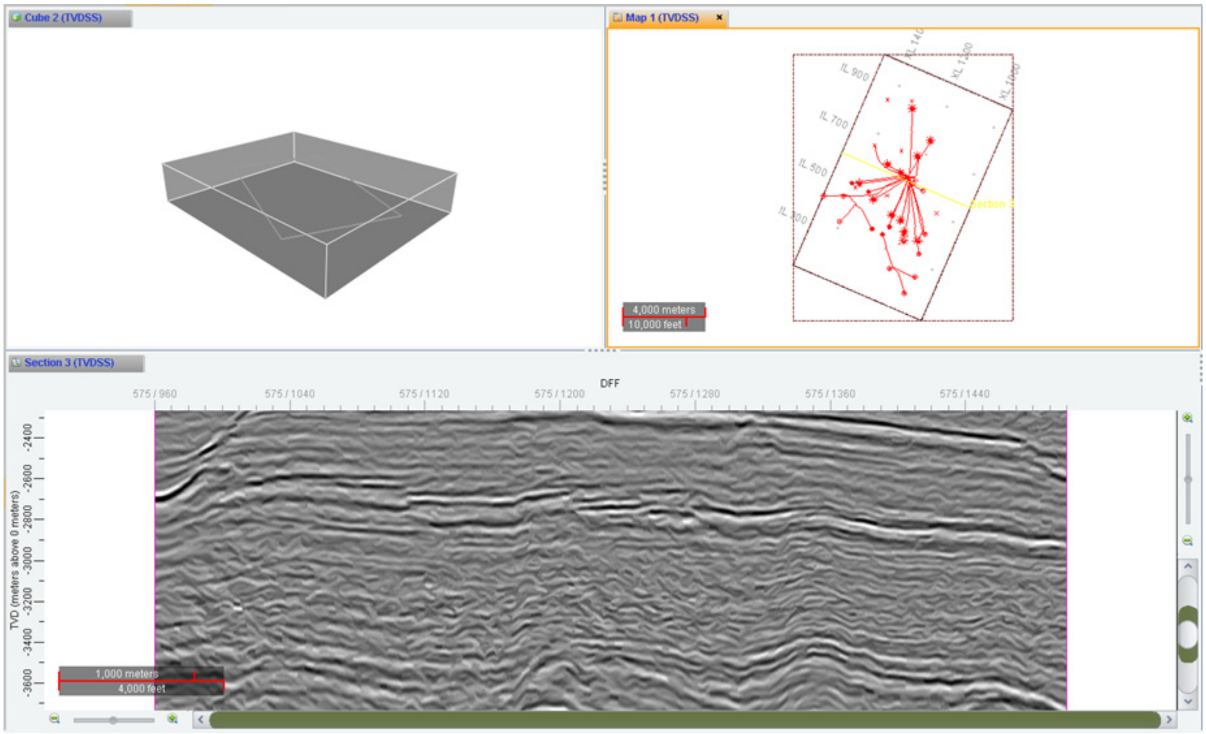
6. From the main menu bar, select **Select > Domain Conversion...**. Ensure that **DFF_Velocity_Model** (in depth) is the Active Model and **Wells always use TD model** is turned on. Click **OK**.



7. Load the **StructureFilter, ATTRIBUTE** seismic volume to shared memory. In the *Inventory*, **MB3** on the **StructureFilter, ATTRIBUTE** volume, and then select **Load to Shared Memory...**.

8. All three views should be in TVDSS. If not, convert them now (when they are converted, all tabs have blue font).

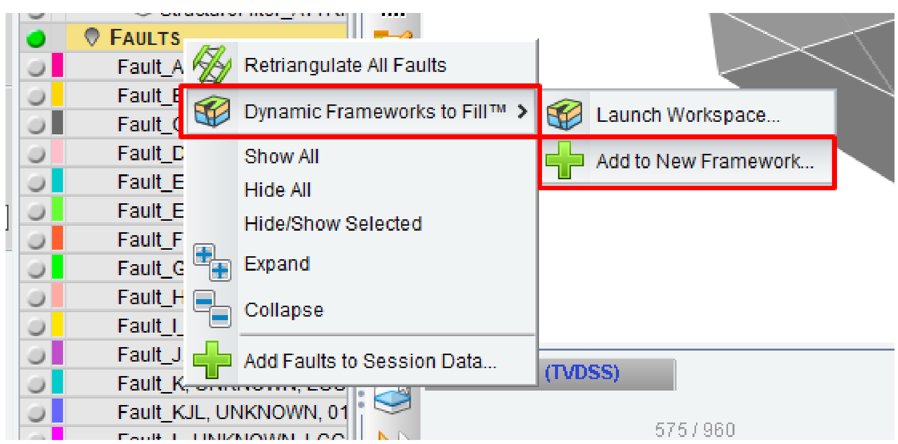
Your views should appear similar to the image below.



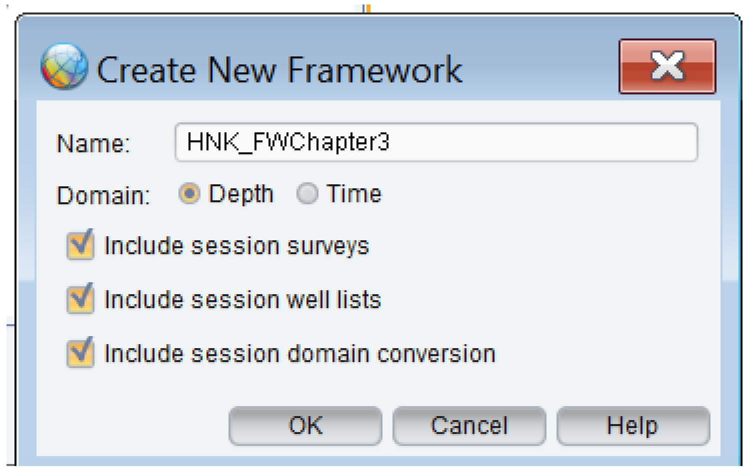
Next, you will build a framework with connected faults and offset surfaces.

9. Display inline **575** in your *Section* view.

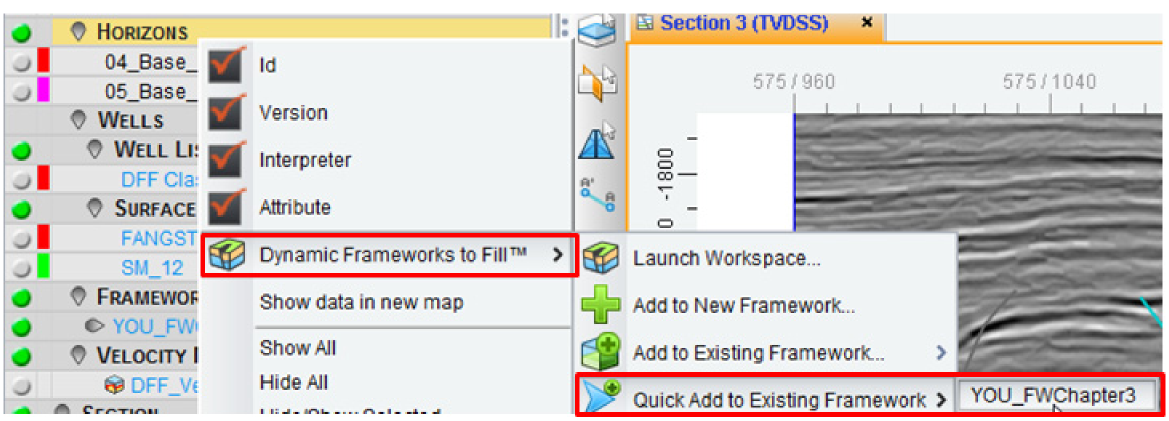
10. In *Inventory*, **MB3** on the **FAULTS** category, and then select **Dynamic Frameworks to Fill** > **Add to new Framework**.



11. The *Create New Framework* dialog box displays. Name the framework "YOU_FWChapter3". Make sure the framework is in **Depth** domain. (If you need to rename your framework, double click on it within the *Dynamic Frameworks to Fill* task-pane). Accept the defaults in *Add Sources to Framework* dialog box to add the faults as new objects.



12. In *Inventory*, **MB3** on the **HORIZONS** category, and then select **Dynamic Frameworks to Fill > Quick Add to Existing Framework > YOU_FWChapter3**. Refresh the framework. The option *Quick Add to Existing Framework*, will always add the selected objects as new objects in the framework. Do not use this option if you want to add any specific object as a secondary source of an existing framework component.



The framework is by default in *Dynamic, Manual* ( ) mode. In this mode, any changes are queued until either the framework is refreshed ( ) or the mode is changed to *Dynamic, Auto Refresh* ( ). To change modes click the icon in the *Dynamic Frameworks to Fill* task pane or workspace.

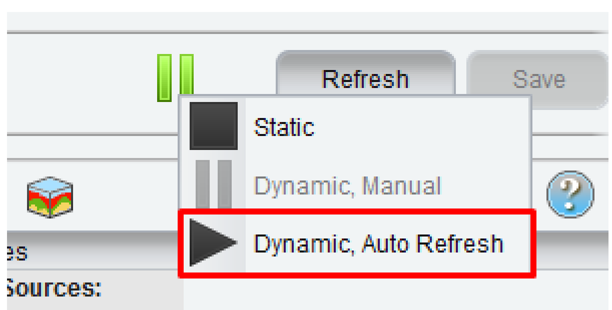
Similarly, these three icons , , and , share the same position. Therefore you will see only one of them at a time.

To refresh the framework, click the **Refresh Framework** button at the top of the *Dynamic Frameworks to Fill* workspace, or click the Refresh ( ) icon in the *Dynamic Frameworks to Fill* task-pane. The presence of the refresh icon indicates that changes are waiting to be applied, while the hammer icon ( ) indicates that the framework is being updated. The green check ( ) icon indicates the framework is updated and no changes are pending.

13. In *Cube* and *Section* view turn on all of the **FW Surfaces** and **FW Faults**, and in *Map* view turn on the FW Surface **04_Base_Cretaceous_Decimate_100**.

14. On the *Dynamic Frameworks to Fill* task pane, click the **Launch the Frameworks Workspace Window** ( ) icon.

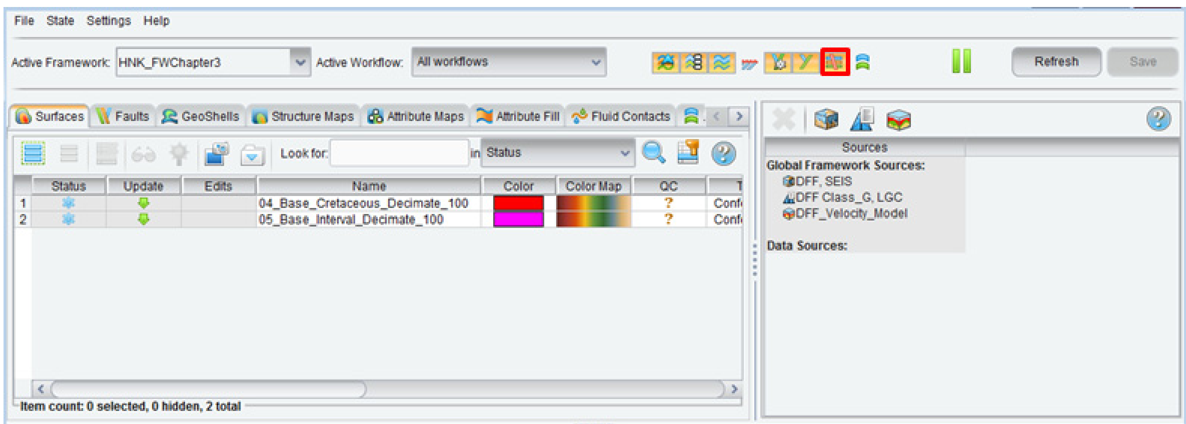
15. Click the **Dynamic, Manual** icon at the top of the workspace and select **Dynamic, Auto Refresh** as the current mode for your framework.



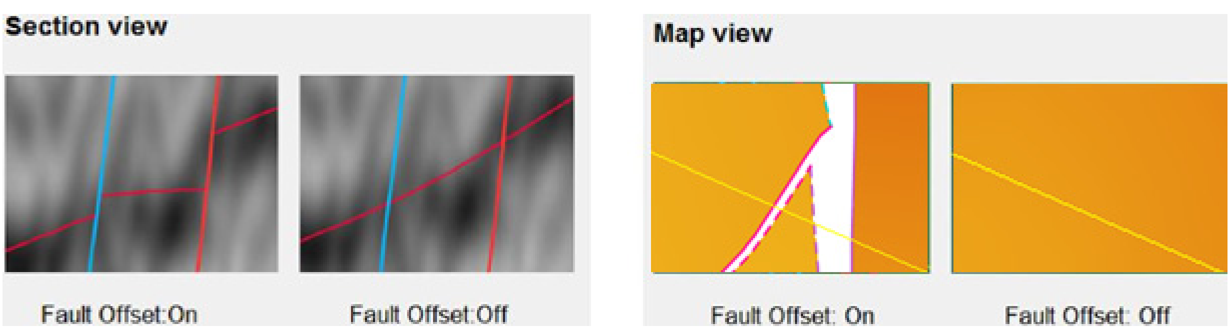
For a first pass interpretation, you will enable Fault Offsetting and Fault Networking to see how the framework model looks with the suggested fault-surface and fault-fault relationships.

> **Note**
>
> Because of lengthy horizon and surface names, names in the text may be shortened. Therefore, 04_Base_Cretaceous_Decimate_100, will be referred to as **04_Base Cretaceous**, and 05_Base_Interval_Decimate_100 referred to as **05_Base_Interval**.

16. In the *Dynamic Frameworks to Fill Workspace* window, turn on the **Fault Offset** ( ) icon in the uppermost tool bar. The orange shaded background shown in the figure below indicates the Fault Offset is set to on, which is the state that you want.



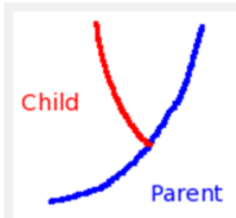
This will automatically calculate displacements and introduce offsets across the faults, as shown in figure below.



17. Within the *Dynamic Frameworks to Fill Workspace* activate the **AutoNetwork Faults** ( ) icon.

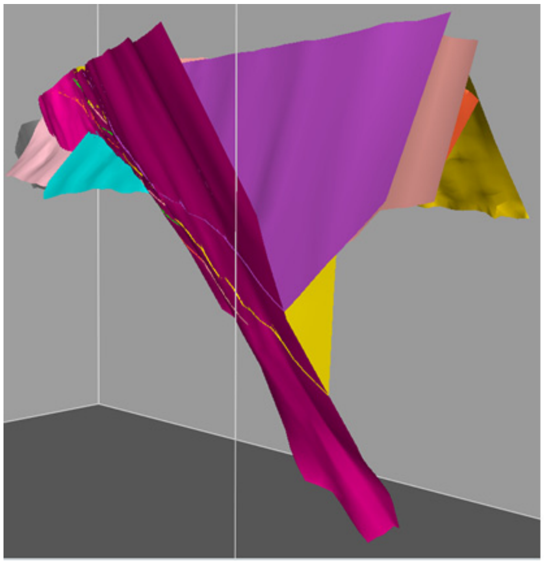
Notice the networking relationships that have been formed. You can see the details of these relationships in the *Networking* action tab of the *Faults* tab.

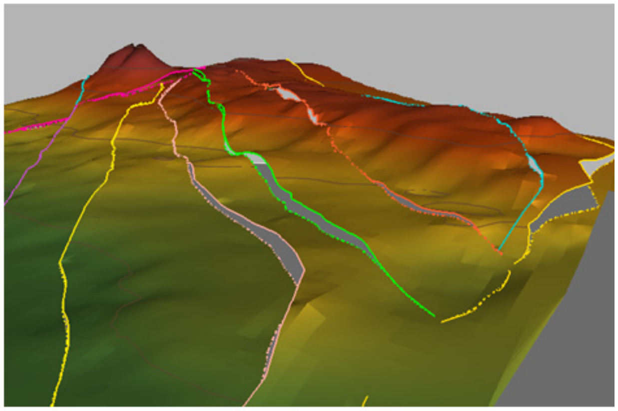
This will calculate fault relationships, based on relative fault size, and create a networked fault model. Note the update to the *Networking* sub-panel of the *Dynamic Frameworks to Fill Workspace*. In fault networking, the parent fault truncates the child fault (illustrated below).



18. Review the resulting fault framework in *Cube* view. To best visualize the geometry in *Cube* view, you may want to hide some faults or horizons.

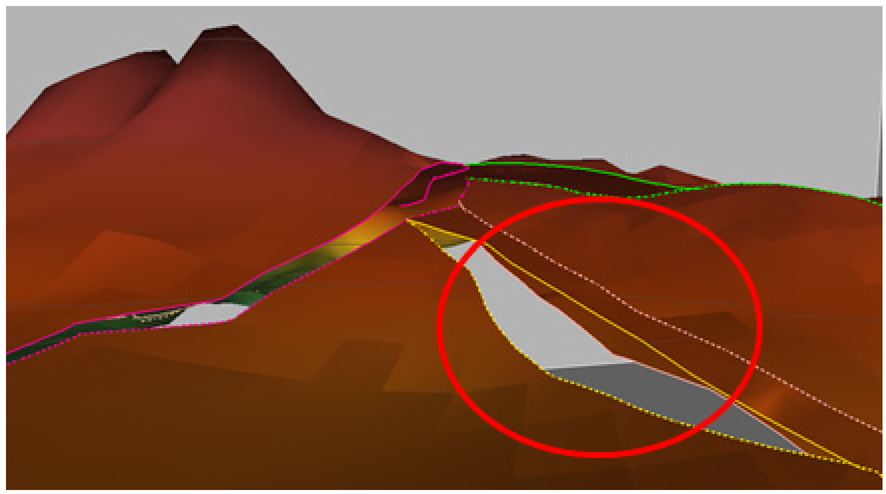
    The pictures below show the faults and the **04_Base_Cretaceous** framework surface after **AutoNetworking Faults** and **Fault Offsetting** have been applied.





Note

There can be some geologic inconsistencies, such as unreasonable fault displacements, incorrect fault connections, and crossing faults. Narrow fault blocks, in particular, can show surface geometries that are inconsistent with the original source data.



These inconsistencies stem from the automated framework modeling process of incomplete or bad interpretations. You will correct these problems in later steps.

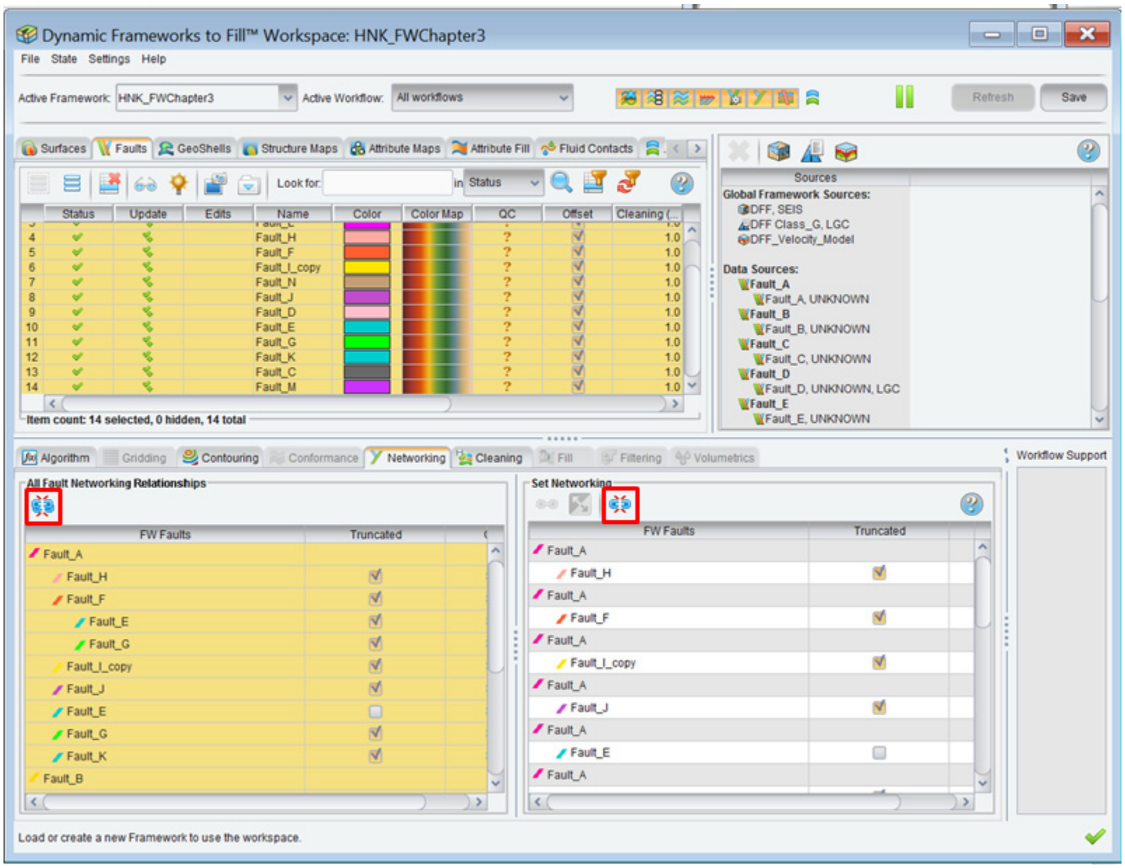
Note

For greater detail on the techniques that follow, see "Chapter 2: Best Practices for Dynamic Frameworks to Fill" in *DecisionSpace Geosciences: Software Best Practices*,

Sometimes unneeded fault conditions occur, and are indicated by a yellow hazard-triangle ( ), which is located near your framework name at the top right of the *Dynamic Frameworks to Fill Workspace* window. Unlinking your faults will make this hazard warning go away. This hazard warning may also appear for other reasons like there is not any velocity model selected, data duplicated, problems calculating thickness, etc.

Next, you will unlink this fault network example, you will create fault networks again later.

19. In the *Dynamic Frameworks to Fill Workspace* window, turn off the **AutoNetwork Faults** ( ) icon, and then click the **Unlink All Network Relations** ( ) icon located in the *Networking* action tab in the *Faults* object tab. Click **Yes** to confirm the unlinking of all shown relationships.



> **Note**
>
> If you click the **Unlink** icon on the left side, under the *All Fault Networking Relationships* sub-panel, all fault relationships within the framework will be unlinked and a warning message will appear making sure this is what you want to do. If you click the **Unlink** icon on the right side, under the *Set Networking* sub-panel, it will unlink only the relationships within that panel. In this case, there will not be a warning message before they are unlinked, so make sure only the relationships you want unlinked are selected.

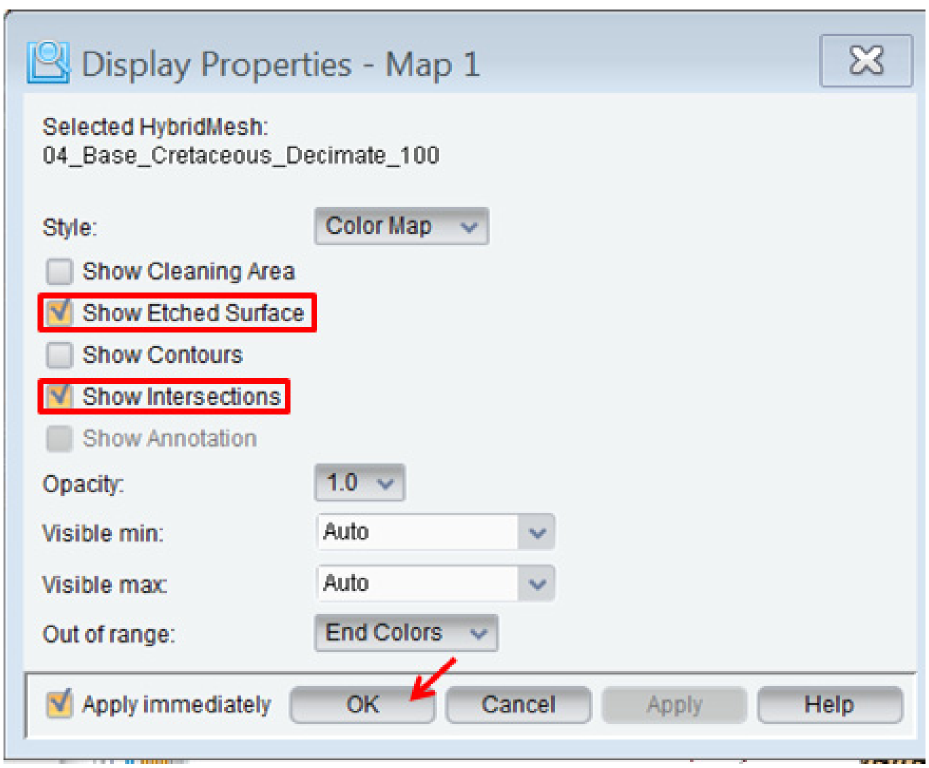
Finding Optimal Grid Resolution

For best fault-offsetting results, you must find an optimal grid resolution that balances gridding performance against resolution of the smallest geologic features. In this section you will compare different cell sizes to determine what is optimal for the greatest resolution of your narrow fault blocks, consistent with the greatest gridding speed.

Your cell size should be about 1/5th the width of the smallest structure you want to resolve. In the dataset you use in this class, the smallest fault block is about 300 m wide. This means the cell size should be 60 m. You can measure the block size using the measuring tool in DecisionSpace.

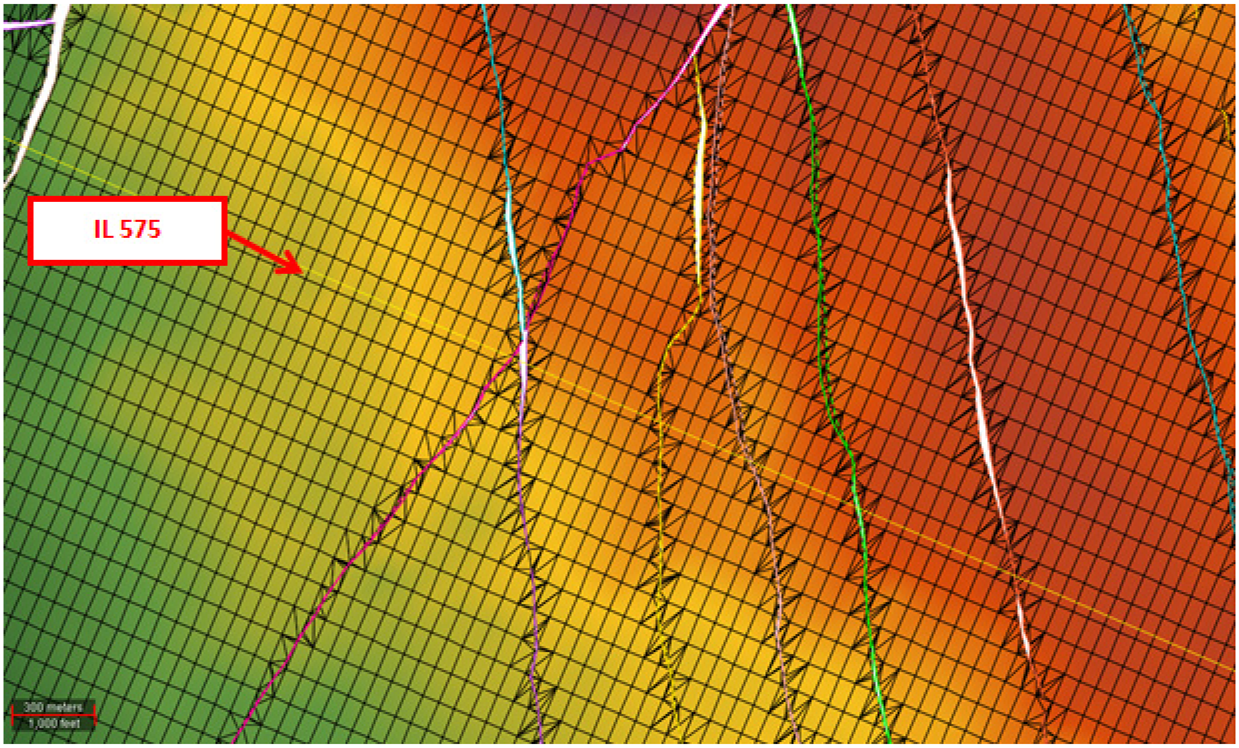
20. Activate your *Map* view, **MB3** on **04_Base_Cretaceous**, and then select **Display Properties…**.

21. In the *Display Properties* dialog box, turn off **Show Contours** and turn on **Show Etched Surface** and **Show Intersections**. Click **OK**. The *Etched Surface* option will display the current grid; the *Show Intersections* option will display the fault polygons on the map. The fault polygons were generated when you enabled the fault offsetting option in *Dynamic Frameworks to Fill Workspace*.



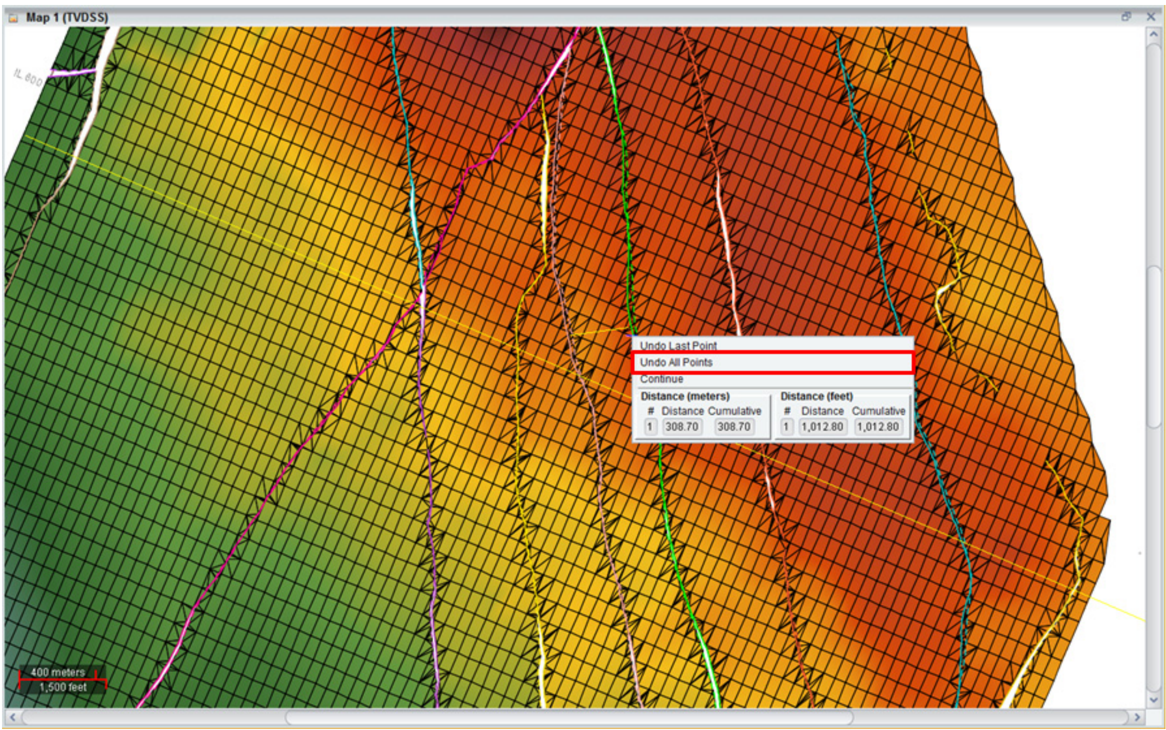
This will show individual grid cells. In the present case, the default is to get as close to 100 rows by 100 columns.

22. To examine some of the narrow fault blocks, **Zoom** into the area around the center of **IL575** (yellow line in *Map* view).



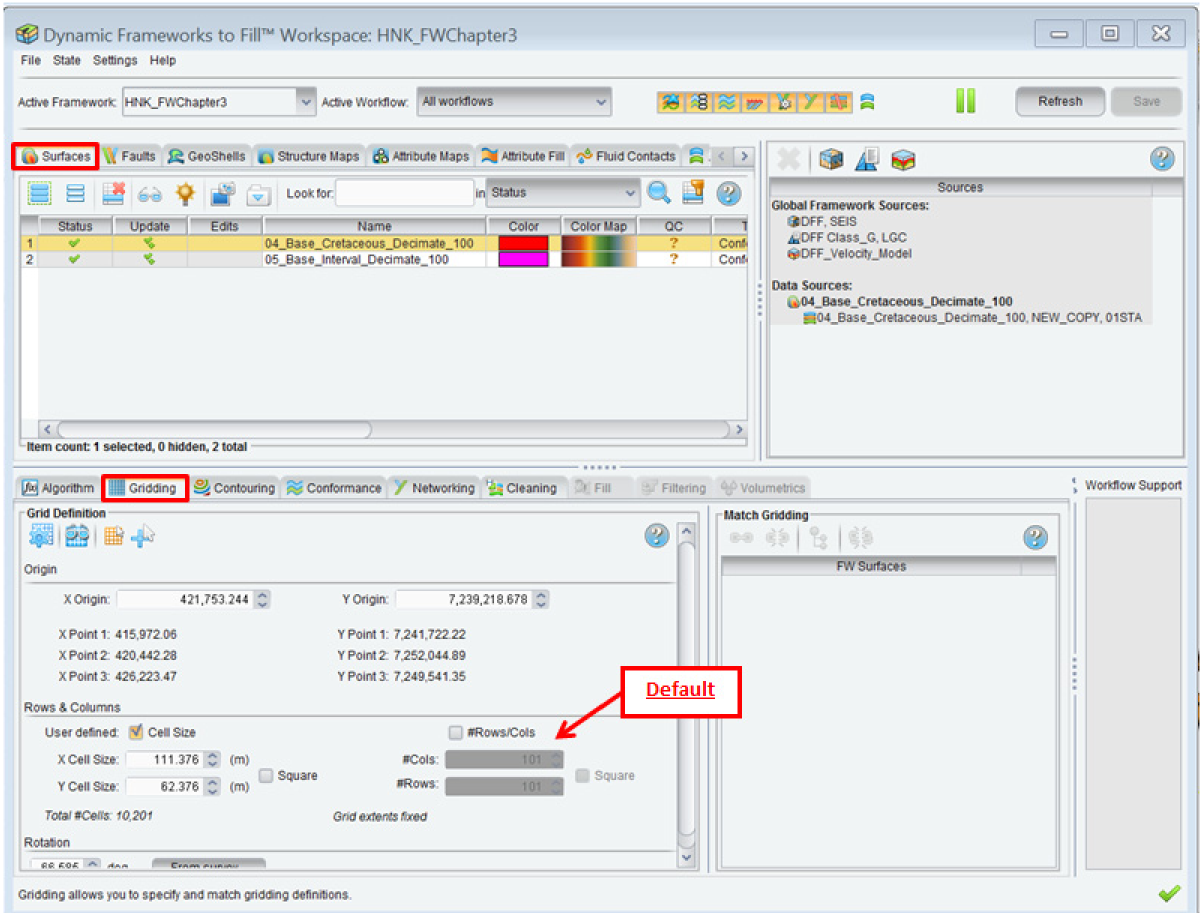
You will now use the measurement tool to determine the width of the smaller fault blocks on the map.

23. At the top of the window, click the **Polygon, Select Data, Measure Distance/Area** ( ) icon. **MB1** on one side of the fault block, at the point where you wish to measure, and then **MB1** again on the other side. This will stop the line. **MB3** to display a pop-up containing automated calculation of the line you just drew. The results are presented in meters and in feet. The width of these narrow blocks is about **300** meters, or **1000** feet. To close the calculation box, select **Undo All Points**. When you are finished, turn off the **Polygon, Select Data, Measure Distance/Area** ( ) icon.



> **Note**
>
> The Polygon, Select Data, Measure Distance/Area icon is available only in *Map* View.

24. Return to the *Dynamic Frameworks to Fill Workspace* window. If it is closed, open it from the *Dynamic Frameworks to Fill* task pane by clicking the **Launch Dynamic Frameworks to Fill Workspace** icon ( ). In the *Surfaces* tab, select the **04_Base_Cretaceous** surface, and activate the *Gridding* action tab.

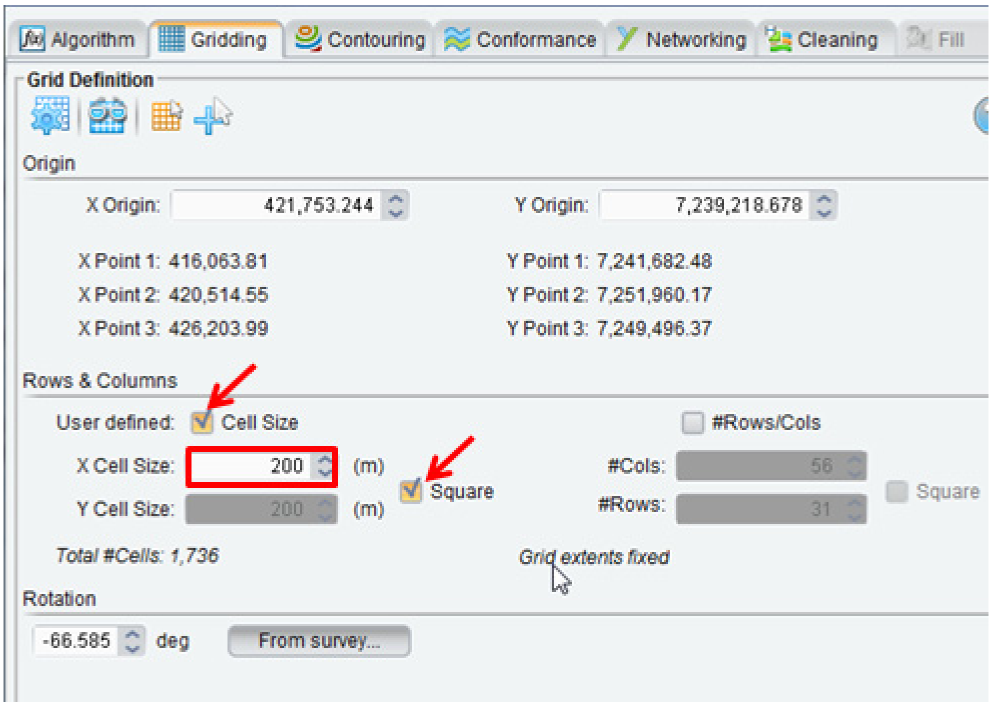


Note

The default is to have a grid cell size that allows for a result as close to 100 rows by 100 columns. If your framework is set to **Dynamic, Auto Refresh** mode, it will automatically update with changes to the values in these cell boxes. Otherwise, you must select Refresh Framework.

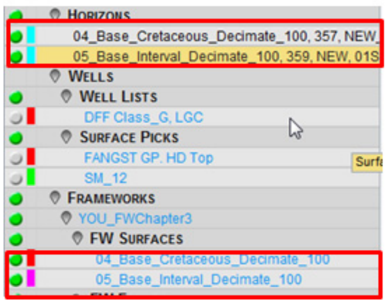
You will now test the results of specifying different grid sizes to determine what works best for your geological area.

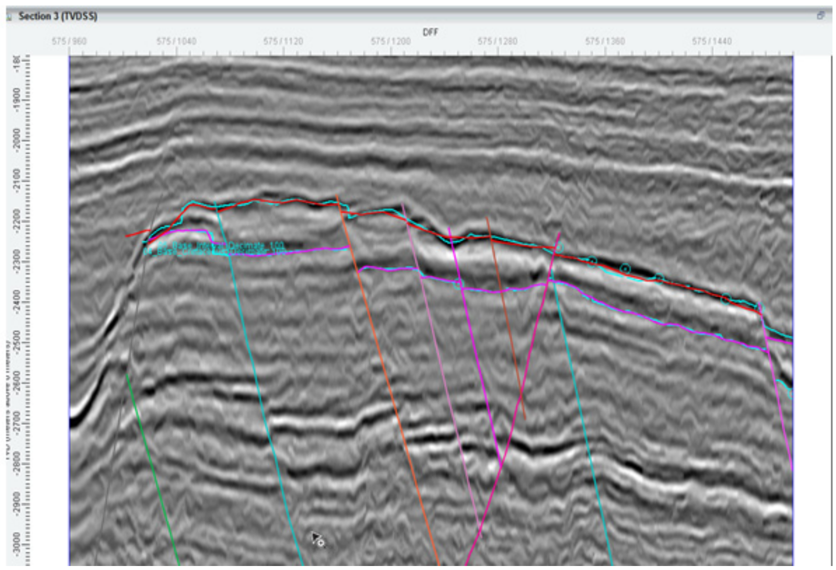
25. Make sure the framework is in **Dynamic, Auto Refresh** ( ) mode. Check the **Square** box located in *Rows & Columns* section within *Gridding* action tab. Enter “200” in the *X Cell Size*; when you press <**Enter**> the framework will begin to recalculate (this sets a square, 200 by 200 meter grid cell). The map will be redrawn with larger cell sizes.



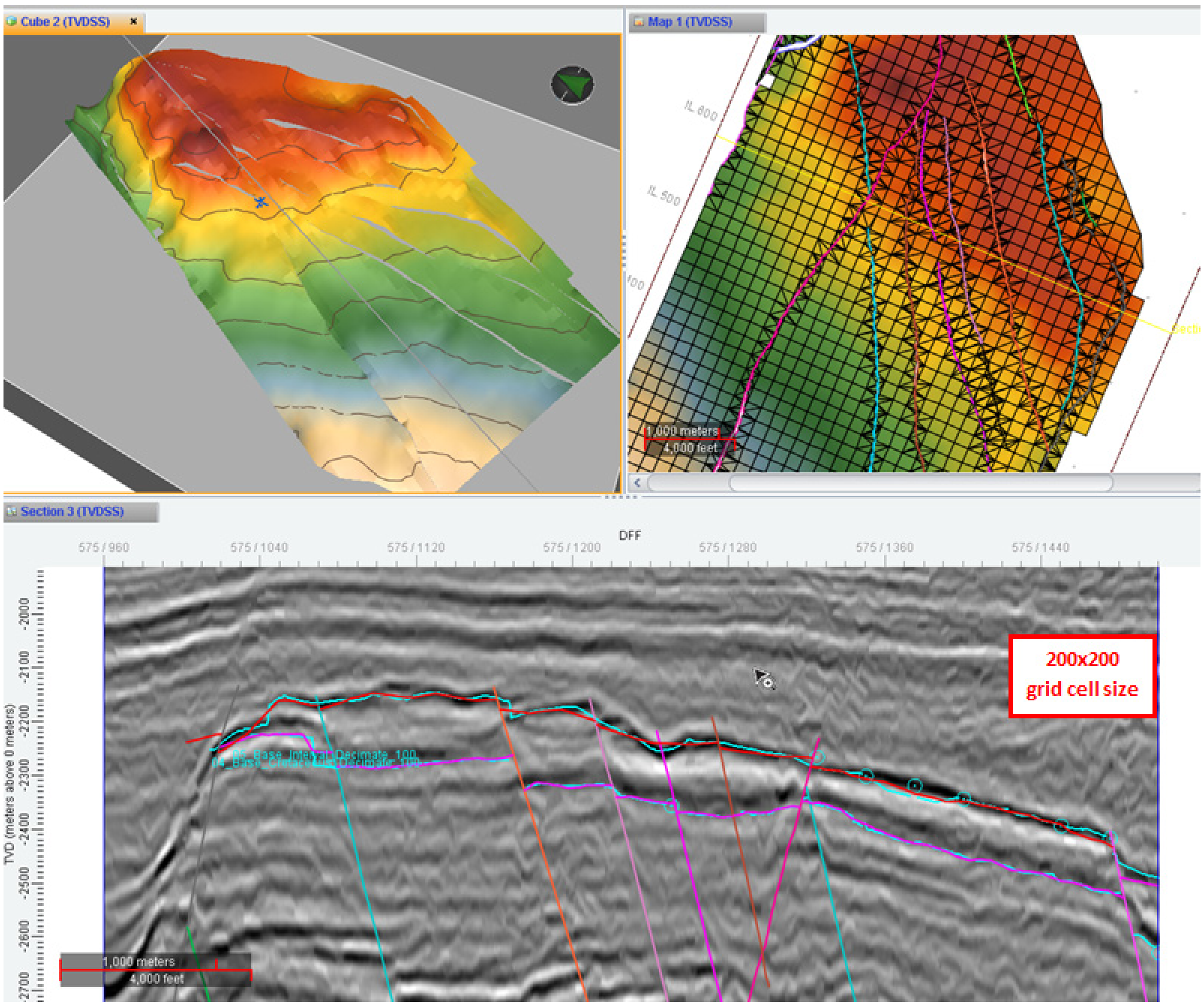
These changes can be observed in your *Map*, *Section*, and *Cube* views.

26. In *Section* view, show both original seismic **HORIZONS** and the **FW SURFACES**. Zoom in on the **04_Base Cretaceous** horizon. Change the color of the original horizons to a lighter color, so they can be easily seen (**MB3** on the source horizons in your *Inventory* task pane, and select **Display Properties**). In the picture below, the original horizons were changed to light blue.



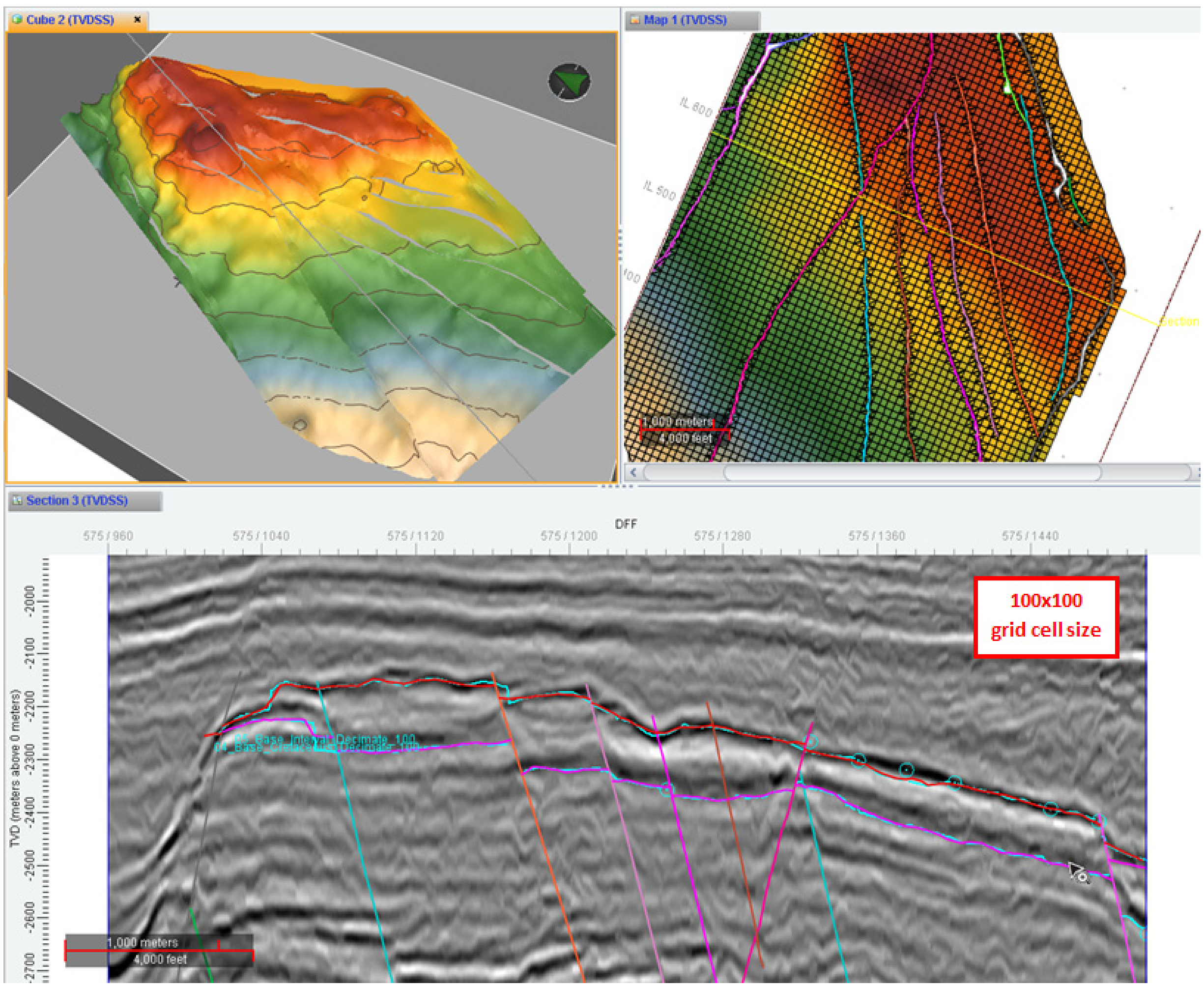


27. In *Cube* view hide all the **FW FAULTS** and the framework surface **05_Base_Interval**, display only the framework surface **04_Base_Cretaceous**. M*ap* view should still display the **04_Base_Cretaceous** framework surface. In both views, look specifically at the smoothness of the Base Cretaceous horizon, at the shape of the horizon in the small fault blocks, and the consistency of the throw on the fault. In *Section* view look at the differences between the seismic horizon **04_Base_Cretaceous** and the equivalent framework surface.



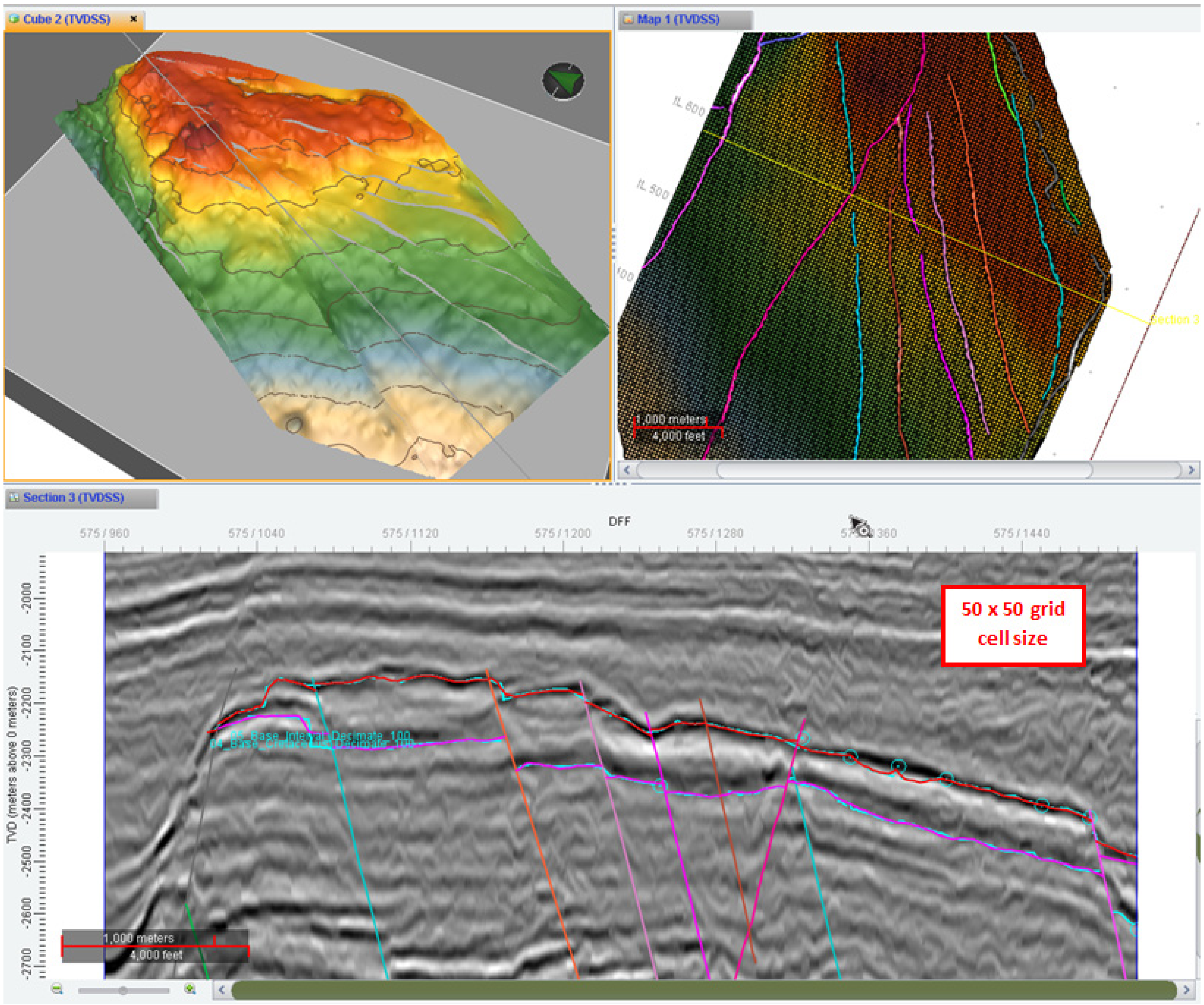
28. Go back to the *Dynamic Frameworks to Fill Workspace* window, enter “**100**” in the X Cell Size (m) and Y Cell Size (m) boxes. Press <**Enter**>.

    The framework refresh will take more time than the previous calculations, because four times as many grids are defined. Observe the changes in all views. What differences can you see between the previous grid and the 100 by 100 m grid?



29. Repeat the previous step, except enter “**50**” m spacing.

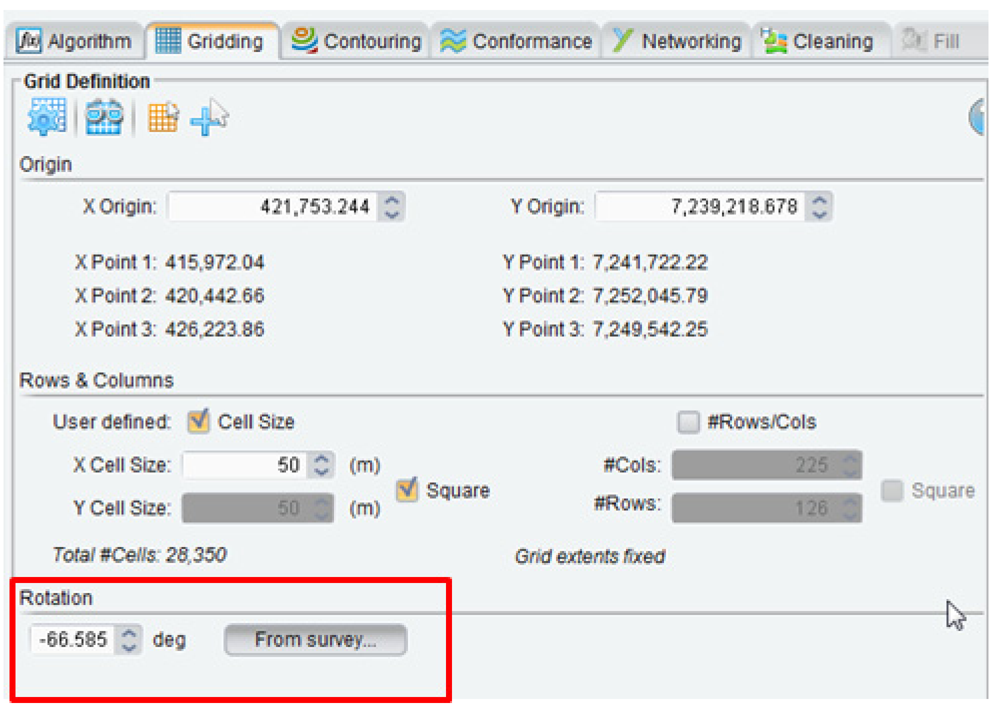
Even more time will be required to grid all surfaces and faults, because of the increased number of calculations. Observe the changes from the previous two grid sizes.



The 200 by 200 m grid is too smooth. For example, it does not show the original dip on the small fault blocks. The 100 by 100 m grid is better, but it does not accurately represent the initial interpretation. The 50 by 50 m grid may be best. It follows the grid resolution rule that the cell size should be 1/5th the size of the smallest feature that you want to resolve. Also notice that the framework surfaces follow closely the original horizon interpretation. However, the 50 by 50 m grid computes slowly and it can honor noisy interpretations. In practice, the smaller grid size might be preferred. One-fifth of the 300 m that you measured earlier would suggest a 50 by 50, or perhaps a 60 by 60 m grid.

However, in the following exercises you will work with 100 by 100 m grids primarily to reduce computation time.

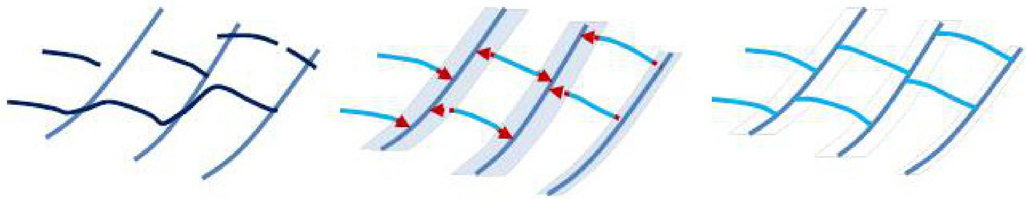
Additionally, it is important to mention that framework grids can be rotated. The Rotation From survey option aligns grid cells with geologic trends in the data. For example, a grid that has the same orientation as the fault blocks should have better resolution of these features. Fewer grids will straddle the fault and record an average depth of the up- and down-thrown sides of the fault. The **Rotation** feature is located at the bottom of the *Gridding* action tab.



30. In the *Dynamic Frameworks to Fill Workspace* window, under the *Gridding* action tab of the *Surfaces* tab, change the grid cell size back to “100” for the **04_Base_Cretaceous** framework surface.

Cleaning Horizon Distance

Cleaning distance controls the amount of horizon data on the two sides of a fault. The data is suppressed from being used in the gridding operation. In the cleaned areas, the surfaces are re-projected to the faults, resulting in a modified fault offset.



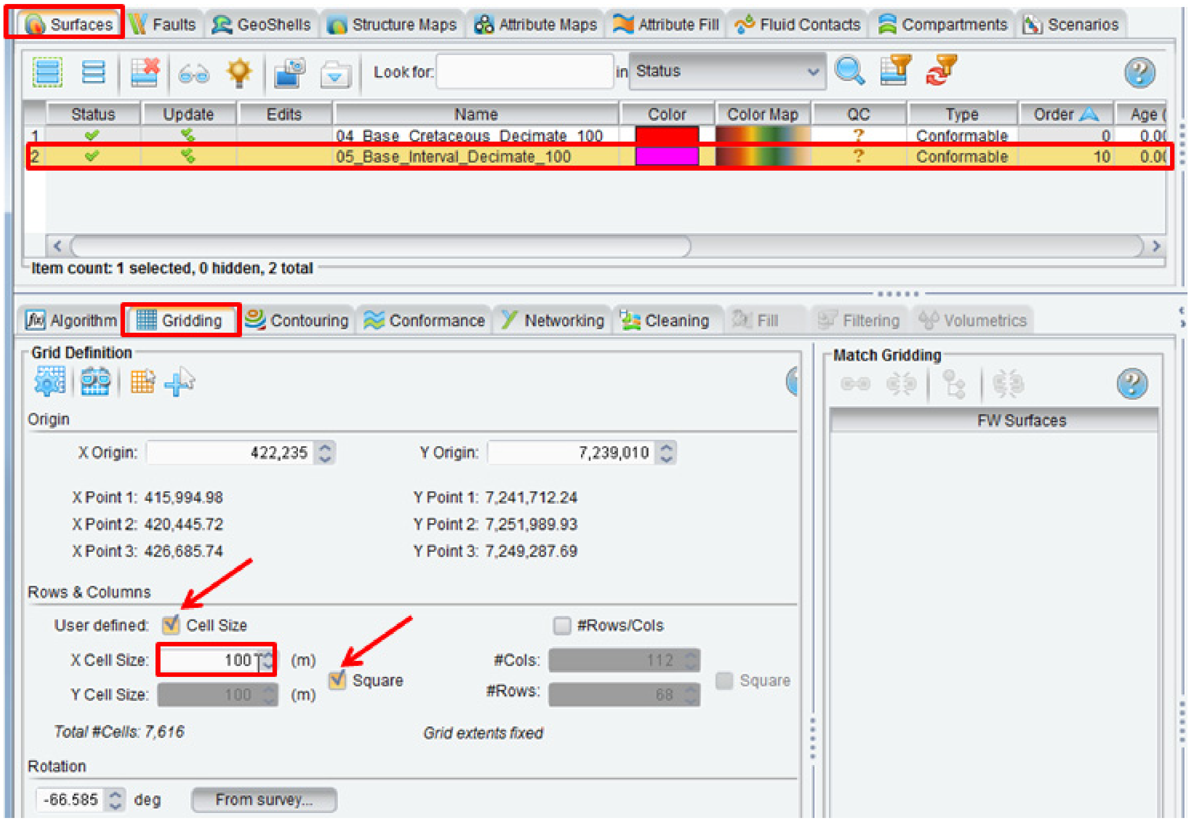
The default value for cleaning distance is 0.33 (1/3) times the grid cell diagonal length. For a 100 m by 100 m grid size, the cell diagonal length is 141.4 m. The default cleaning distance in this case is about 47 m, or 0.33 times 141.4 m. The global cleaning distance works well for most areas, except the narrow fault blocks.

As you increase cleaning distance, you remove more data from the gridding process requiring a longer projection distance. However, if you make the cleaning distance too small, you increase the chances of including poor or incorrect horizon interpretation in the vicinity of the faults. For more information on this, refer to the “Chapter 1: Best Practices for Dynamics Frameworks to Fill Framework Construction” in *DecisionSpace Geosciences: Software Best Practices*.

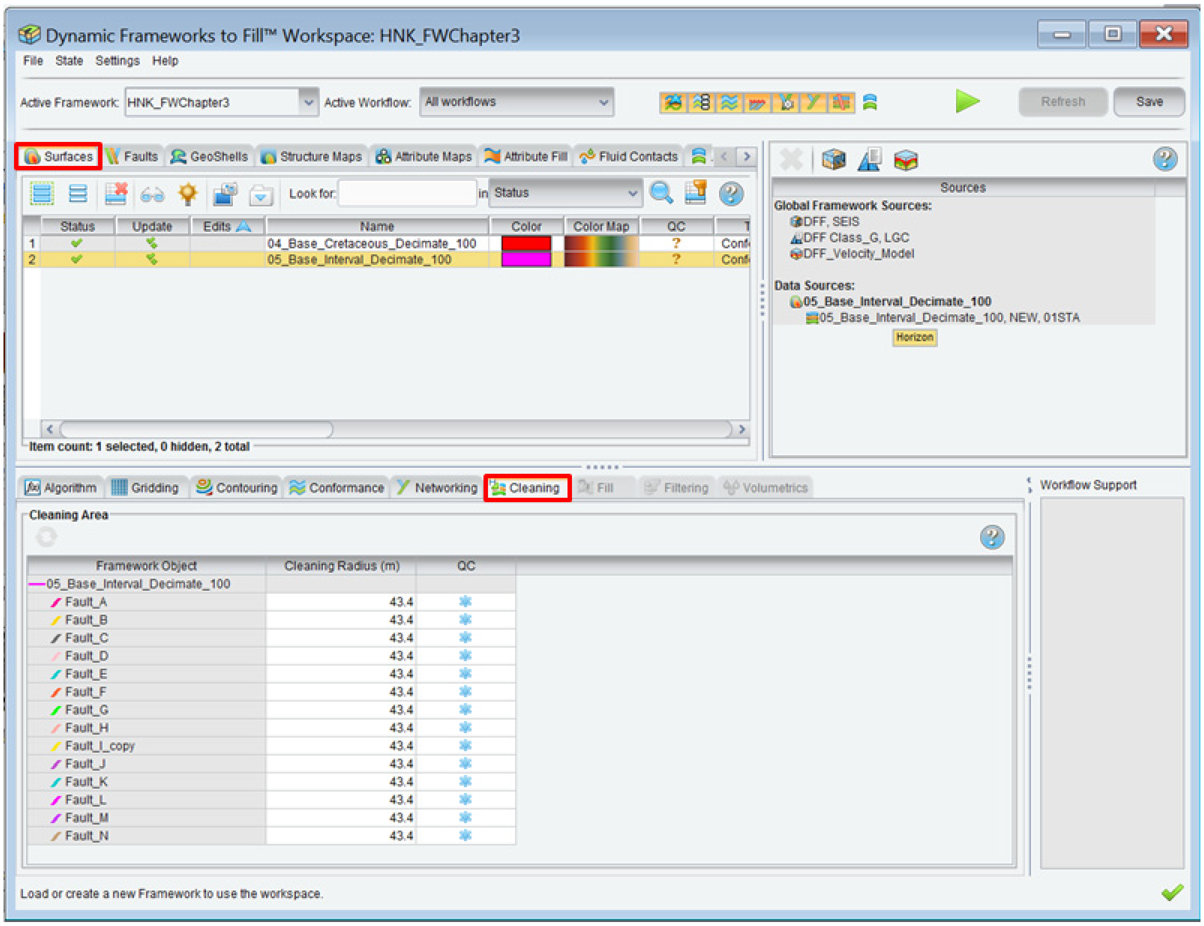
You can individually adjust the cleaning distance for specific faults, to overcome the problem of narrow blocks. In narrow fault blocks, the cleaning area can become larger than the fault block. This results in little or no resolution of the structure.

You can test this proposition by increasing the cleaning area of an individual fault within the fault block and then observe how the framework horizon and the source horizon react. In this section, you will adjust the cleaning area of an individual fault to improve the fault offset and achieve optimum resolution.

31. In the *Dynamic Frameworks to Fill Workspace* window *Surfaces* tab, highlight the framework surface **05_Base_Interval**. In the *Gridding* action tab, check the **Square** box and then change the grid cell size to “100”.



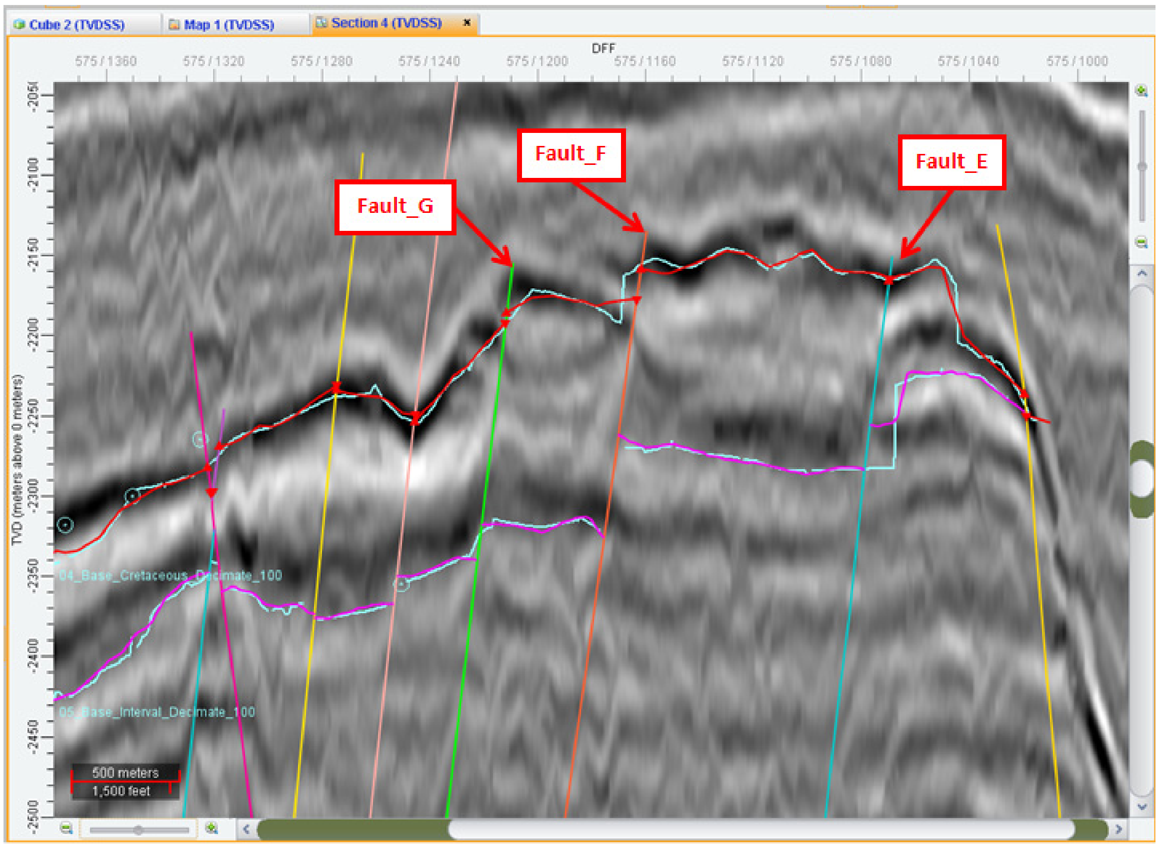
32. Select the *Cleaning* action tab within the *Surfaces* tab.



Note

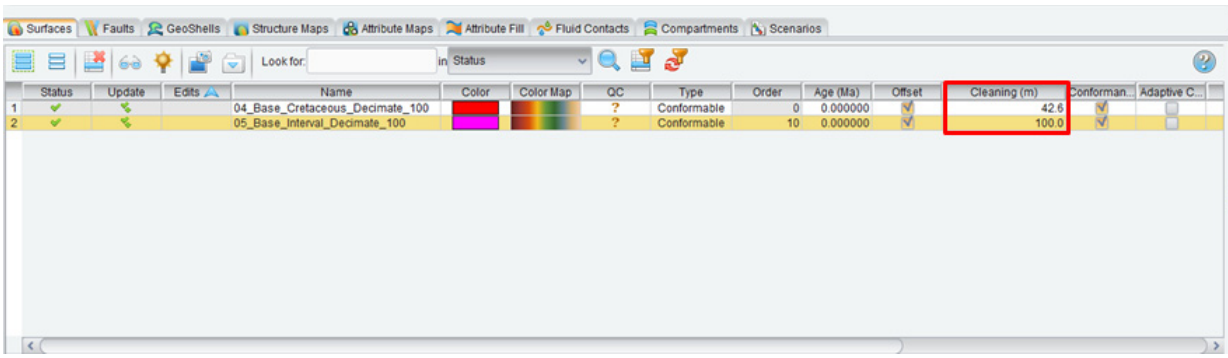
The default cleaning value is set to 43.4 which is approximately 1/3 of the diagonal of a 100 x 100 cell.

33. Activate the *Section* view. If you are not displaying inline 575, move to that section. Show the **04_Base_Cretaceous** and **05_Base_ Interval** horizons and surfaces. The colors of the horizons and framework surfaces should be easy to distinguish. If necessary, change their colors. If your *Section* view is not oriented like the picture below, you can press the hot key <**V**> in *Section* view to modify the orientation if desired.

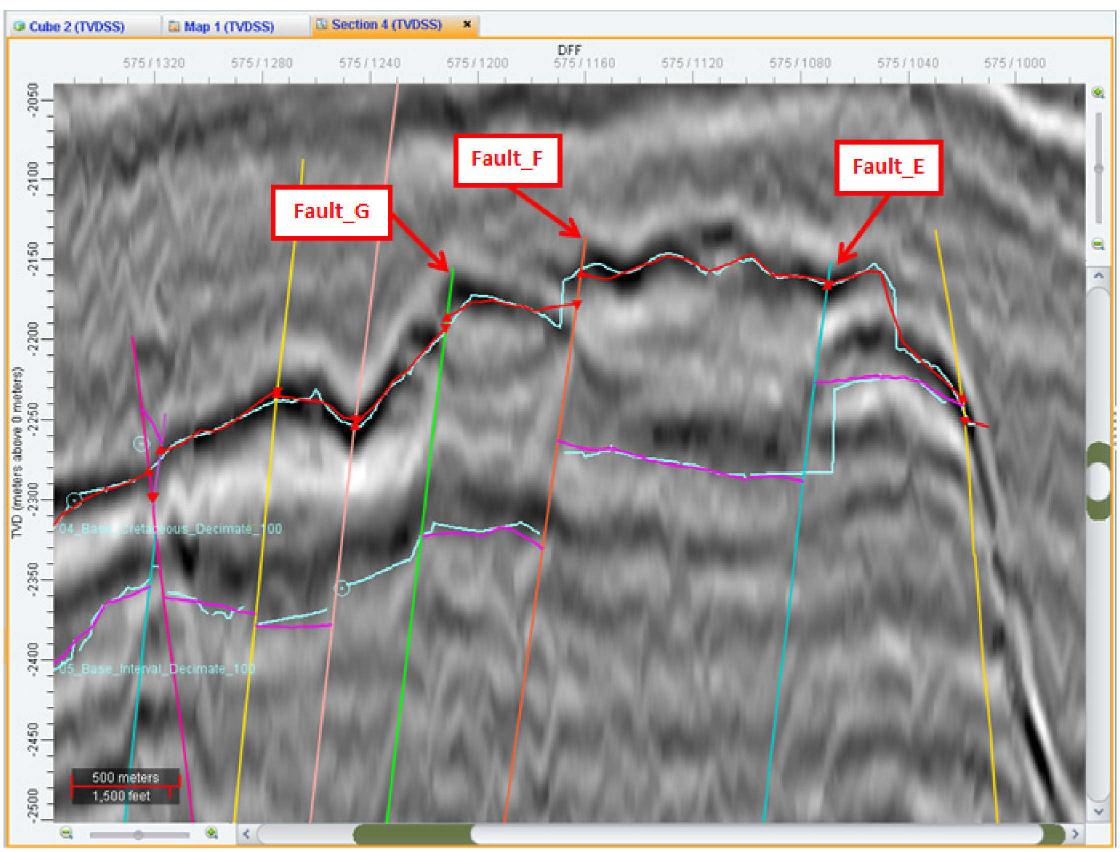


Notice how the **05_Base_ Interval** horizon crosses **Fault_E** (interpretation error), though the framework surface is offset correctly. In the next few steps, you will change the cleaning distance to understand how framework surfaces respond to modifying that parameter.

34. In the *Dynamic Frameworks to Fill Workspace* window, in the *Surfaces* tab, change the cleaning distance of the **05_Base_Interval** to “100”. Press <**Enter**>.



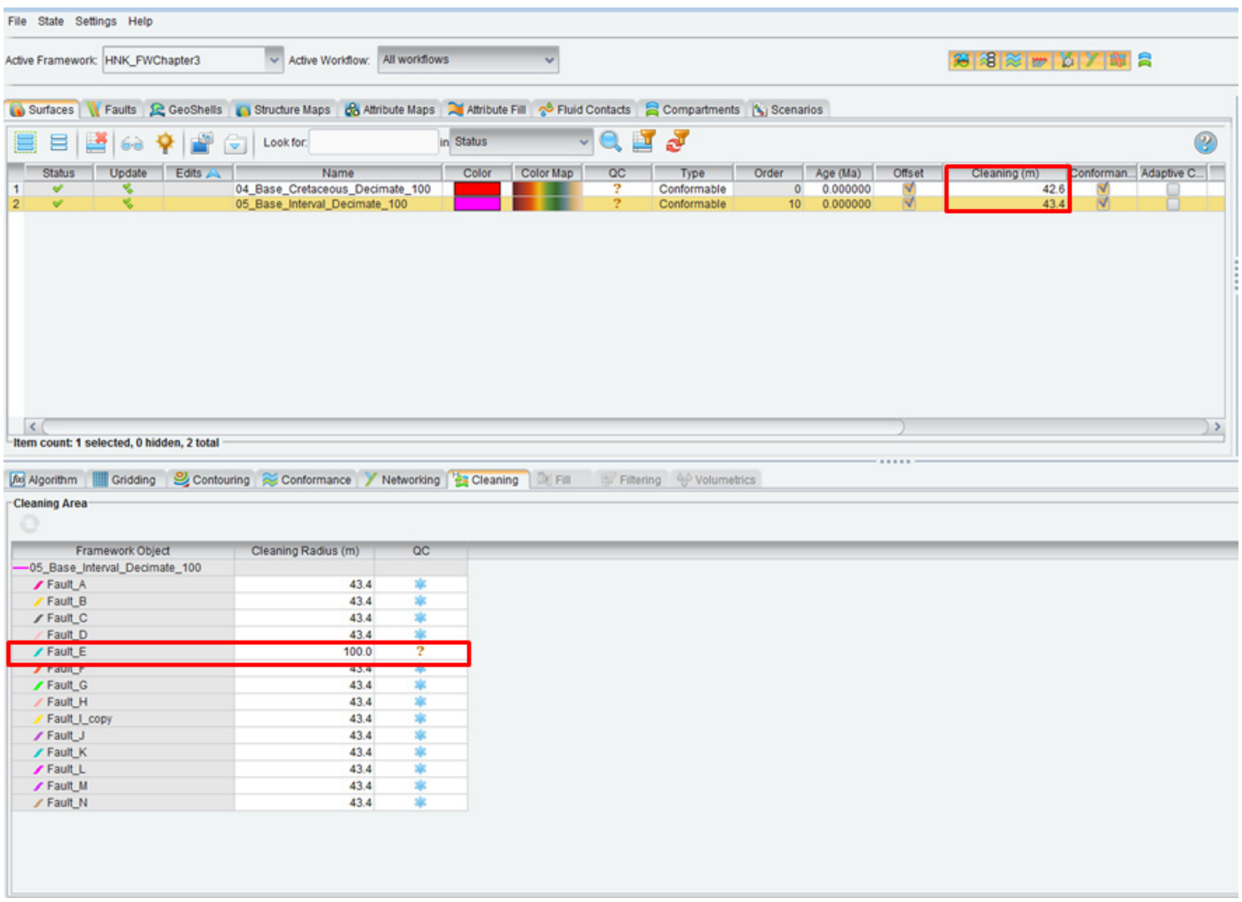
This makes the global cleaning distance 100 m. Relative to a 43 m cleaning distance (previous section image), the **05_Base_ Interval** surface offset improves for **Fault_E**, but declines the quality of the offset around the other faults. The reduced cleaning distance is more appropriate for the smaller fault blocks, where honoring the original horizon data is important. The larger cleaning distance is better at **Fault E** and may be suitable for larger fault blocks in general.



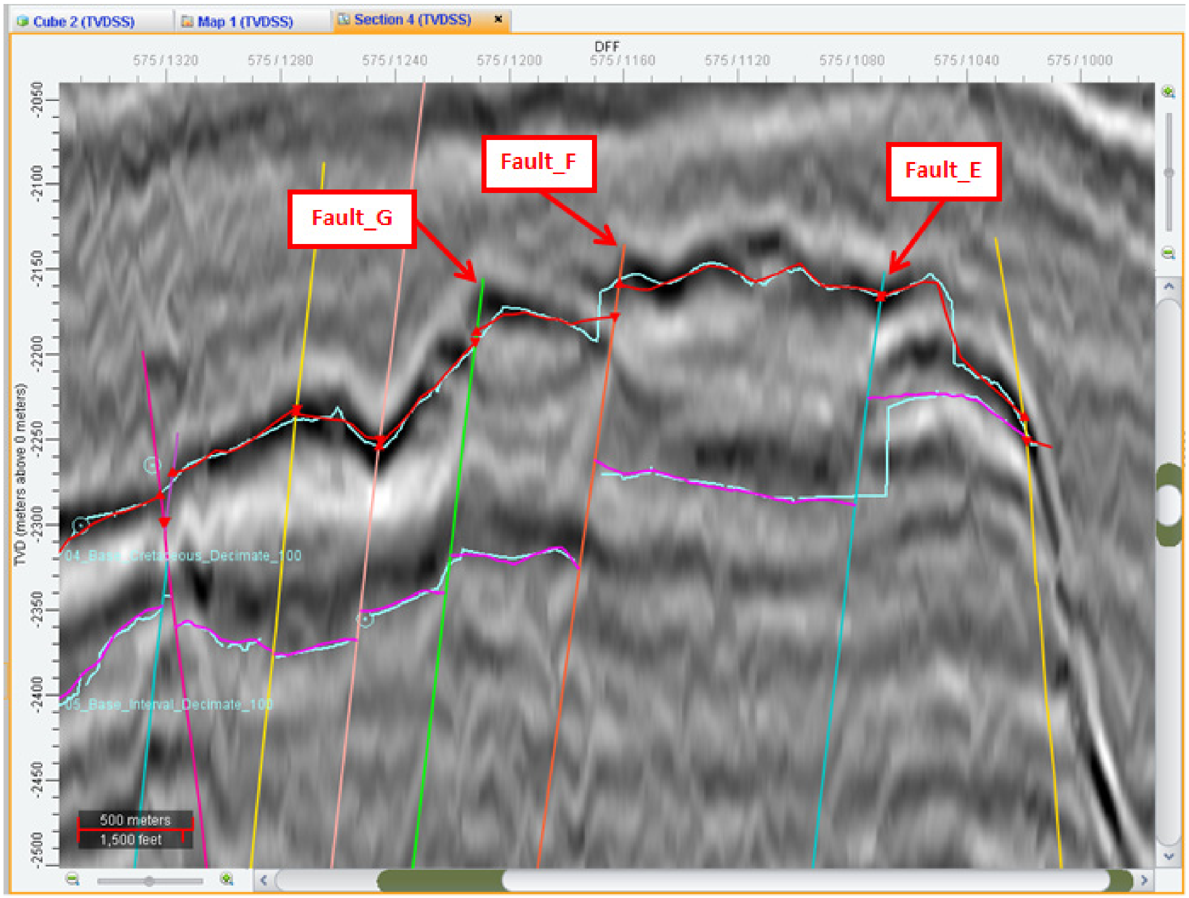
You have narrow fault blocks that are quite sensitive to cleaning distance and a situation where the horizon was picked incorrectly on one side of a fault. You can use a combination of cleaning distance tuning and map based editing, as you will see. First, however, you can apply specific cleaning distances to individual surfaces and faults.

35. Change the global cleaning distance for **05_Base_Interval** back to “43.4”.

36. You will now change the cleaning distance for only one fault. In the *Cleaning* action tab of the *Surfaces* tab, change the *Cleaning Radius (m)* for **Fault_E** to “100”. Press <**Enter**> to proceed with the changes.



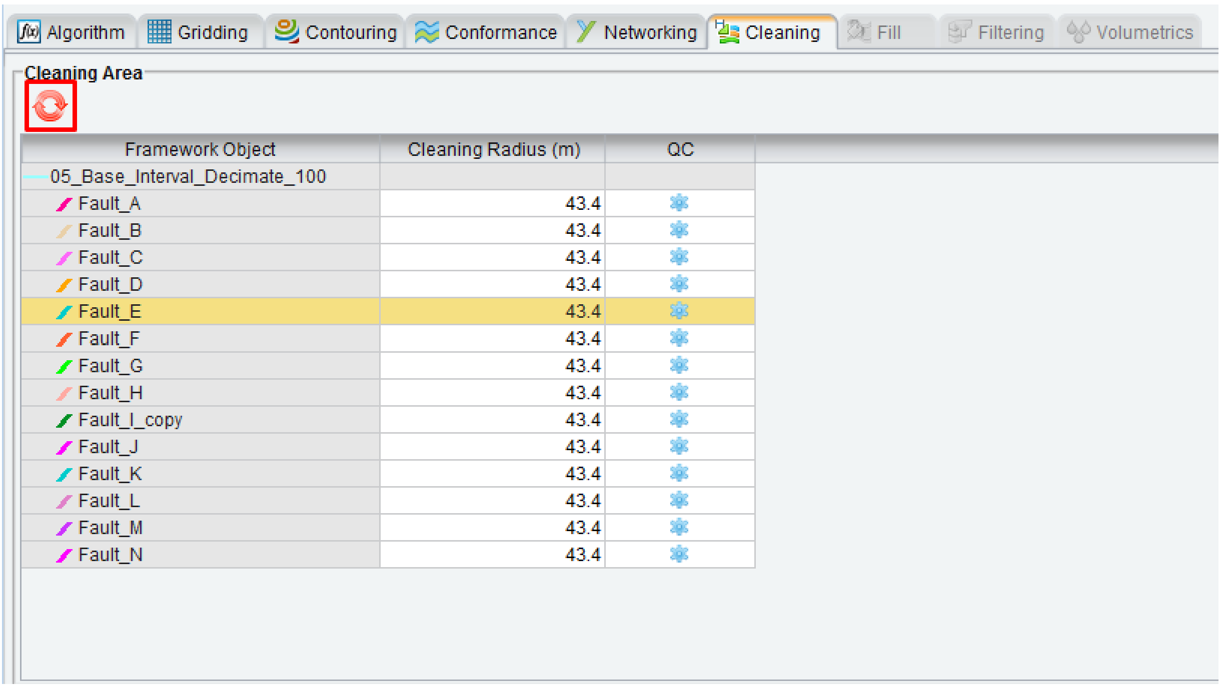
The framework surface in *Section* view shows the results of a 100 m cleaning distance applied to the **05_Base_Interval** horizon at **Fault_E** and a 43.4 m cleaning distance at all other faults. The offset for the **05_Base framework** surface is fixed at **Fault_E**.



For certain problem areas, you can work with cleaning area in *Map* view. You can achieve a similarly effective correction at **Fault_E** using a different method, as you will see in the next steps.

To do this, you will reset the cleaning distance back to 43 m.

37. Highlight **Fault_E** in the *Cleaning* action tab and click the **Reset cleaning radius to default** ( ) icon. This will change the cleaning area of **Fault_E** to be the same as the other faults.

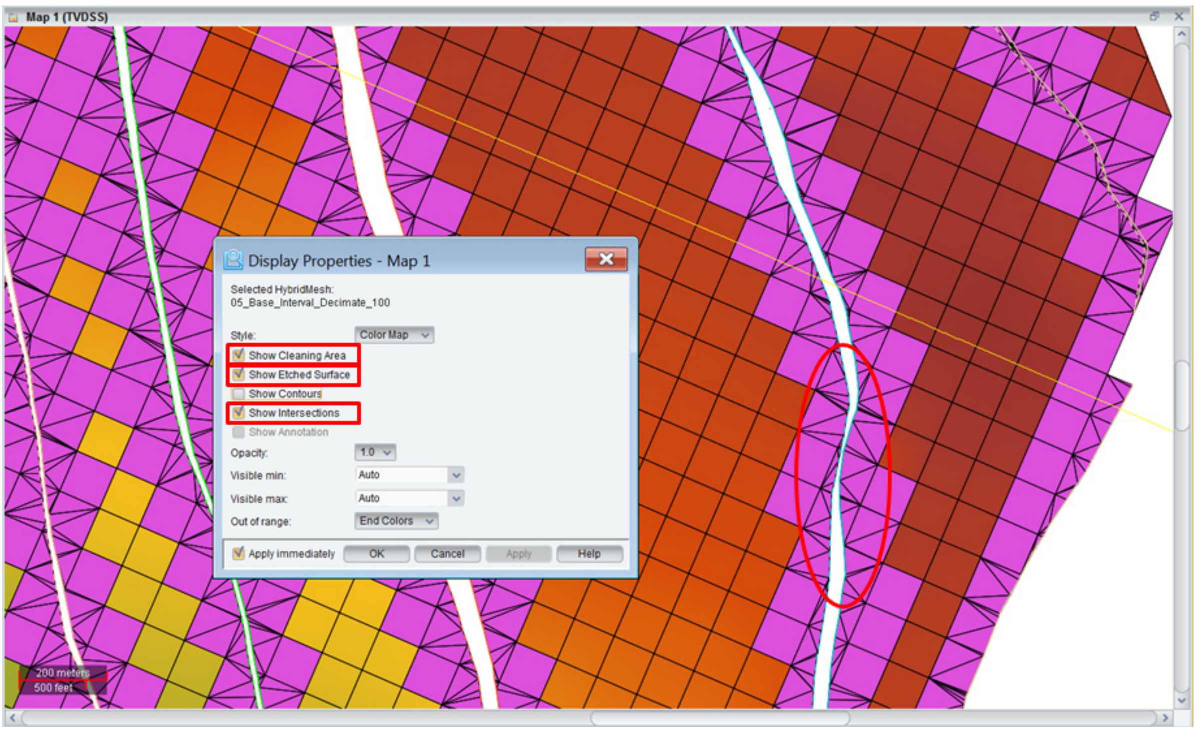


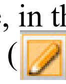
Source Data Suppression Editing

In some cases you may notice specific problem areas with one of the features in your framework. You will see in the next example that there is a small problem with the fault polygon in one area. Changing the cleaning distance for the entire fault would cause you to potentially remove useful data for the other parts of the fault. You can solve this situation graphically by creating a polygon around the problem area. You can then include it as a source to the framework surface that the fault is interacting with. You will do this in the following steps.

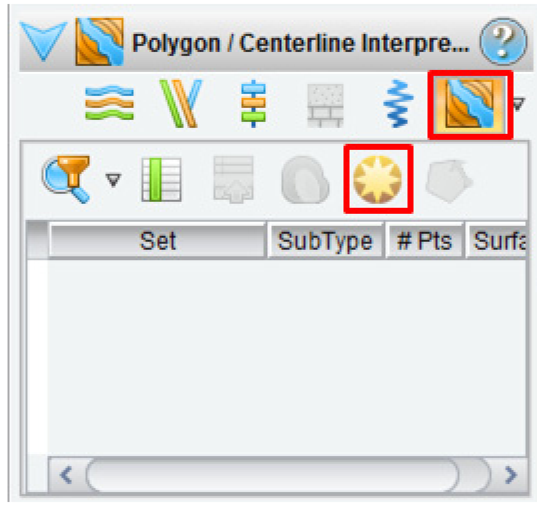
38. In *Map* view display now the **05_Base_Interval** framework surface. **MB3** on the surface and select **Display Properties**. Turn on **Show Cleaning Area**, **Show Etched Surface**, and **Show Intersections**.

39. Locate **Fault_E** in your map (it is the eastern most Fault intersecting **inline 575**). Zoom in into the area showing the intersection of **Fault_E** polygon with **inline 575**. Notice that a little bit at the south of that intersection, the polygon is thinner than in the other areas. In the previous exercise, when you modified the cleaning distance to 100 m for **Fault_E**, you saw the changes in *Section* view. These changes will also make the fault polygon to be corrected at that point. However, in the following steps you will fix the fault polygon by drawing a polygon to suppress interpretation data in the vicinity of the fault.

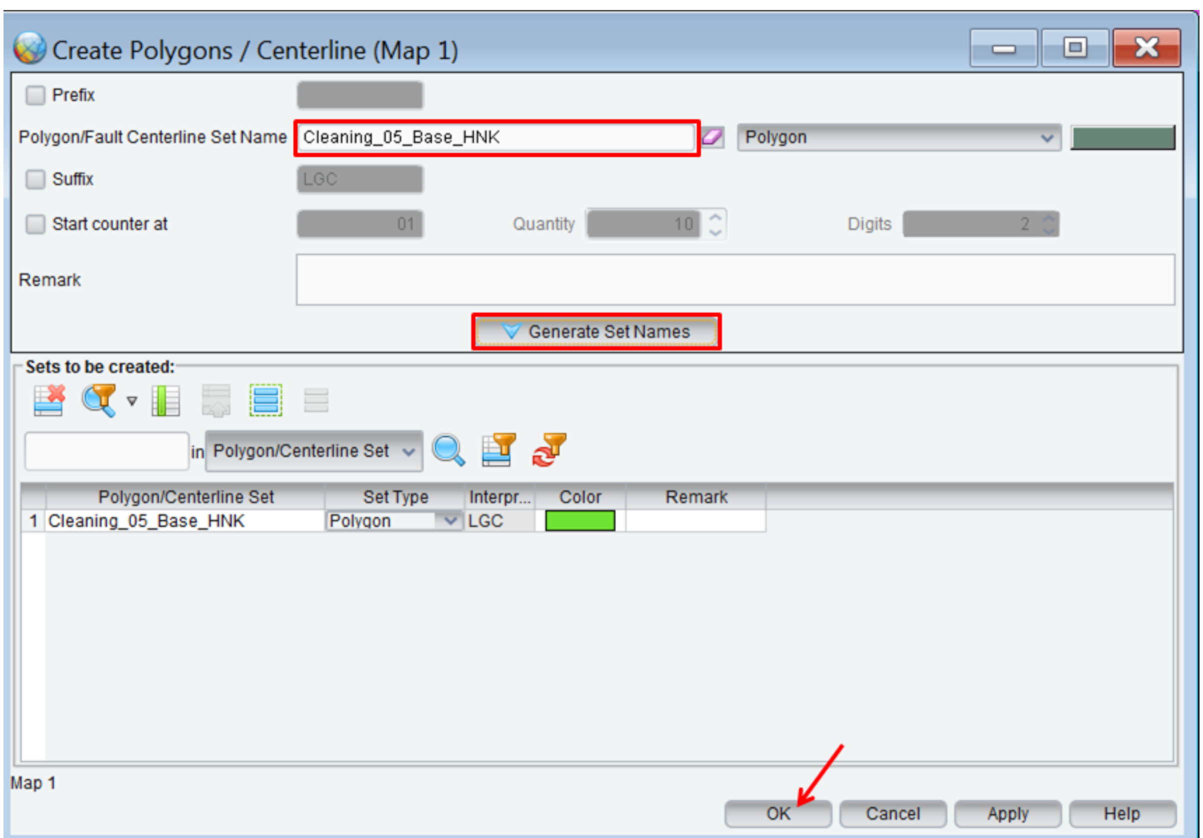


40. With *Map* view active, in the main tool bar activate the **Interpretation Mode** () icon, and select **Polygon/Centerline** from the drop-down menu, or from the *Interpretation* task pane select the option for **Polygon/Centerline** ().

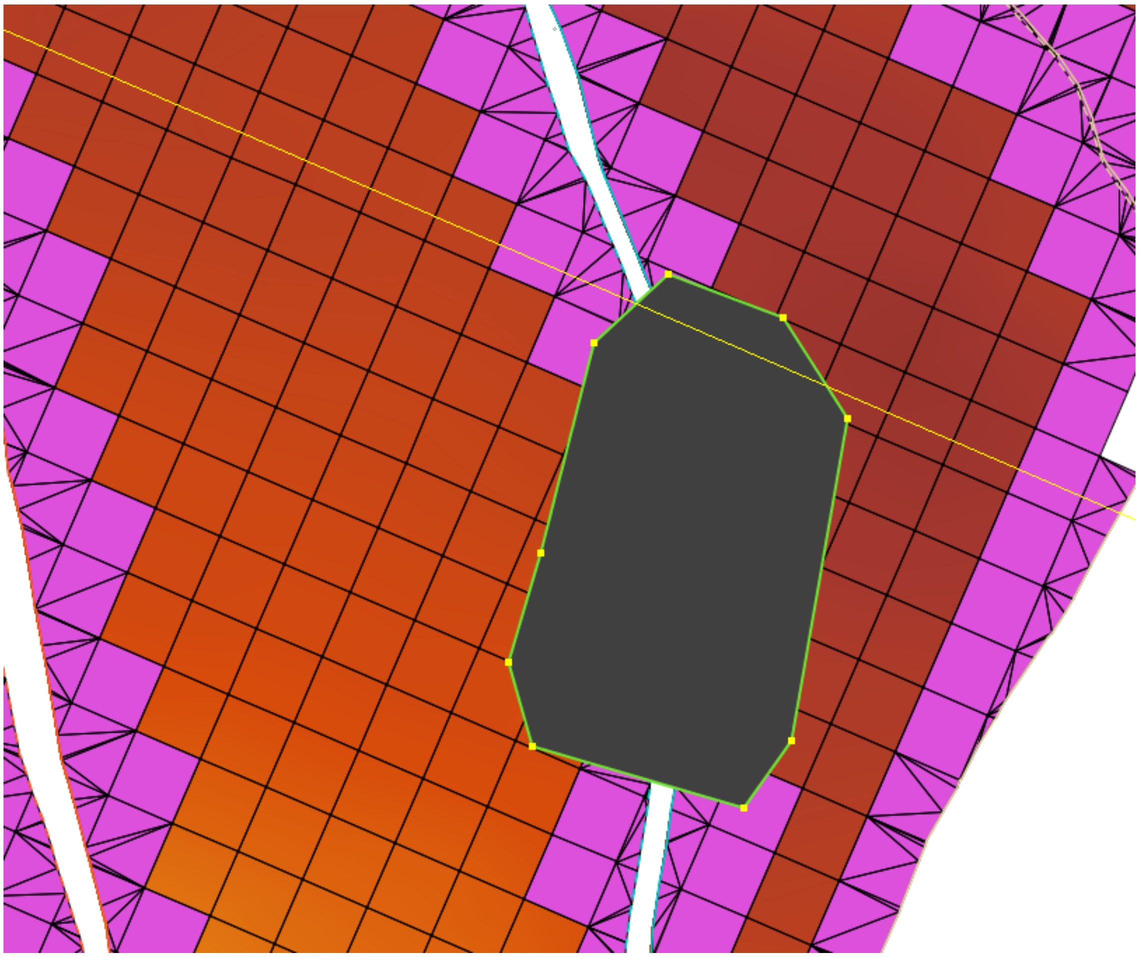
41. Click the **Launch Create Polygon/Centerline dialog** icon to create a new polygon for cleaning.



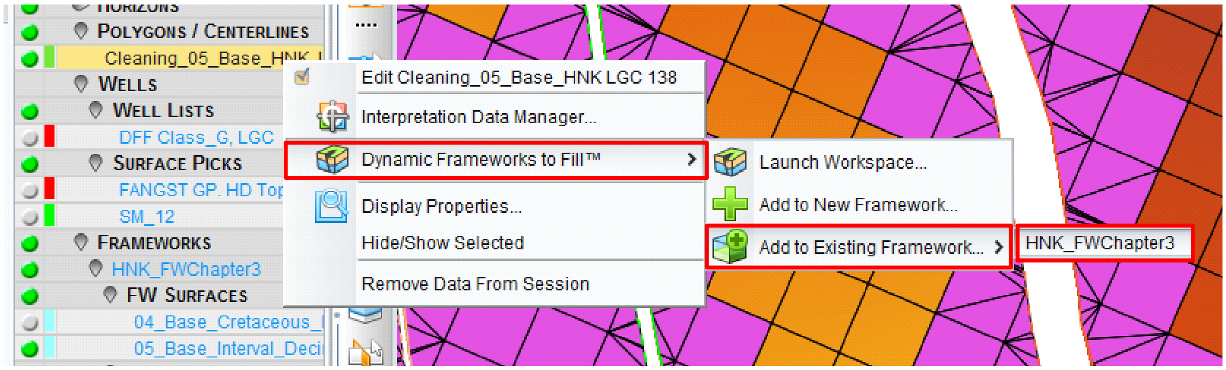
42. In the *Create Polygons/ Centerline* dialog box, name your polygon "Cleaning_05_Base_YOU", and click the **Generate Set Names** button. Click **OK** to close the *Create Polygons / Centerline* dialog box.



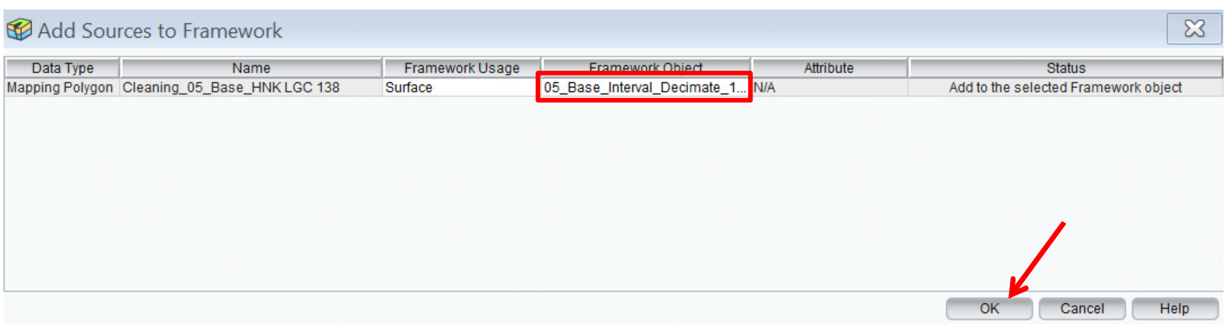
43. In *Map* view create a polygon around **Fault_E** encompassing the area right below **inline 575**. **MB1** to add nodes and **MB2** to close the polygon. Your polygon should be similar to the picture below.



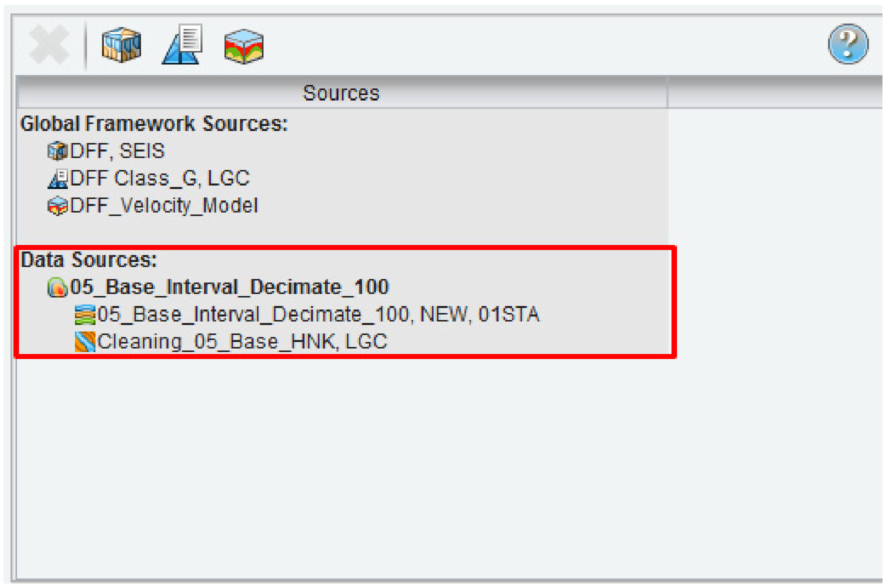
44. In the *Inventory* task pane, a new category appears: **POLYGONS / CENTERLINES**. Under that category, **MB3** on the polygon you just created, **Cleaning_05_Base_YOU**, and select **Dynamic Frameworks to Fill > Add to Existing Frameworks > YOU_FWChapter3**.



45. The *Add Sources to Framework* dialog box displays. Under the *Framework Object* category select the option to add it to the **05_Base_Interval**. This will add the **Cleaning_05_Base_YOU** as a source for the existing framework surface.

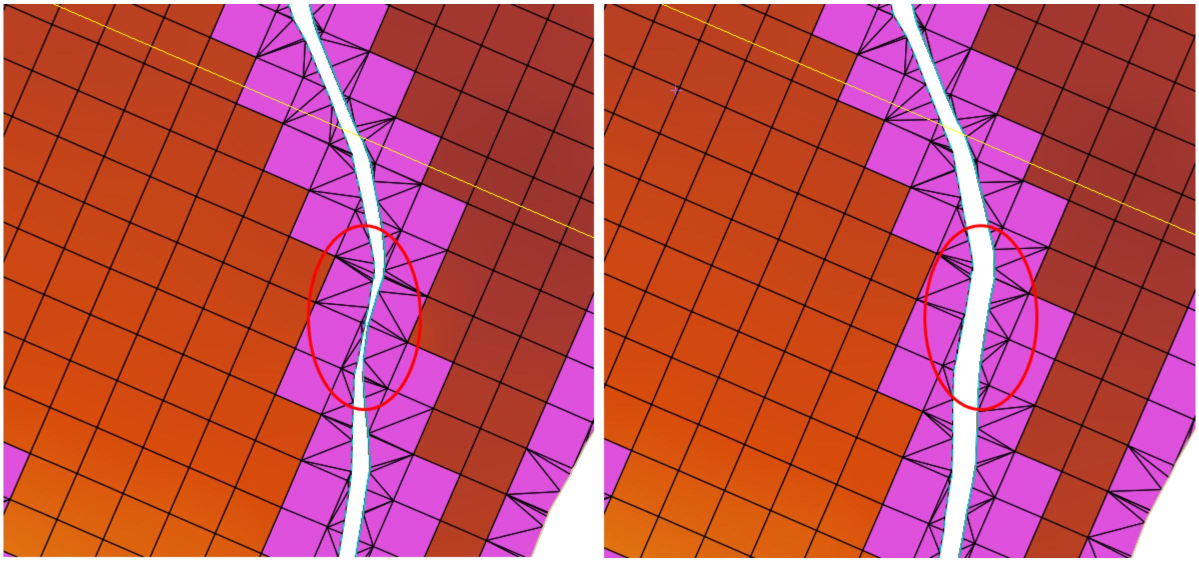


46. Take a look at the *Dynamic Framework to Fill Workspace* and notice that in **Data Sources** for **05_Base_Interval** framework surface there are now two sources listed: The horizon **05_Base_Interval** and the **Cleaning_05_Base_YOU** polygon.



47. Your framework should update automatically if you are still in **Dynamic, Auto Refresh** mode. If necessary, **Refresh** your framework manually. Remove the polygon from *Map* view and observe the changes in the fault polygon. Because the software is no longer considering the information, within the polygon, when calculating **05_Base_Interval**, the fault polygon was improved.

Below is before and after the cleaning polygon has been taken into consideration.



Note

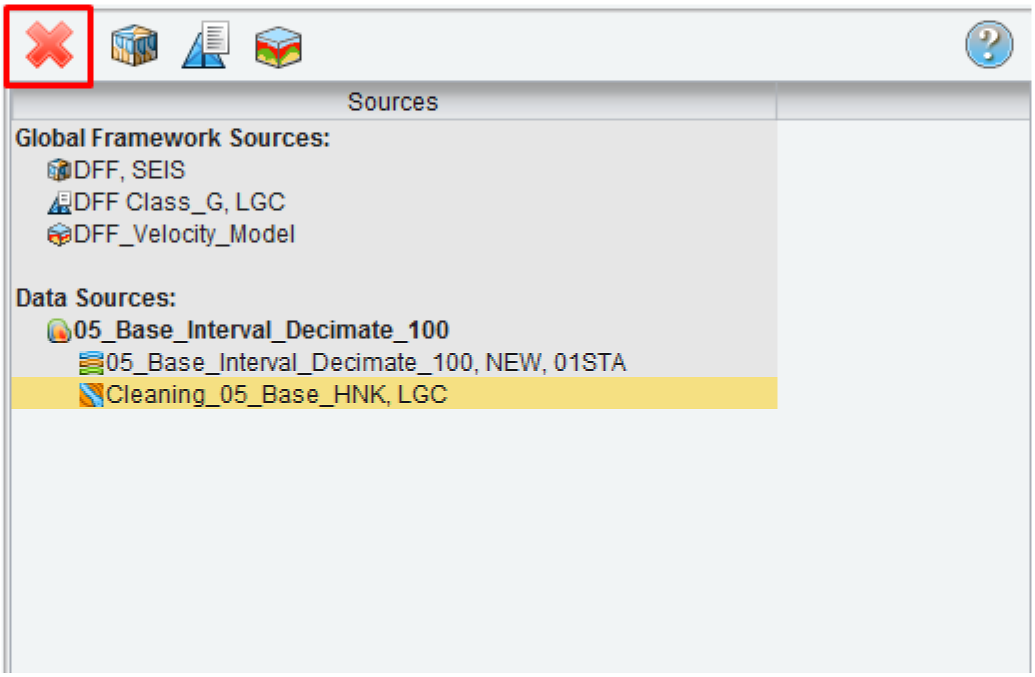
This method is not exclusively meant for cleaning, and can also be used for attribute maps, and structure maps to eliminate bull's-eyes.

Manually Editing Intersections

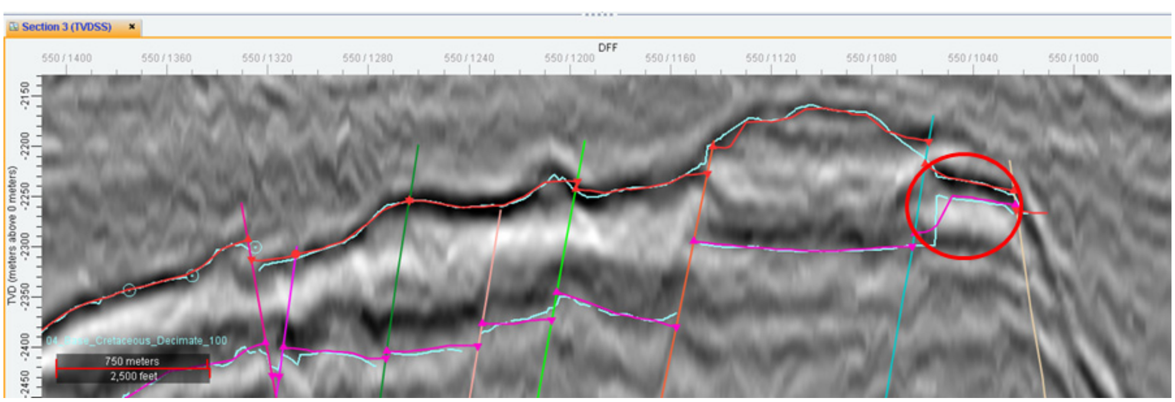
Manually editing a fault-surface intersection is another useful technique. This is best done in *Map* view, by editing nodes in the fault/surface intersection, or by drawing a new intersection line. This changes the geometry of the fault polygon and applies a different fault offset to the affected area.

48. To speed up the intersection editing, this methodology works only in **Dynamic, Manual** mode. Change your framework state to **Dynamic, Manual** () mode.

49. To practice manually editing the intersections, you need to remove the polygon you created as a source from **05_Base_Interval**. Within the *Dynamic Frameworks to Fill Workspace* window remove the polygon **Cleaning_05_Base_YOU**. In the *Sources* section, highlight **Cleaning_05_Base_YOU** and then click **Delete Selected source (s)** ( ) icon. Refresh your framework, since it is now **Dynamic, Manual**.



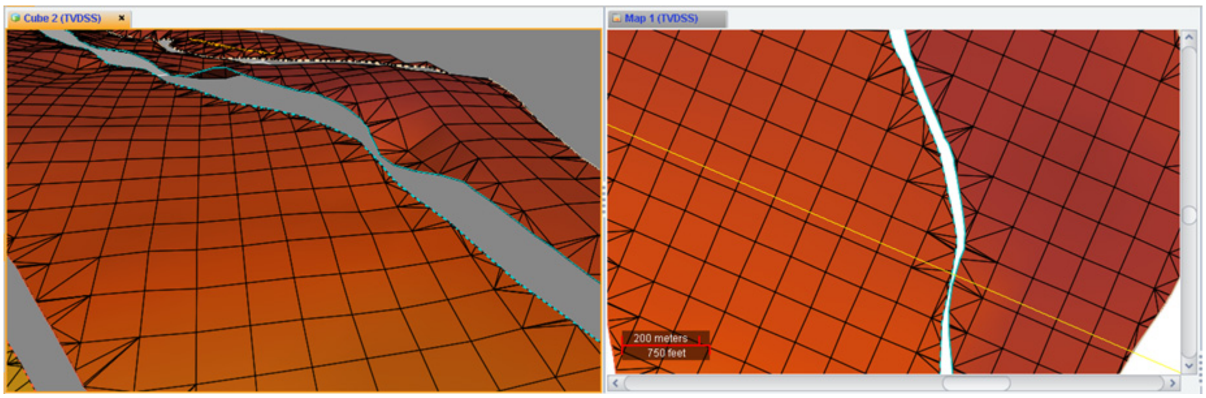
50. In *Section* view, move to inline **550** and note the interpreted structure near **Fault_E**.



As you saw on line 575, interpretation errors in the input horizons are carried forward into the gridded framework surface. Recommended best practice at this point is to correct the horizon interpretation prior to building the framework. That path forms an exercise a little later.

For now, you will use this example to learn intersection editing found on the *Dynamic Frameworks to Fill* task pane.

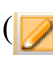
51. In *Map* and *Cube* views, **zoom** into the area around **Fault_E**. In both views, show framework surface **05_Base_Interval**. Turn on **Intersections** and **Etched surfaces** in *Cube* view in the same way you did for *Map* view. (**MB3** and select **Display properties**.)

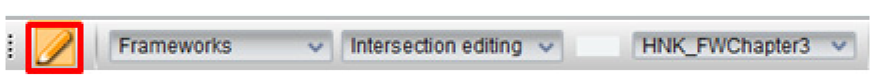


You will use the intersection editing tool to directly modify the surface-fault intersection and create a normal-fault displacement in the vicinity of lines 550 and 575 that is more consistent with the displacement along the strike of the fault.

You can work with the cleaning cells on or off. Similarly, the underlying horizon display is your choice.

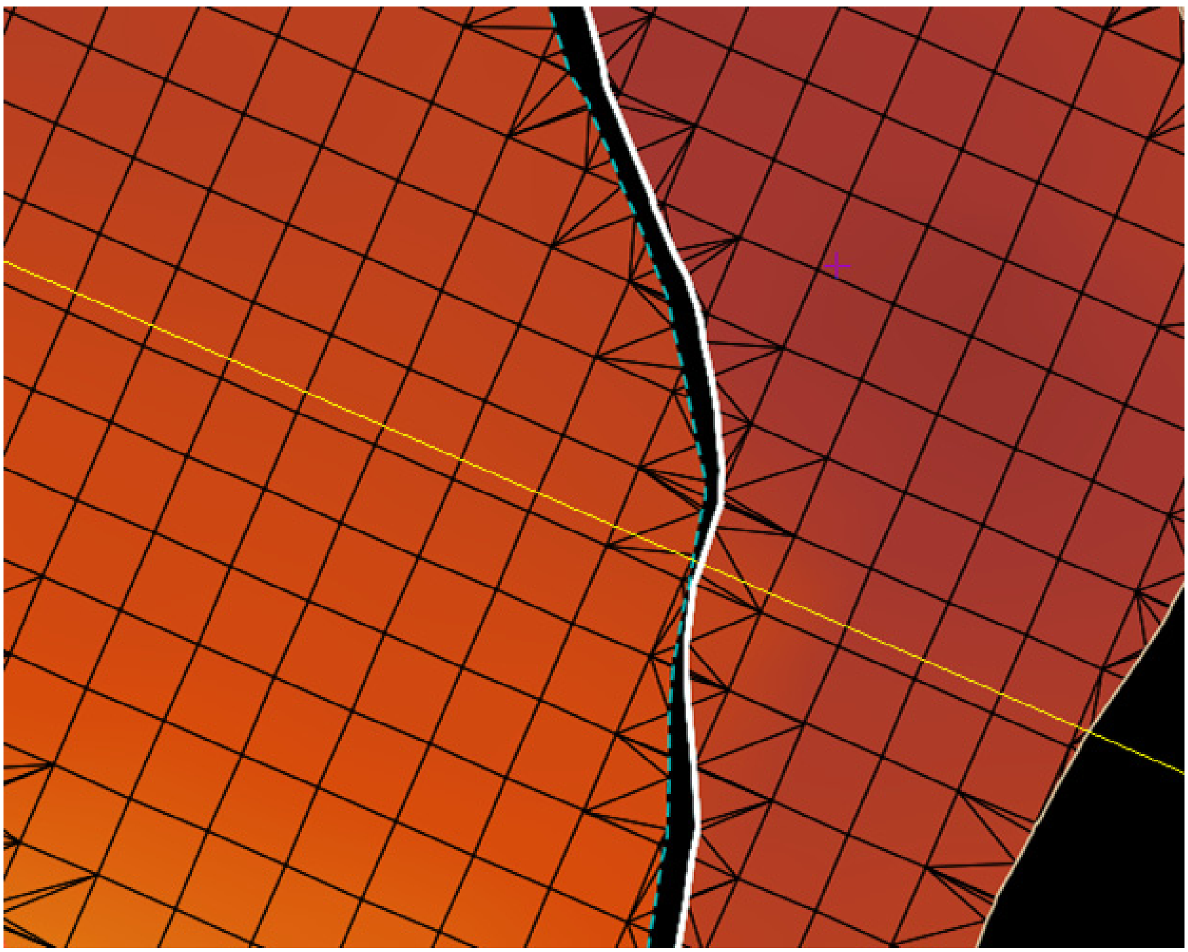
52. Ensure *Map* view is active. In the *Inventory* task pane, under **FW SURFACES** on the **05_Base_Interval** row, **MB3** and then select **Display Properties...**. In the resulting *Display Properties* dialog box, turn off **Show cleaning area**, and then click **OK**.

53. In the main tool bar, activate **Interpretation Mode** (), and make sure that the data type you are interpreting is **Frameworks**. This will give you the option to enter the intersections, which is the only option in Framework Interpretation.

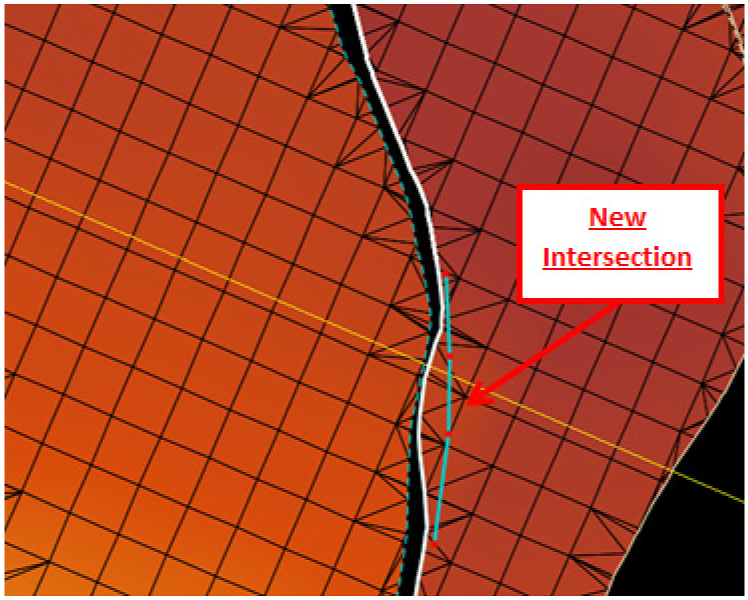


> **Note**
>
> Make sure that your framework is in **Dynamic, Manual** mode ( ). In order to edit intersections your framework must be in either **Dynamic, Manual** or **Static** mode.

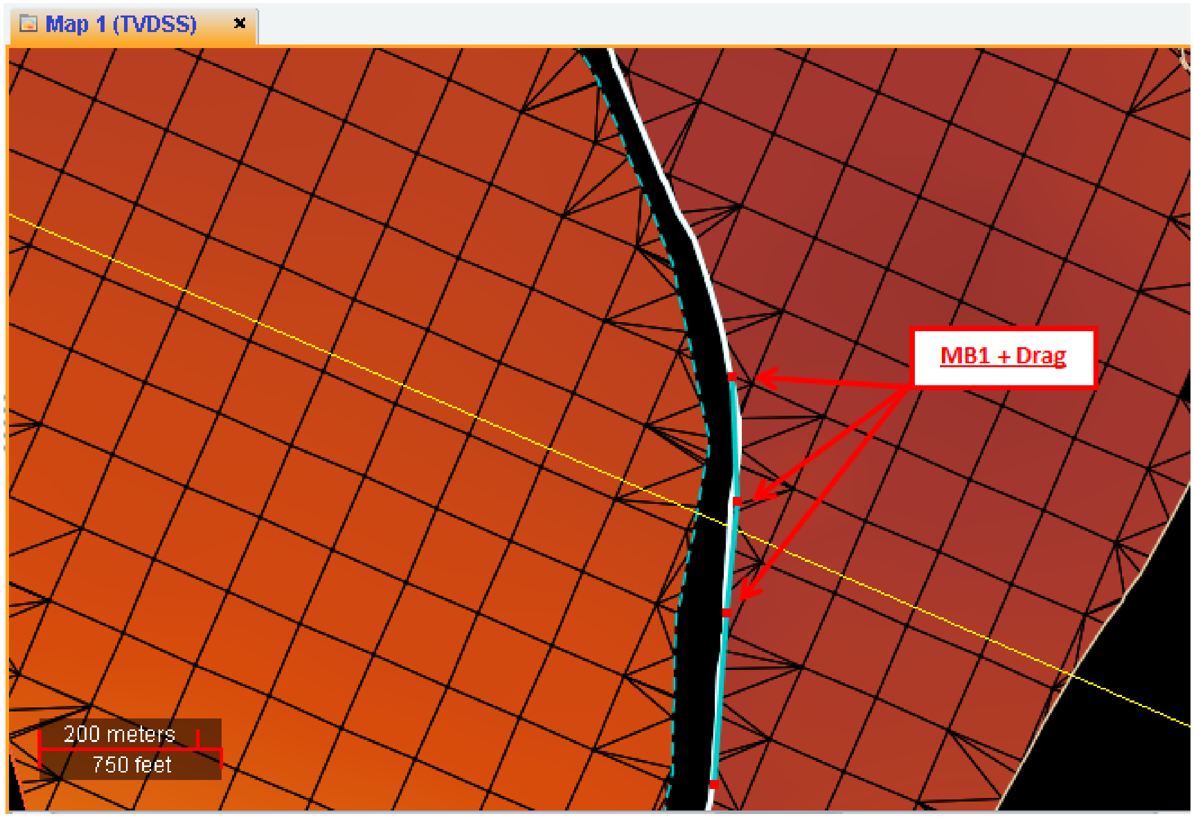
54. Hover your mouse over the right/east side of **Fault_E**, the mouse should change to ( ). **MB1** on the fault to select it for interpretation, the side you selected will highlight.



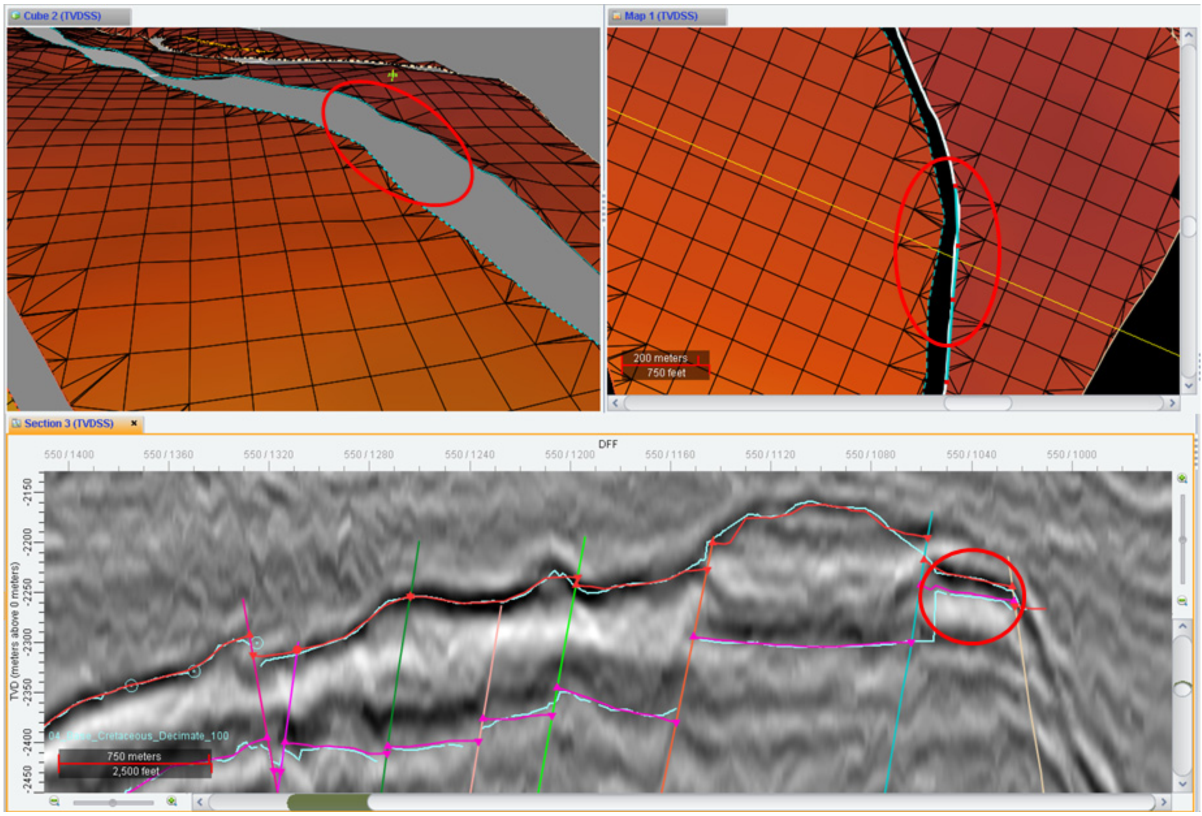
55. Draw a new intersection line by clicking **MB1** in a series where you want to change the intersection. You want to increase the offset. Click **MB2** to terminate the editing action. **Refresh** ( ) the framework.



56. You can also modify the line by moving individual nodes (click **MB1** and drag). **Refresh** ( ) the framework.



Notice the update that occurs in all your *Cube*, *Map*, and *Section* views. They should look similar to the picture below.



You have used several framework editing techniques to adjust the surface **05_Base_Interval** (and its fault intersections) to improve your structural model. You could continue to explore gridding and cleaning parameters and manual intersection editing, but that does not change the data coming into the Dynamic Frameworks to Fill module. If you have an interpretation issue (often detected by framework building efforts), you should return to the interpretation data.

57. Before you move on to the next exercise, undo your corrections to return to a framework surface, so that the surface is based directly on a poor interpretation. Click the Undo ( ) icon in the main tool bar until it is greyed out, and refresh your framework.

You will correct this framework surface by re-interpreting the input horizon.

Editing Original Horizon

Instead of adjusting the framework surfaces, you can edit the original horizon data to improve the interpretation. Editing the framework source data is a more permanent solution.

For example, you can erase the horizon data that are on the wrong side of a fault and then re-interpret the horizon or fault. You can delete horizon data in *Map* view, then re-interpret *Section* view, or use your own preferred method.

You saw poor horizon interpretation on lines 550 and 575.This interpretation source data was used in framework building and not surprisingly, the gridded structural result needed further work. Best practice for framework building is to correctly define the structure with optimum interpretation source data (horizons and faults in this case).

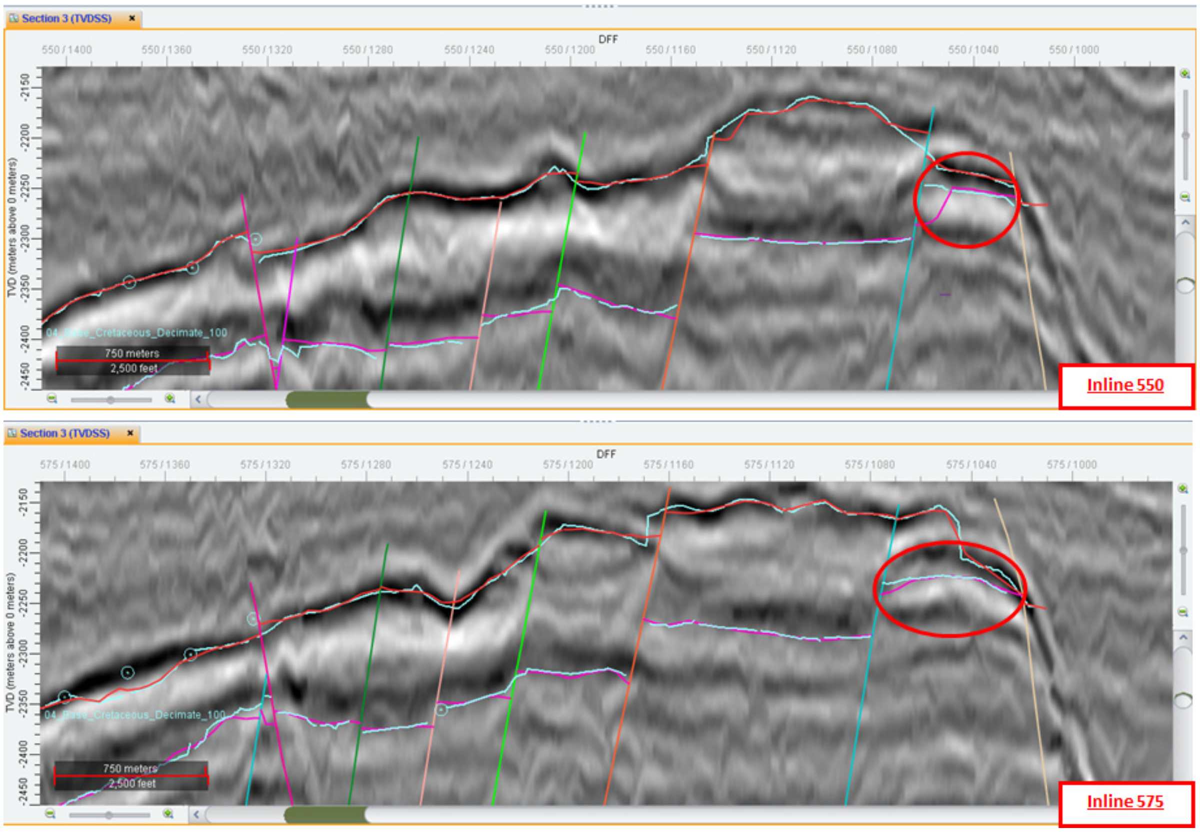
These next steps ask you to examine and correct the interpretation of horizon **05_Base_Interval_Decimate_100** on lines 550 and 575, and then update the framework. You will see how improved horizon interpretation relates directly to a better framework model.

Numbered steps below are significantly and intentionally less detailed than earlier in the exercise.

58. Improve the structural interpretation of horizon **05_Base_Interval** near **Fault_E** on lines 575 and 550. For the small corrections, use **Point** action, not Auto Track or Auto Dip.

    Don't forget to **Save Horizon changes to the database** ( ) after you finish your editions and before refresh the framework.

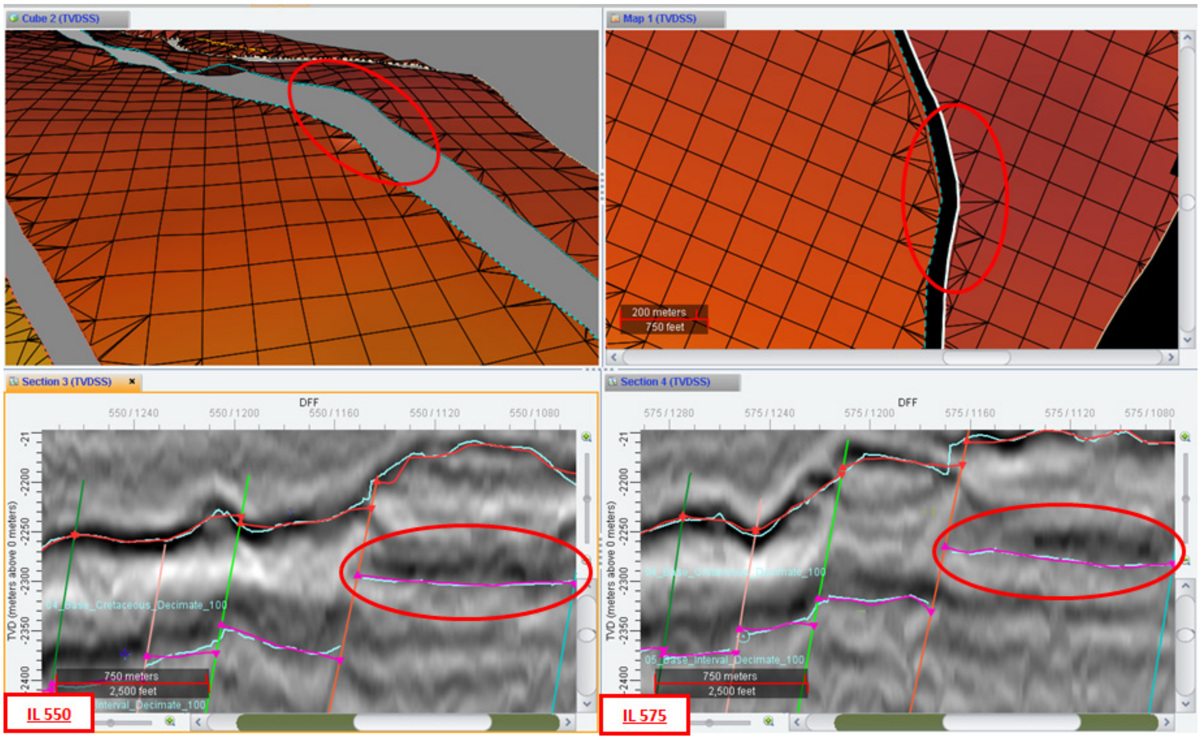
The image below shows the updated **05_Base_Interval** horizon (in light blue) and the un-refreshed **05_Base_Interval** framework surface (in pink).



59. In the *Dynamic Frameworks to Fill* task pane, **Refresh** ( ) the framework.

Best practice is to re-visit the interpretation when structural questions present themselves in the framework.

Your framework surfaces should be updated like the ones below.

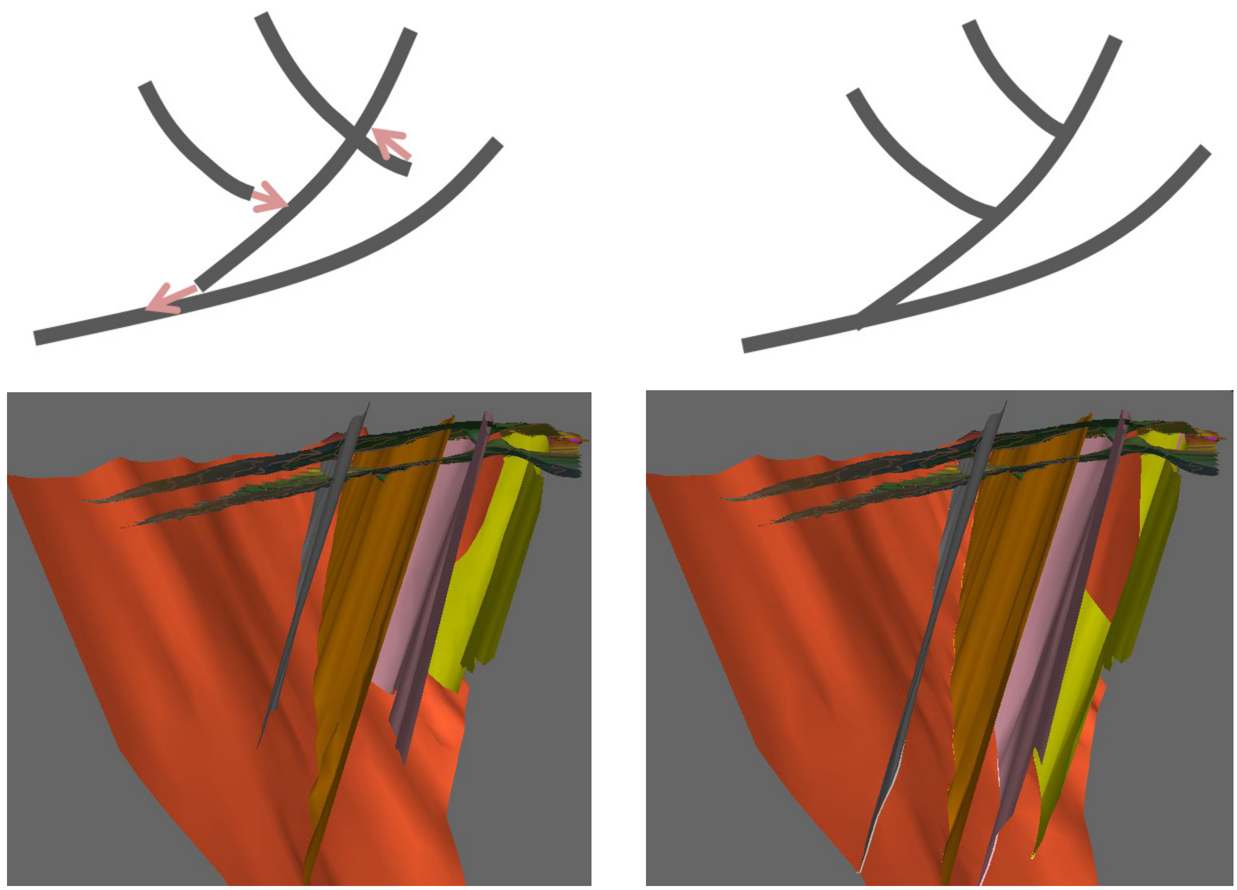


Overview: Networking Faults

Fault Networking is a Dynamic Frameworks to Fill tool that defines fault hierarchies and establishes a network of framework faults. You can generate fault relationships manually or automatically, and then review and edit the faults to fit a geologically reasonable model. The Fault Networking tool uses the concept of parent and child faults, wherein the parent fault truncates the child fault, to define fault relationships in the network.

The recommended workflow for large fault groups that are not well defined is to use the automated fault hierarchy tool first and then edit the results. In situations where the master faults and geologic fault relationships are well established but perhaps difficult to detect by the software, you can start building the fault network manually.

Refer to "Chapter 2: Best Practices for Dynamics to Fill Fault Network" in *DecisionSpace Geosciences: Software Best Practices,* for a more detailed discussion of the two workflows and an examination of a generic example.



Exercise 3.2: Editing the Fault Network

To provide a clear demonstration of fault network editing, this exercise includes fewer faults than the previous exercise.

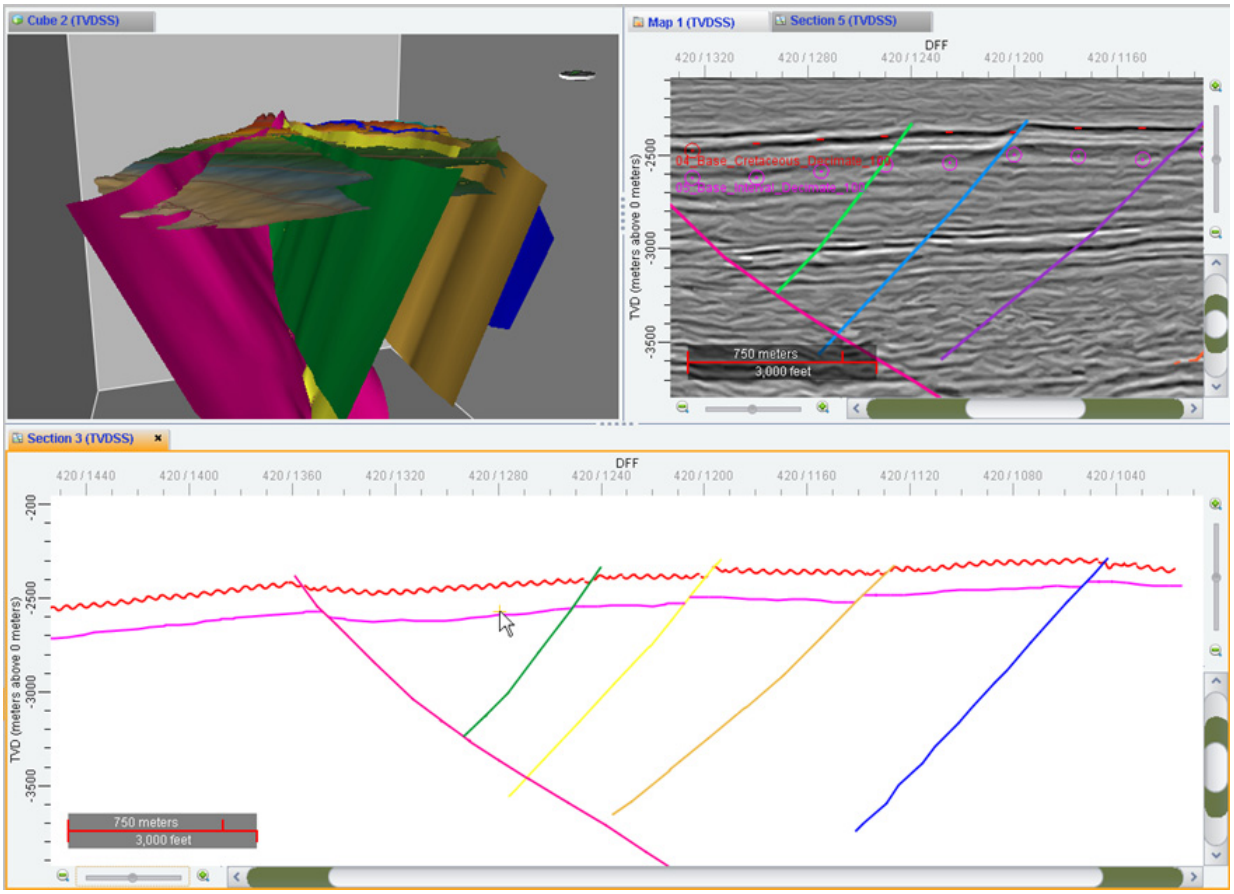
1. If DecisionSpace is open, select **File > Exit**. Launch DecisionSpace using session **Chapter3_AdvancedFWConstruction_Part2**. If the session opens successfully go to step 5.

2. If the session is not available, start a new depth session and load ISet **DFF_Ch3.2** (from the *Tools* task pane) and load Framework **Chapter3FW_Part2** (using *Select Session Data*).

   Confirm that you are using a specific velocity model for domain conversion.

3. From the main menu bar, select **Select > Domain Conversion...**. Ensure that **DFF_Velocity_Model** (depth) is the Active Model and **Wells always use TD model** is turned on. Click **OK**.

4. Configure your TVDSS views, as shown below notice there is also a new *Section* view).



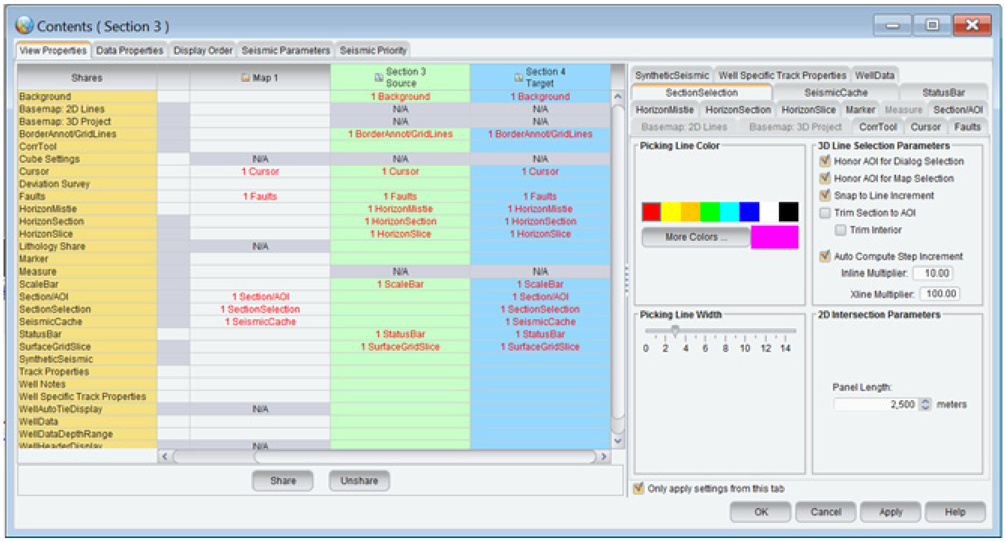
The upper *Section* view displays line 420 with the source, which are originally interpreted horizons and faults. The lower *Section* view displays line 420 with the framework of unlinked faults, as does the *Cube* view. This allows you to continuously compare the source data with the modeled data during framework operations.

Note

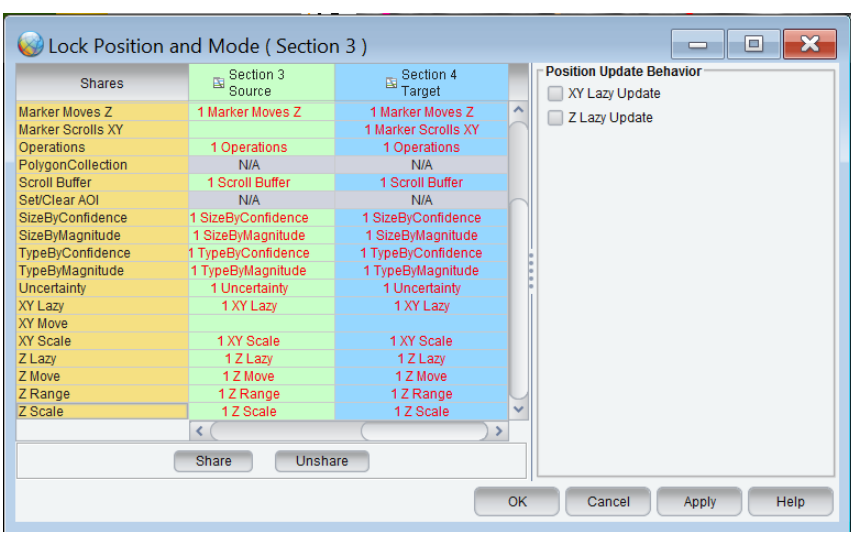
By default, the views are linked together, or shared. When linked, the changes in the *Inventory* in one *Section* view will influence the other, unlike what you want in this exercise. In the session you just opened, the two *Sections* have been unshared, so you will not need to unshare. However, if you started a new session, you need to read the following information to unlink the two *Section* views.

There are two types of sharing between views: 1) Content and 2) Position and Mode.

1. Content: To control the content sharing between views, click the **Contents** icon ( ) in the vertical icon bar. In the *Contents* dialog, *Data Properties* tab, enlarge the left panel so all the views can be seen. Click one view to make it the source, and then click another to make it the target. Highlight the types of shares, and then click **Unshare** (or **Share**, if that is your goal). Click **OK**. For this exercise you need to Unshare **Faults** and **Horizons**.

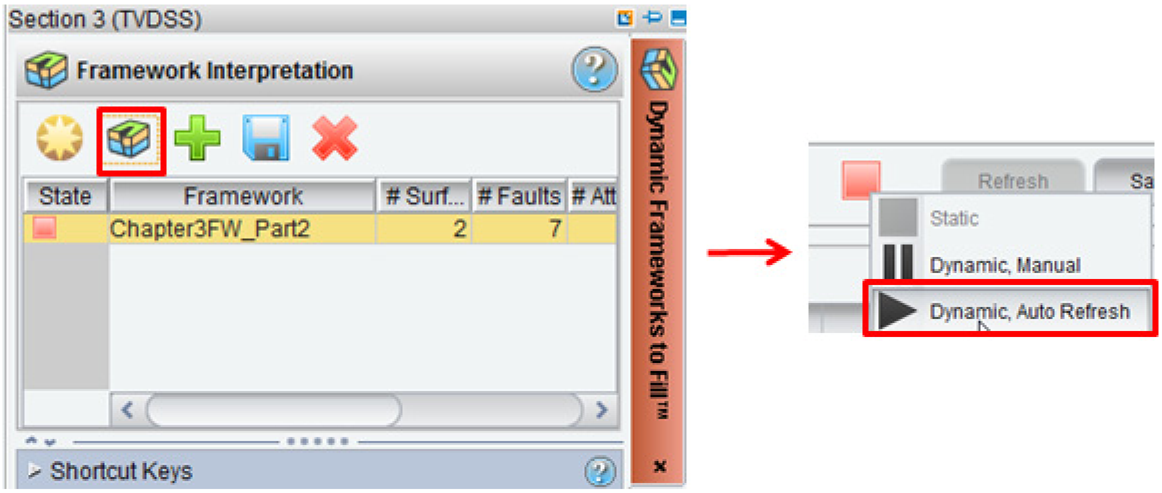


2. Position and Mode: To control the position and mode sharing, from the menu bar select **View > Lock Position and Mode....** From the *Lock Position and Mode dialog*, enlarge the left panel so all the views can be seen. Click one view to make it the source, and then click another to make it the target. Highlight the types of share, and then click **Unshare** (or **Share**). Click **OK**.



Setting Fault Type or Relationship

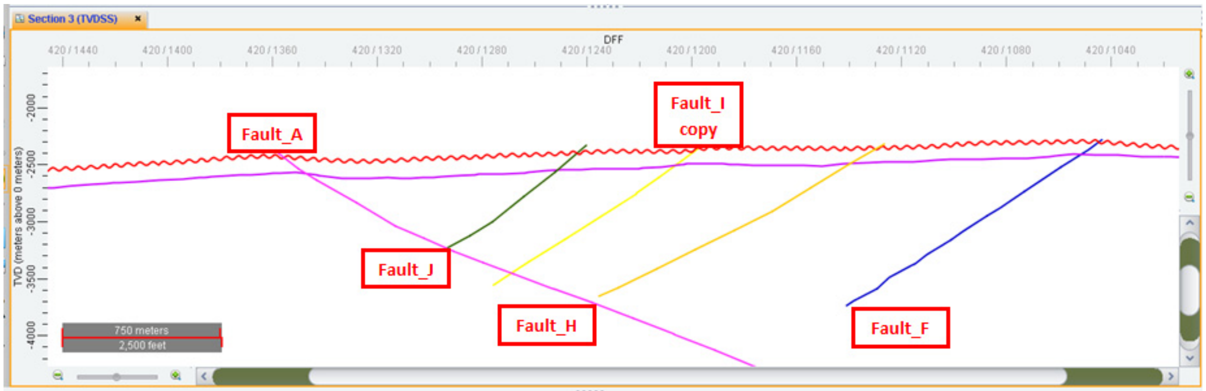
5. Click the **Launch the Dynamic Frameworks to Fill Workspace** () icon. In the *Dynamic Frameworks to Fill Workspace* window change the framework to **Dynamic, Auto Refresh**.



In the next steps, you will not be referring to the surfaces, so you can save time by turning off the Fault Offset calculations. This will avoid having the surfaces constantly update while you change the faults in the framework.

6. In the *Dynamic Frameworks to Fill Workspace* window, turn off **Fault Offset**. Click the *Fault* tab and leave this window open.

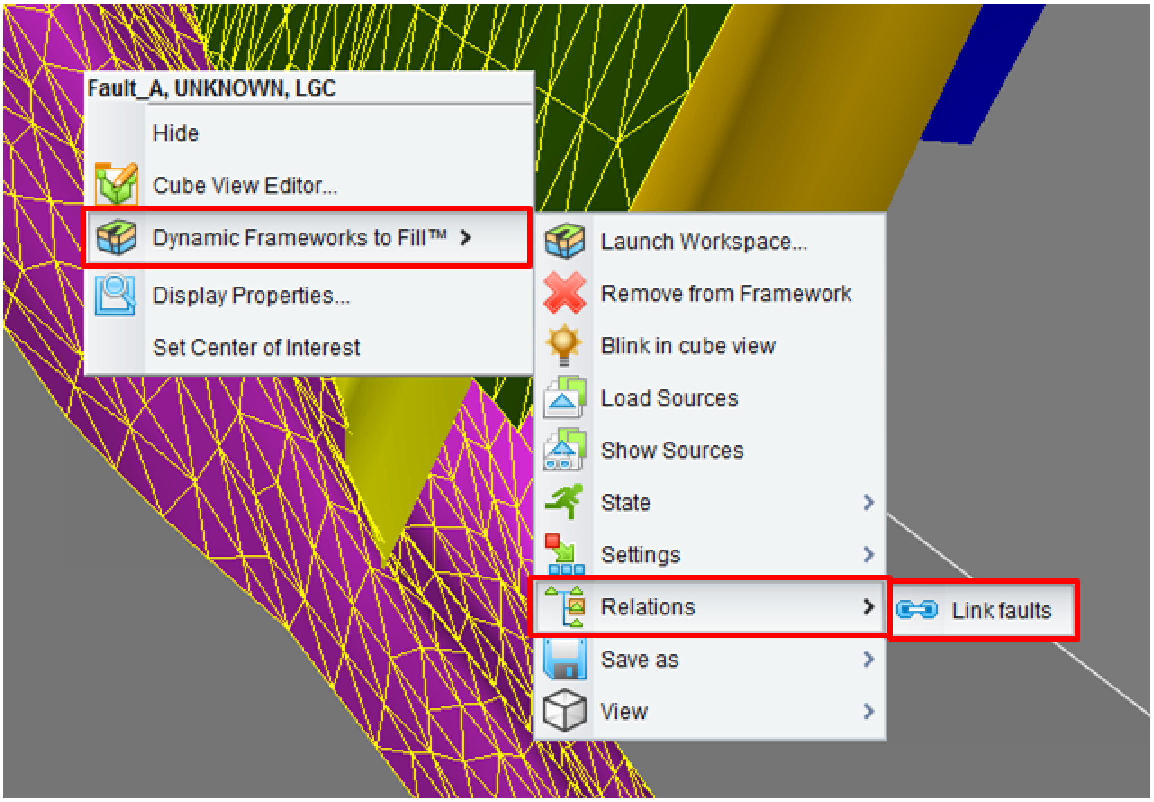
You will connect the faults in a geologically reasonable manner to create a fault network. You can see **Fault_A** and several antithetic faults that dip at a high angle towards **Fault_J**. These antithetic faults are not properly connected, as they are either crossing or ending at some distance.



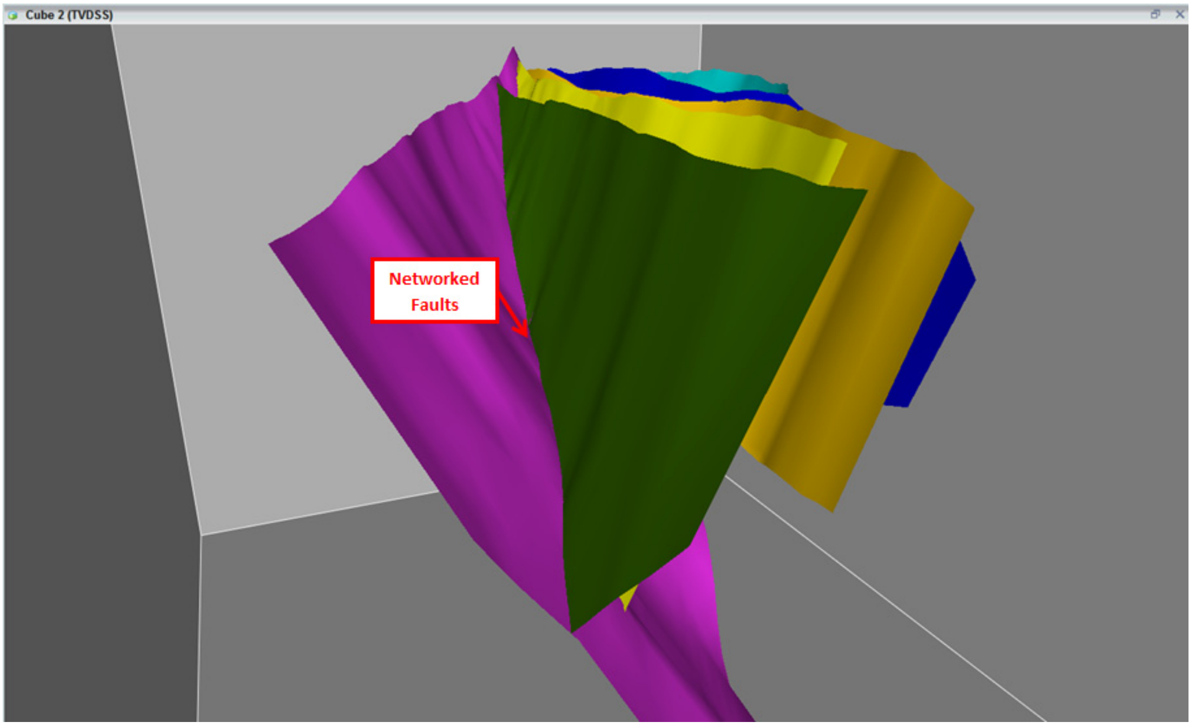
You will use the fault networking tools from *Cube* view to begin a manual fault networking operation.

7. Activate *Cube* view, and then double-click it to maximize the view. Turn off the **FW SURFACES**. Make sure you are in **Select/Drag** mode ().

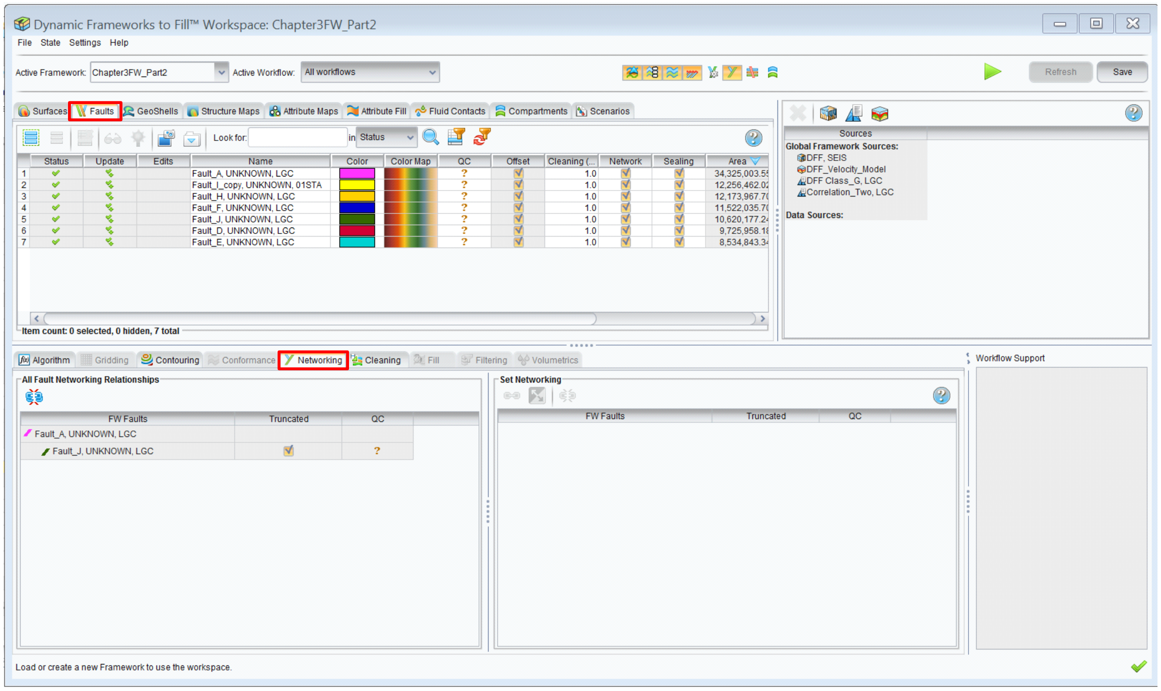
8. Multi-select two faults by first clicking **Fault_A**, and then clicking **Crtl+MB1** on **Fault_J**. On one of the highlighted faults, **MB3** and then select **Dynamic Frameworks to Fill > Relations > Link Faults**.



After your framework updates, you should see that both faults have been linked, where **Fault_J** (child) is truncated by **Fault_A** (parent). To rotate the volume again you need to switch to **Pan/Zoom/Rotate** () mode.



9. In the *Dynamic Frameworks to Fill Workspace* window, select the *Fault* tab, if not already active. Open the *Networking* action tab to see the status of the faults you just linked.



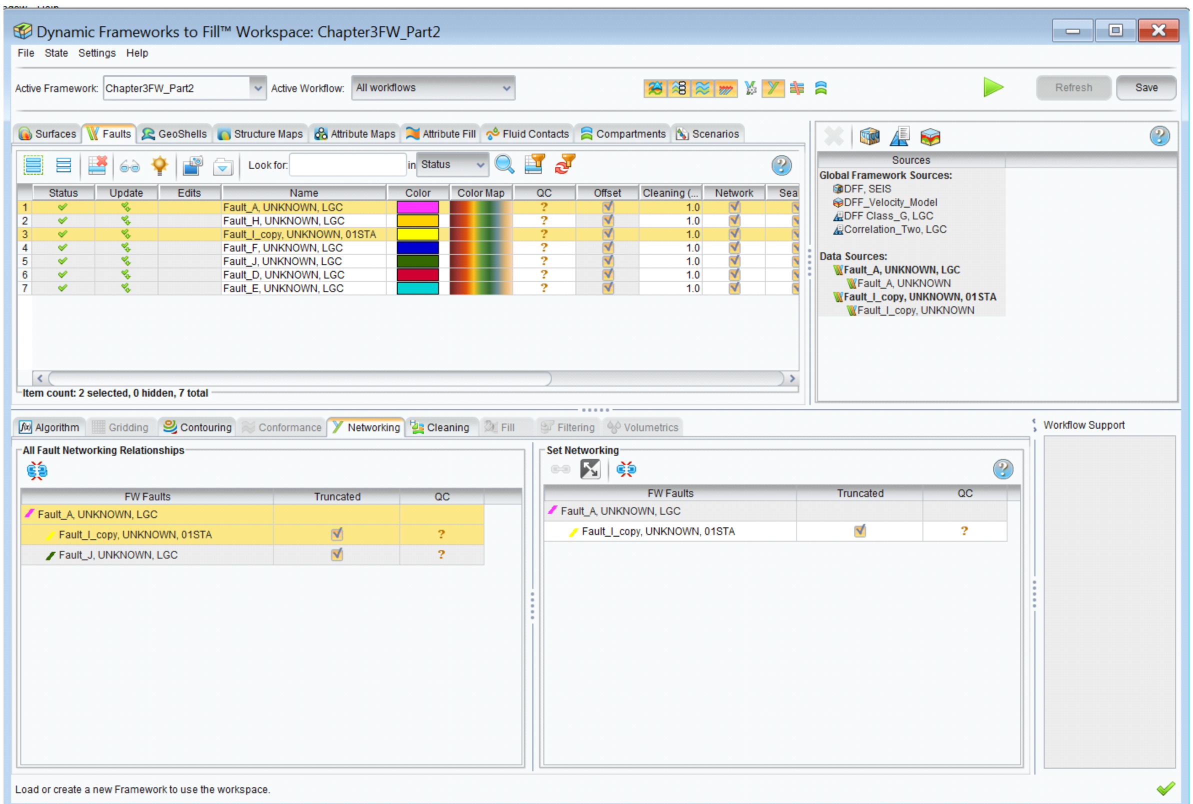
The two faults you manually linked are correctly listed in the fault network tree with **Fault_A** as the parent and **Fault_J** as the child.

You can add all other faults manually, as you did in *Cube* view, or you can do it from within *Dynamic Frameworks to Fill Workspace*.

10. Within the *Dynamic Frameworks to Fill Workspace* window, select **Fault_A** in the main *Faults* tab to designate it as the parent, and then select **Fault_I_copy**, which will designate that it will be truncated on **Fault_A**.

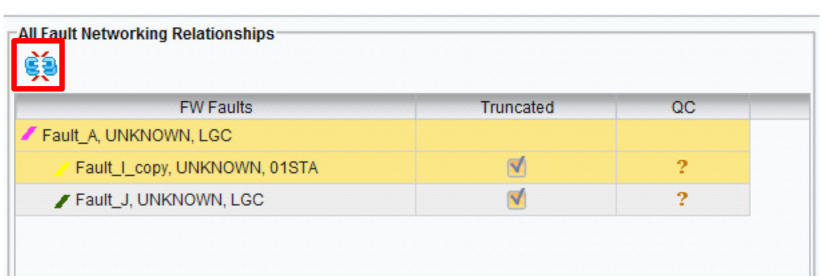
11. In the *Set Networking* panel within the *Networking* action tab, click the **Link** ( ) icon. This will create the parent-child relationship between **Fault_A** and **Fault_I_copy**.

All of the relationships from the framework will appear in the left panel of the *Networking* tab, and the fault relationships only for the selected faults will appear in the right panel.

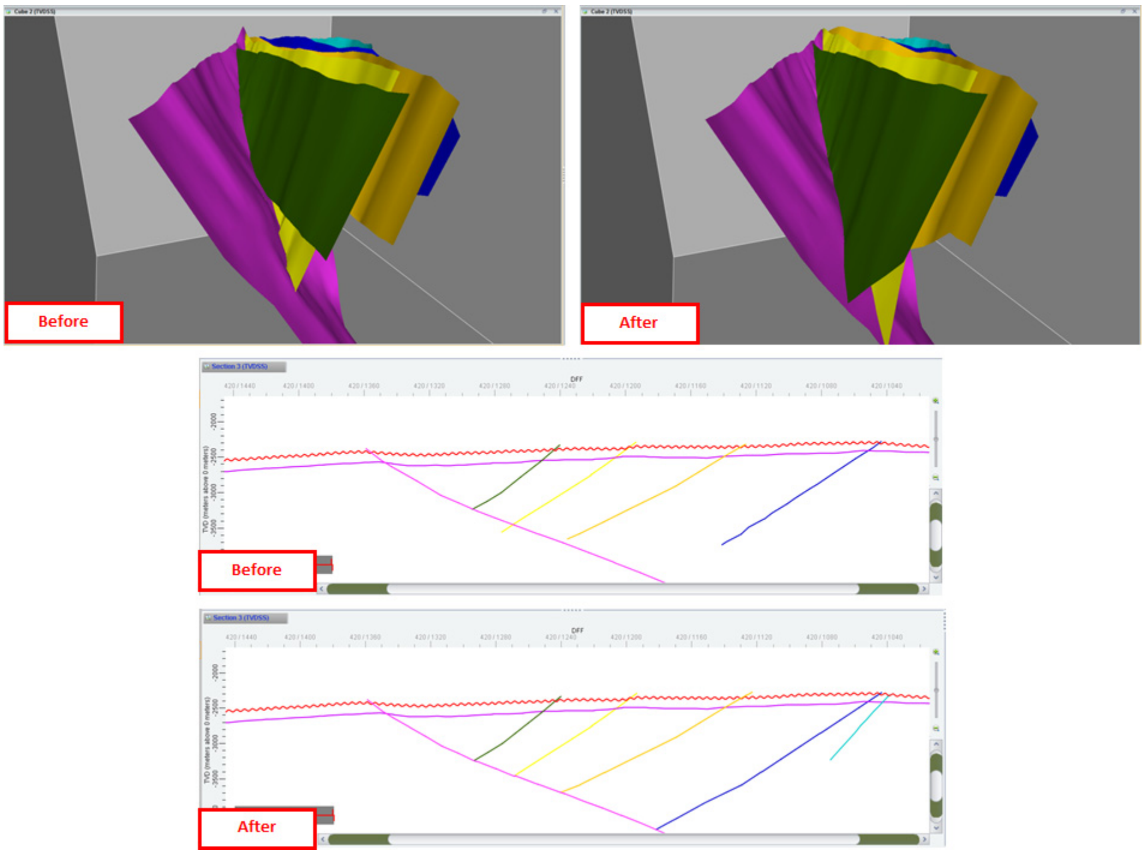


The following example is straight forward. Instead of linking faults one at a time, you can automate the process by letting the Fault Networking tool establish the relationships. Before that, undo your manual link to give the automated method a fresh start.

12. Click the **Unlink All Shown Relations** icon. Click **YES** to the dialog box to confirm you want to unlink the existing relationships.



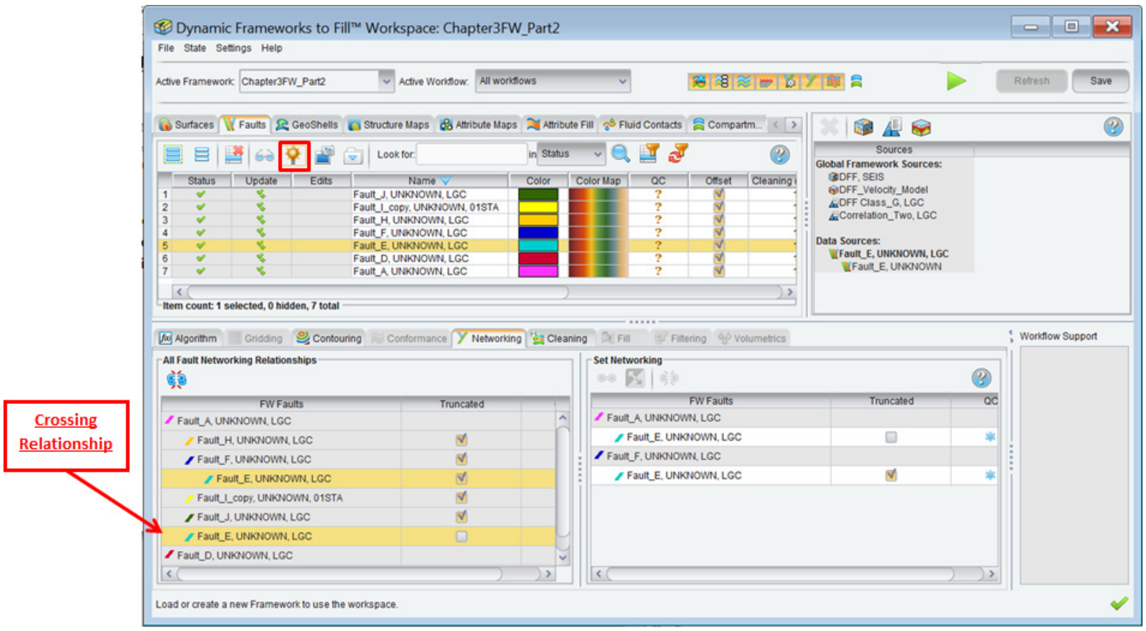
13. In the top of the *Dynamic Frameworks to Fill Workspace* window enable the **AutoNetwork Faults** ( ) icon. The framework will automatically refresh.

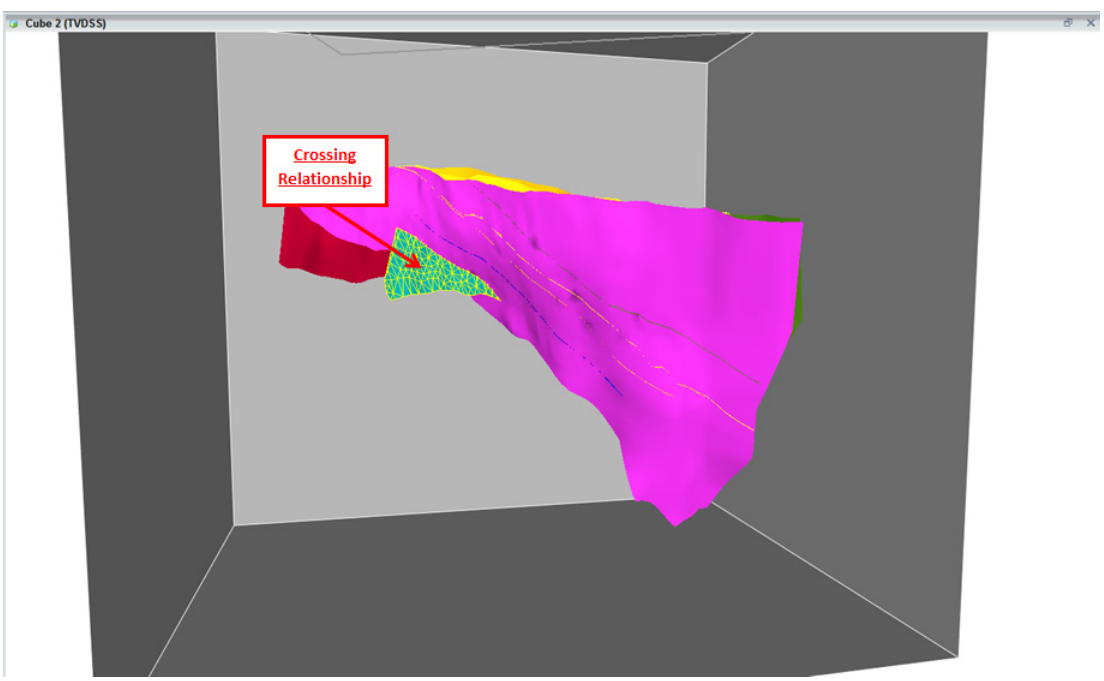


Most of the faults are properly linked and truncated against the master (parent) fault **Fault_A**.

The fault network tree shows one crossing relationship. You can easily identify the crossing fault in your *Cube* view.

14. In the *Dynamic Frameworks to Fill Workspace* window, select the **Fault_E** (Crossing) in the tree, all relationships involving the fault will be highlighted. Click the **Blink** ( ) icon. The fault will be highlighted repeatedly (it will blink). Adjust the *Cube* view so you can see the fault intersection clearly.

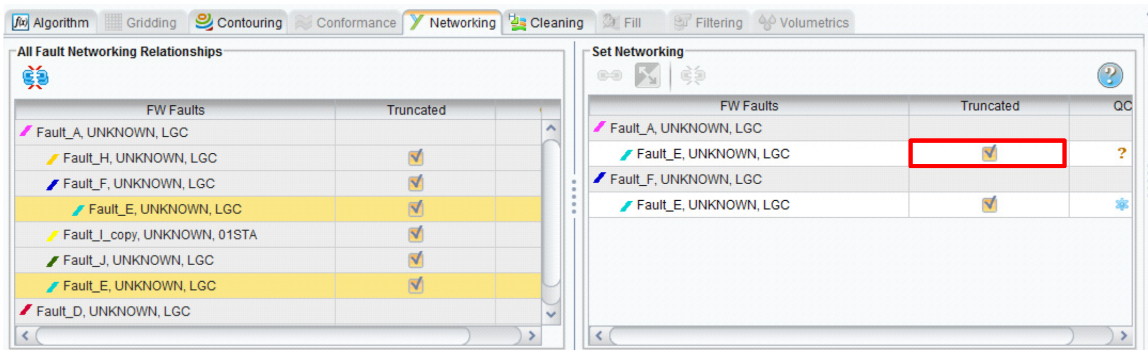




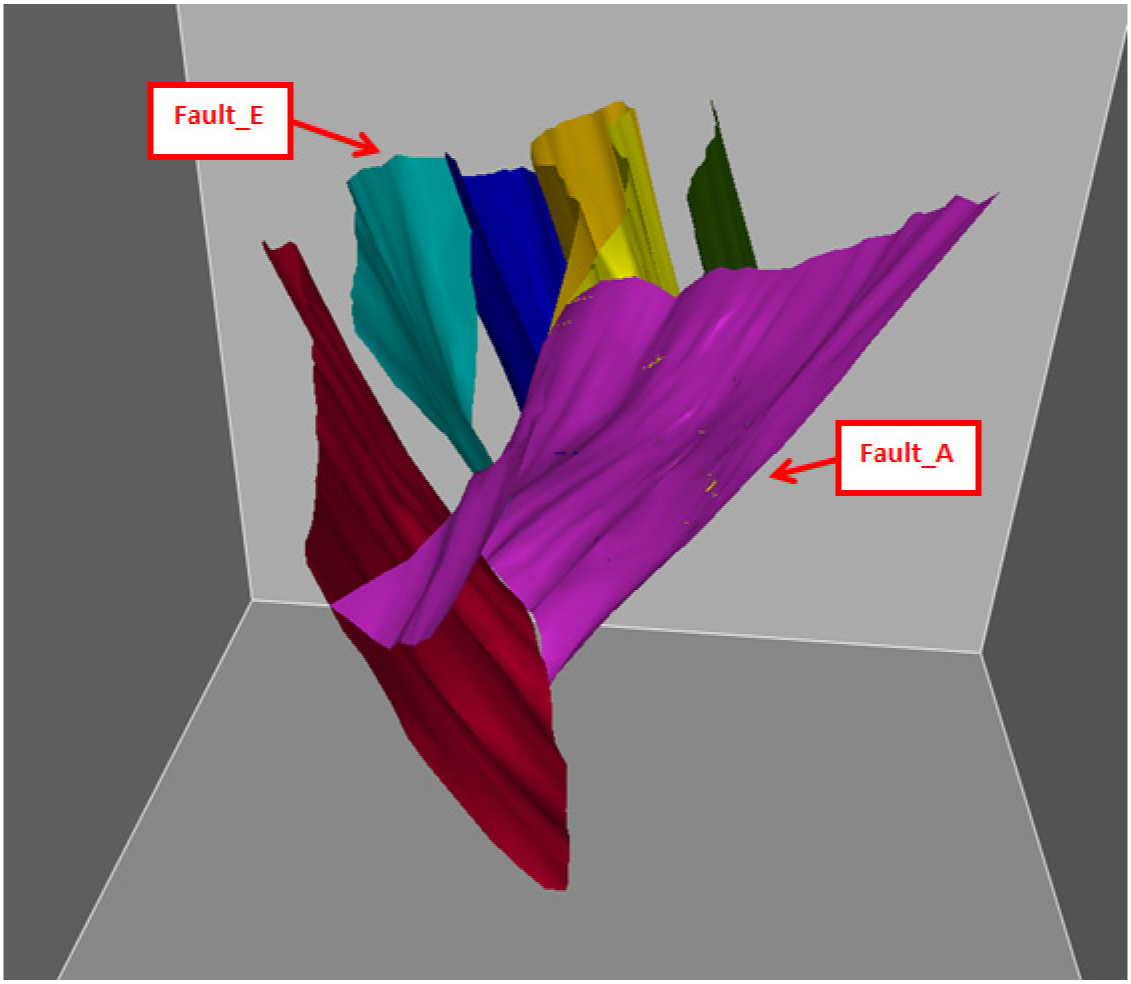
This northern area is more complex; this is due to the fact that the faults are also connecting laterally with each other.

In order to truncate **Fault_E** into **Fault_A** you must change the relationship manually within the *Dynamic Frameworks to Fill Workspace* window.

15. Within the *Dynamic Frameworks to Fill Workspace* window, make sure that **Fault_E** is highlighted in the main *Faults* tab. In the *Set Networking* panel, check the box for truncation for **Fault_E** against **Fault_A**.

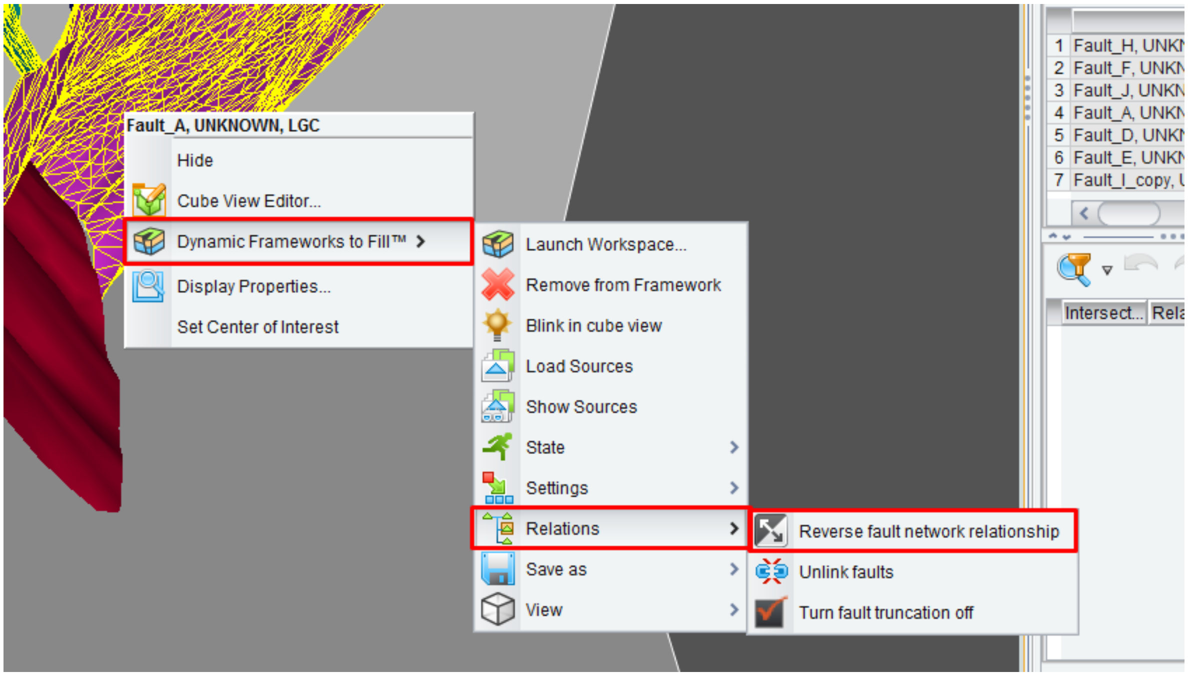


Fault_E is now truncated against parent **Fault_A**.

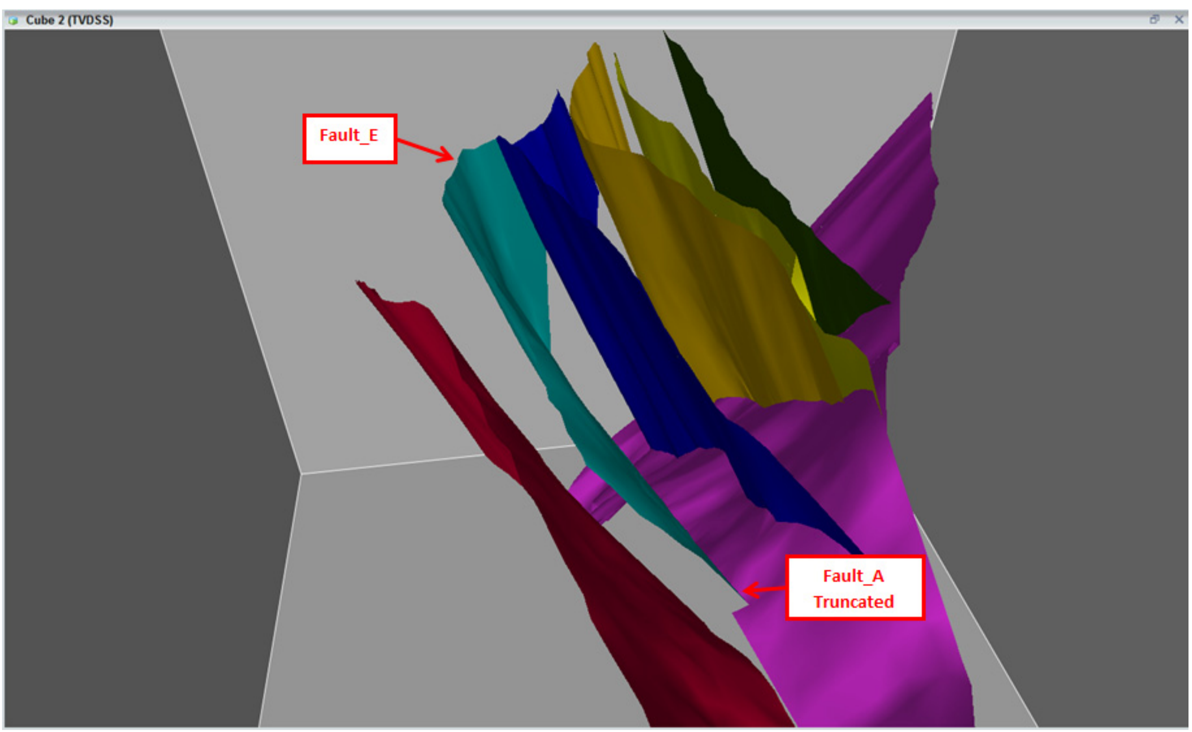


You can change the parent/child relationship to truncate **Fault_A** against **Fault_E**. You will multi-select both faults.

16. In *Cube* view in **Select/Drag** ( ) mode, click **MB1** to select **Fault_A**, and then click **Crtl+MB1** to select **Fault_E**. On one of the highlighted faults, **MB3** and then select **Dynamic Frameworks to Fill > Relations > Reverse fault network relationship**.



You should see the following. Although this intersection is geologically questionable, leave it for now. You will remake the framework shortly.



Editing Fault-Fault Intersections in 3D

Where necessary, you can directly modify the intersection line between two faults after fault networking. For example, when faults are extrapolated during fault networking, they are extended along trend, which may not always be the optimal orientation.

In your model, you will change the fault intersection between **Fault_I_copy** and **Fault_A** to make it smoother and farther from **Fault_H**.

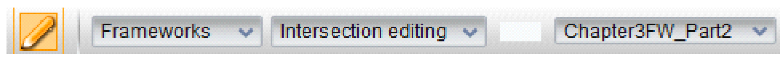
17. In *Cube* view, turn off all of your **FW Faults**, except for **Fault_A**, **Fault_I_copy**, and **Fault_H**. This will make it easier to see the interaction of the active faults.

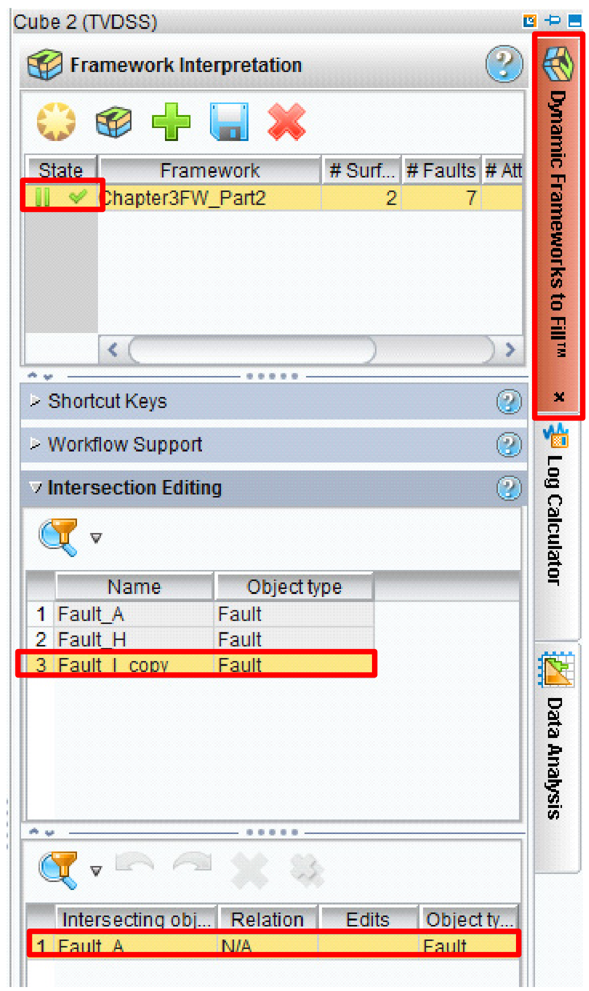
18. Examine the intersection between **Fault_A** (pink) and **Fault_I_copy** (yellow) in *Cube* view. Notice where this fault intersection is close to the intersection of **Fault_A** and **Fault_H** (gold).

You will be moving intersection nodes to move the faults away from each other.

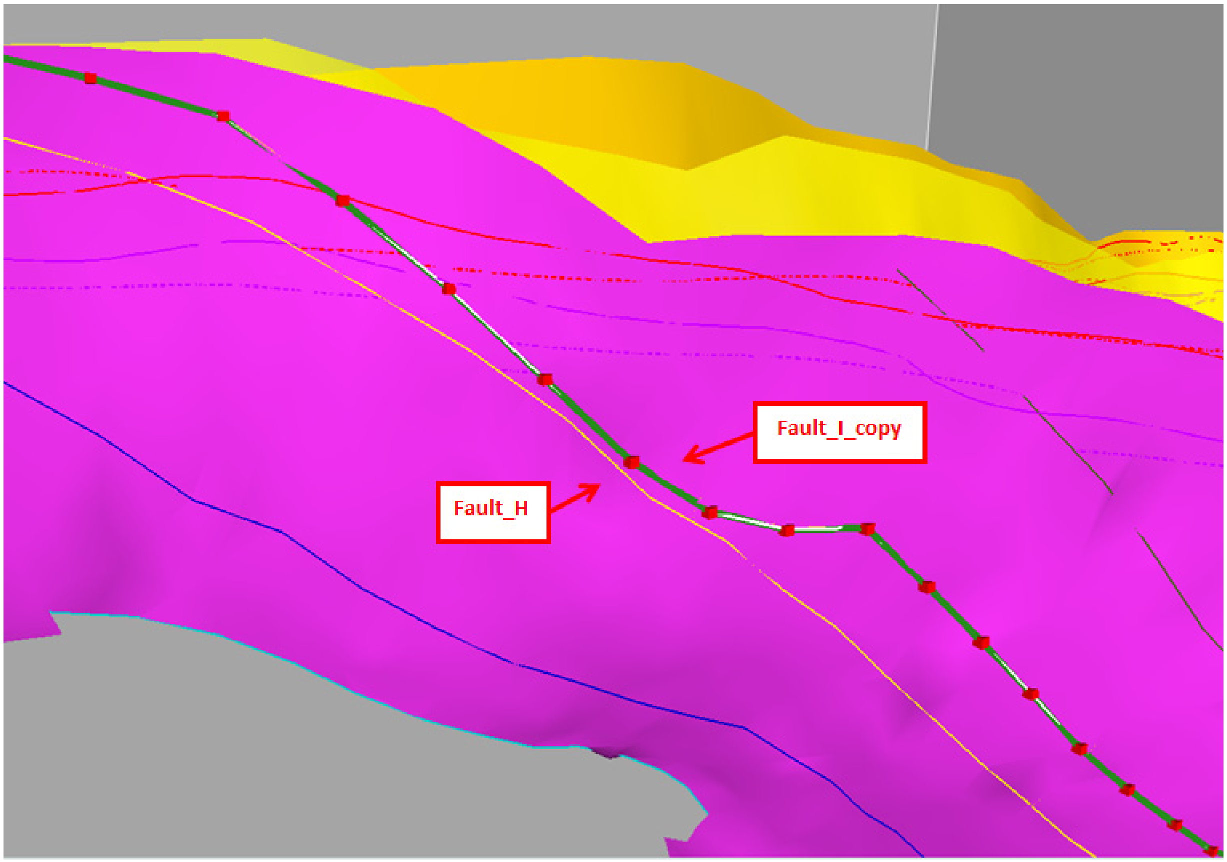
19. Within the *Dynamic Frameworks to Fill Workspace* window or task pane, change your framework to **Dynamic, Manual** mode.

20. With *Cube* view active, enable **Interpretation Mode** for intersection editing of **Fault_I_copy** by clicking the **Interpretation mode** icon in the main tool bar and selecting frameworks as your data type. Double-click on the intersection of **Fault_I_copy** with **Fault_A** to activate the nodes. Alternative, you can activate the intersections nodes in *Dynamic Frameworks to Fill* task pane, in the *Intersection Editing* sub-panel highlight **Fault_I_copy** and then highlight **Fault_A**.

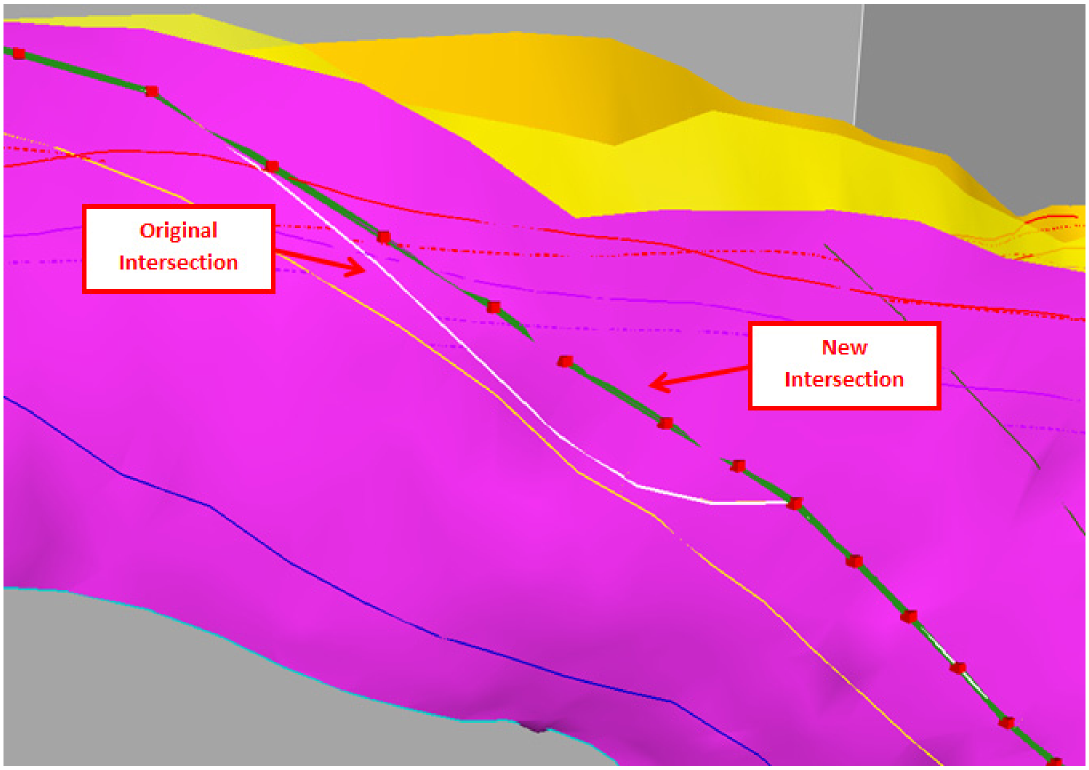


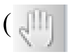


Nodes will appear along the **Fault_I_copy** intersection.

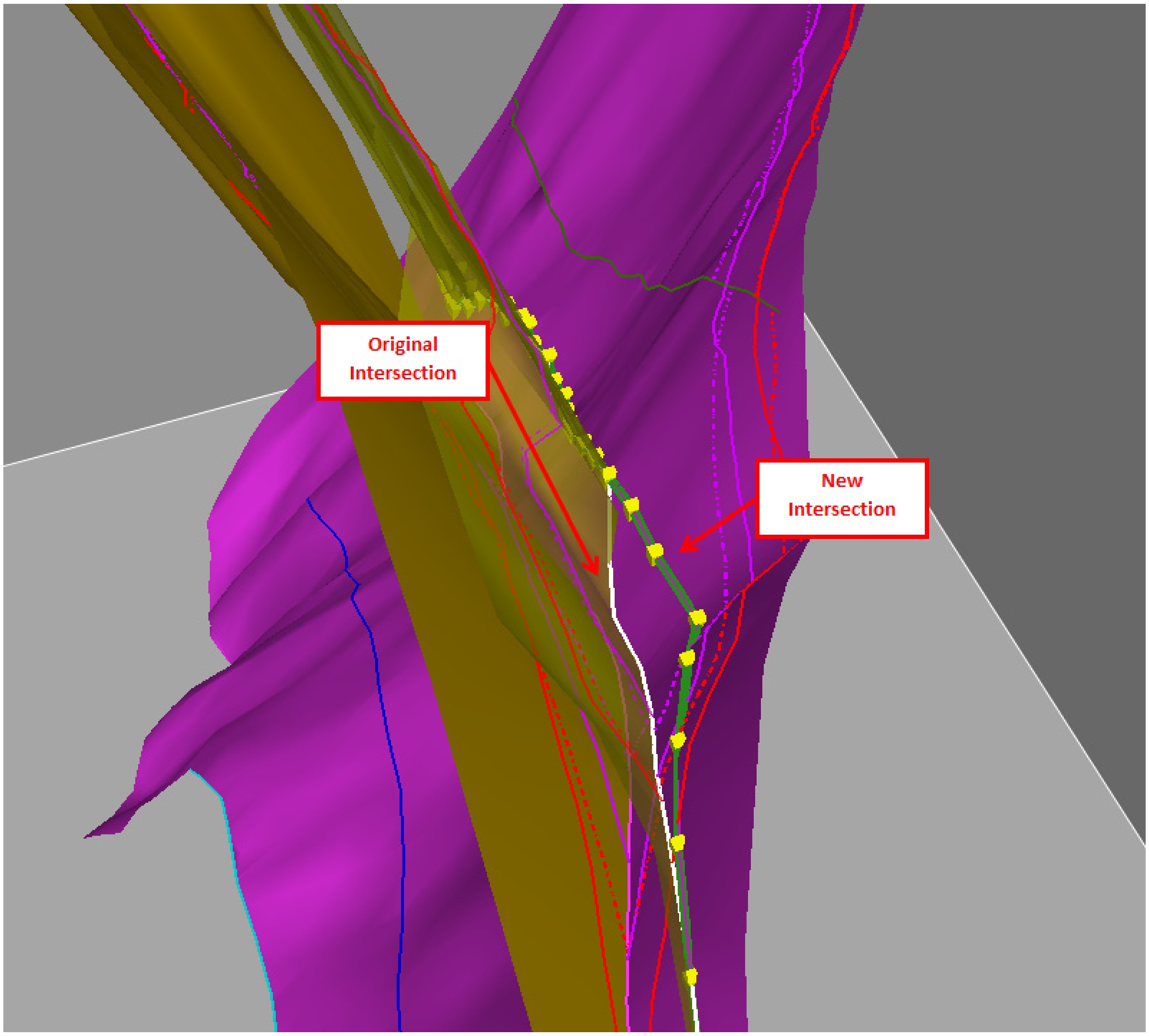


21. In *Cube* view, you can now move **individual nodes** to the desired position (drag-and-drop). Delete nodes by clicking **MB2**. Rotate the scene as necessary.

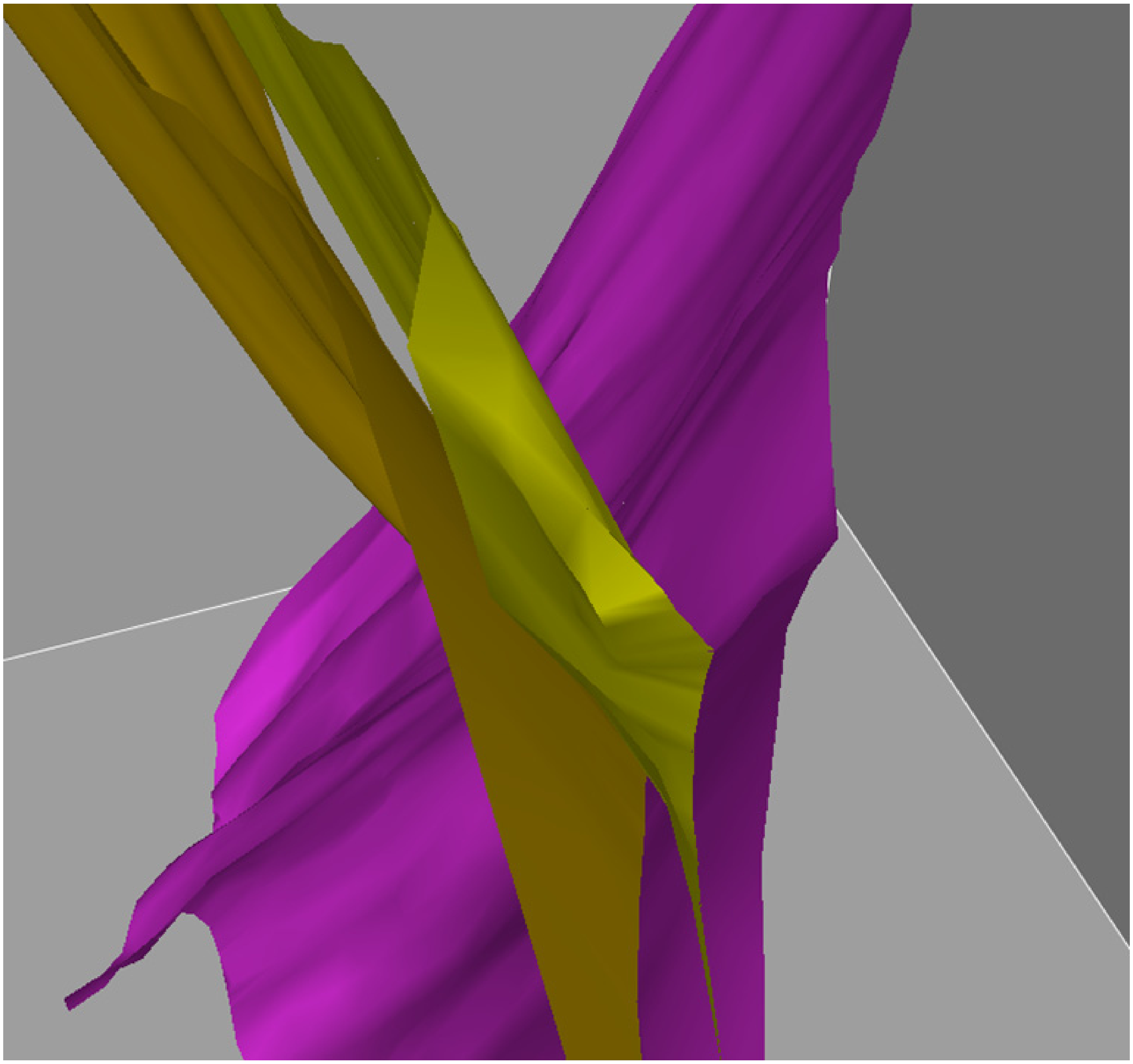


> **Note**
>
> You can switch between **Pan Mode** () and **Interpretation Mode** () using <**F12**>.

22. When you are satisfied with your edits, select **Pan/Zoom/Rotate** mode. Look at the upper side of this intersection.



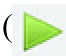
23. Refresh the framework and observe the update of **Fault_I_copy**.



The improved intersection appears to warp the fault plane. The best practice is to revisit the original **Fault_I_copy** interpretation, and modify it from there.

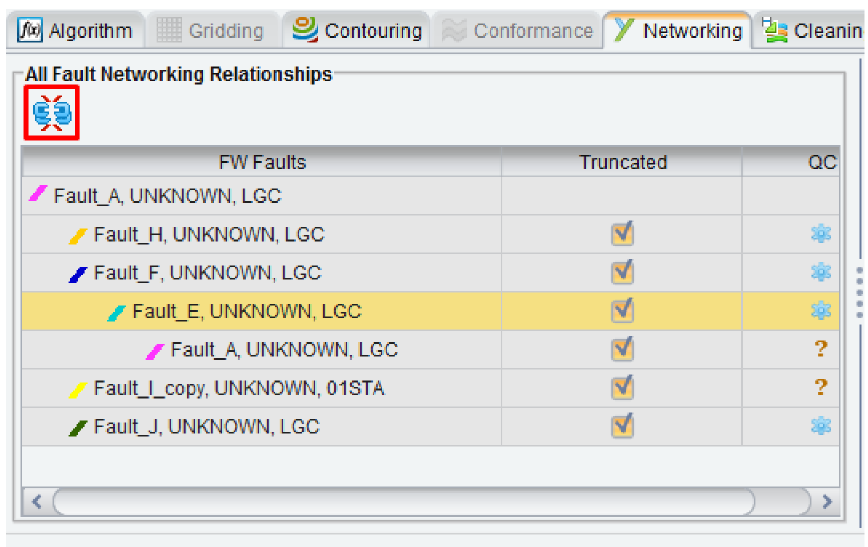
Editing Framework Faults

If you feel you cannot reach the desired fault framework results with the techniques described thus far, you can modify the framework faults so they become larger or smaller. Modifying the size of these faults will allow other connections to occur.

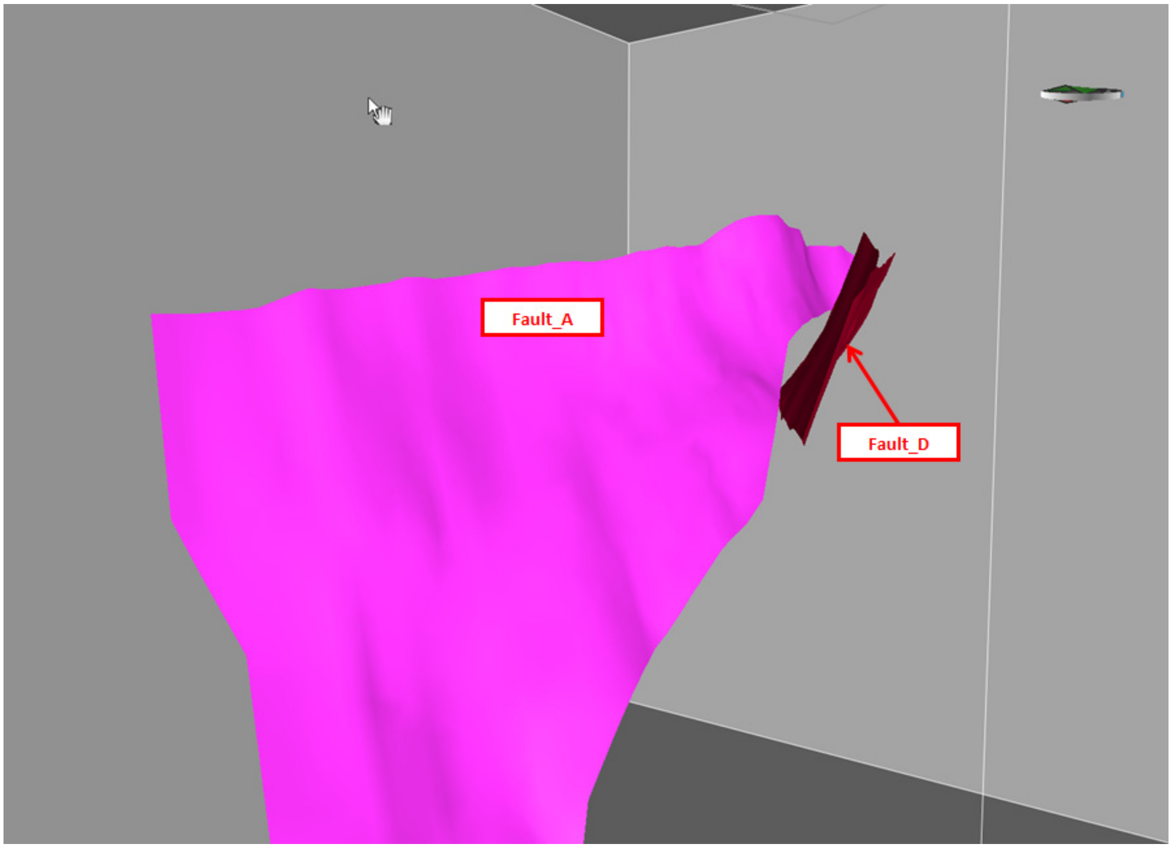
24. Change your framework back to **Dynamic, Auto Refresh** ().

Clear the existing fault network to begin this section with unlinked faults.

25. Within the *Dynamic Frameworks to Fill Workspace* window turn off **AutoNetwork faults**, () and then click the **Unlink all shown relationships** () icon from the *Networking* action tab in the *Faults* object tab.



26. In *Cube* view, view display only **Fault_A** and **Fault_D**.



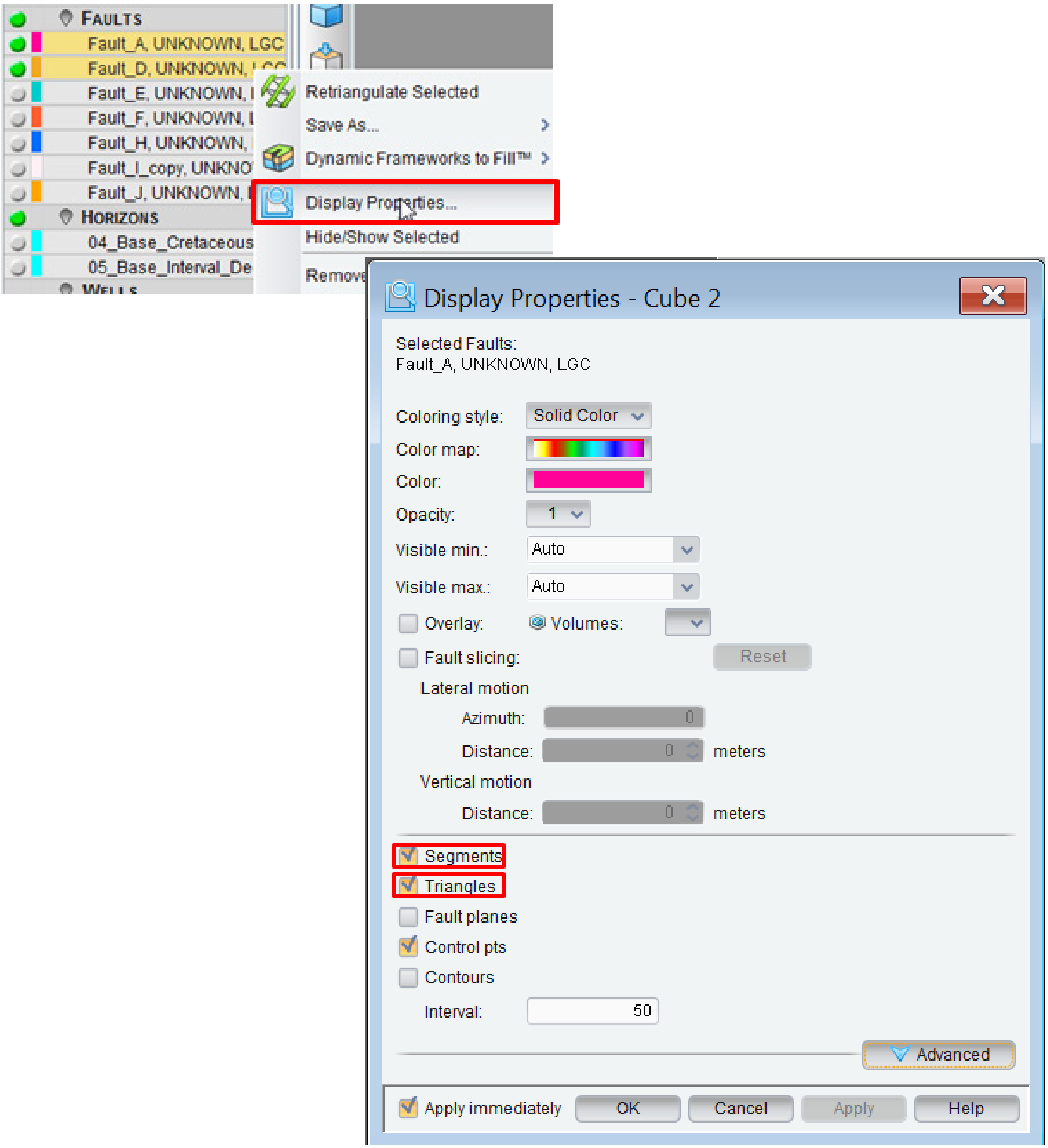
You can see that **Fault_D** is not connected to the parent **Fault_A**. Prior to fault networking, **Fault_A** has a curved lower fault termination which provides no area where **Fault_D** can connect.

You will correct the situation by manipulating the fault tip behavior.

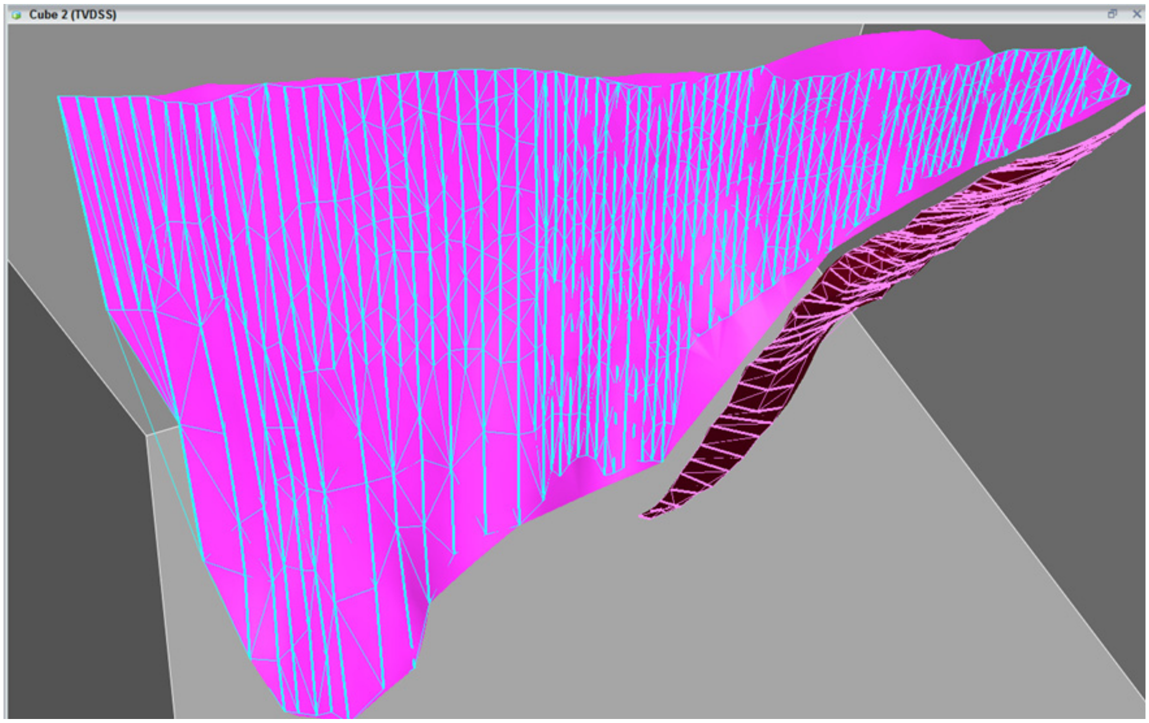
You can display the input fault interpretation while you adjust the mapping parameters and triangulation settings of the framework fault.

27. Turn on the original **Fault_A** and **Fault_D** (seismic interpretation) so they are displayed along with the **FW Faults**.

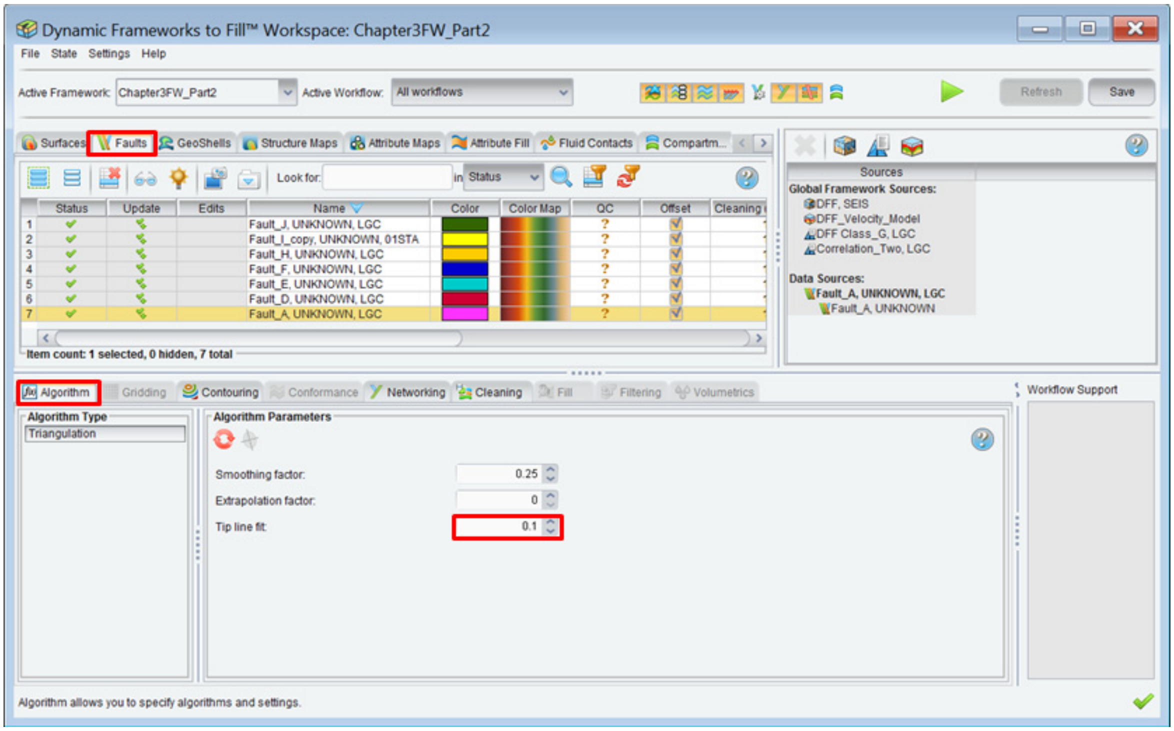
28. In the *Inventory* task pane multi-select both seismic faults, **MB3** on the faults and select **Display Properties**. Turn on the option to show **Segments** and **Triangles**. Alternative, you can turn on the source fault interpretation (segments and triangles) directly from the Framework object by **MB3** on the framework object and selecting **Dynamic Frameworks to Fill > Show Sources**.



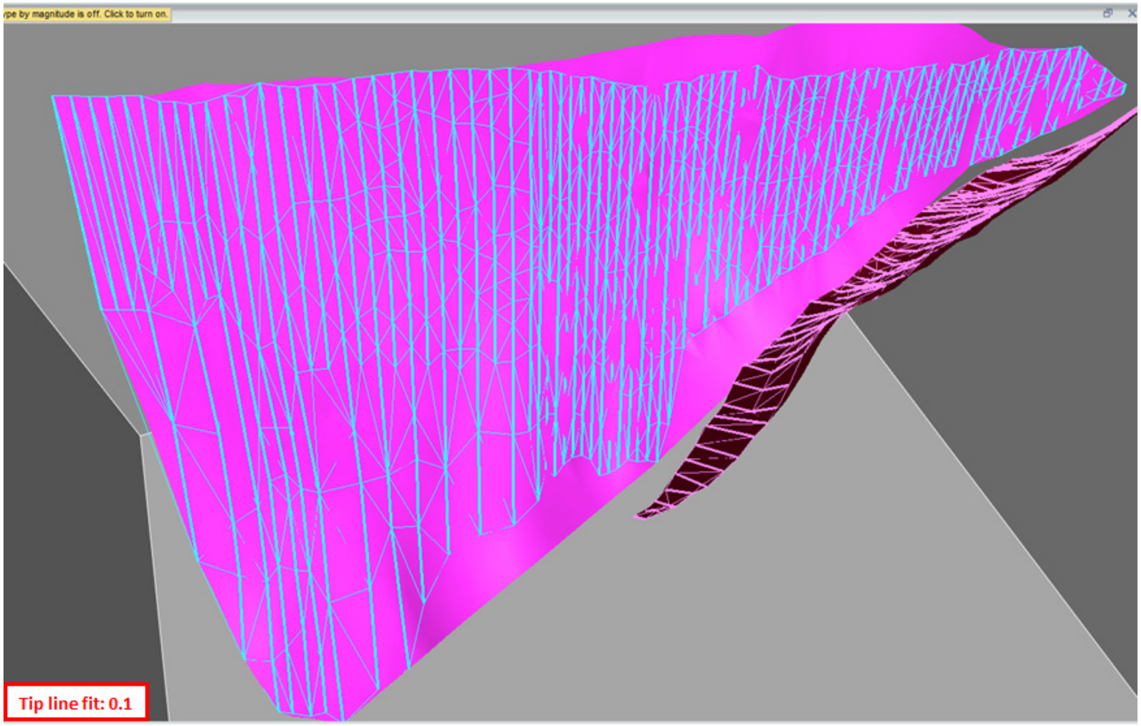
29. Use *Cube* view to compare the differences between the FW **Fault_A** and the original **Fault_A** triangulation.



30. In the *Dynamic Frameworks to Fill Workspace* window, select **Fault_A** from the *Faults* tab, in the *Algorithm* action tab, change the *Tip line fit* from 0.5 to "**0.1**" and then press <**Enter**>. Your framework will automatically refresh.



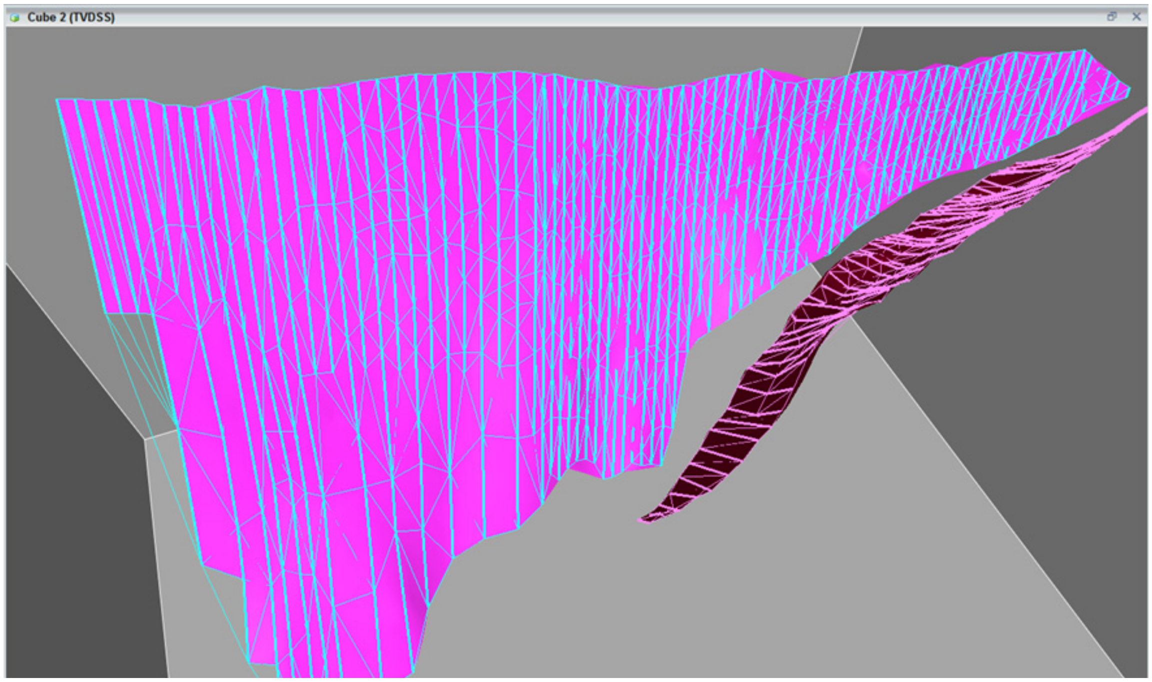
Your FW Fault_A should look similar to the one below.



Tip line fit alters the modeled fault area to allow additional links. It controls how closely the outline of the modeled fault corresponds to the outline of the input fault.

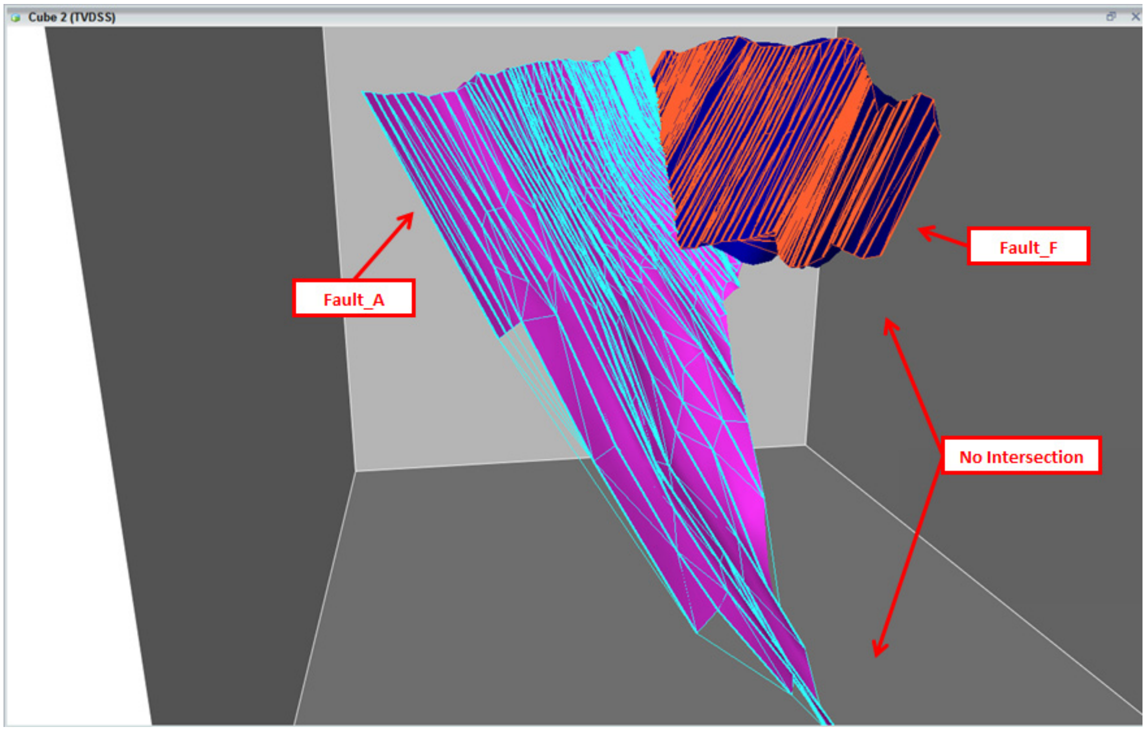
If you regenerate the fault hierarchy at this point, the faults would be close enough together to allow linking the faults. You will not be doing this step right now.

31. Change the *Tip line fit* to “**0.9**”, and press <**Enter**>.

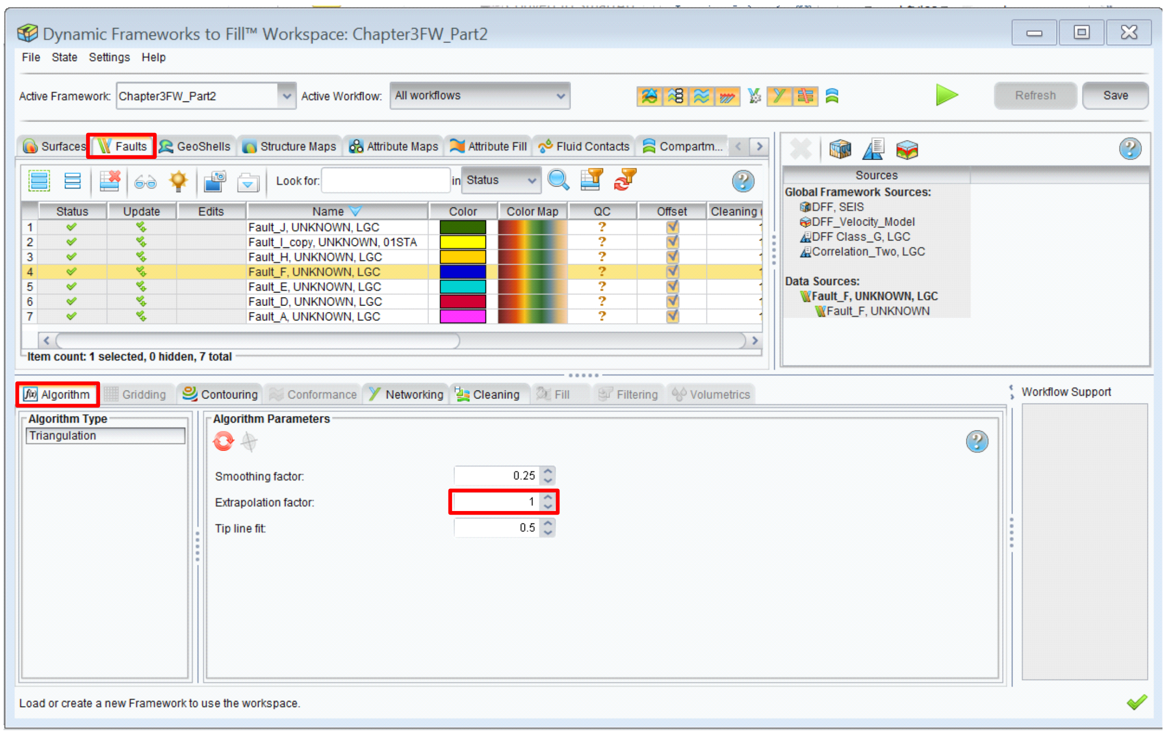


Alternatively, you can make a framework fault larger by adjusting the extrapolation parameter, as you will do for **Fault_F**.

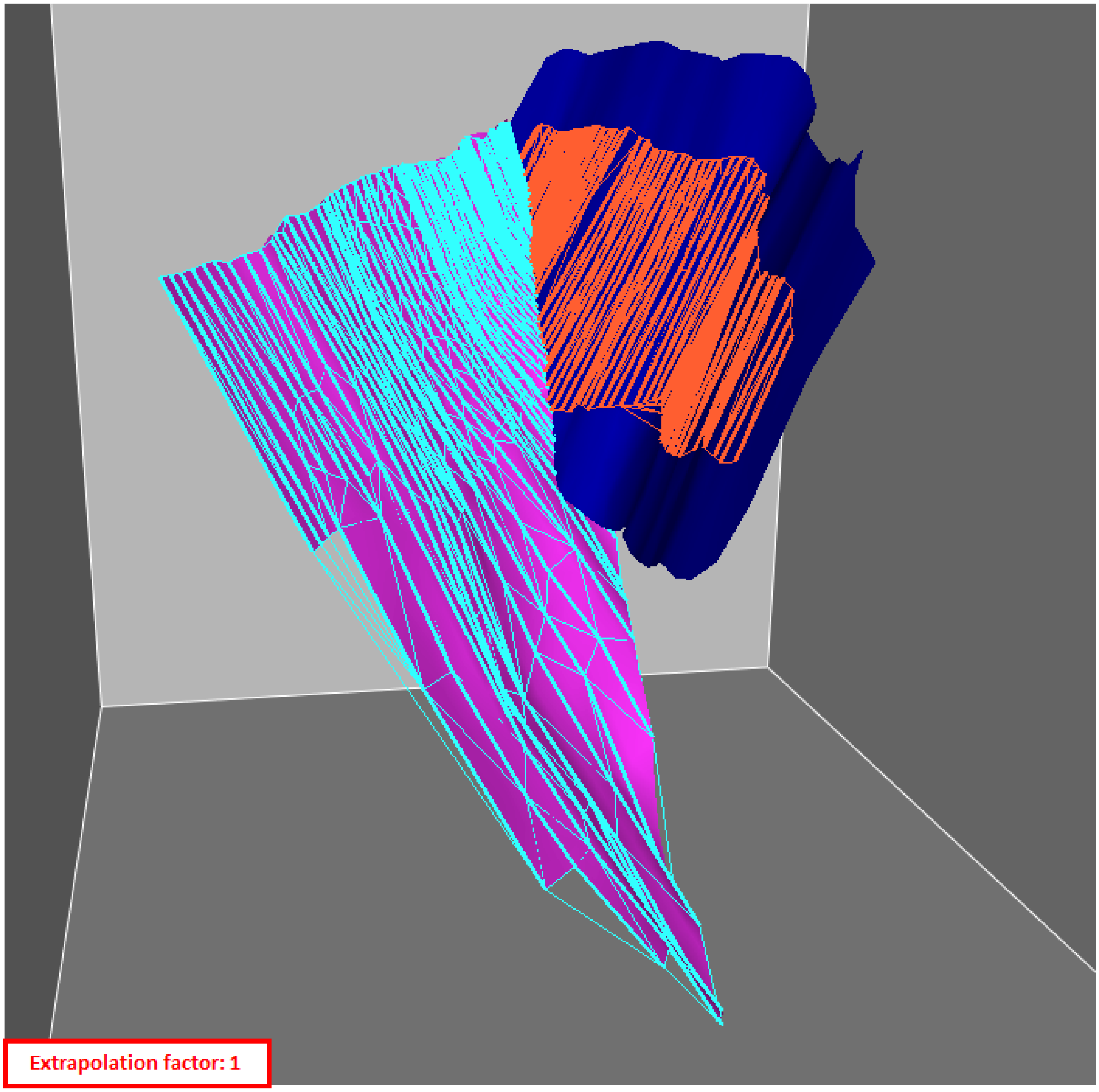
32. In *Cube* view, turn on **Fault_F** (Framework and Original) and turn off **Fault_D** (Framework and Original); note that **Fault_F** (dark blue) does not reach **Fault_A** everywhere along the extent of **Fault_F**.



33. In the *Dynamic Frameworks to Fill Workspace* window, select **Fault_F** in the upper *Faults* table. Enter “1” for Extrapolation Factor within the *Algorithm* action tab.

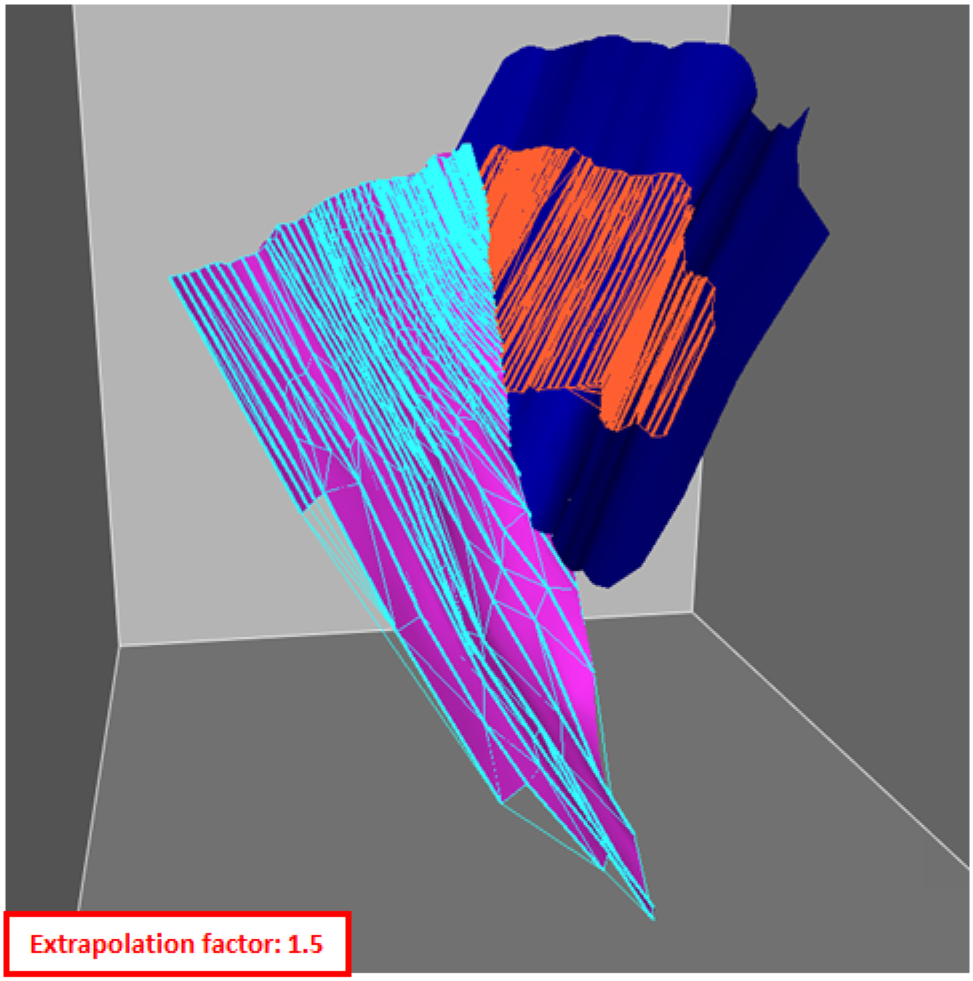


Your Fault_F should look similar to the one below.



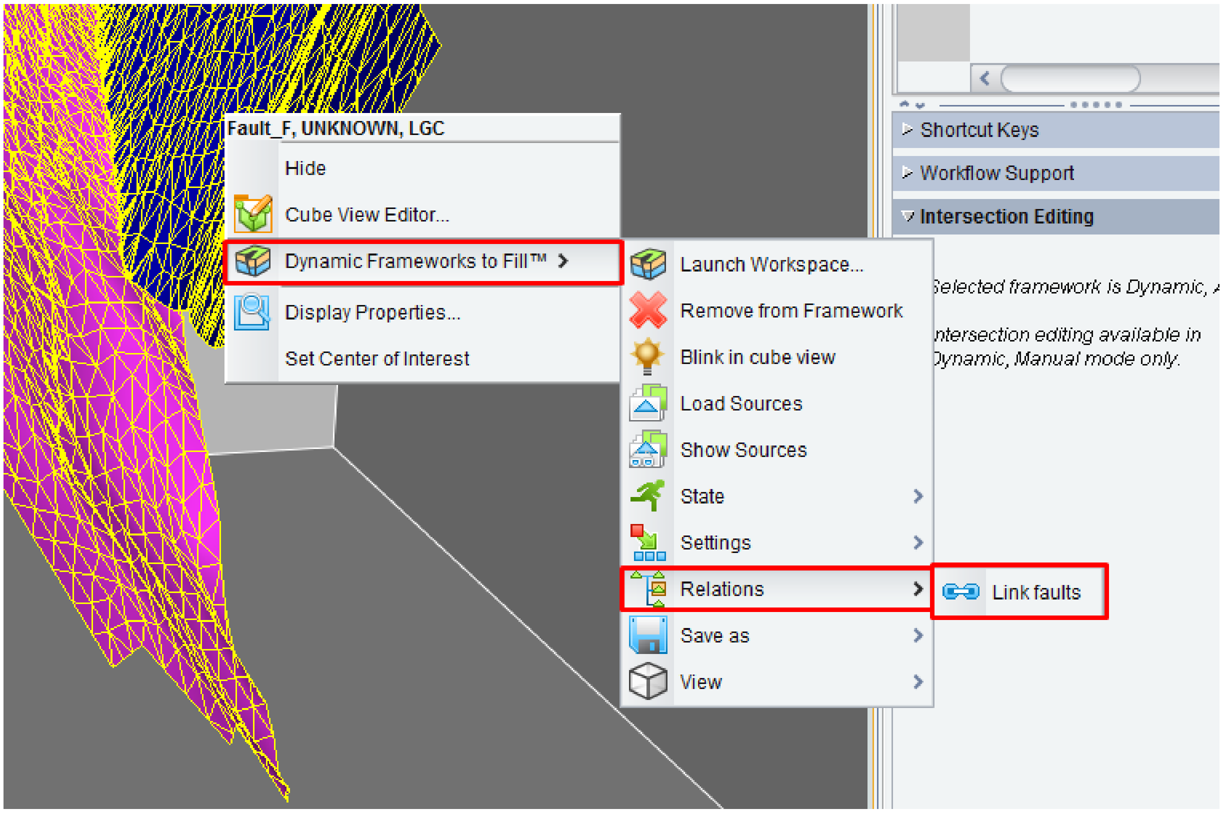
Increase the Extrapolation Factor again, as **Fault_F** does not reach **Fault_A** quite enough.

34. Change the Extrapolation factor from 1 to "1.5" for **Fault_F**. Your framework will automatically update, as long as you still have your framework in **Dynamic, Auto Refresh**.

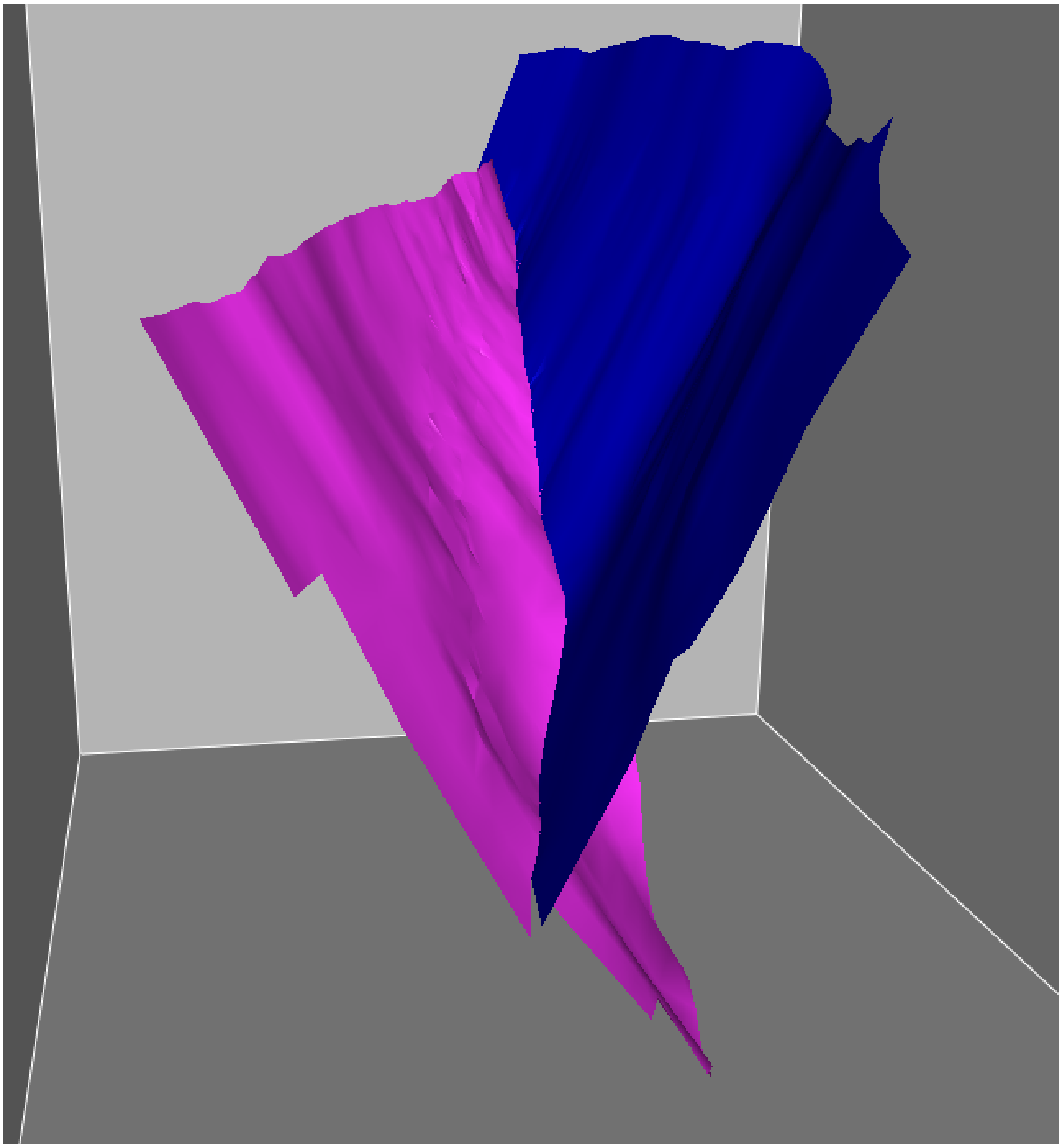


35. In *Cube* view, turn off the original source faults for **Fault_A** and **Fault_F**.

36. Get into **Select/Drag Mode** (), and **MB1** on either of the faults in the view. **Ctrl+MB1** on the other fault within the view. M**B3** on either of the selected faults and select **Dynamic Frameworks to Fill** > **Relations** > **Link faults**.

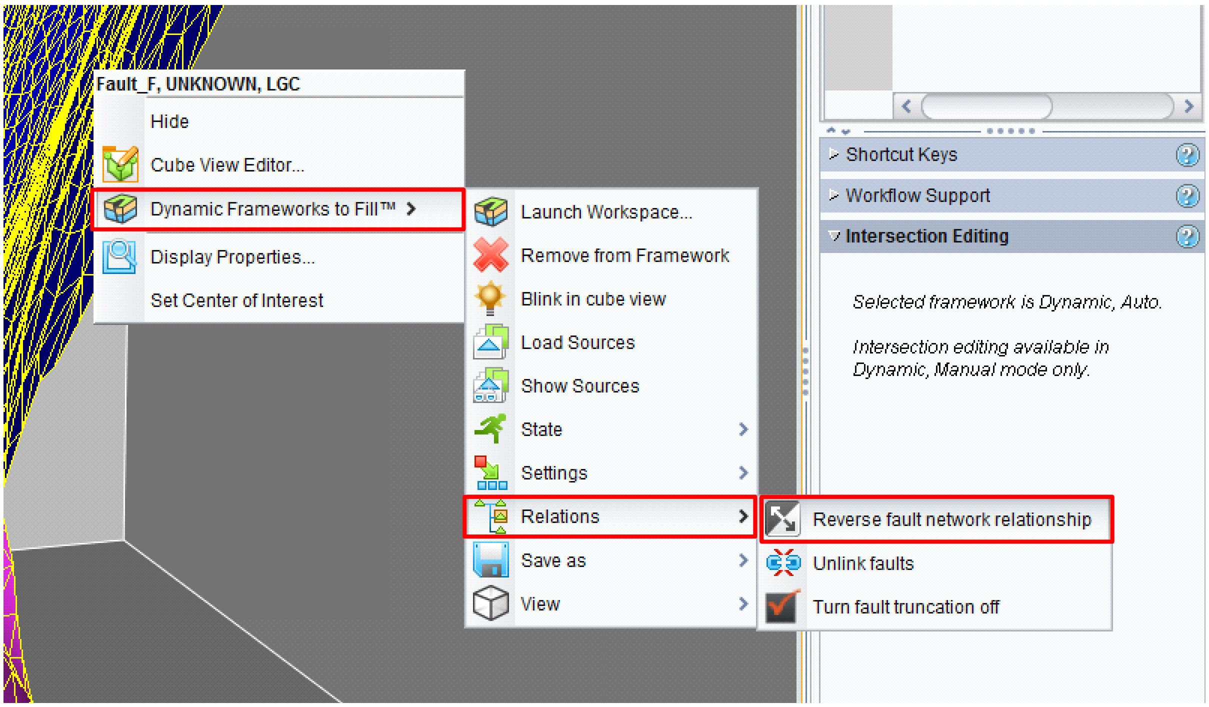


This process will cause the faults to be linked along their entire extent. Your fault relationship should look similar to the one below.

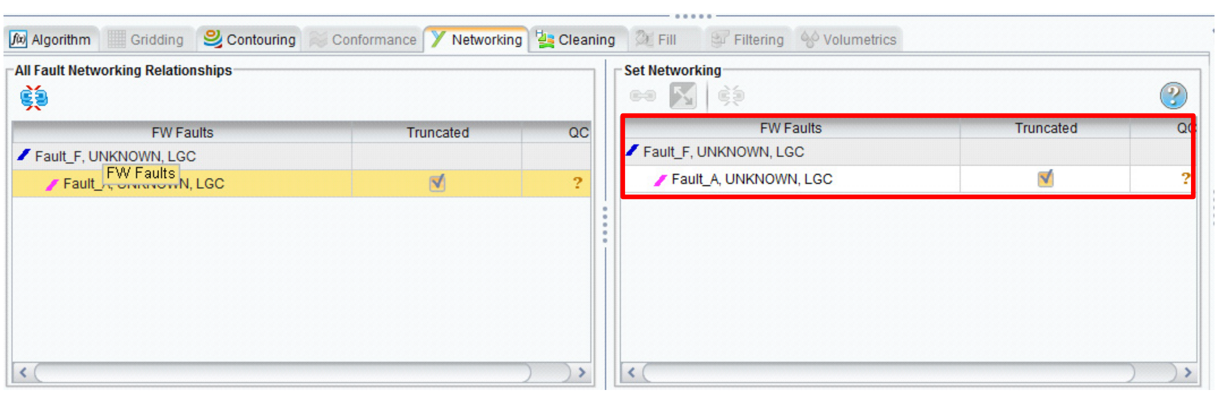


You can also reverse the relationships between faults, making the parent the child and visa-versa.

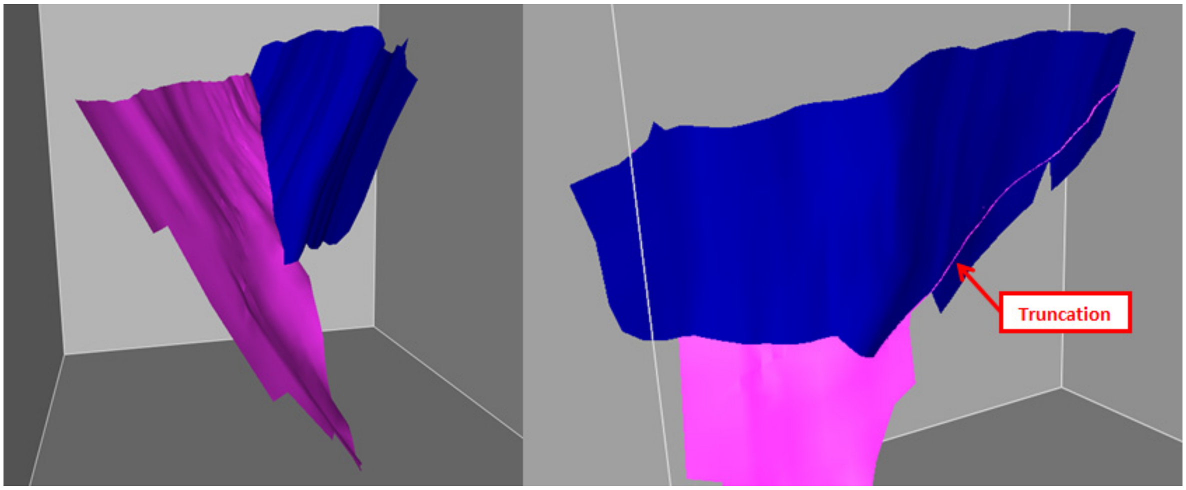
37. In Select/Drag Mode, **MB1** on either of the faults in *Cube* view. **Ctrl+MB1** on the other fault within the view. M**B3** on either of the selected faults and select **Dynamic Frameworks to Fill > Relations > Reverse fault network relationships**.



This will cause **Fault_F** to become the parent, and for **Fault_A** to become the child. This relationship can be seen in the *Dynamic Frameworks to Fill Workspace* window.



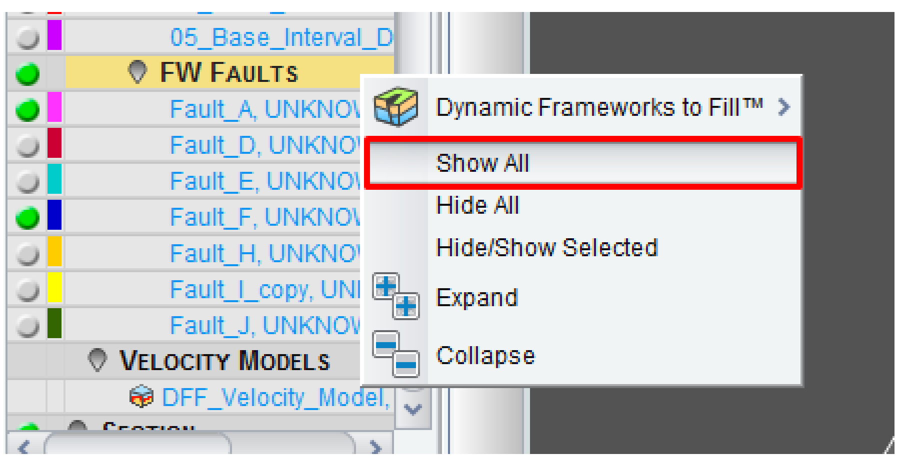
Examine this relationship in *Cube* view, and see how the fault geometries have changed. They should look similar to the ones below.



These new fault geometries are not geologically likely, but now you know how to reverse fault relationships. You will now reverse the relationship again to have the most geologically reasonable interpretation.

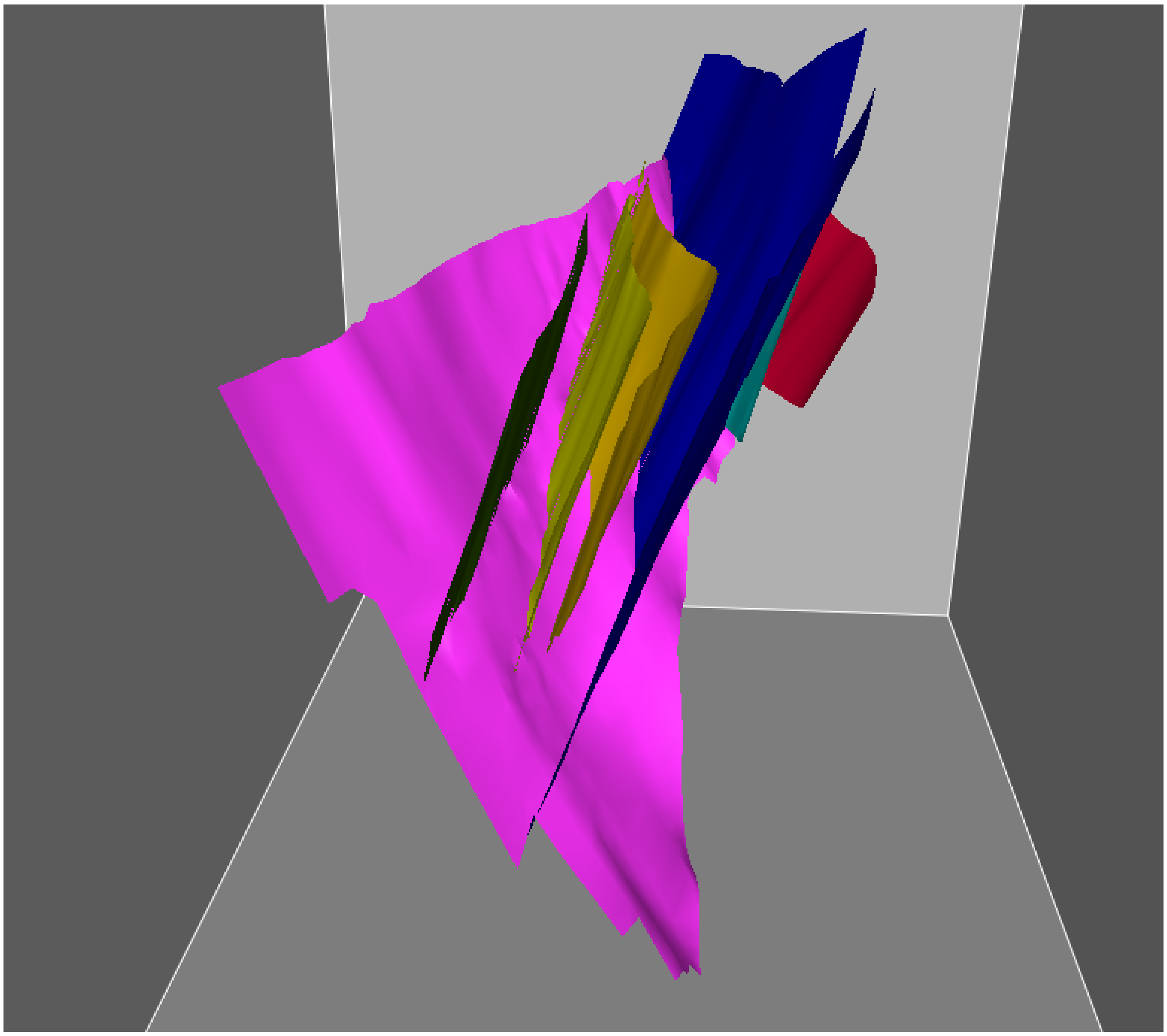
38. In **Select/Drag Mode**, **MB1** on either of the faults in *Cube* view. **Ctrl+MB1** on the other fault within the view. M**B3** on either of the selected faults and select **Dynamic Frameworks to Fill > Relations > Reverse fault network relationships**.

39. Within the *Inventory* task pane **MB3** on **FW Faults** and select **Show All**.



40. In the *Dynamic Frameworks to Fill Workspace* window click the **AutoNetwork Faults** ( ) icon. Your framework should refresh.

You now have a fully networked group of faults, with geologically realistic relationships. Your *Cube* view should look similar to the one below.



Review

This chapter demonstrated advanced methods for controlling framework surfaces and faults in your structural model.

The activities in this chapter included:

- Experimenting with gridding parameters for surfaces
- Examining how these surface grids relate to faults
- Learning about horizon cleaning
- Editing fault-horizon intersections
- Understanding Fault Type (fault relationships)
- Controlling the fault network
- Editing fault-horizon intersections
- Adjusting framework faults
- Finalizing structure with Fault Network

Chapter 4

Dynamic Property Mapping and Volumetrics

You will explore several applications of a completed framework in the exercises in this chapter.

Topics Covered in this Chapter

The following topics are covered in this chapter:

- Defining mappable intervals using framework surfaces
- Calculating multiple reservoir property attributes per mappable interval
- Controlling mapping parameters for each property map
- Disconnecting grid extents from structural framework
- Using the *Inventory* tree to control visibility in sections
- Using the log calculator to create a calculated log curve which when changed will cause dependent property map to be updated
- Framework-based volumetric calculations that update in response to changes in framework and fluid contact changes
- Using Zone Manager for advanced petrophysical calculations, and the creation of pointsets to use in the framework
- Compartment utilization

The overview section, starting on the next page, will discuss the chapter highlights.

Overview: Property Mapping and Volumetrics

In this chapter, you will focus on ‘filling’ your framework with reservoir properties and the calculation of hydrocarbon volumes.

We will discuss the basics for creating log-derived property maps and displaying these maps in standard map views as well as showing them as ‘fill’ in *Section* view between intervals defined by the structural framework. Mapping tools support the definition of multiple top-base intervals (based on tops and/or surface intersections with the well bore) with multiple log-derived attributes per interval (e.g., gross thickness, average porosity, average hydrocarbon saturation, average Vshale, net pay, etc.).

As with the structural framework construction process, you will see how changes to inputs to the property maps trigger an automatic (dynamic) update to all affected maps. Examples of input changes can include the drilling of a new well in the field or updates to the inputs to the parameters used in a log-curve calculation (e.g., Archie equation parameter inputs, or changes to pay flag criteria).

Note

While mappable intervals are defined by framework surface ‘names’, when surfaces are defined with well tops, the top-base interval definition for log-derived calculations utilizes the actual surface pick top locations to define the interval extent. Only when a well top is absent from a given well will the surface intersection with that well be used as the interval definition.

Deterministic vs. Probabilistic Mapping

The calculation and mapping of log-derived attributes in the *Dynamic Frameworks to Fill* workflow is performed using deterministic mapping techniques which utilize standard interpolation algorithms (e.g., refinement gridding, Kriging, and triangulation).

This type of property mapping is deterministic as compared to probabilistic. In earth modeling applications (including DecisionSpace Geoscience Earth Modeling tools), property mapping can be applied using probabilistic simulations to assess the range of uncertainty for a given property distribution. Probabilistic simulations are important when a knowledge of reservoir property uncertainty is of critical importance (i.e., for well planning and infrastructure planning). However, if reservoir properties are fairly uniform or only vary slowly across the field or study area, use of the Dynamic Frameworks to Fill property mapping has significant advantages, including dynamic updatability as new data are added to the project.

Exercise 4.1: Gross Thickness Mapping

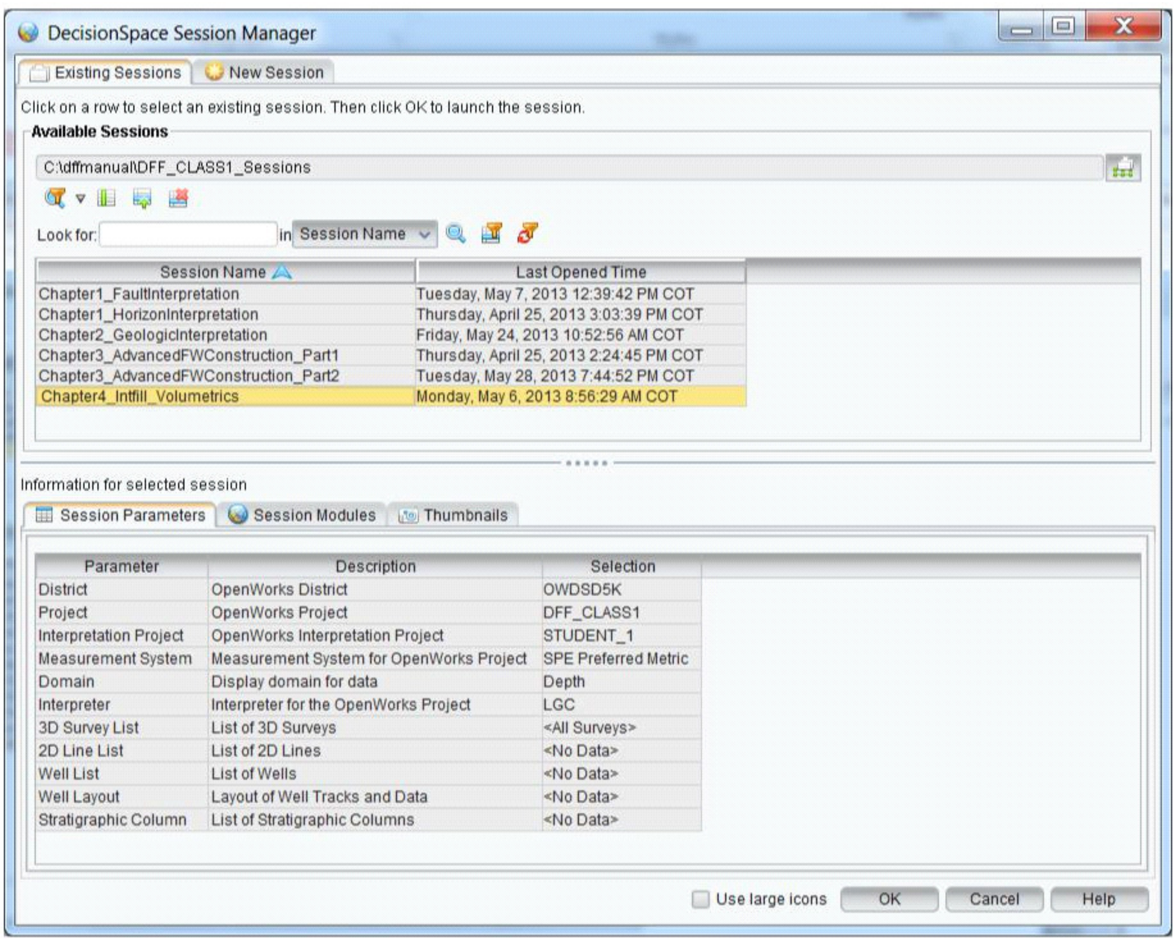
Interval Attribute Property mapping contributes to your understanding of the field in two major areas:

- Distribution of rock and fluid properties between structural layers
- Thickness relationships in the structural model

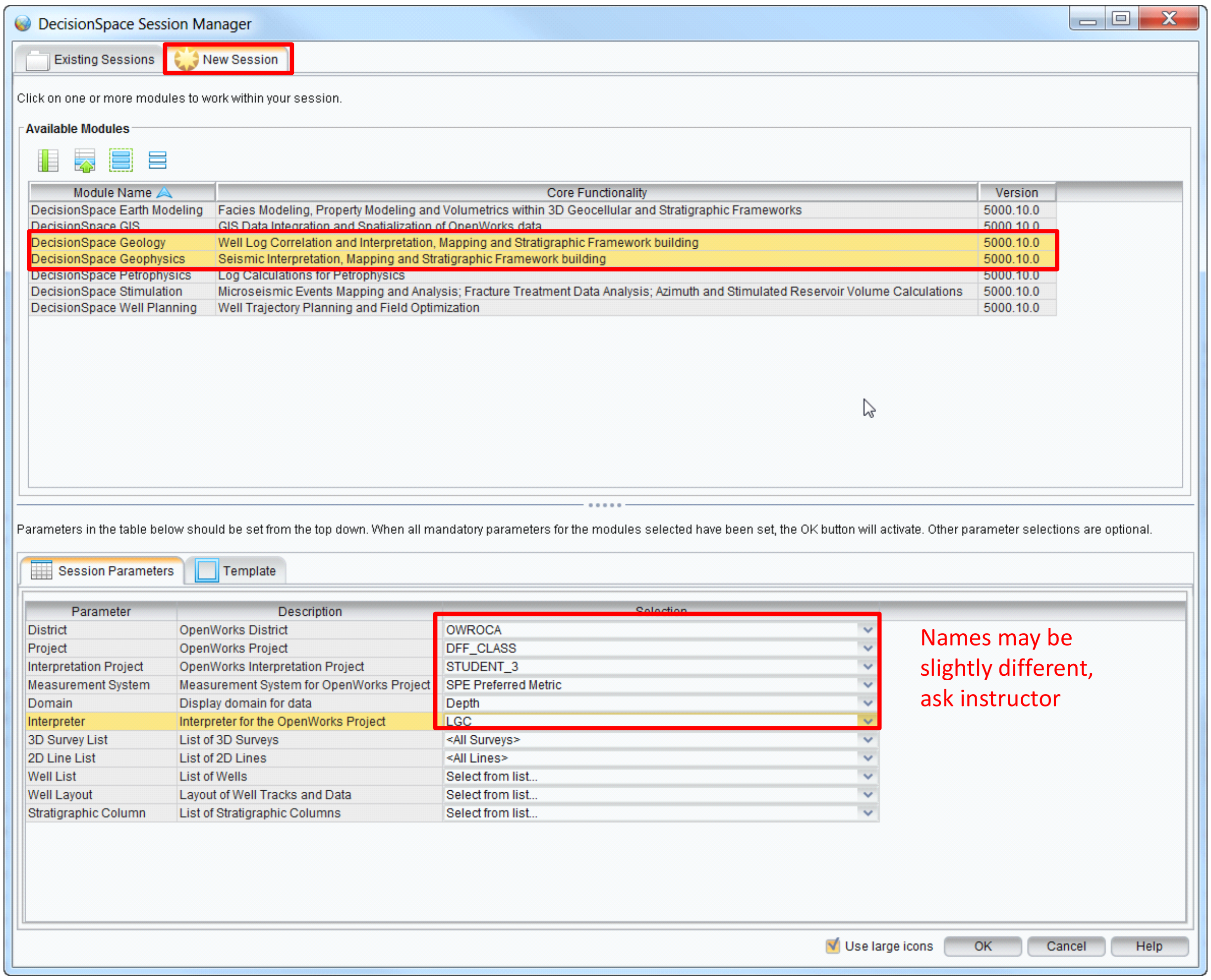
The following exercises will explain the basic workflow.

You will begin this chapter with your final framework from Chapter 2, or a similar example saved as a dynamic framework.

1. Launch DecisionSpace. Load session **Chapter4_IntFill_Volumetrics**. If it opens successfully skip to step 6.

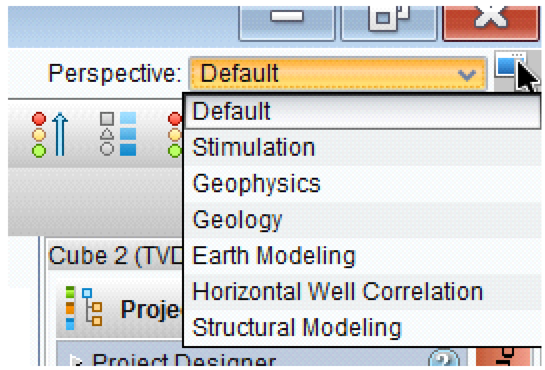


2. If you have trouble loading the session named above, initiate a **New Session** in **Depth** as shown below and accept the default **Map/Section/Cube** triple tile template.



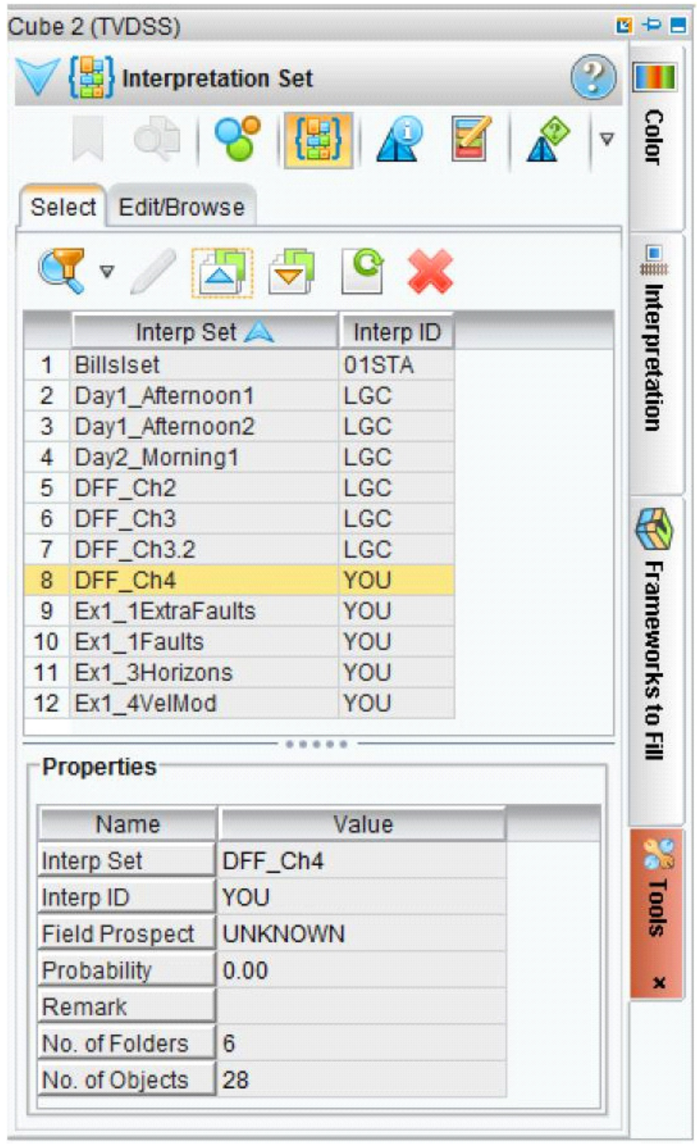
Note

You can customize your window with different perspectives that allow you to show only the options that you need for different workflows.

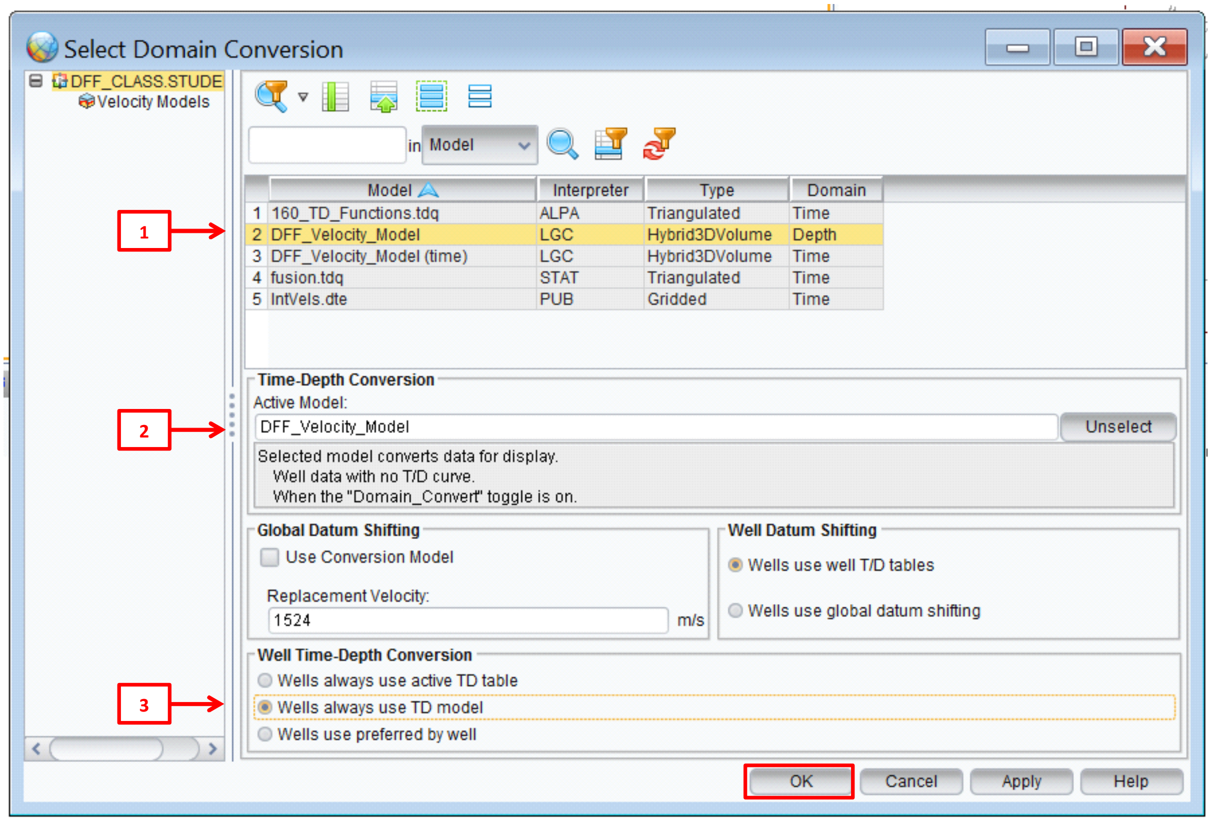


3. If you did not use the session named above, load ISet **DFF_Ch4**.

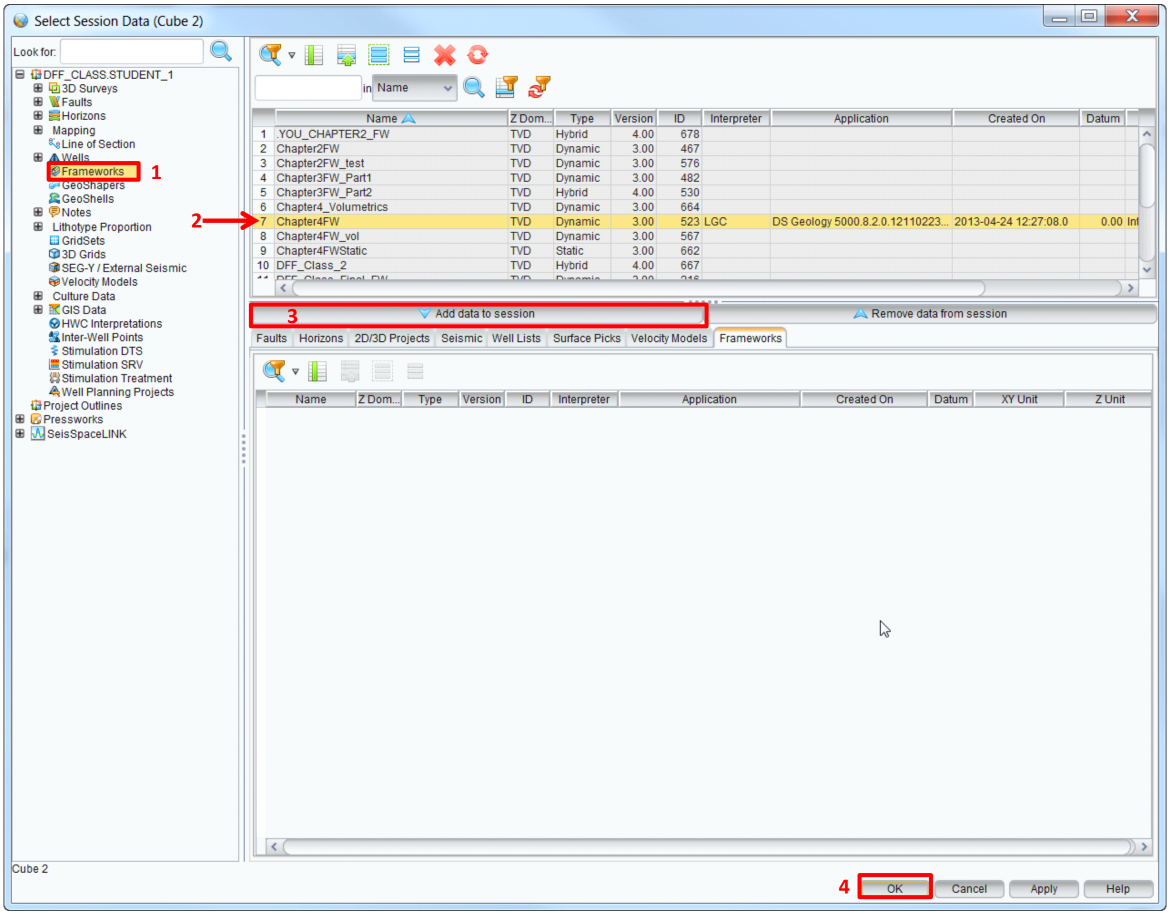
   In the *Tools* task pane, click the **Interpretation Set** ( ) icon. Select the **DFF_CH4** interpretation set and select the **Load Data to Session** ( ) icon.



4. From the main menu bar, select **Select > Domain Conversion...**. Then select the velocity model **DFF_Velocity_Model** (in depth). The name of the model should appear in the *Active Model* box. Finally, click the **Wells always use TD model** option, and then click **OK**.

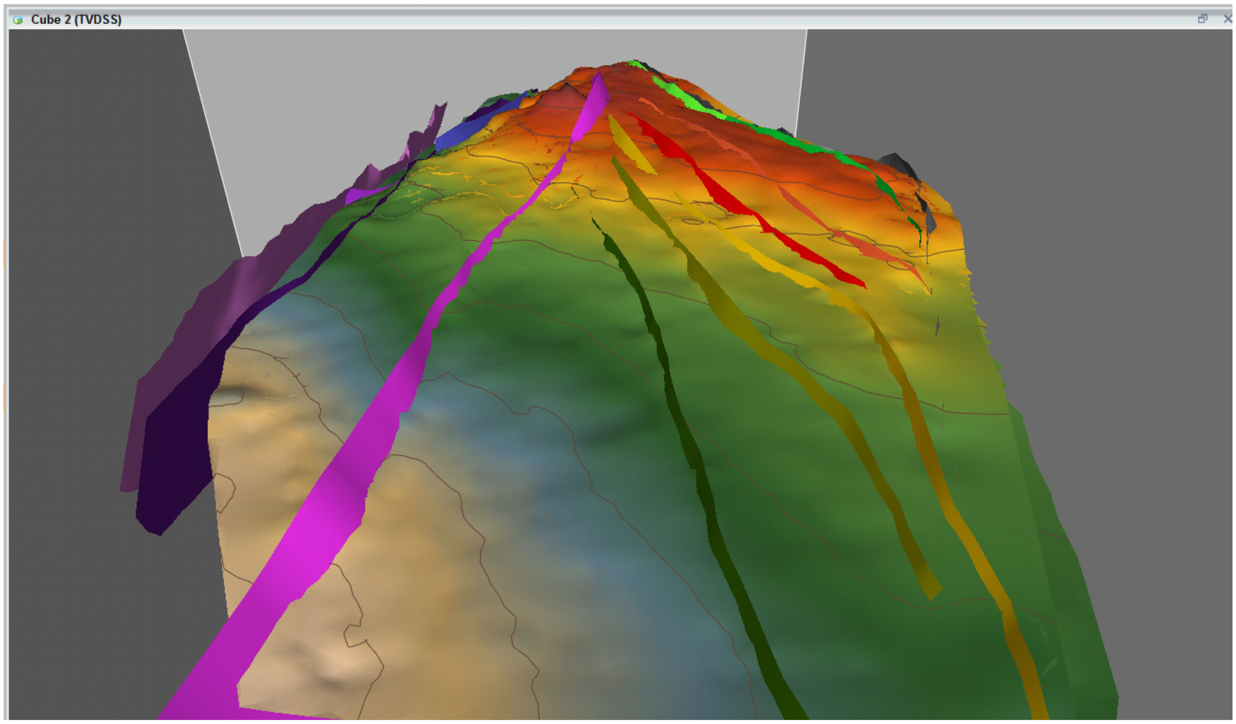


5. Click the **Select Session Data** ( ) icon. In the *Select Session Data* dialog box, select **Frameworks > Chapter4FW**, and click **Add data to session**. Click **OK** to close the dialog box.

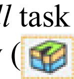


6. In *Cube* view familiarize yourself with the framework. This will give you a good idea of the relationships of the surfaces with the complex fault network.

Your view should look similar to the one below.

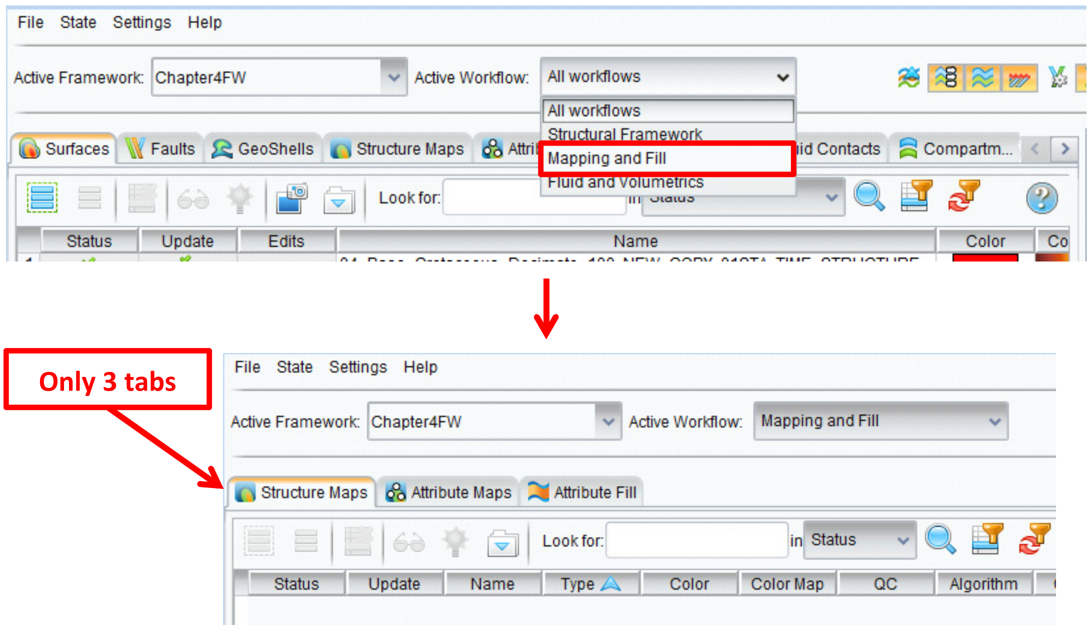


Now you will create different intervals from the framework model. These intervals are used to fill with different calculations. You will start creating gross thickness attribute maps from the intervals and then create other attributes based on petrophysical calculations. To do that, you need to work in the *Dynamic Frameworks to Fill Workspace* window.

7. In the *Dynamic Frameworks to Fill* task pane, click the **Launch Framework Workspace Window** () icon.

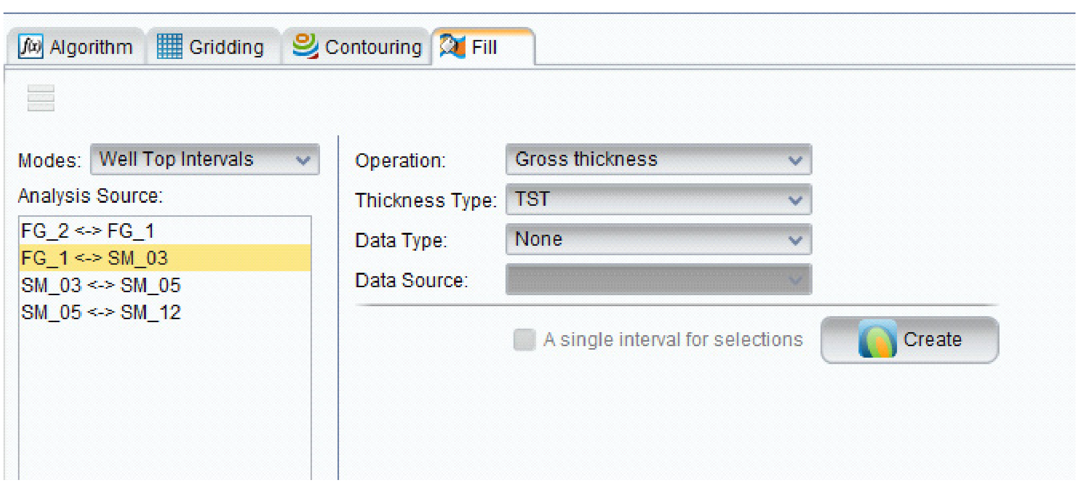
8. At the top of the window switch the framework to **Dynamic, Auto Refresh** () mode.

9. The *Dynamic Frameworks to Fill Workspace* window opens. To make the window more manageable, you only need to work with a limited amount of tabs in the workspace. At the top of the window under *Active Workflow* select **Mapping and Fill**. This will allow you to only have the tabs that you will be using visible.



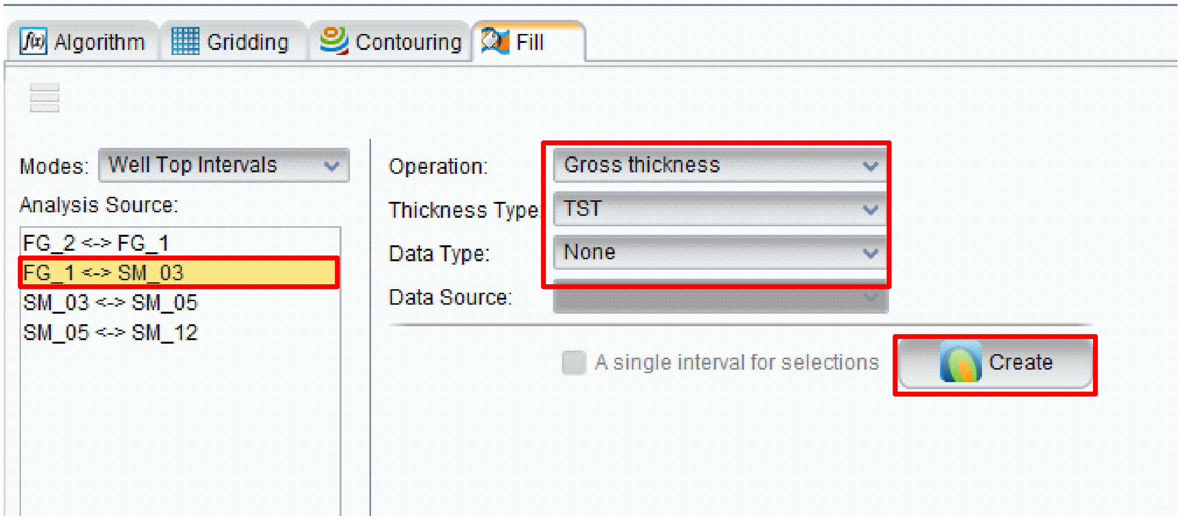
10. Navigate to the *Attribute Fill* tab and the *Fill* action tab.

The left portion of the tab shows all of the intervals that are available for fill from your surface picks in your wells. The right portion of the tab gives you multiple choices of operations to run to fill those intervals.

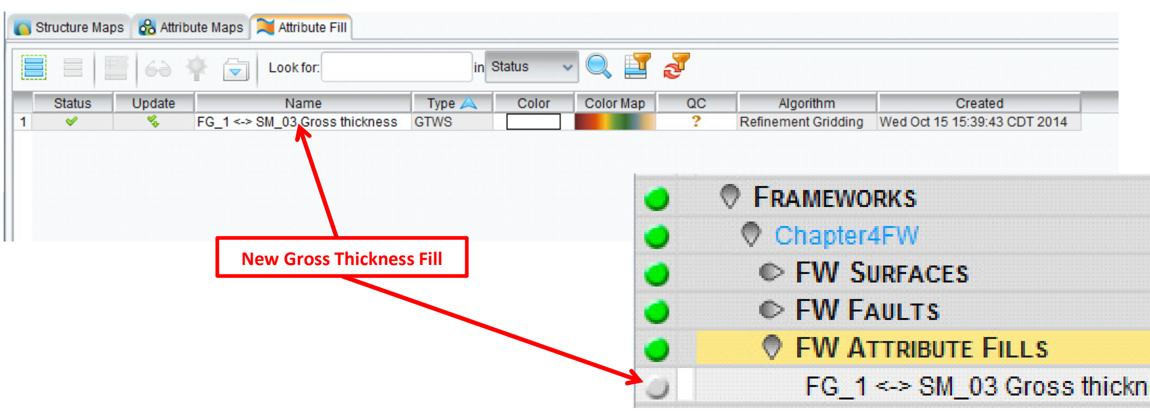


11. Select the second interval **FG_1 <->SM_03** as the interval to be used to fill. For *Operation* select **Gross thickness**; *Thickness Type* select **TST**; *Data Type* select **None**. This will create a gross thickness map, specifically an Isopach due to using TST, in between the **FG_1** and **SM_03** surface picks.

12. Click the **Create** button.

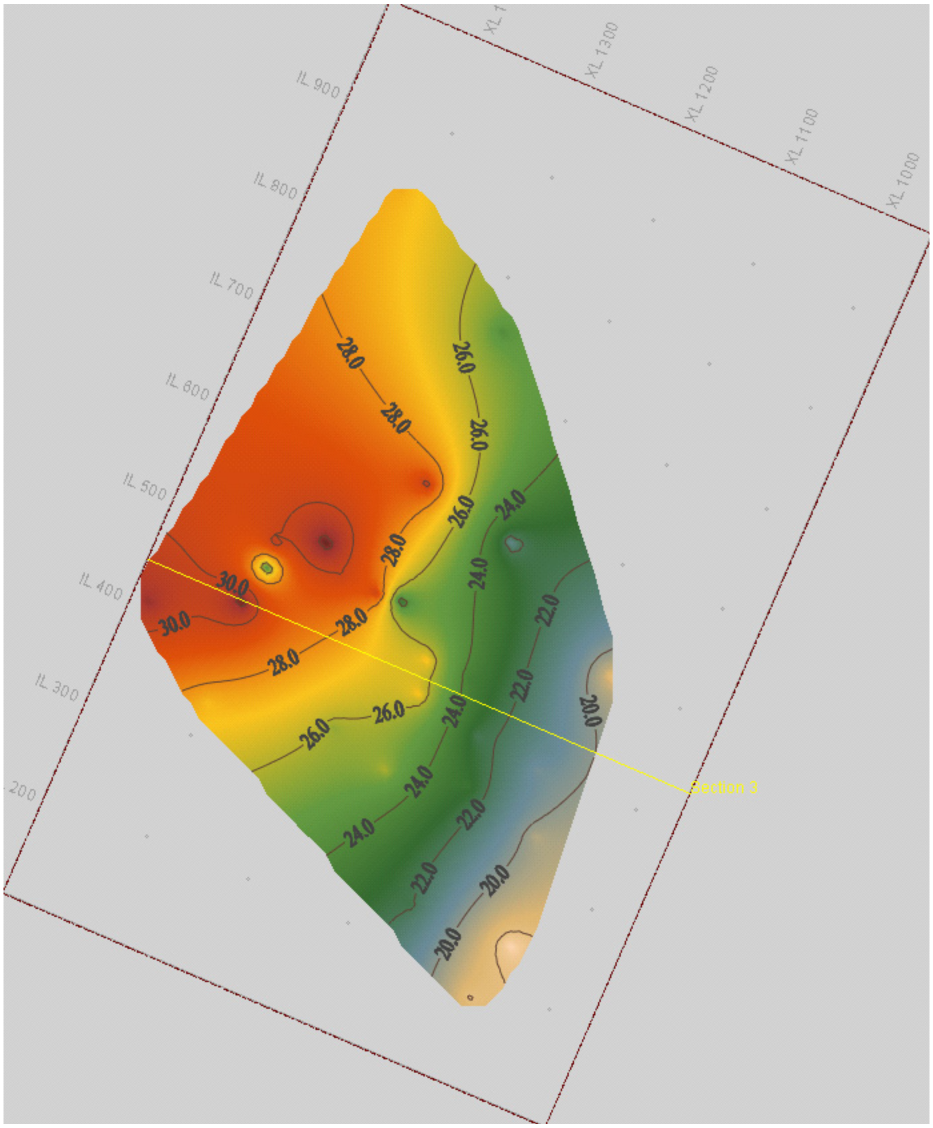


13. The newly created gross thickness map will show up in the upper *Attribute Fill* tab. It will also appear in the *Inventory* task pane under **Frameworks > Chapter4FW > FW Attribute Fills**.



14. For now maximize your *Map* view and display the gross thickness attribute.

Your view should look similar to the one below.

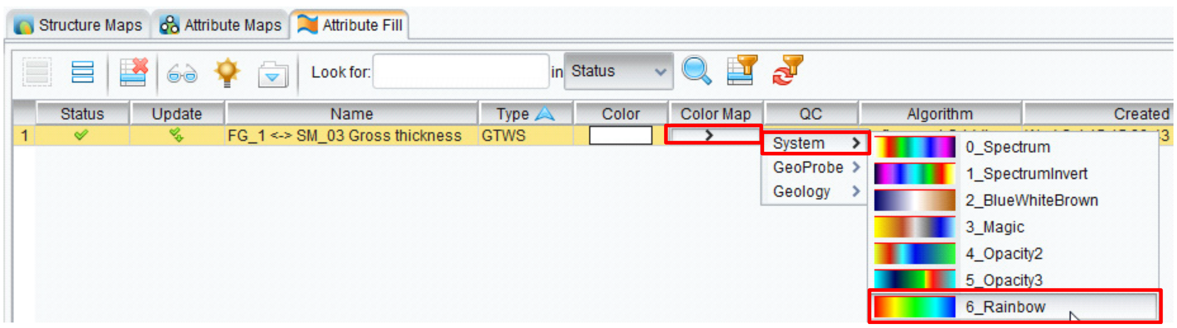


Note

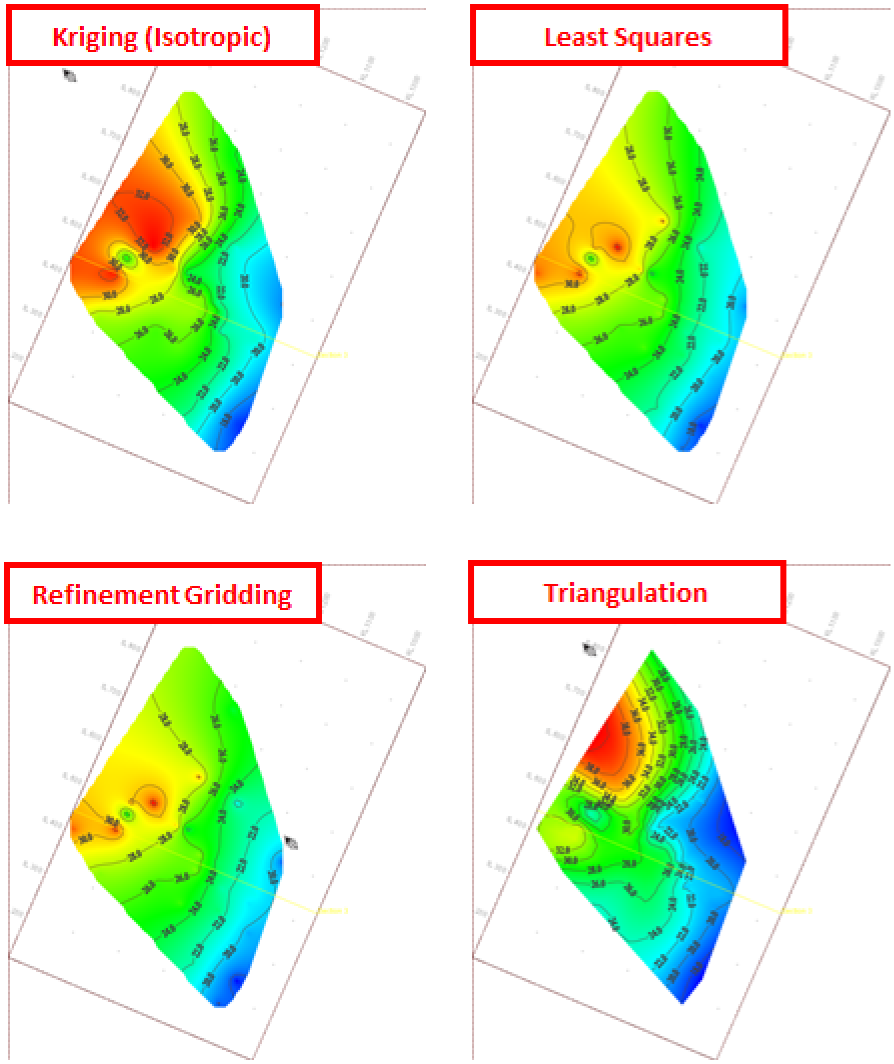
If you want to see more contours, highlight the interval from the *Attribute Fill* object tab and select the *Contouring* action tab. From there, you can modify contour interval. The picture above has been modified to show **Regular contour interval** every **2** meters.

All changes that need to be made on your gross thickness map can be done from the *Dynamic Frameworks to Fill Workspace* window. You can change the Color Map, the Algorithm used for calculation, and the contours on the map.

15. In the *Dynamic Frameworks to Fill Workspace* window, **MB1** on the **Color Map** box in the main *Attribute Fill* tab. Select **System > 6_Rainbow**. This type of color map is more appropriate for maps like gross thickness.

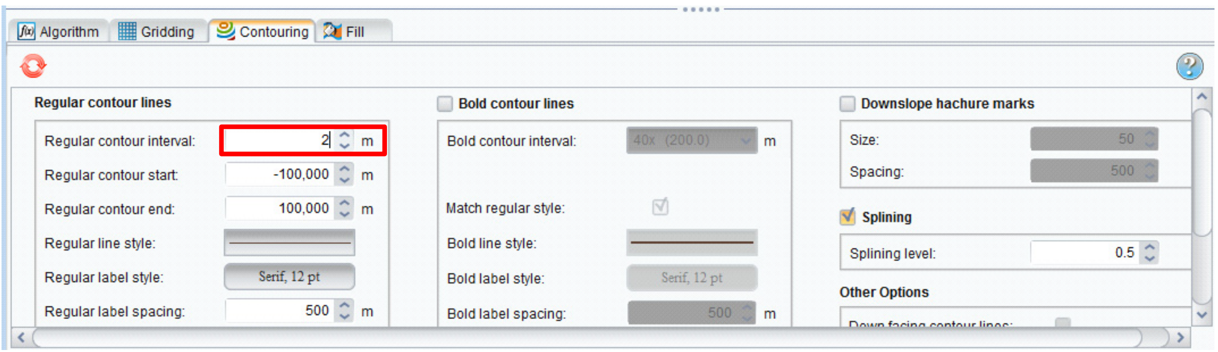


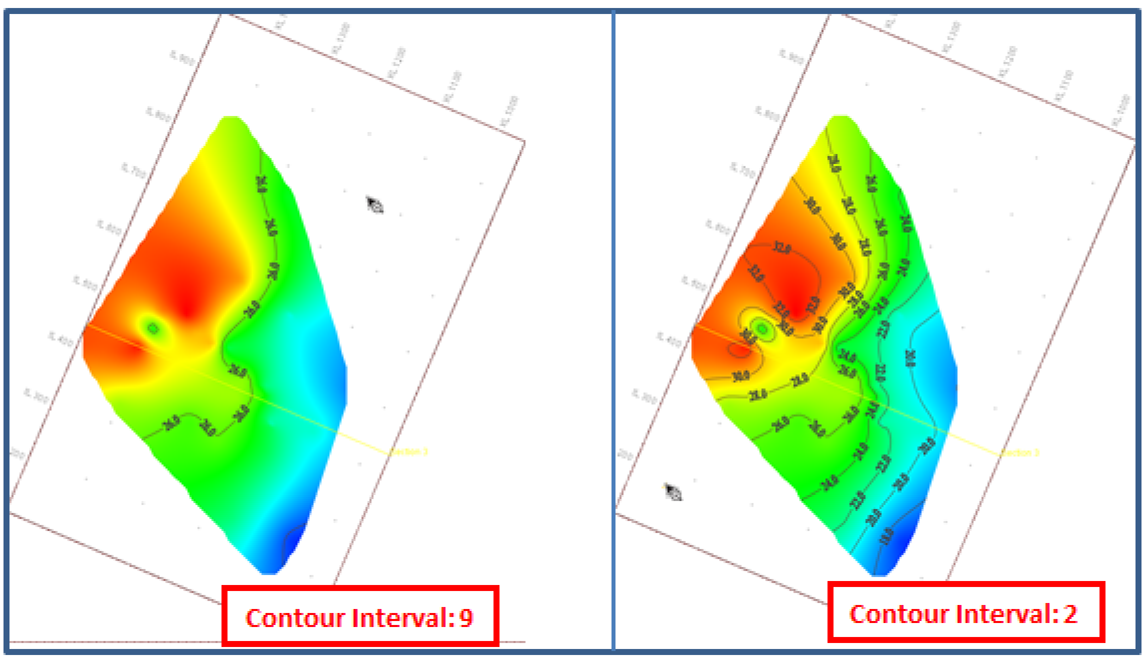
16. In the *Attribute Fill* tab, navigate to the *Algorithm* action tab. You can change the different algorithms used to calculate the attribute fill here. Highlight the **gross thickness** map in the *Attribute Fill* object tab, and go through some of the algorithms. Pay attention to the changes being made to the attribute fills in your *Map* view as you change algorithms.



17. You will move on with the gross thickness map using **kriging (isotropic)** as the algorithm for calculation.

18. With the gross thickness attribute fill highlighted (**FG_1 <->SM_03 Gross thickness**) navigate to the *Contouring* action tab. Here you can change the starting and stopping contours, as well as the interval at which they are shown. Change the *Regular contour interval* to “2”.



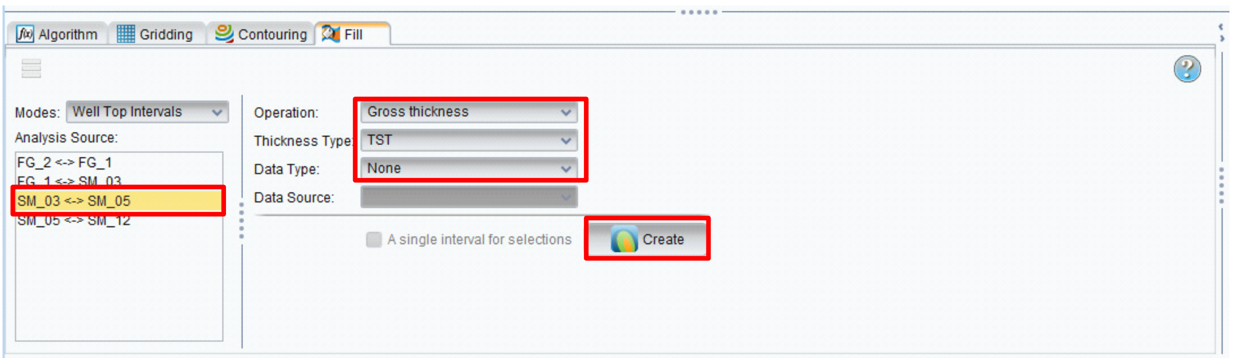


> **Note**
>
> There is also an option in the *Contouring* action tab to turn on **Downslope hachure marks**, this is where the direction of dip is marked on the contours. You can experiment with this option now; however, it is more useful for structural maps.

You will now create another gross thickness map for the interval **SM_03 <-> SM_05**.

19. In the *Dynamic Frameworks to Fill Workspace* window, in the *Fill* action tab, click the **Deselect all items in the table** ( ) icon. This will deselect the previously made gross thickness map.

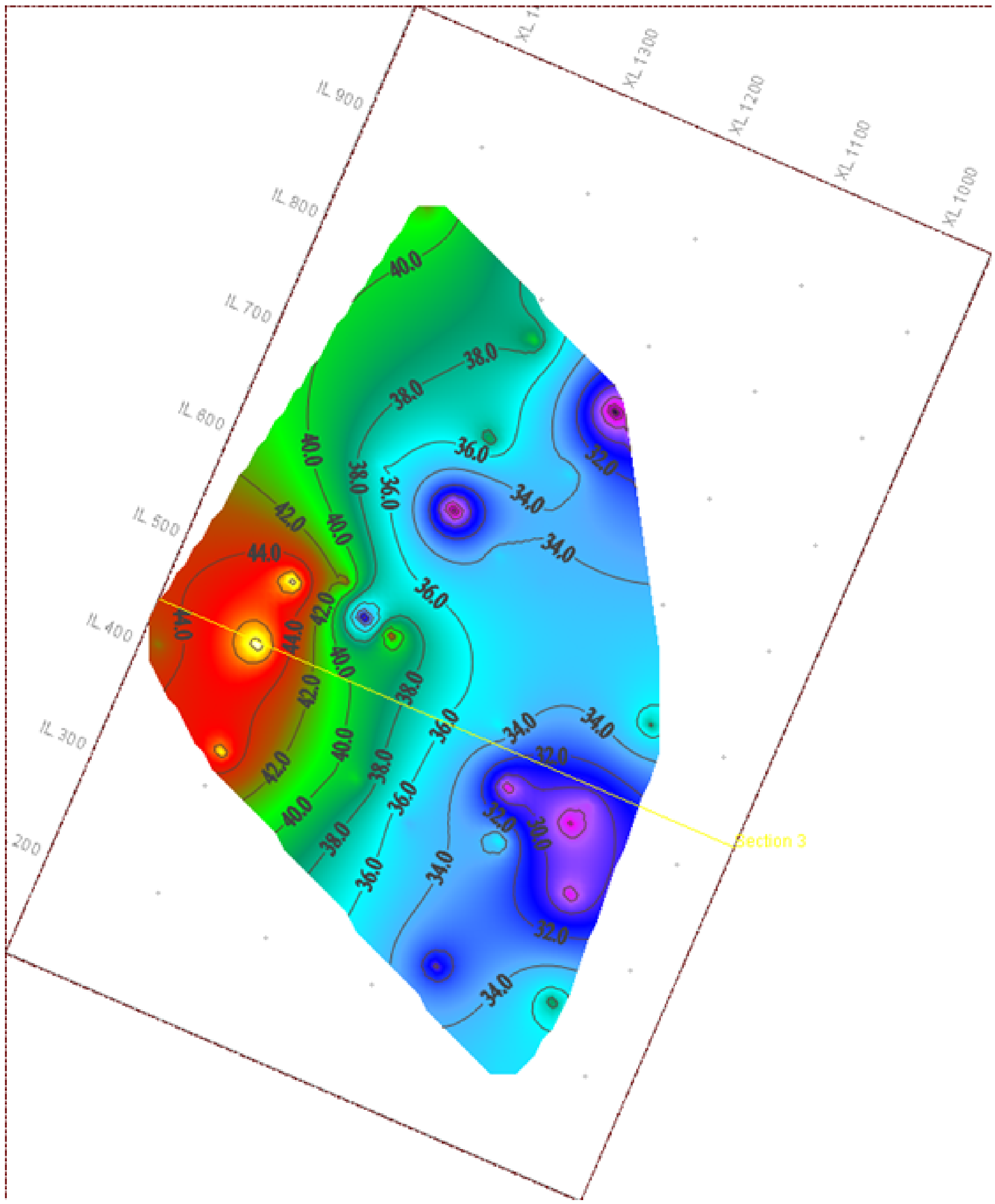
20. Select the **SM_03 <-> SM_05** interval. Select **Gross thickness** and **TST** for the parameters for the attribute fill. Click **Create**.



21. In the main *Attribute Fill* tab, change the new gross thickness map to the **0_Spectrum** color map. In the *Contouring* action tab, change the Regular contour interval to **2** m.

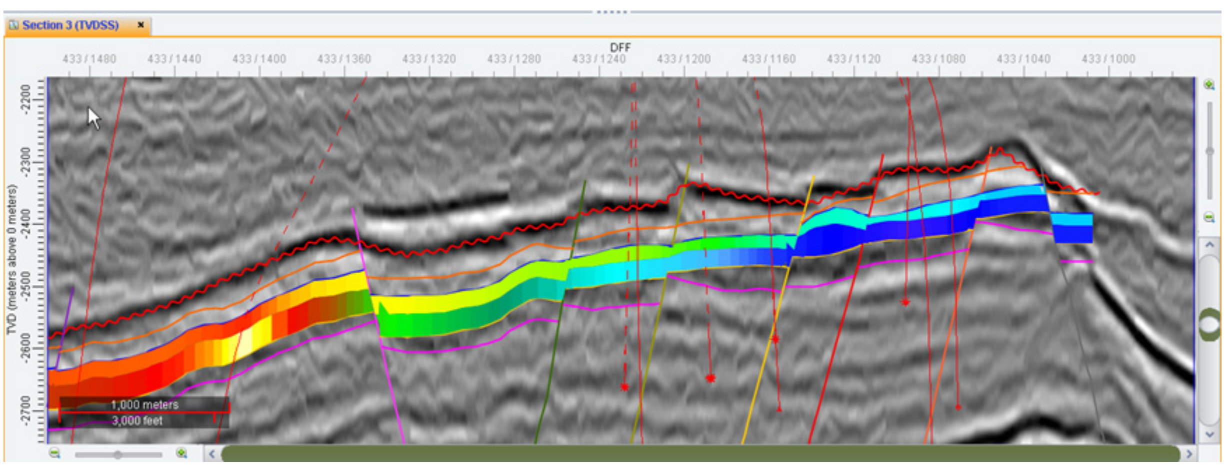
You will now visualize the newly created gross thickness attributes in your *Map* and *Section* views.

22. Display only the new gross thickness map for interval **SM_03 <-> SM_05** in *Map* view.



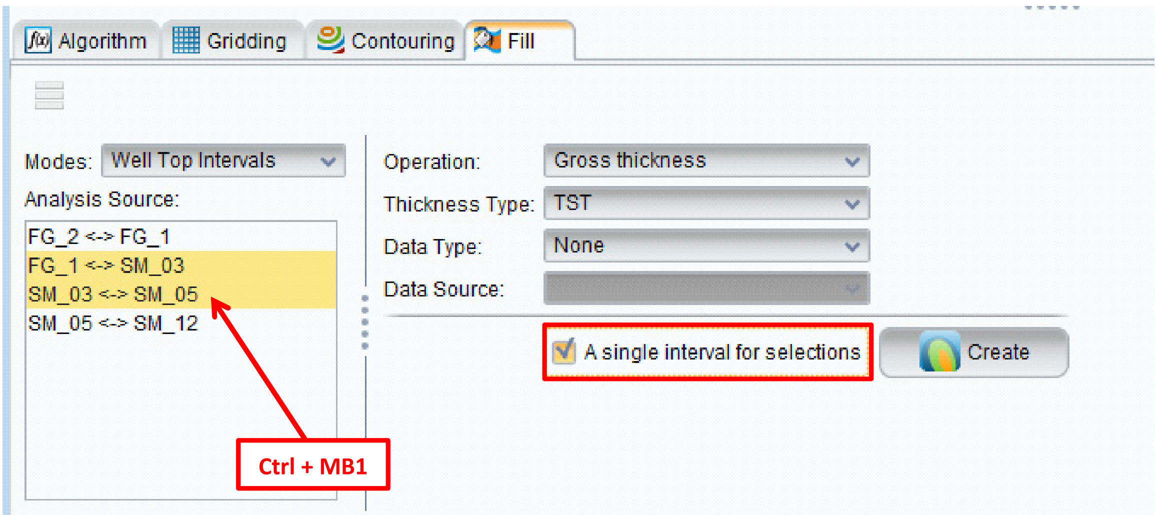
23. In *Section* view, from the *Inventory* task pane drag and drop the **StructuralFilter** volume into the *Section* view, and move to **Inline 433** (if you started from the session you should already have this inline displayed). Turn on all of the **FW Surfaces** and **Faults**, as well as the two gross thickness maps (**FW Attribute Fill**). To better visualize the attributes, change the color of your seismic to grayscale (Hint: **MB3** on the seismic and select **Display Properties**). Exaggerate the vertical scale as desired until you have a good view of the intervals.

> **Note**
>
> In *Section* view, these maps are shown as color fills between the two surfaces. This is a good QC display for well picks and fault picks.



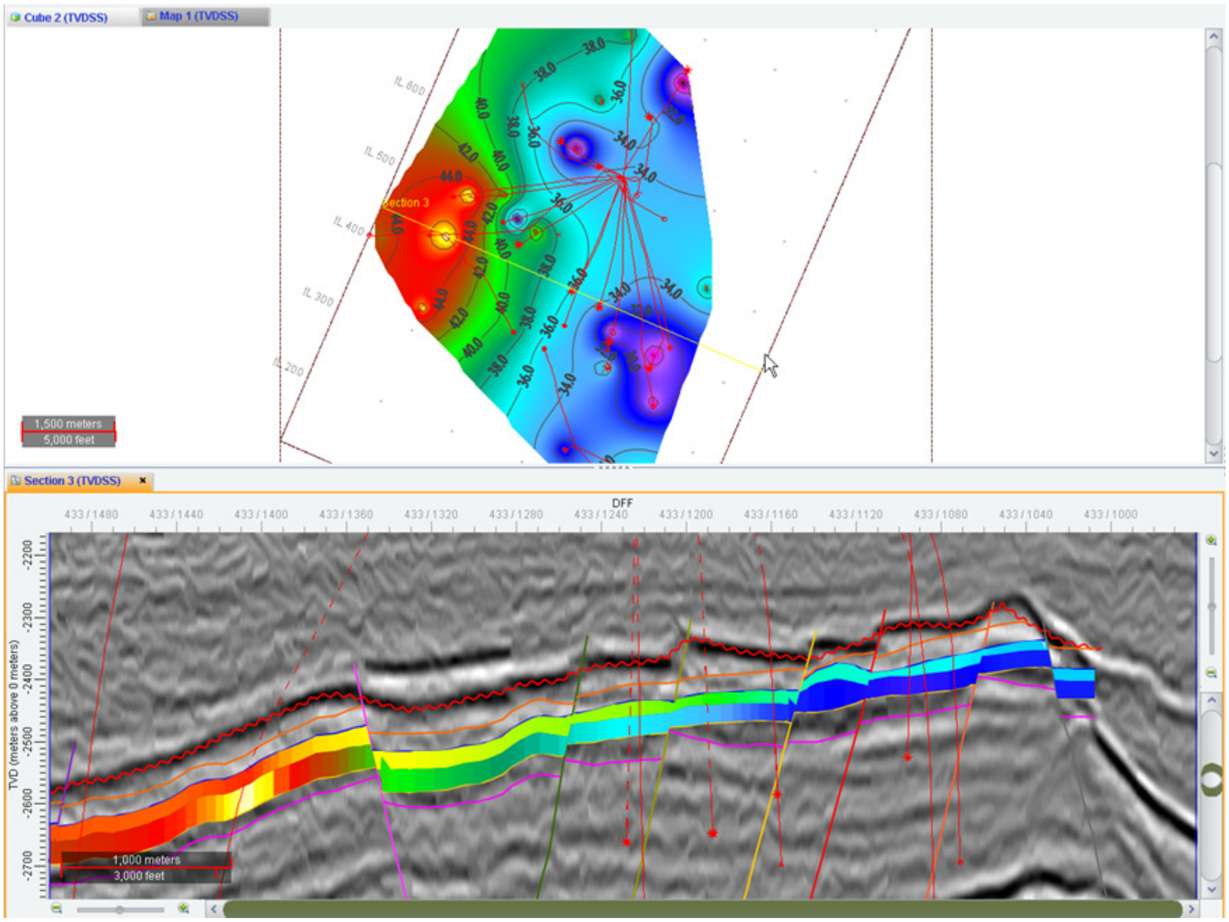
Note

Sometimes it is necessary to calculate an attribute over multiple intervals. For example, one of the formations you are looking at has an upper, middle, and lower part. If you want to get a gross thickness map of the formation as a whole, it is necessary to span multiple intervals. You can do this by selecting all of the intervals you want to use to calculate your attribute using **ctrl+MB1**. When multiple selections are made the **A single interval for selections** check box will become available. If you check this, it will make one attribute including all of the chosen intervals.



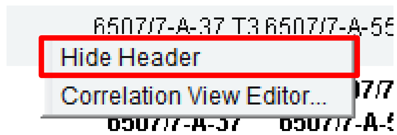
To perform a round of QC on your gross thickness maps, you can compare them to what you see in *Section* and *Correlation* views.

24. Turn on the **DFF Class_G** well list in your *Section* view. If necessary press the hot key <**V**> from the keyboard to orient the *Section* view in the same direction of *Map* view, see picture below.



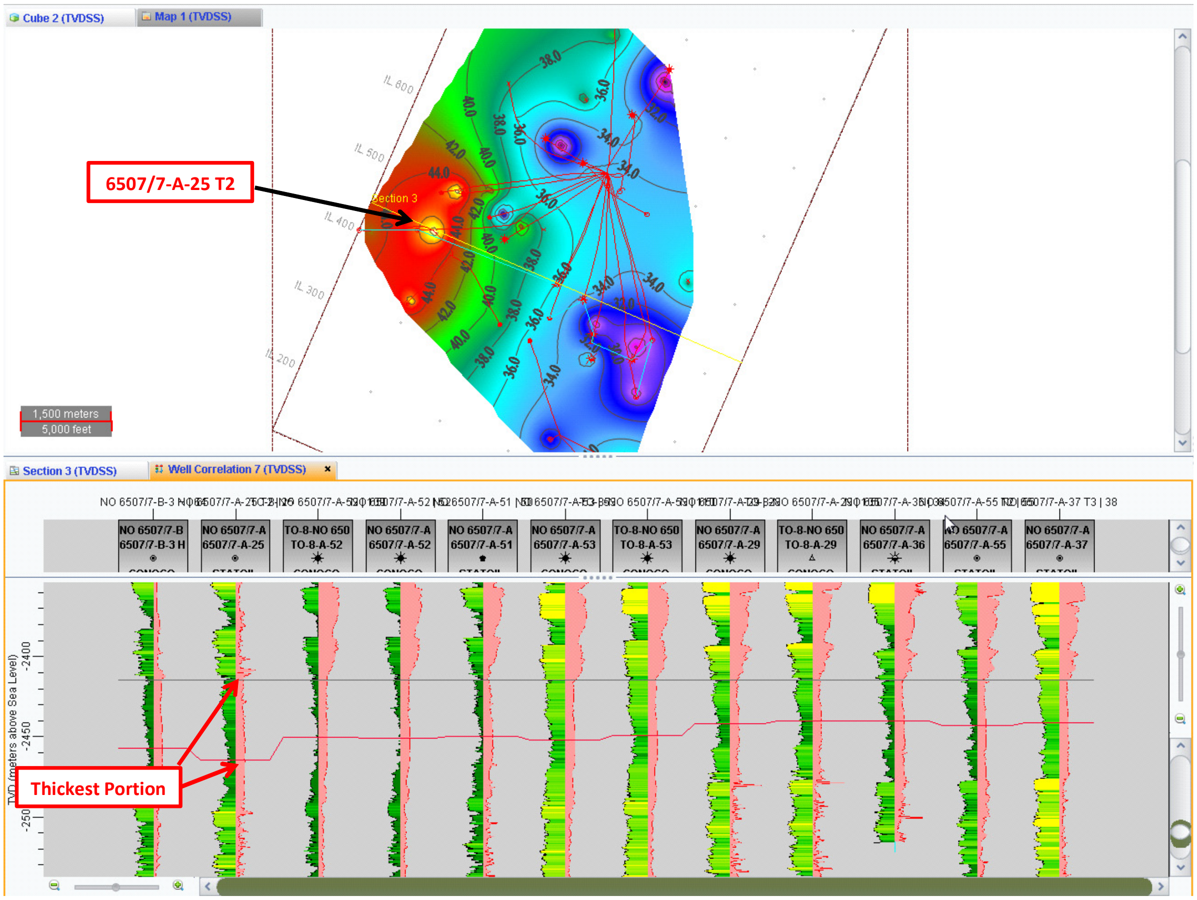
25. With *Section* view active, select the drop-down arrow next to the **New Tab** ( ) icon, and click the **New Correlation** ( ) icon. This will open a new *Correlation* view with all of the wells from your *Section* view.

26. **MB3** on any of the wells in *Correlation* view, and select **Layout: All Wells in View > Open**. Select **DFF_Simple_Class**, and click **OK**.

> **Note**
>
> You can choose to remove the headers from the top of your *Correlation* view by clicking **MB3** on the very top of the view and selecting **Hide Header**.
>
> 
>

27. In your *Correlation* view, turn off all picks except for **SM_03** and **SM_05**, and flatten on **SM_03** by clicking the **Select Pick for Flattening** () icon. This will make it easier to see the thickening/thinning between those two surfaces.

28. To make it easier to compare with the gross thickness map, turn on the **DFF Class_G** well list in *Map* view.



With Dynamic Frameworks to Fill, interpreters can generate internally consistent and robust subsurface interpretations. This is a highly valuable approach.

When you look at the TST map, you want to ensure that bed thickness across your prospect has a generally consistent trend other than local anomalies that might be accounted for by faulting or unconformities.

Looking at the picture above in *Correlation* view the interval between **SM_03** and **SM_05** is thickest at well **6507/7-A-25 T2**. Looking at *Map* view this corresponds to the gross thickness map you created. The interval within that well is located right in the thickest portion of the map, measuring about 48m. In *Map* view you can also see a general trend of thinning to the east, to about 30 m. This is also reflected in the *Correlation* view, with wells **6507/7-A-29** <-> **6507/7-A-37 T3** being significantly thinner than the wells on the other side of the structure.

Exercise 4.2: Dynamic Property Mapping Using Log Calculations

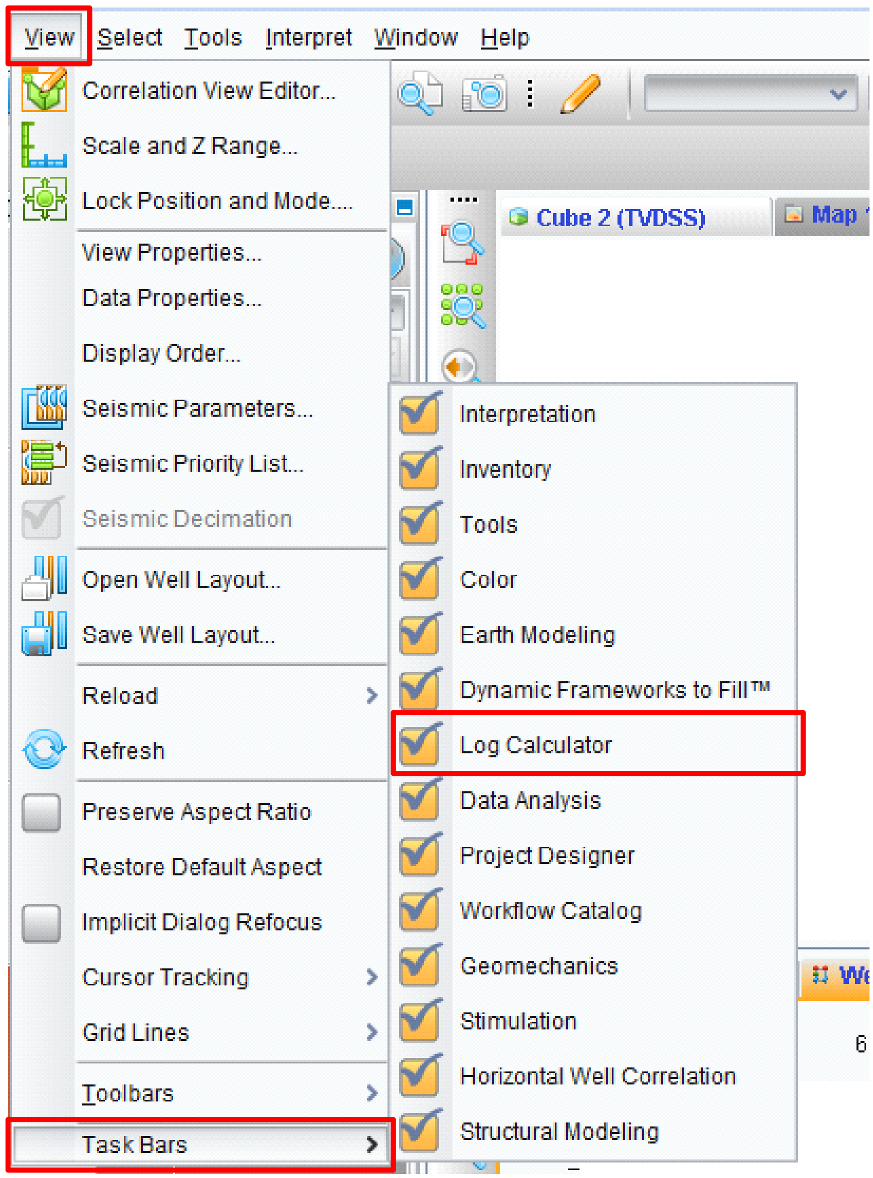
In this exercise, you will use the Log Calculator to generate multiple curves, including one for PAY, and then use those curves to create multiple attribute fill maps in Dynamic Frameworks to Fill.

You will also see another example of the dynamic updatability of Frameworks. Dynamic Frameworks to Fill will update automatically when any curves or attributes used by Log Calculator change. All of your maps that are associated with the equations will automatically update every time the Log Calculator is ran with new parameters.

1. Activate your *Correlation* view, if it is not already active.

> **Note**
>
> If you have closed your *Correlation* view from the last exercise, open a *Correlation* view from **IL 433**.

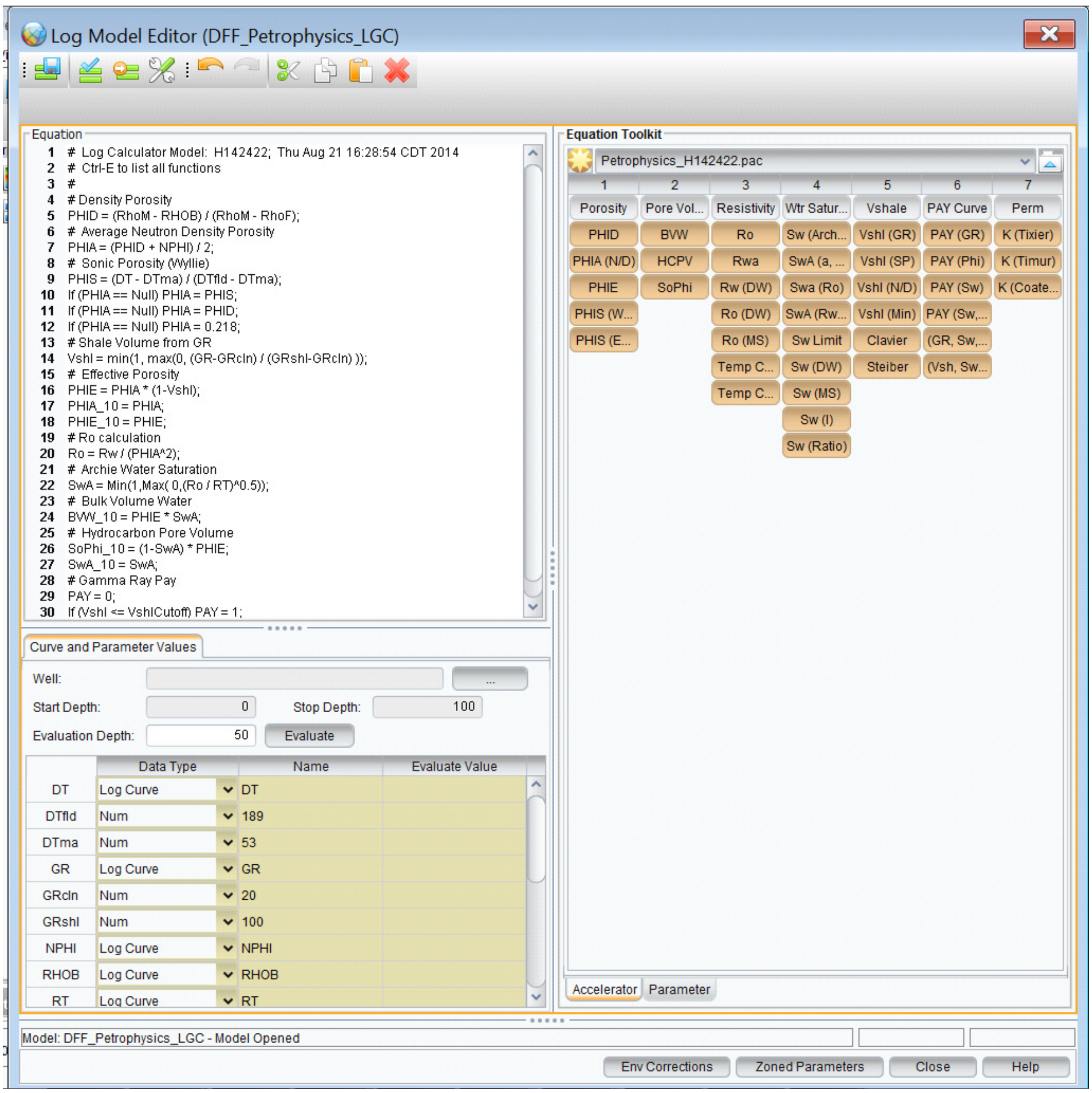
2. Navigate to the *Log Calculator* task pane. If it is not available select **View > Task Bars > Log Calculator**.



Calculating Pay

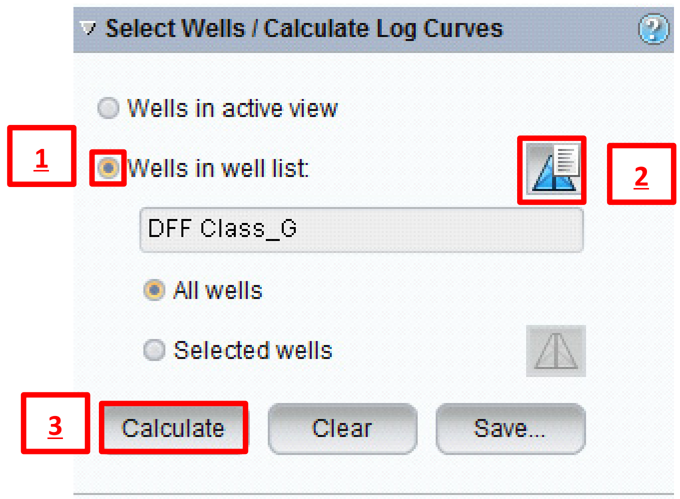
3. In the *Log Calculator* task pane, select the **DFF_Petrophysics** model, and click the **Edit the selected model** ( ) icon.

4. The *Log Model Editor* dialog box displays. The *Equation* panel shows mathematical models to calculate several curves like Sw, PHIA, PHIE, Vshl, SoPhi, PAY, etc. Take a moment to look at the equations and have a general idea of what is being calculated. **Close** *Log Model Editor*.

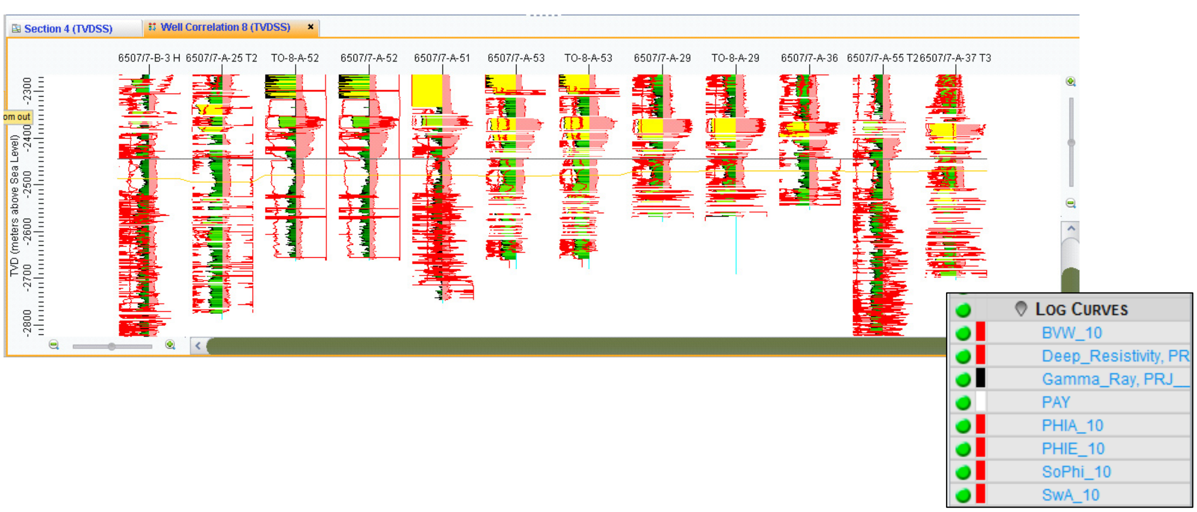


There are two options when executing the petrophysical model (See *Select Wells / Calculate Log Curves* sub-panel in the *Log Calculator* task pane). The first option is **Wells in active view**; this option will only do the calculations for the curves on the wells that are currently active in your *Correlation* view. The other option is **Wells in well list**; this will do the calculations for the wells you specify in a chosen well list.

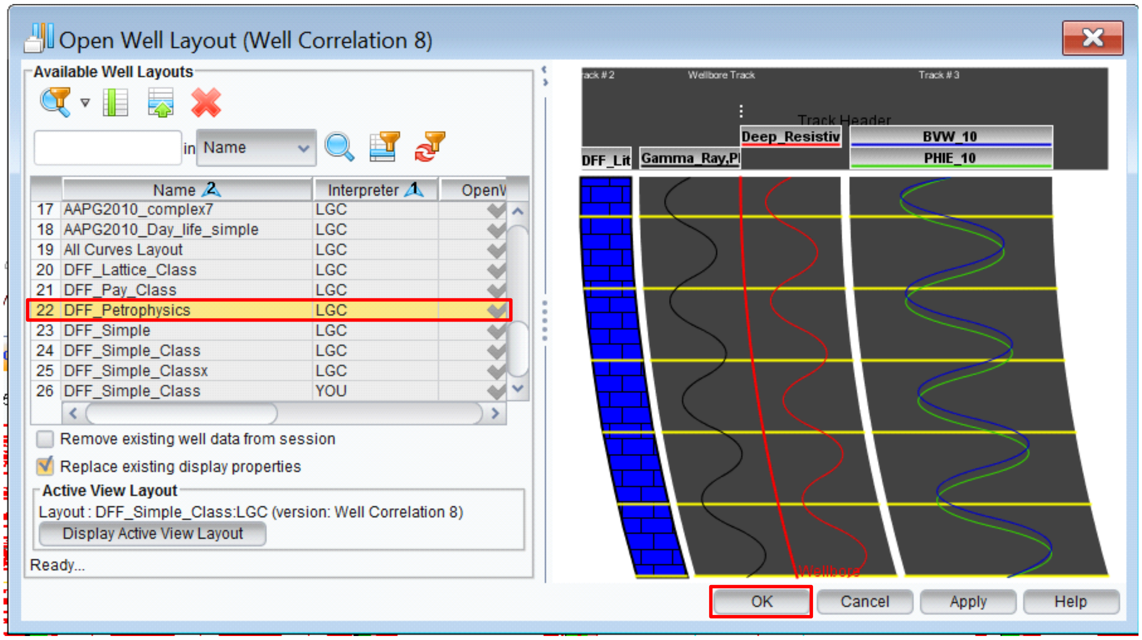
5. In the *Select Wells / Calculate Log Curves* sub-panel select the option to calculate for **Wells in well list**, because later you will be making a map of all of your wells. Click the **Select Well List** ( ) icon, and select **DFF Class_G**. Click **Calculate**.



The software computes all of the curves from the equation, and displays them in all of the wells in the *Correlation* view, as well as in the *Inventory* task pane under *Log Curves*.



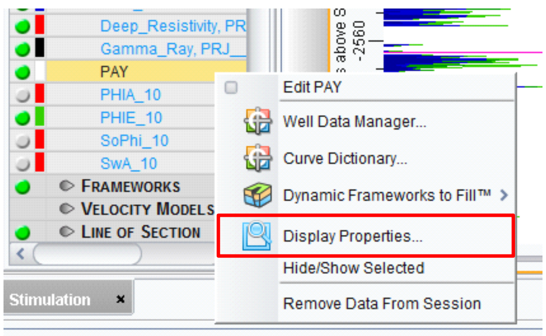
6. On any of the wells in your *Correlation* view, **MB3** and then select **Layout: All Wells In View > Open**. Select the **DFF_Petrophysics** well layout, and click **OK**.

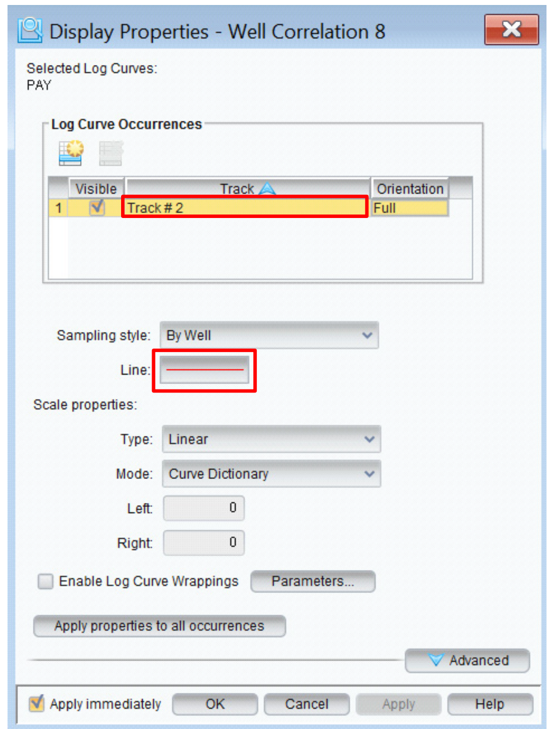


This well layout better displays some of the curves you just calculated, but it does not include your **PAY** curve.

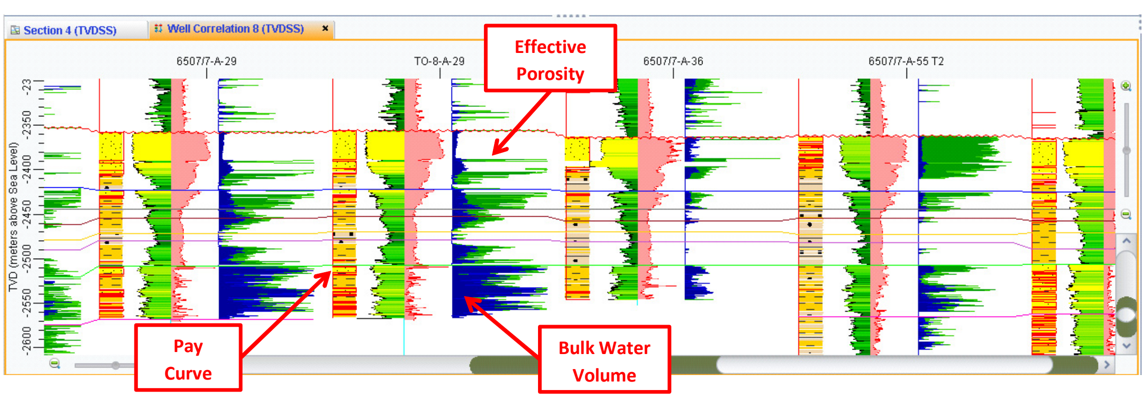
7. In the *Inventory* task pane, turn on the **PAY** curve.

8. The PAY curve appears in the Wellbore Track, and it is difficult to see. **MB3** on the **PAY** curve in your *Inventory* and select **Display Properties**. In the *Display Properties* dialog box change *Track* to **Track #2**, and the *Line* color to **Red**.





The **PAY** curve will now be displayed in the same track as the lithology strip, in red. Your layout should look similar to the one below.



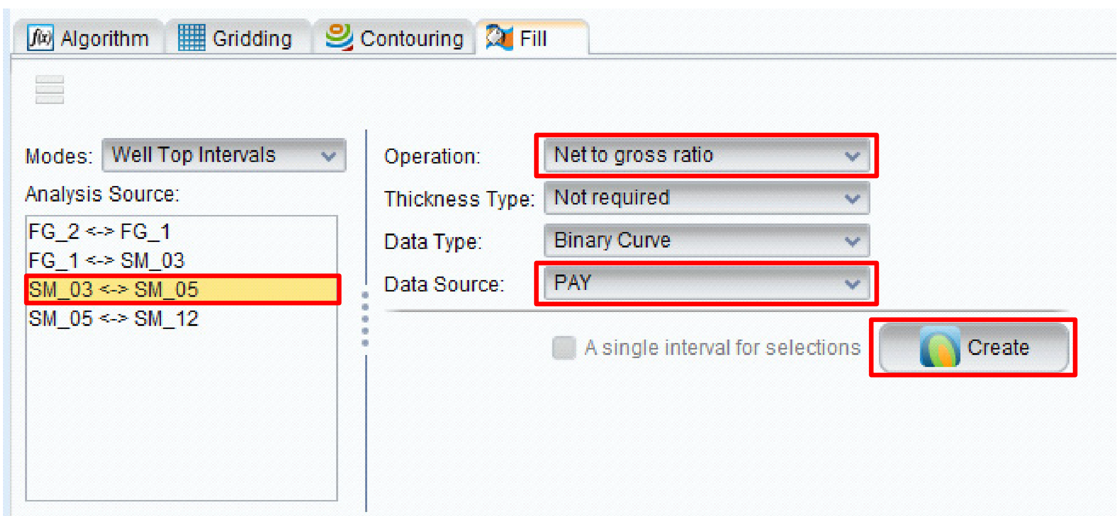
Calculating Net to Gross in Frameworks

Calculating a Net to Gross Ratio (Net/Gross) for your reservoir is very important. The Net/Gross calculates the overall amount of pay thickness within the reservoir. You will now calculate a Net to Gross Ratio for the **SM_03 <-> SM_05** interval.

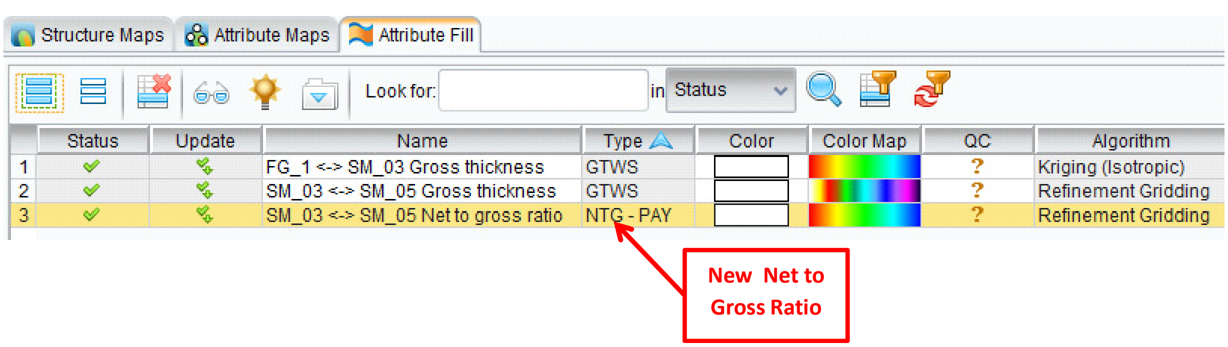
9. Open the *Dynamic Frameworks to Fill Workspace* window. Navigate to the *Fill* action tab in the *Attribute Fill* tab. If one of your Gross thickness maps from the previous exercise is still selected, click the **Deselect all items in the table** ( ) icon.

10. Select the **SM_03 <-> SM_05** interval from the *Analysis Source* panel. For the *Operation* select **Net to gross ratio**.

11. Notice that the *Data Source* option is now available; **PAY** should be selected. This curve now appears since in previous steps you ran petrophysical calculations. Click **Create**.

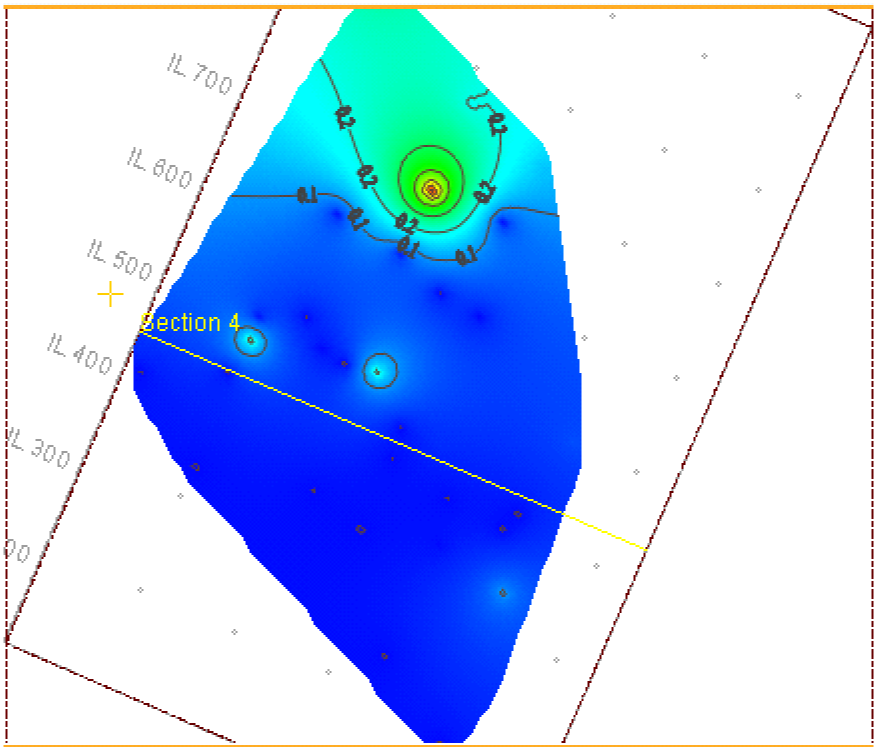


12. The new Net to Gross Attribute Fill will be created and placed in the top *Attribute Fill* tab. Change the *Color Map* to **6_Rainbow**.



13. Activate your *Map* view and in the *Inventory* task pane, turn off the gross thickness, and turn on the net to gross ratio for the **SM_03 <-> SM_05** interval. Also turn off the **DFF Class_G** well list.

    Your view should look similar to the one below.



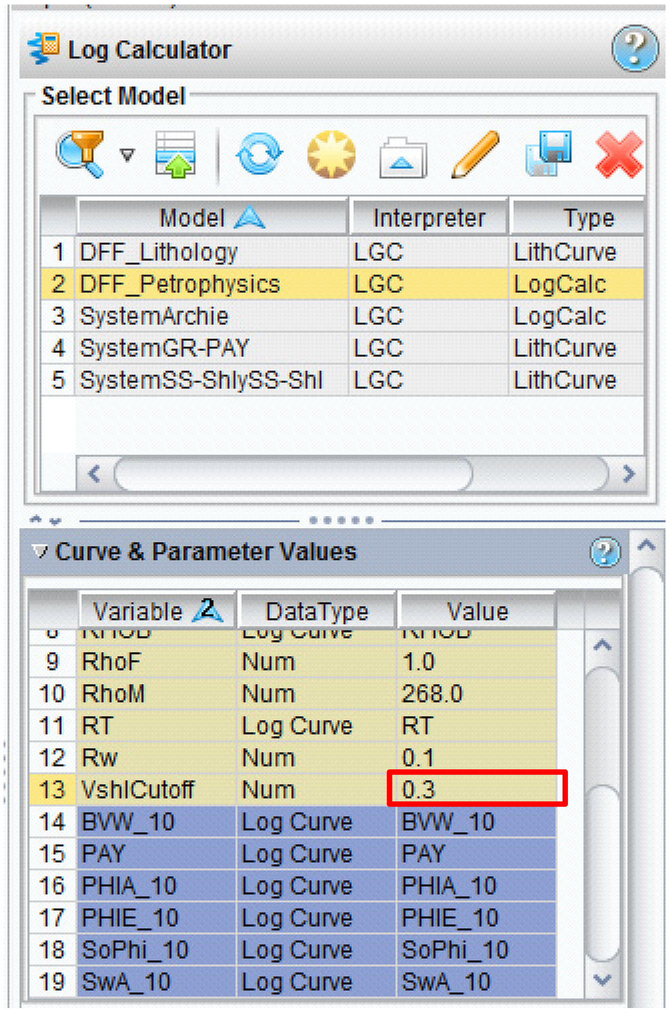
Dynamic Update to Framework

As mentioned before, these attributes are also dynamically updateable. Like surfaces are directly tied to your horizons and surface picks, these attributes are directly tied to the curves used to calculate them. So, if anything is altered in the petrophysical equation the maps will update as well.

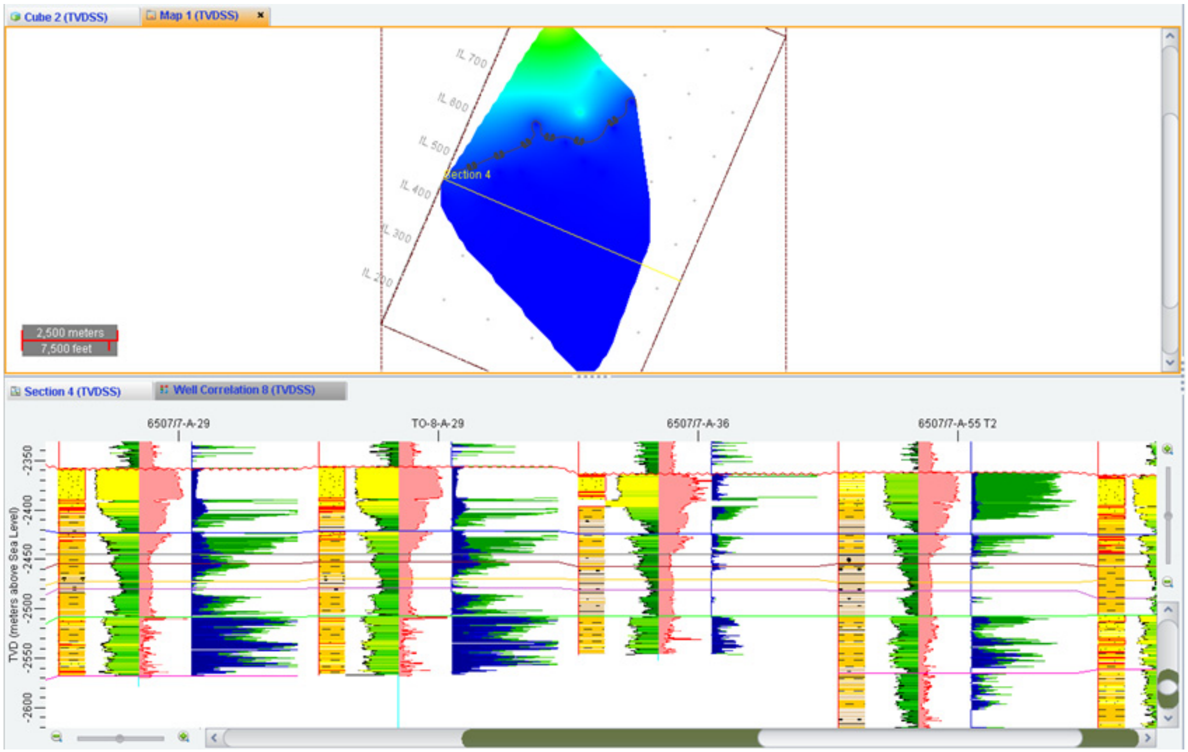
With the Framework in **Dynamic, Auto Refresh** or **Dynamic, Manual** mode, the changes made will be reflected in the framework objects. In the following exercise you will change one of the parameters of the **DFF_Petrophysics** equation, thus changing the **PAY** curve results (in memory), and therefore changing the attribute fills.

14. You will continue working in Dynamic, Auto Refresh. Confirm, in either the *Dynamic Frameworks to Fill* task pane or workspace, that the mode is set to **Dynamic, Auto Refresh** (▶).

15. Activate *Well Correlation* view, and go to the *Log Calculator* task pane. Select your **DFF_Petrophysics** model and change the **VshlCutoff** value from 0.5 to “0.3”. This can be done under the *Curve & Parameter Values* sub-panel as shown in the picture below.



16. Click the **Calculate** button in the *Select Wells / Calculate Log Curves* sub-panel and note the updates to the *Correlation* and *Map* views.



17. Experiment with different cutoff values, noting changes in *Correlation* view (PAY curve) and *Map* view (Net to gross ratio).

These last few steps emphasize the updatability of the Dynamic Frameworks to Fill. Though you might not work with 'live updates' on all the time in your day-to-day work, the framework is always actively listening to updates.

Note

Traditional mapping tools typically handle one surface at a time. Layer updates can be made into serial operations using macros. These macros can be executed to give model updates. DecisionSpace automates this process. Because all the maps in the framework system are aware of their sources, it is a very efficient way to trigger updates to the model without having the burden of maintaining complex macros.

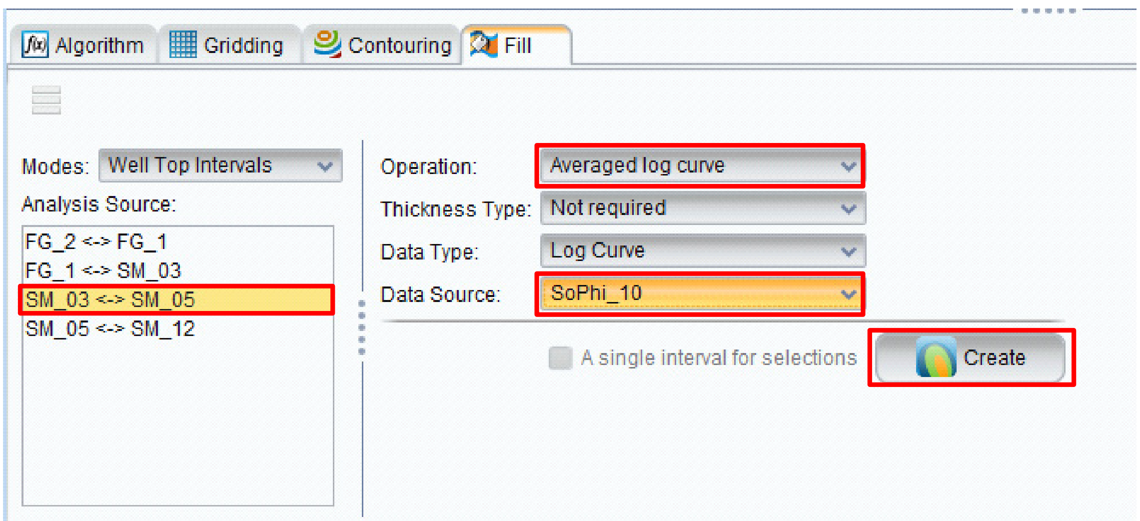
Customers report significant productivity gains with Dynamic Frameworks to Fill. Large macros that took three to four days to run are comparable to Dynamic Frameworks to Fill models that update in 30 minutes to one hour. This represents a huge gain in operational efficiency.

Creating an Attribute Fill from Any Curve

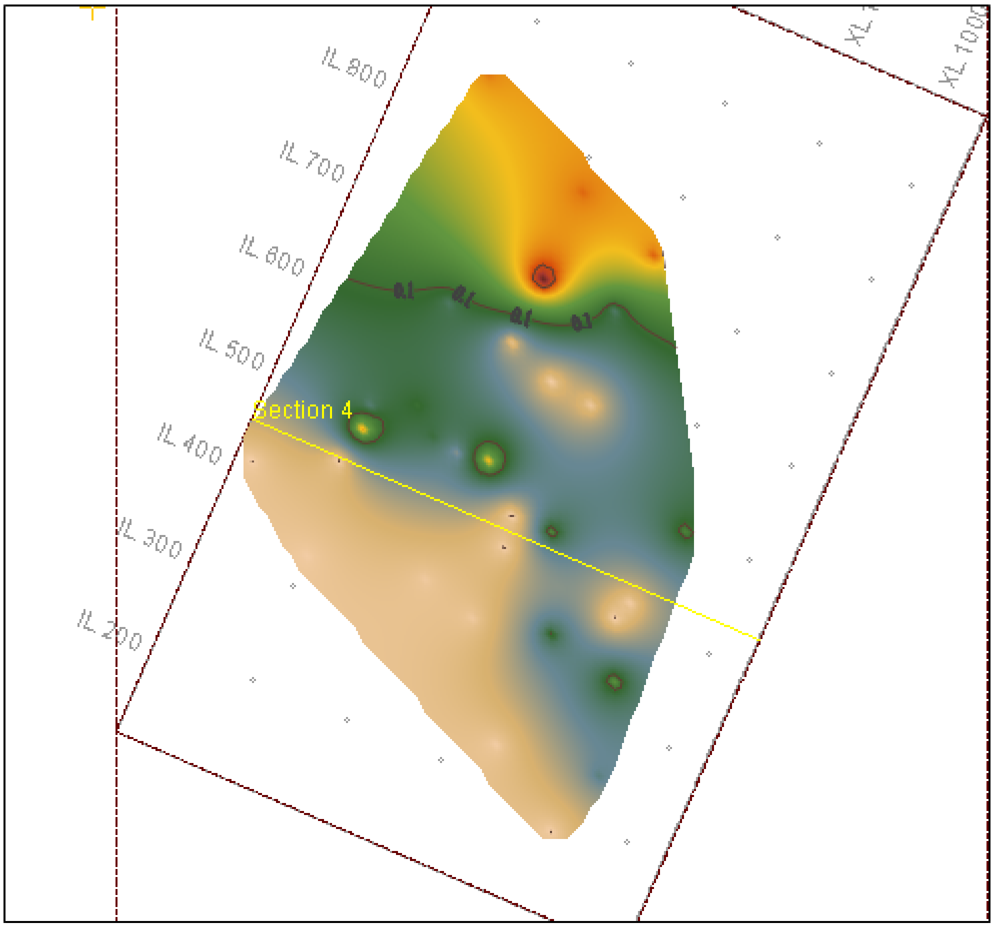
Sometimes it is necessary to just see the distribution of the values of a particular log over an area. In this example, you will create another attribute, the average value of SoPhi in an specify interval.

18. Go back to the *Dynamic Frameworks to Fill Workspace* window, under the *Fill* action tab, click the **Deselect all items in the table** ( ) icon, so you can create the a new attribute.

19. Select the **SM_03 <-> SM_05** interval. For *Operation* select **Average log curve**, and use the **SoPhi_10** for the *Data Source*. Click **Create**.



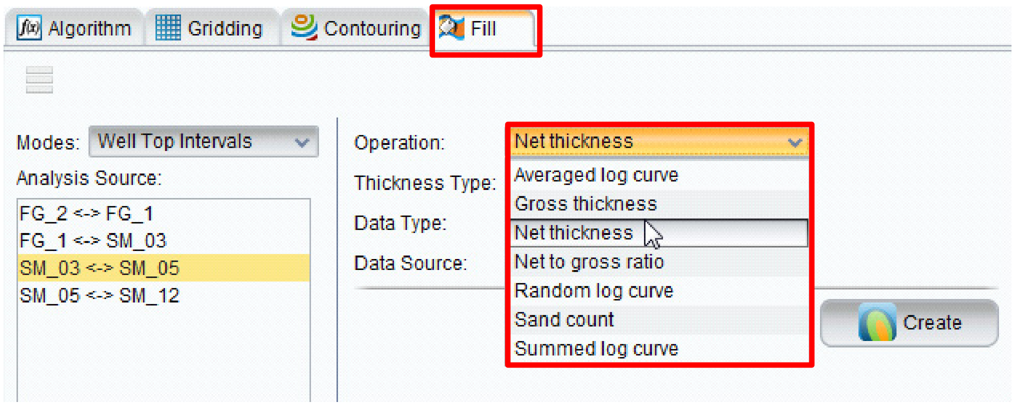
20. There is no need to change the color map for this one. So, in *Map* view, turn off the **net to gross ratio** attribute and turn on the **SoPhi Average log curve** attribute fill for interval **SM_03 <-> SM_05**.



21. Experiment creating two or more attributes from the petrophysical model: (SwA_10, PHIE_10, BVW_10, etc). Compare the attributes maps and analyze possible sweet spot areas.

Exercise 4.3: Creating Attribute Maps from Pointsets in Dynamic Frameworks to Fill

Up to this point, you have seen how to create attributes to fill the framework using surfaces from Well Top Intervals. The picture below shows all the available attribute operations in Dynamic Frameworks to Fill.

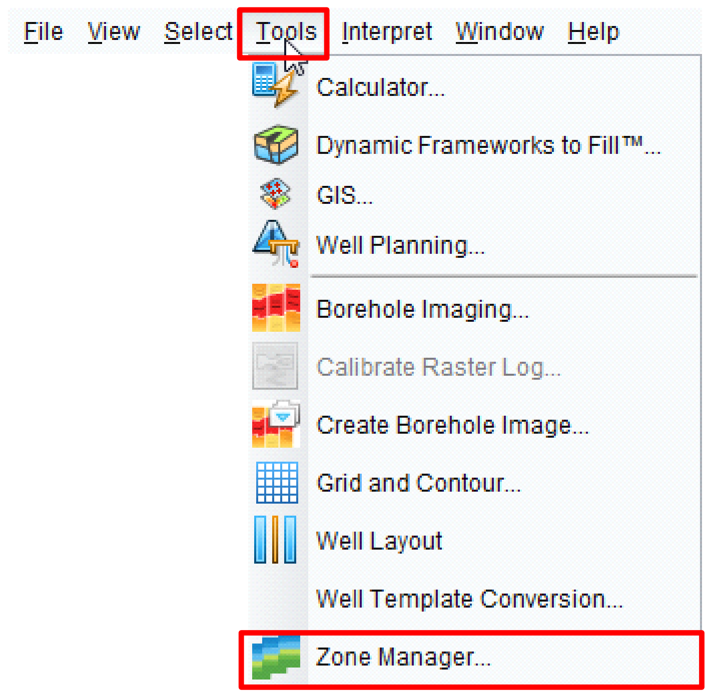


These operations cover most of the common attributes statistics an interpreter needs to map after petrophysical analysis, however sometimes you may need to extract other statistics from attributes that are not specified in the list like minimum values, maximum values, standard deviation, etc. Dynamic Frameworks to Fill offers the option to create attribute maps from point sets so you don't have any gap in your attribute interpretation when using Decision Space Geosciences. You can create the point sets inside Decision Space or import from any other application. The following exercise will highlight this workflow. The same procedure applies for structure maps; you can create structure maps from point sets. When you select the point set to add into the frameworks, you define if the usage will be *Attribute* map, *Structure map*, or *Surface*.

Structure Maps and *Attribute Maps* object tabs share the same actions tabs: *Algorithm*, *Gridding* and *Contouring*; which means if you learn how to use one, you will know how to use the other.

In the following exercise, you will create the point set directly from *Zone Manager*, which is a powerful tool inside Decision Space Geosciences. In *Zone Manager*, you can execute many tasks like: calculate any attribute statistics; extract production data to wells, back interpolate grids in the wells, etc. The attributes can come from maps, geophysical interpretation, geological interpretation, petrophysical interpretation, etc. Any attributes, despite what its origin is, can be handled in *Zone Manager*.

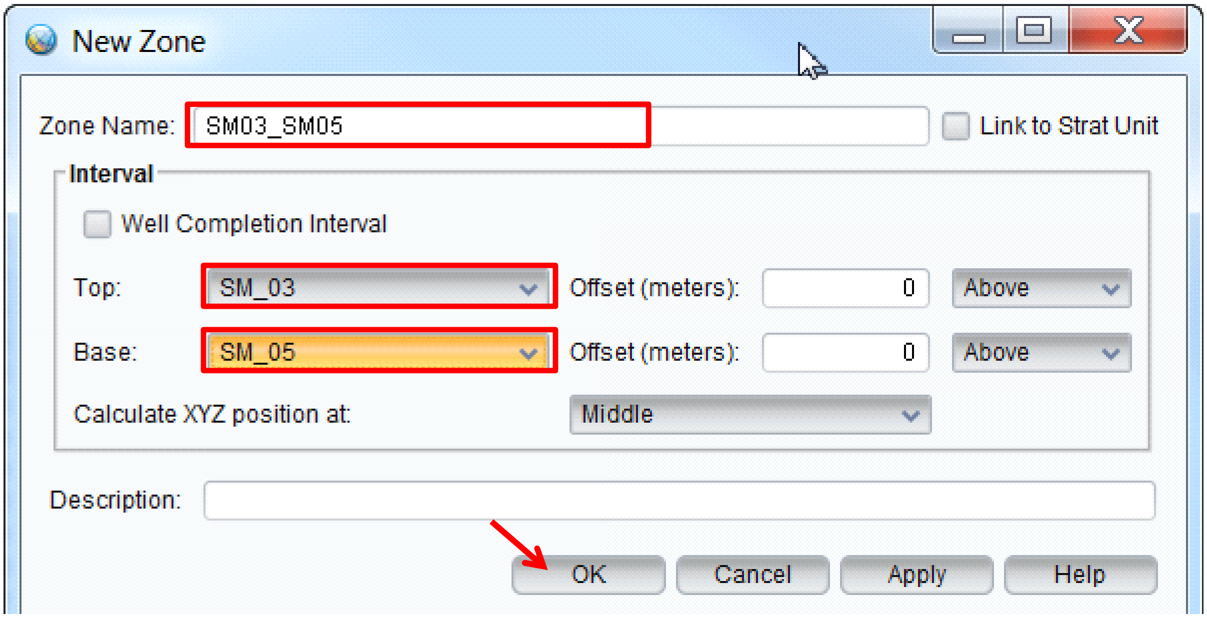
1. In the main menu of DecisionSpace Geosciences, go to **Tools** > **Zone Manager**.



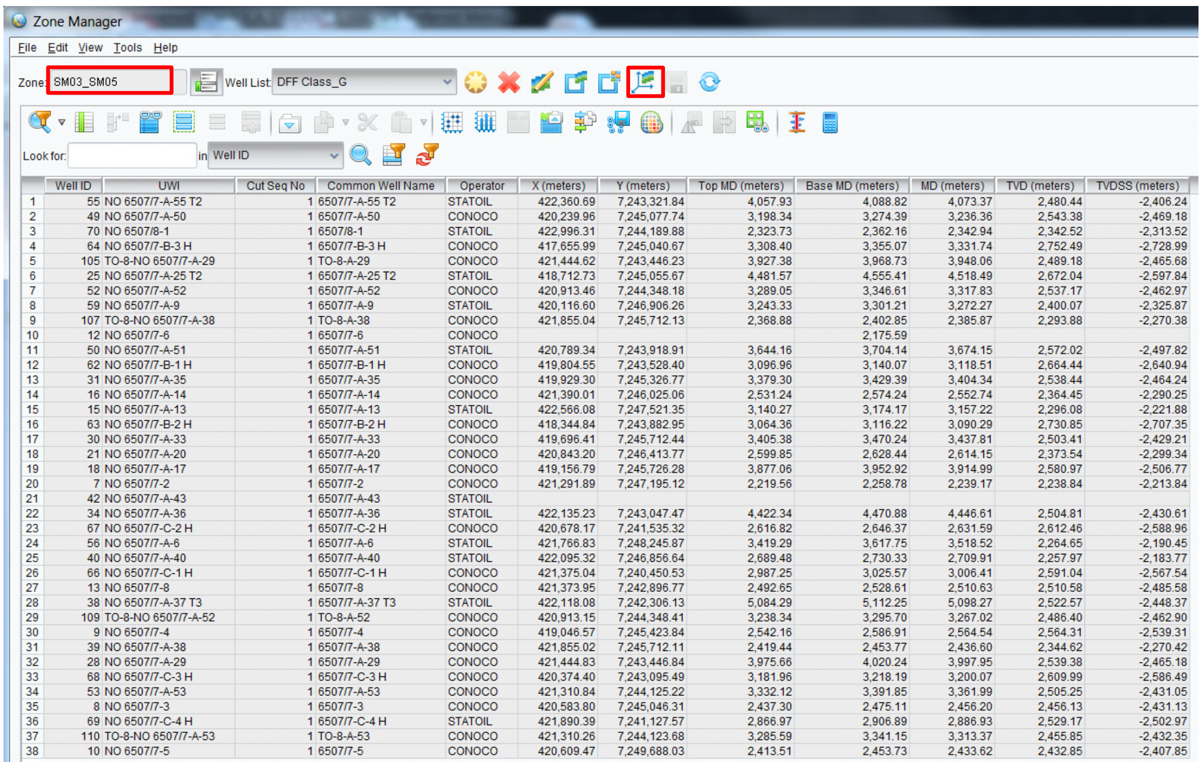
To be consistent with the zone you have been working with in Dynamic Frameworks to Fill, you will create a **SM_03** to **SM_05** interval in *Zone Manager*.

2. In the *Zone Manager* window, from the main menu select **File** > **New Zone** or click the **New Zone** ( ) icon.

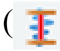
3. Name the new zone: **SM03_SM05**. For *Top* select **SM_03**, for *Base* select **SM_05**, accept all the other defaults and click **OK**.

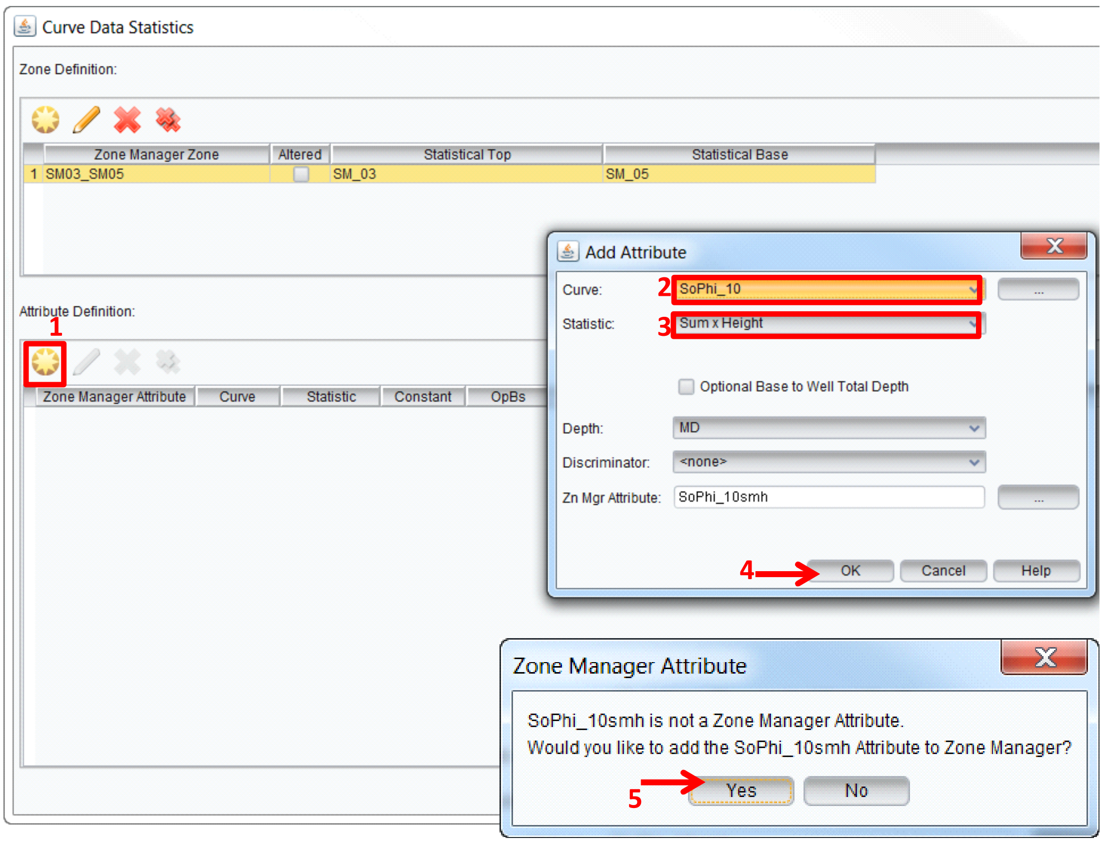


4. *Zone Manager* will show the new **SM03_SM05** zone as active. In Well List, select **DFF Class_G**, this means that the Curve Data Statistics will calculate in all the wells in the selected list (where curves are present). Before extracting any petrophysical curve attribute from *Log Calculator*, you need to calculate XYZ position data for the zone. What this option does is basically calculate the coordinates in the middle of the interval in every well, at that place is where the software will reference the attribute data. Click the **Calculate Zone XYZ data** ( ) icon. Click **YES** to dismiss the dialog box of *XYZ Calculation Successful*. *Zone Manager* will now reflect the coordinates at every well.

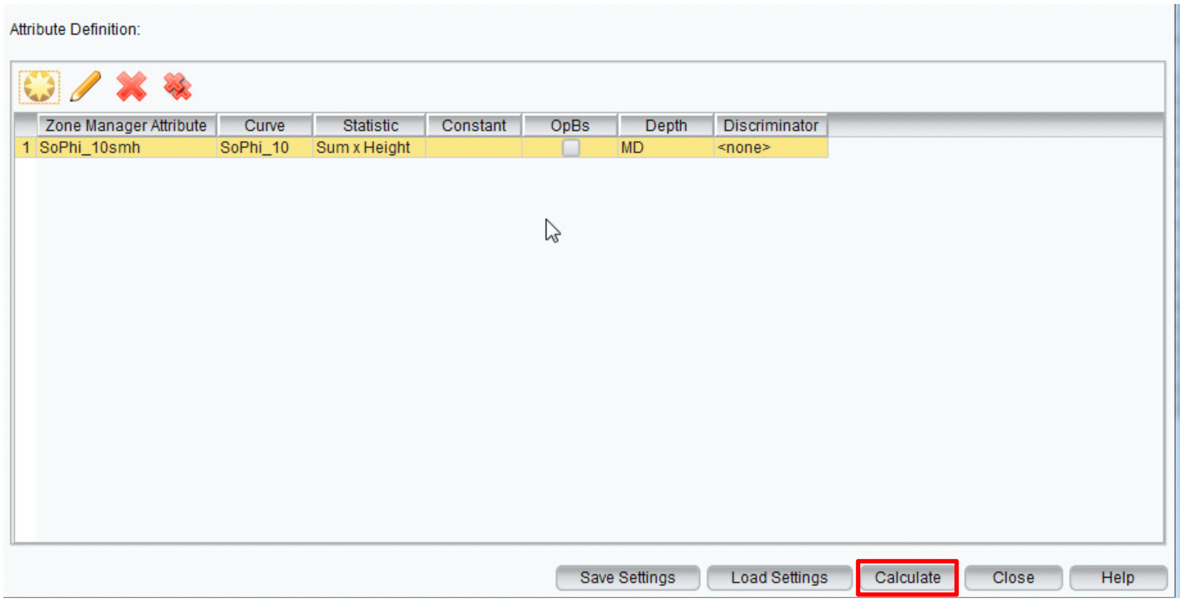


	Well ID	UWI	Cut Seq No	Common Well Name	Operator	X (meters)	Y (meters)	Top MD (meters)	Base MD (meters)	MD (meters)	TVD (meters)	TVDSS (meters)
1	55	NO 6507/7-A-55 T2	1	6507/7-A-55 T2	STATOIL	422,360.69	7,243,321.84	4,057.93	4,088.82	4,073.37	2,480.44	-2,406.24
2	49	NO 6507/7-A-50	1	6507/7-A-50	CONOCO	420,239.96	7,245,077.74	3,198.34	3,274.39	3,236.36	2,543.38	-2,469.18
3	70	NO 6507/8-1	1	6507/8-1	STATOIL	422,996.31	7,244,189.88	2,323.73	2,362.16	2,342.94	2,342.52	-2,313.52
4	64	NO 6507/7-B-3 H	1	6507/7-B-3 H	CONOCO	417,655.99	7,245,040.67	3,308.40	3,355.07	3,331.74	2,752.49	-2,728.99
5	105	TO-8-NO 6507/7-A-29	1	TO-8-A-29	CONOCO	421,444.62	7,243,446.23	3,927.38	3,968.73	3,948.06	2,489.18	-2,465.68
6	25	NO 6507/7-A-25 T2	1	6507/7-A-25 T2	STATOIL	418,712.73	7,245,055.67	4,481.57	4,555.41	4,518.49	2,672.04	-2,597.84
7	52	NO 6507/7-A-52	1	6507/7-A-52	CONOCO	420,913.46	7,244,348.18	3,289.05	3,346.61	3,317.83	2,537.17	-2,462.97
8	59	NO 6507/7-A-9	1	6507/7-A-9	STATOIL	420,116.60	7,246,906.26	3,243.33	3,301.21	3,272.27	2,400.07	-2,325.87
9	107	TO-8-NO 6507/7-A-38	1	TO-8-A-38	CONOCO	421,855.04	7,245,712.13	2,368.88	2,402.85	2,385.87	2,293.88	-2,270.38
10	12	NO 6507/7-6	1	6507/7-6	CONOCO				2,175.59			
11	50	NO 6507/7-A-51	1	6507/7-A-51	STATOIL	420,789.34	7,243,918.91	3,644.16	3,704.14	3,674.15	2,572.02	-2,497.82
12	62	NO 6507/7-B-1 H	1	6507/7-B-1 H	CONOCO	419,804.55	7,243,528.40	3,096.96	3,140.07	3,118.51	2,664.44	-2,640.94
13	31	NO 6507/7-A-35	1	6507/7-A-35	CONOCO	419,929.30	7,245,326.77	3,379.30	3,429.39	3,404.34	2,538.44	-2,464.24
14	16	NO 6507/7-A-14	1	6507/7-A-14	CONOCO	421,390.01	7,246,025.06	2,531.24	2,574.24	2,552.74	2,364.45	-2,290.25
15	15	NO 6507/7-A-13	1	6507/7-A-13	STATOIL	422,566.08	7,247,521.35	3,140.27	3,174.17	3,157.22	2,296.08	-2,221.88
16	63	NO 6507/7-B-2 H	1	6507/7-B-2 H	CONOCO	418,344.84	7,243,882.95	3,064.36	3,116.22	3,090.29	2,730.85	-2,707.35
17	30	NO 6507/7-A-33	1	6507/7-A-33	CONOCO	419,696.41	7,245,712.44	3,405.38	3,470.24	3,437.81	2,503.41	-2,429.21
18	21	NO 6507/7-A-20	1	6507/7-A-20	CONOCO	420,843.20	7,246,413.77	2,599.85	2,628.44	2,614.15	2,373.54	-2,299.34
19	18	NO 6507/7-A-17	1	6507/7-A-17	CONOCO	419,156.79	7,245,726.28	3,877.06	3,952.92	3,914.99	2,580.97	-2,506.77
20	7	NO 6507/7-2	1	6507/7-2	CONOCO	421,291.89	7,247,195.12	2,219.56	2,258.78	2,239.17	2,238.84	-2,213.84
21	42	NO 6507/7-A-43	1	6507/7-A-43	STATOIL							
22	34	NO 6507/7-A-36	1	6507/7-A-36	STATOIL	422,135.23	7,243,047.47	4,422.34	4,470.88	4,446.61	2,504.81	-2,430.61
23	67	NO 6507/7-C-2 H	1	6507/7-C-2 H	CONOCO	420,678.17	7,241,535.32	2,616.82	2,646.37	2,631.59	2,612.46	-2,588.96
24	56	NO 6507/7-A-6	1	6507/7-A-6	STATOIL	421,766.83	7,248,245.87	3,419.29	3,617.75	3,518.52	2,264.65	-2,190.45
25	40	NO 6507/7-A-40	1	6507/7-A-40	STATOIL	422,095.32	7,246,856.64	2,689.48	2,730.33	2,709.91	2,257.97	-2,183.77
26	66	NO 6507/7-C-1 H	1	6507/7-C-1 H	CONOCO	421,375.04	7,240,450.53	2,987.25	3,025.57	3,006.41	2,591.04	-2,567.54
27	13	NO 6507/7-8	1	6507/7-8	CONOCO	421,373.95	7,242,896.77	2,492.65	2,528.61	2,510.63	2,510.58	-2,485.58
28	38	NO 6507/7-A-37 T3	1	6507/7-A-37 T3	STATOIL	422,118.08	7,242,306.13	5,084.29	5,112.25	5,098.27	2,522.57	-2,448.37
29	109	TO-8-NO 6507/7-A-52	1	TO-8-A-52	CONOCO	420,913.15	7,244,348.41	3,238.34	3,295.70	3,267.02	2,486.40	-2,462.90
30	9	NO 6507/7-4	1	6507/7-4	CONOCO	419,046.57	7,245,423.84	2,542.16	2,586.91	2,564.54	2,564.31	-2,539.31
31	39	NO 6507/7-A-38	1	6507/7-A-38	CONOCO	421,855.02	7,245,712.11	2,419.44	2,453.77	2,436.60	2,344.62	-2,270.42
32	28	NO 6507/7-A-29	1	6507/7-A-29	CONOCO	421,444.83	7,243,446.84	3,975.66	4,020.24	3,997.95	2,539.38	-2,465.18
33	68	NO 6507/7-C-3 H	1	6507/7-C-3 H	CONOCO	420,374.40	7,243,095.49	3,181.96	3,218.19	3,200.07	2,609.99	-2,586.49
34	53	NO 6507/7-A-53	1	6507/7-A-53	CONOCO	421,310.84	7,244,125.22	3,332.12	3,391.85	3,361.99	2,505.25	-2,431.05
35	8	NO 6507/7-3	1	6507/7-3	CONOCO	420,583.80	7,245,046.31	2,437.30	2,475.11	2,456.20	2,456.13	-2,431.13
36	69	NO 6507/7-C-4 H	1	6507/7-C-4 H	STATOIL	421,890.39	7,241,127.57	2,866.97	2,906.89	2,886.93	2,529.17	-2,502.97
37	110	TO-8-NO 6507/7-A-53	1	TO-8-A-53	CONOCO	421,310.26	7,244,123.68	3,285.59	3,341.15	3,313.37	2,455.85	-2,432.35
38	10	NO 6507/7-5	1	6507/7-5	CONOCO	420,609.47	7,249,688.03	2,413.51	2,453.73	2,433.62	2,432.85	-2,407.85

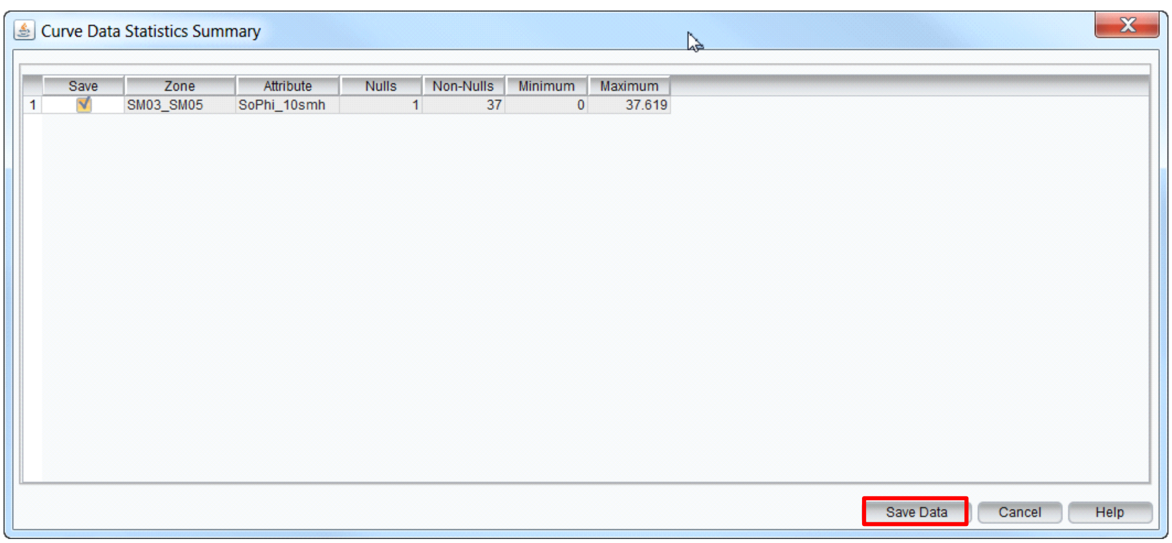
5. Click the **Curve Data Statistics** () icon. With this option you will extract and calculate petrophysical attributes into this zone. The *Curve Data Statistics* window opens with the zone you just created, **SM03_SM05**. Under the *Attribute Definition* section, click the **Add attribute** () icon. Extract from the curve **SoPhi_10** the statistic **Sum x Height**. A new attribute will be created in *Zone Manager*, in this specific case you are calculating **HPV** or **SoPhiHeight**. Follow the sequence in the picture below.



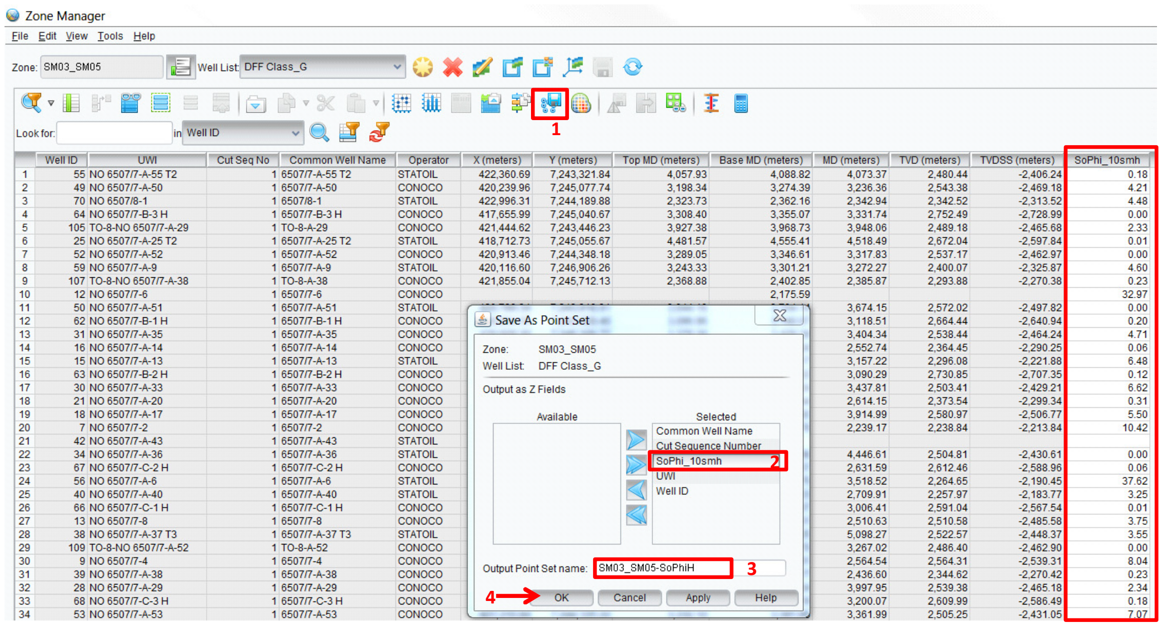
6. In the *Curve Data Statistics* window, under the *Attribute Definition* section, click the **Calculate** button.



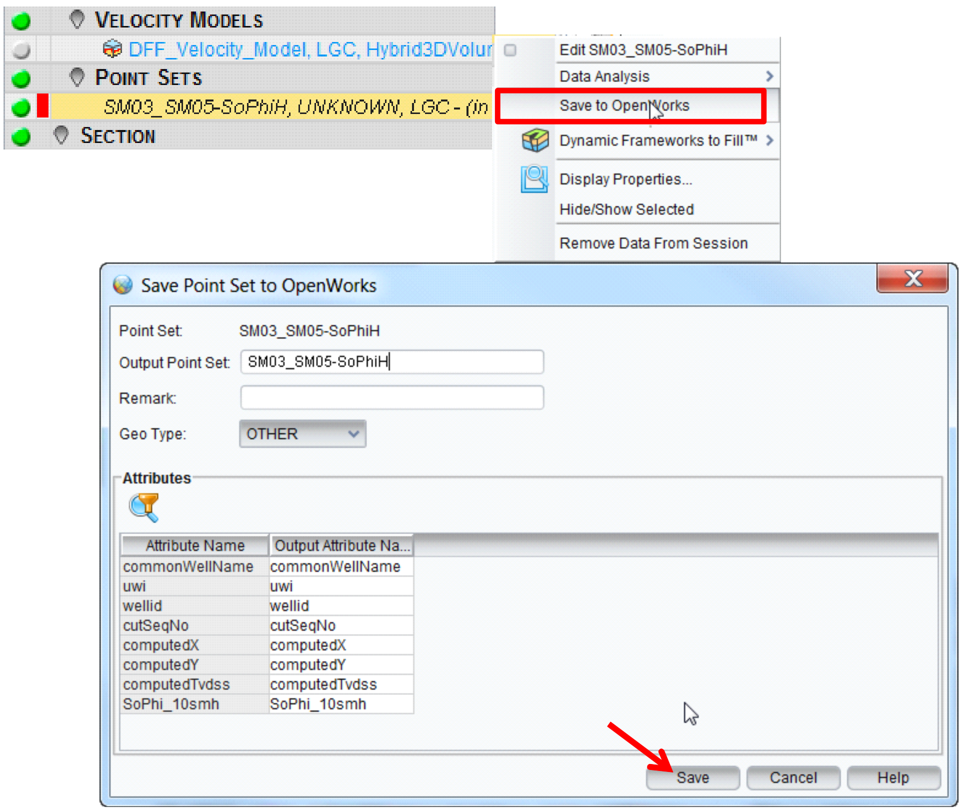
7. A new window showing the *Curve Data Statistics Summary* appears. Look at the statistics in this window and then click the **Save Data** button.



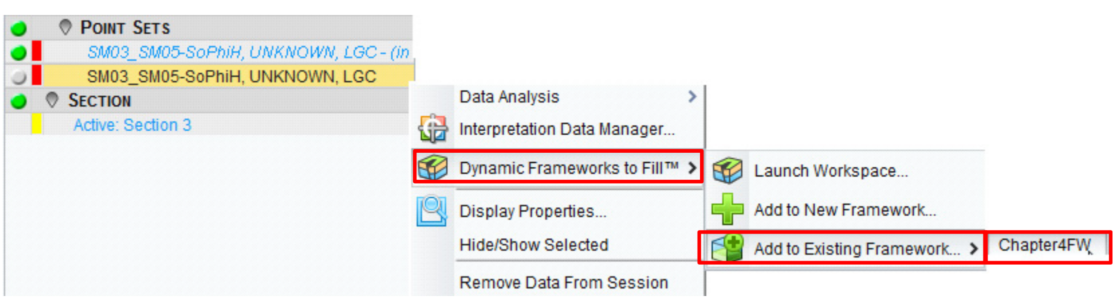
8. A new column in *Zone Manager* appears showing the attribute **SoPhi_10smh** (HPV) in every well. To create the point set, click the **Save zone attributes to Point Sets** ( ) icon. In the *Save As Point Set* dialog box, make sure **SoPhi_10smh** is under the **Selected** list. Name the Output Point Set: **SM03_SM05-SoPhiH** and click **OK**.



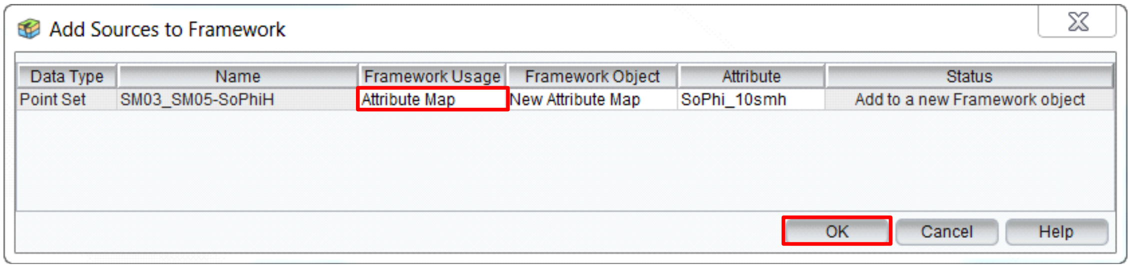
9. Close or minimize *Zone Manager.* A new category should appear in the *Inventory* task pane: **POINT SETS**. You will also see the created point set locations in all your views. Notice that the **SM03_SM05-SoPhiH…** is in memory (*Italic font*). In order to use the point set in frameworks you need to save it into OpenWorks. MB3 on the point set you just created and select **Save to OpenWorks**. Accept the default name in the *Save Point Set to OpenWorks* dialog box and click **Save**.



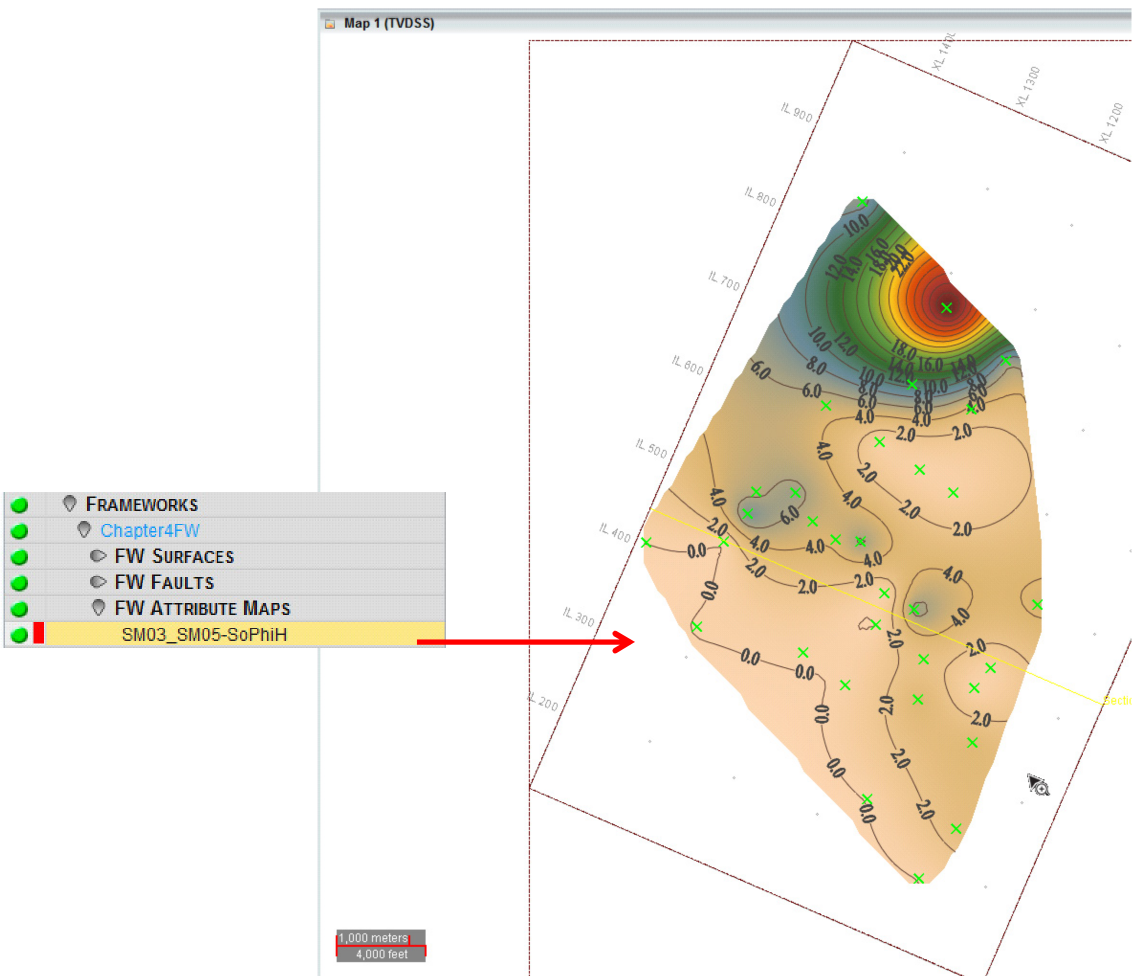
10. The OpenWorks point set will be listed in the *Inventory* task pane, under the (*in memory*) one. **MB3** on the OpenWorks point set **SM03-SM05-SoPhiH…** and select **Dynamic Frameworks to Fill** > **Add to Existing Framework** > **Chapter4FW**.



11. The *Add Sources to Framework* dialog box appears. For *Framework Usage* select **Attribute Map** and click **OK**.



12. Bring back the *Dynamic Frameworks to Fill Workspace* window and make sure it is in **Dynamic, Auto Refresh** mode. Navigate to the *Attribute Maps* object tab. Notice that the new attribute is listed there. In the *Algorithm* action tab, change to **Kriging (Isotropic)**. In the *Contouring* action tab change *Regular contour interval* to **2** meters. Display the attribute map **SM03_SM05-SoPhiH** in *Map* view. Your map should look similar to the picture below.

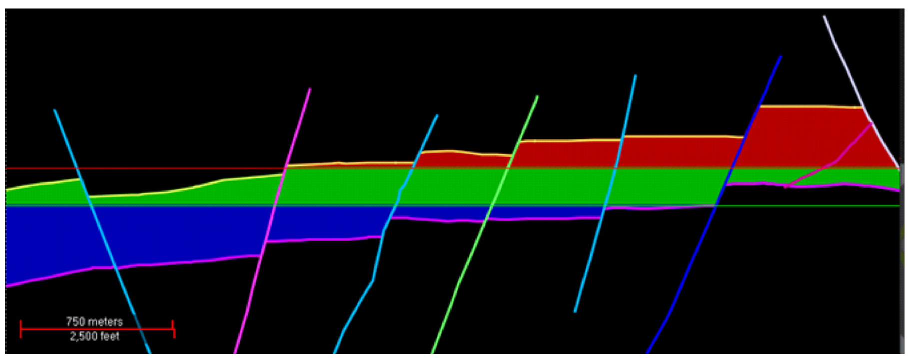


Compartment and Volumetrics Features

Volume Calculation Technologies

The new volumetric visualization solution is referred to as *Visual Volumetrics*, and is based on highly accurate volume calculations of compartments. These technologies represent significant improvements over the traditional slicing method in particular where the body of volume calculation is complex. Three different compartment-based volume calculation methods are used:

- Direct Polyhedral Volume Calculation
- Fast Sweep Thickness Extraction
- Slice-based Volumetrics

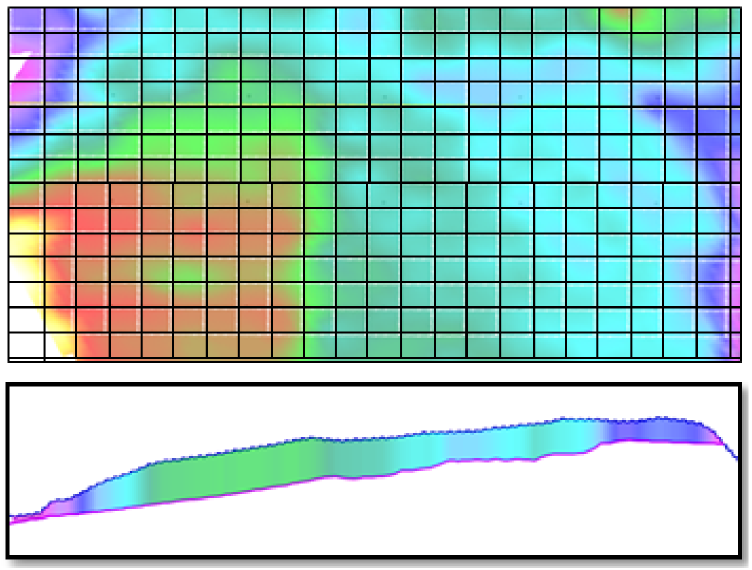


Direct Polyhedral Volume Calculation

Gross Rock Volumes (GRV) are computed directly from the compartment geometry, which is a significant improvement over the traditional slicing techniques. The compartment GRV is calculated through the "Direct Polyhedral Volume Calculation" technology, which offers a highly accurate deterministic volume calculation. This technique is based on the mathematical definition of a polyhedron volume and the amount of polyhedrons to fit a specific compartment geometry.

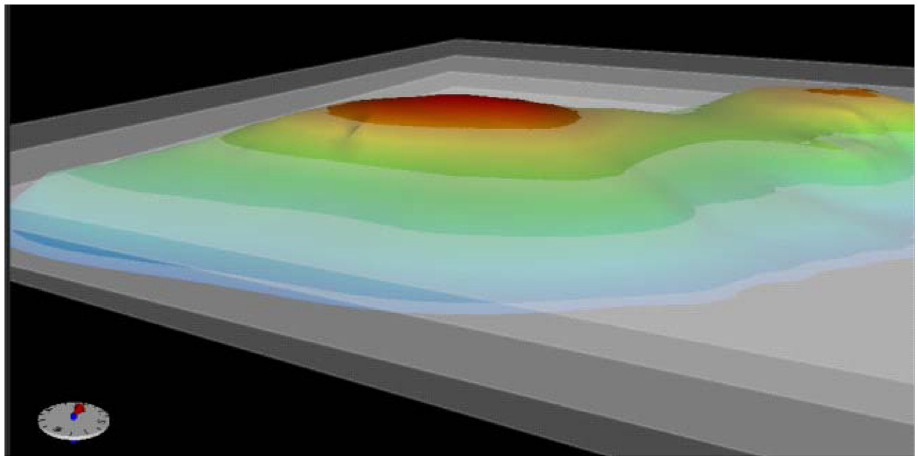
Fast Sweep Thickness Extraction

This very fast technique is based on the extraction of a gross thickness grid representing the vertical thickness of a compartment at each grid node. The extracted thickness grid is unrotated and has a dimension of 1000 x1000, matching the XY extents of the compartment. “Fast Sweep Thickness Extraction” is the underlying volume calculation technique for “Grid-based Volumetrics” operations. Gross thickness maps can be multiplied by a constant value or by one or more attribute maps or grids with laterally-varying attributes to produce net thickness grids.



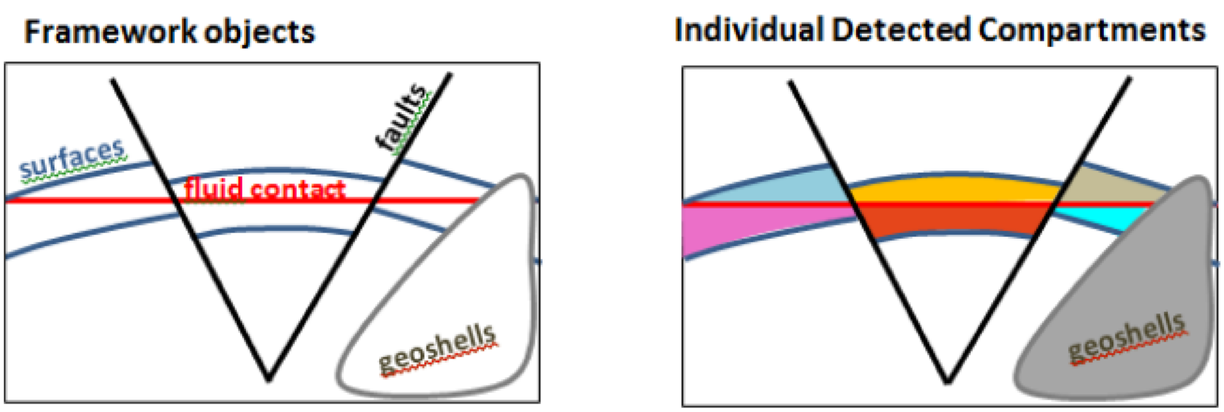
Slice-Based Volumetrics Calculations

Traditional "slice-based" volumetric calculations are used for backward compatibility, as well as for plotting (e.g. depth/area graphs). Compartments are sliced horizontally to calculate the volume and top-surface area of each volumetric slice.



Compartment Technology

- Compartments are groups of solid bodies which again are triangular mesh representations of sealed spaces.
- A sealed space is bounded by framework objects such as surfaces, faults, geoshells, fluid contacts and the surface boundaries.
- Compartments are automatically detected and grouped into different categories. They also automatically update to any changes of the framework and/or source data.

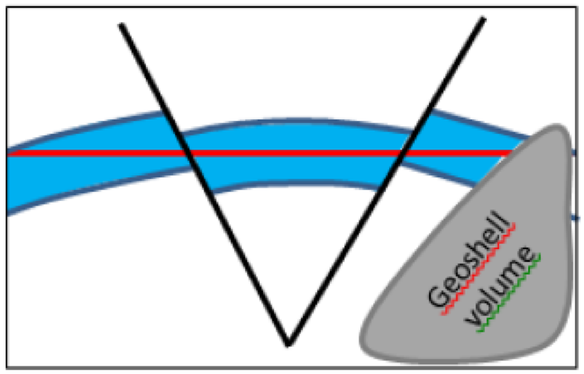


Compartment GeoGrouping

Individual compartments (sealed spaces) are automatically grouped into geological categories defined by the bounding framework objects.

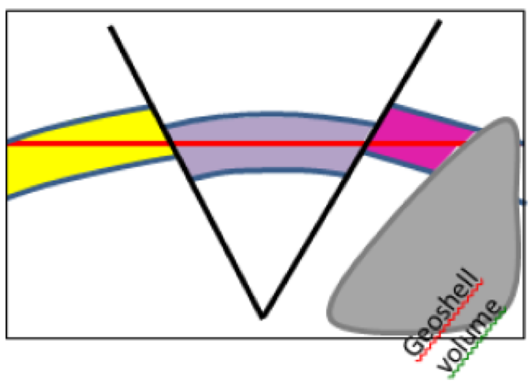
- All individual compartments between two surfaces are grouped into a “Stratigraphic Layer.”

Stratigraphic Layers

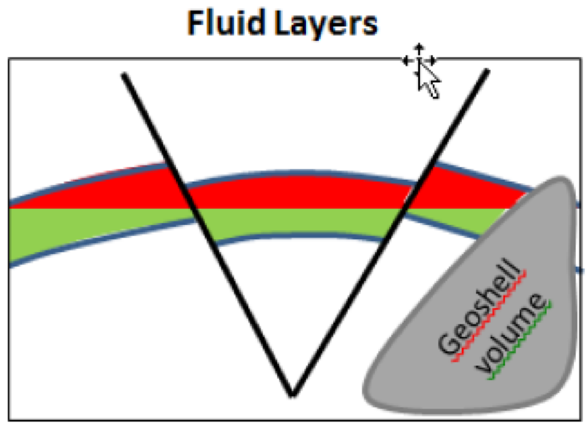


- All individual compartments between sealing faults are grouped into a “Fault Block.”

Fault Blocks



- All individual compartments between two fluid contacts are grouped into a “Fluid Layer.”



- A geoshell becomes a “Geoshell Volume” compartment.
- “Custom Reservoirs” can be manually created by the user, combining multiple compartments.

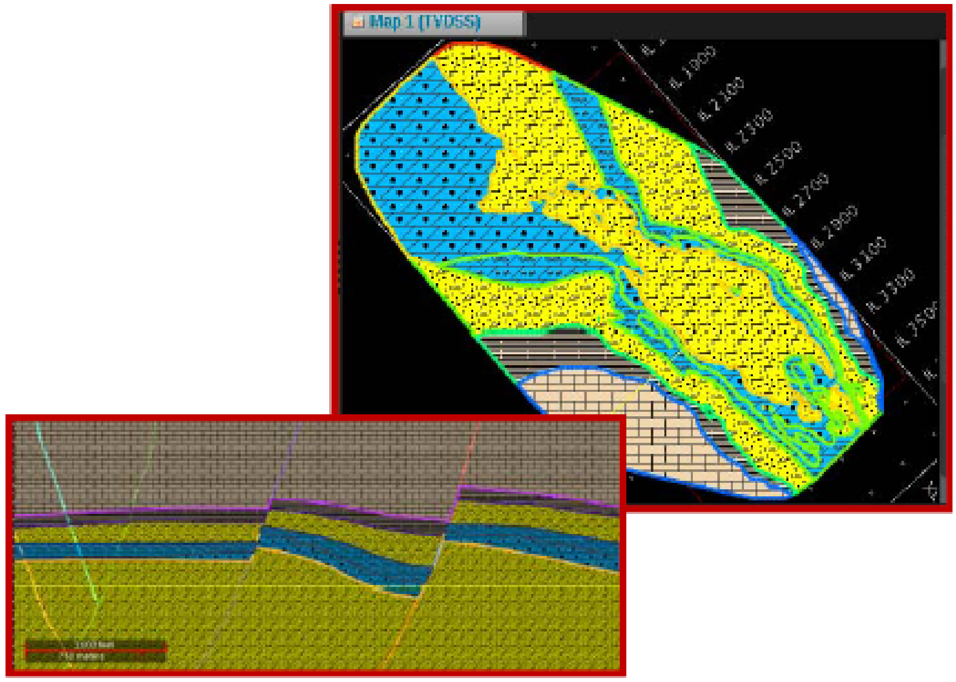
Advanced Compartment Functionality

The concept of “Visual Volumetrics” is based on the visualization and display of compartments as bodies of volume calculations for improved accuracy and user experience. Several key improvements have been made to compartments to optimize compartment functionality and display.

- Compartment color and lithology fill
- Custom reservoir creation options
- Compartment VOI by polygon and by depth
- Compartment attribute overlays

Compartment Color and Lithology Fill

Compartments can now be color filled in all views via the Display Properties. Compartments can also be filled with lithology patterns in *Section*, *Map* and *Map Slice* views.



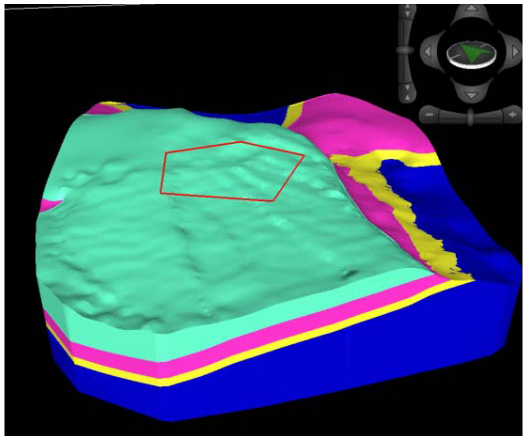
Custom Reservoir Creation

This feature gives the user option to create custom reservoirs (compartment) by intersect/merge operation from several compartments. The intention of this feature is to facilitate optimal compartment combinations for volumetric calculation.

1. Merge selected compartments to custom reservoir.	
2. Intersect any selected to custom reservoir.	
3. Intersect all selected to custom reservoir.	

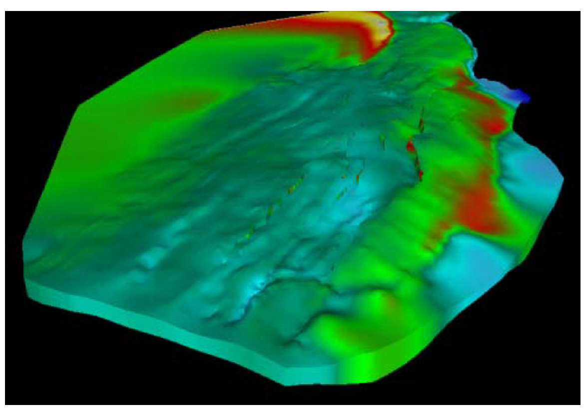
Compartment VOI

A global compartment VOI can be specified in the Compartments tab to constrain the compartment model to the desired size using polygons/ geoshapers and depth values.



Section and Cube View Attribute Overlay

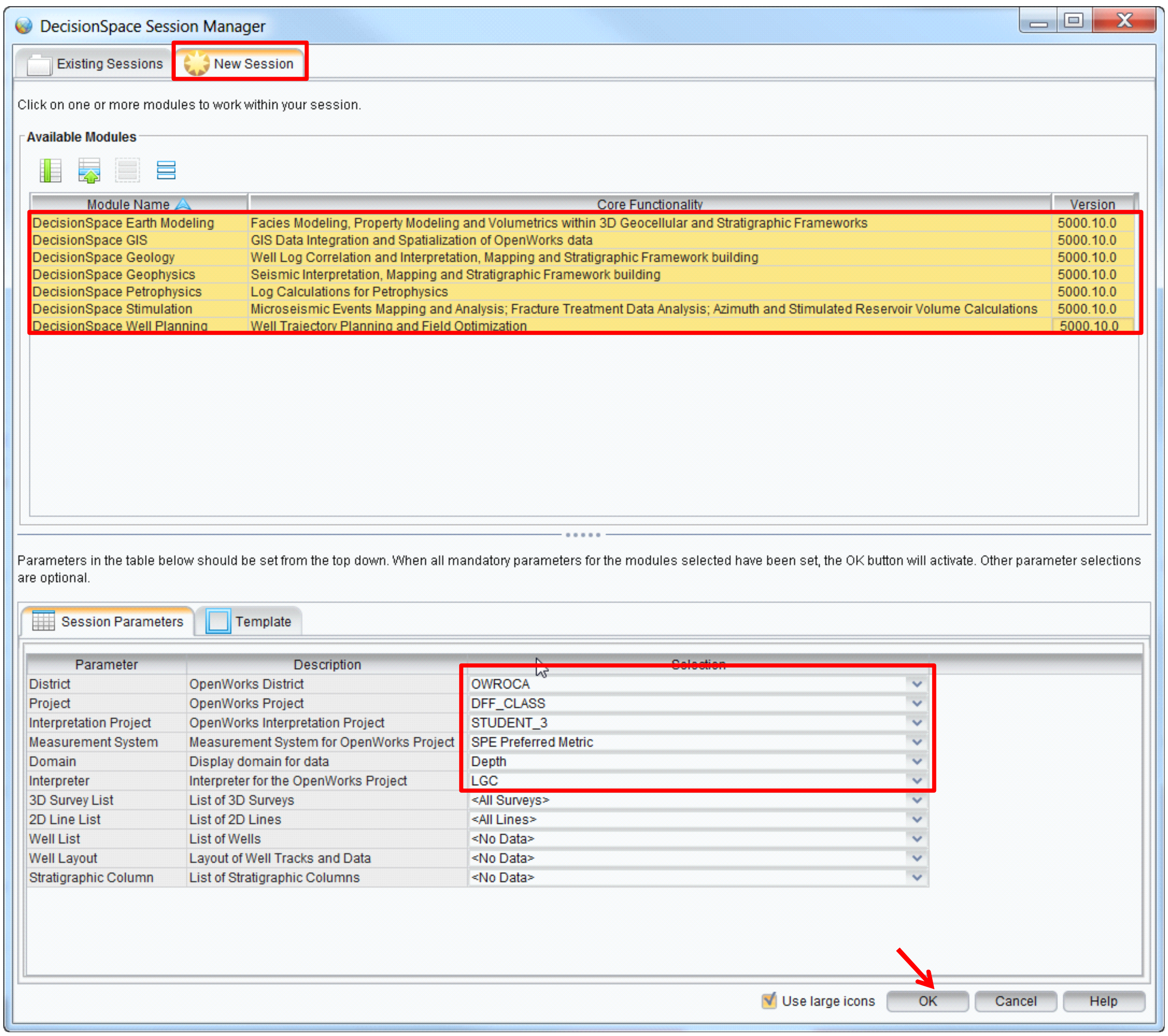
- 3D overlay of attributes (seismic attributes, interval fills, etc.) is available for compartments in *Cube* view and in *Section* view.
- This is an analog functionality to the attribute overlay on framework surfaces in cube view.
- It can be accessed by clicking **MB3** on the compartment in the view, selecting **Display Properties** > **Advanced**, and then selecting the desired attribute map.



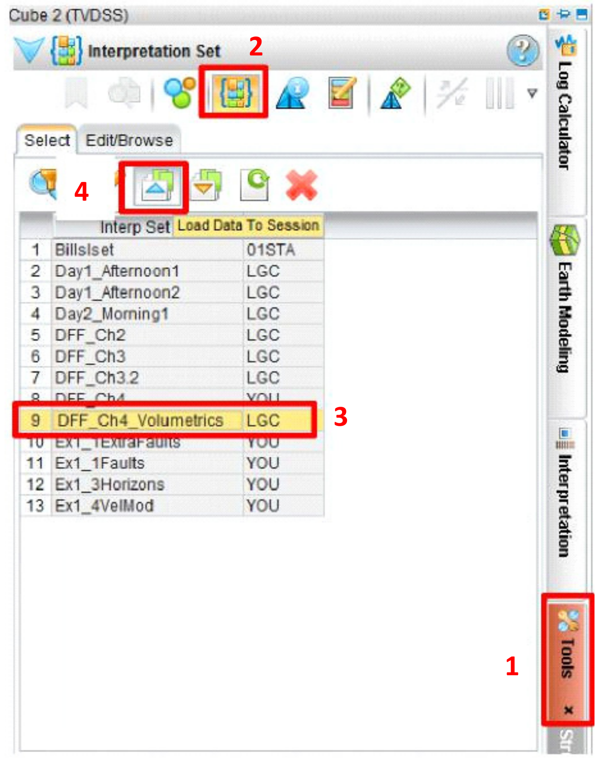
Exercise 4.4: Compartments and Volumetric Calculation

1. Close Decision Space Geosciences, you will start a new session for this exercise.

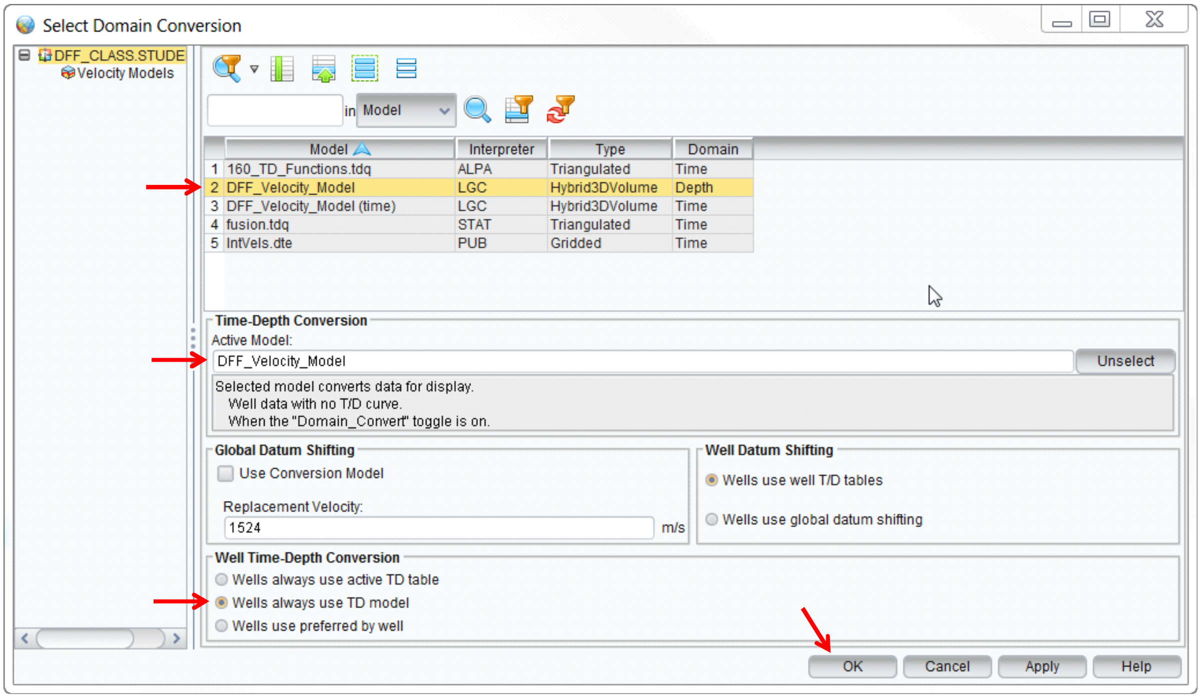
2. Create a new session in **DEPTH** domain as follows (accept the default **Map/Section/Cube - Triple Tile** template):



3. In the *Tools* task pane, go to **Interpretation Set**. Load the ISet **DFF_Ch4_Volumetrics**.

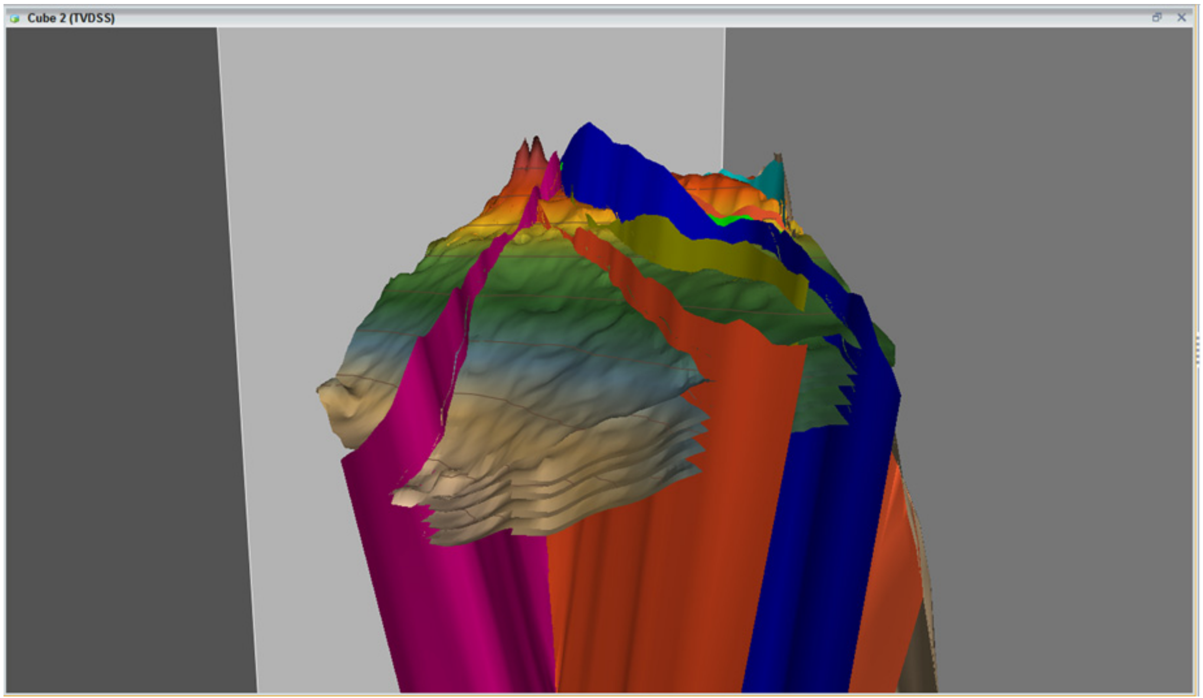


4. In the main menu, go to **Select > Domain Conversion**. Select **DFF_Velocity_Model (Depth)** and **Wells always use TD** model. Click **OK** to close the *Select Domain Conversion* window.



5. With *Cube* view active, in the main menu go to **File > Select Session Data**. Select the Framework **Chapter4_Volumetrics**, and add it to your session.

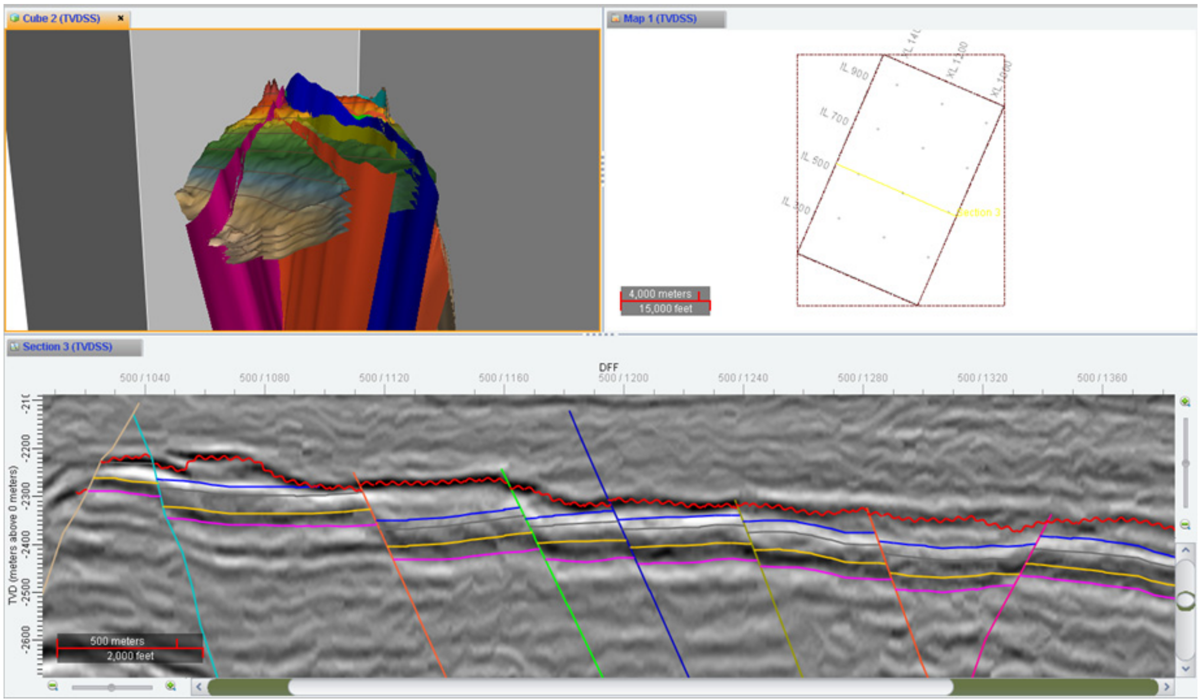
6. Once, the framework is done building, it will be displayed in *Cube* view. The framework contains fault networks, multi-surface conformance, and unconformity trim applied.



7. In the *Inventory* task pane, **MB3** on the seismic volume **StructureFilter, ATTRIBUTE** and select **Load to Shared Memory**.

8. In *Section* view, display Inline **500** from the share memory volume, turn on all the Framework surfaces and faults, and zoom in to the reservoir area. Change the color of the seismic to greyscale in order to see the compartments you will create later as best as possible.

Your views should look similar to the ones below.

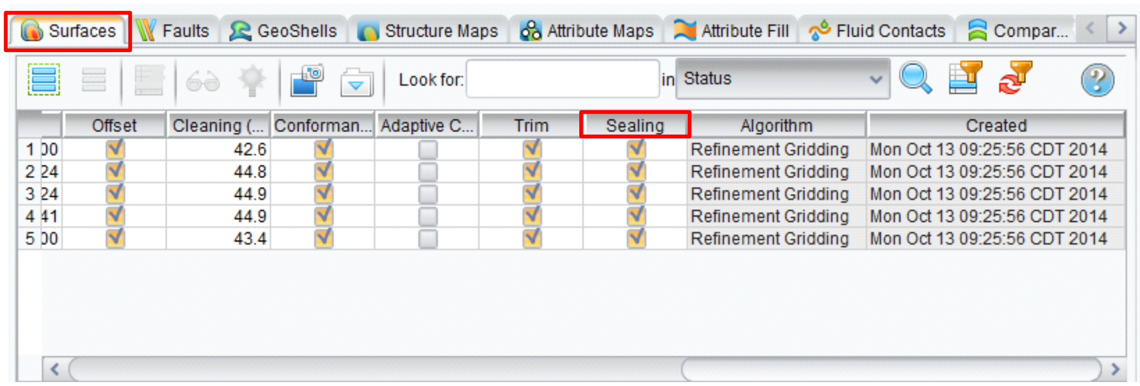


9. From the *Dynamic Frameworks to Fill* task pane, click the **Launch Frameworks Workspace Window** ( ) icon.

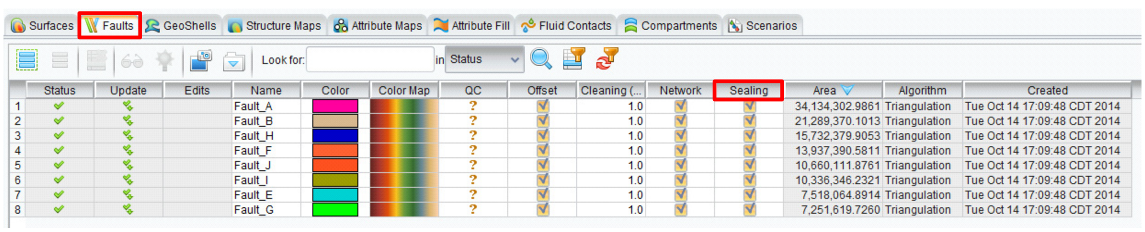
10. Change the state of the framework to **Dynamic, Auto Refresh** ( ).

There are two very important factors that need to be considered for Compartments within Frameworks to work properly. First, the surfaces that you want to include in the creation of the compartments need to be marked as sealing surfaces. Second, the faults within your network need to be properly networked and set as sealing faults. Both of these factors will be addressed in the following steps.

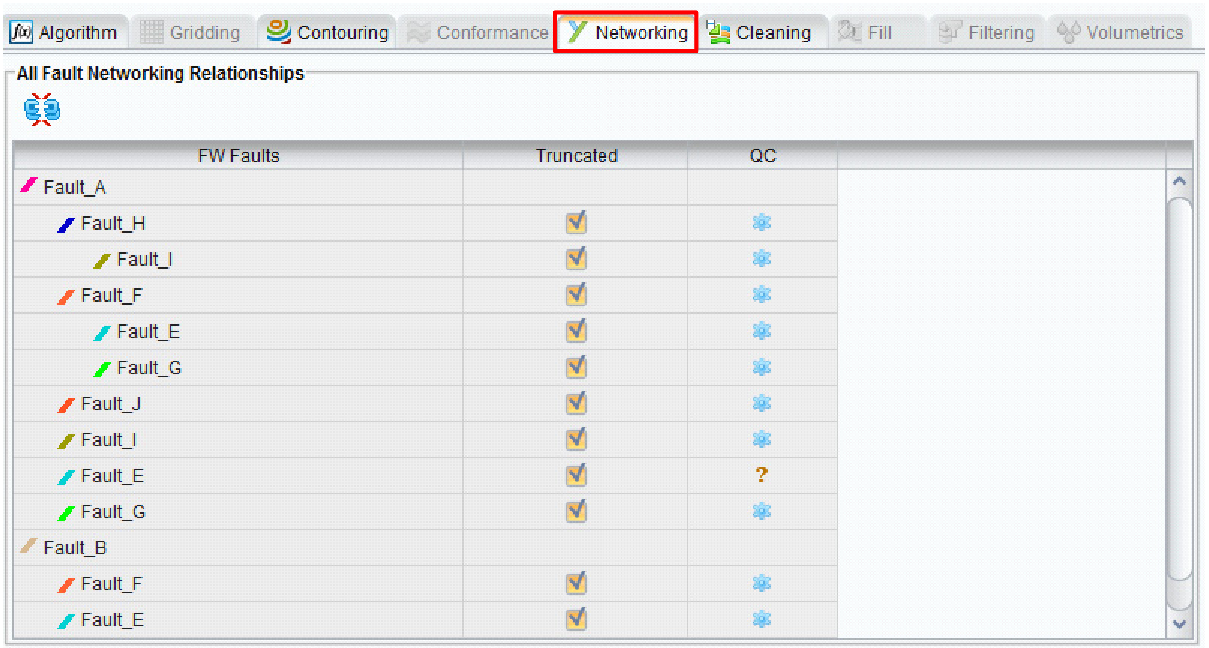
11. Navigate to the *Surfaces* tab, and scroll to the right, you will see the *Sealing* column. If you want to exclude any of the surfaces from the compartments calculations you would uncheck the box here. For this exercise you will leave all of the boxes checked.



12. Navigate to the *Faults* tab, and check that the faults, like the surfaces, are marked as Sealing faults.



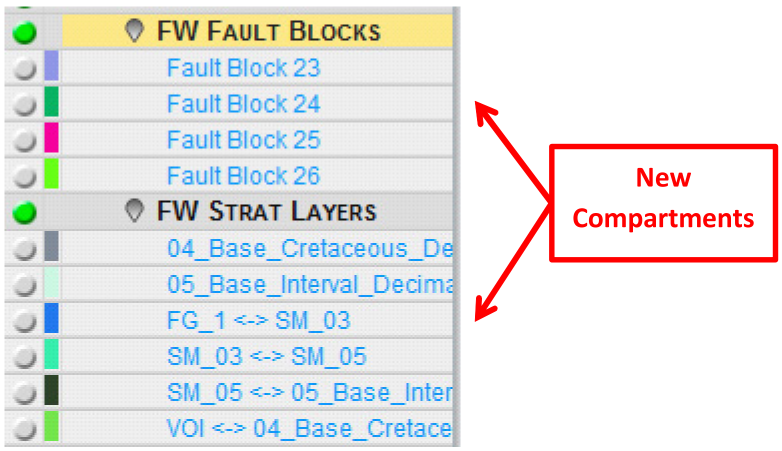
13. After checking the faults in the main tab, navigate to the *Networking* action tab. Here you can see all of the Fault Networking relationships within the framework. Ensure that the **AutoNetwork Faults** ( ) icon, at the top of the *Dynamic Frameworks to Fill Workspace* window, is on to insure that all of the faults are networked properly.



Now that you have ensured that all of the surfaces are set as sealing surfaces, and that all of the faults are networked properly, you can create the compartments.

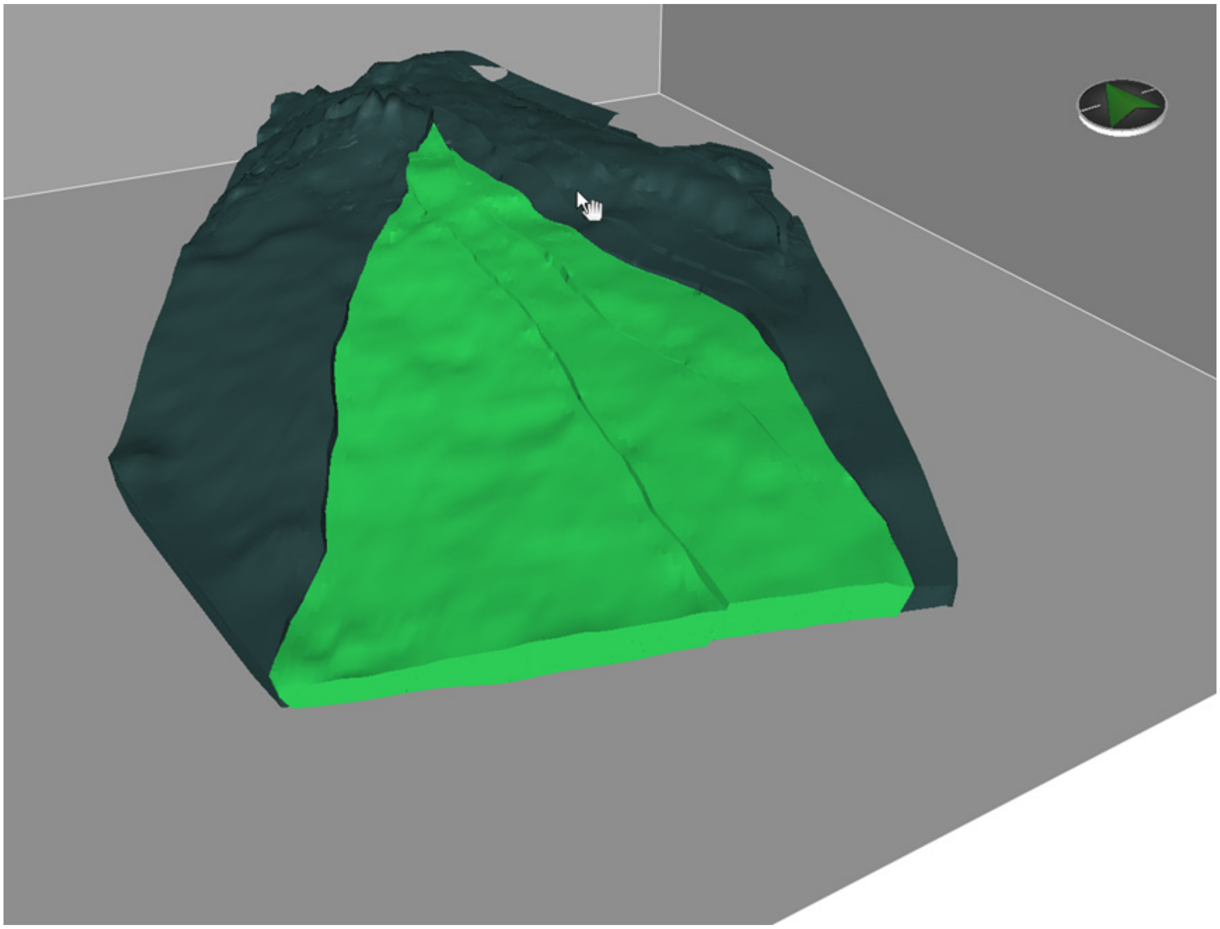
14. Also, at the top of the *Dynamic Frameworks to Fill Workspace* window, click the **Compartments** ( ) icon. Your framework will automatically refresh, calculating all of the compartments.

Your new compartments will appear in the *Compartments* tab of the *Workspace*, as well as in the *Inventory*, under **FW STRAT LAYERS** and **FW FAULT BLOCKS**.



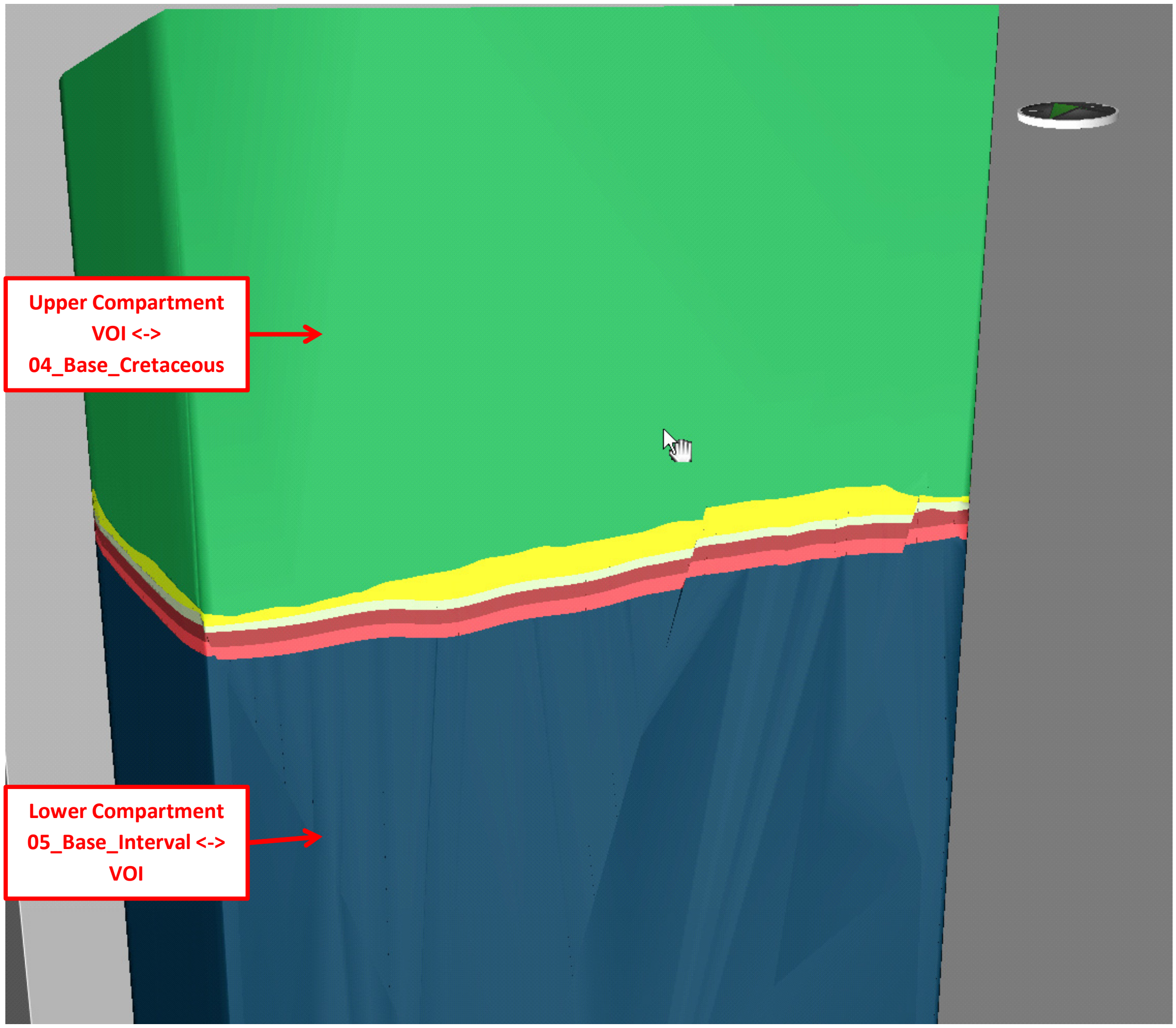
15. To best visualize the **FW FAULT BLOCKS** compartments, activate your *Cube* view, turn off your **FW SURFACES** and **FW FAULTS**, and turn on all of your **FW FAULT BLOCKS**.

Your **FW FAULT BLOCKS** compartments should look similar to the ones below.



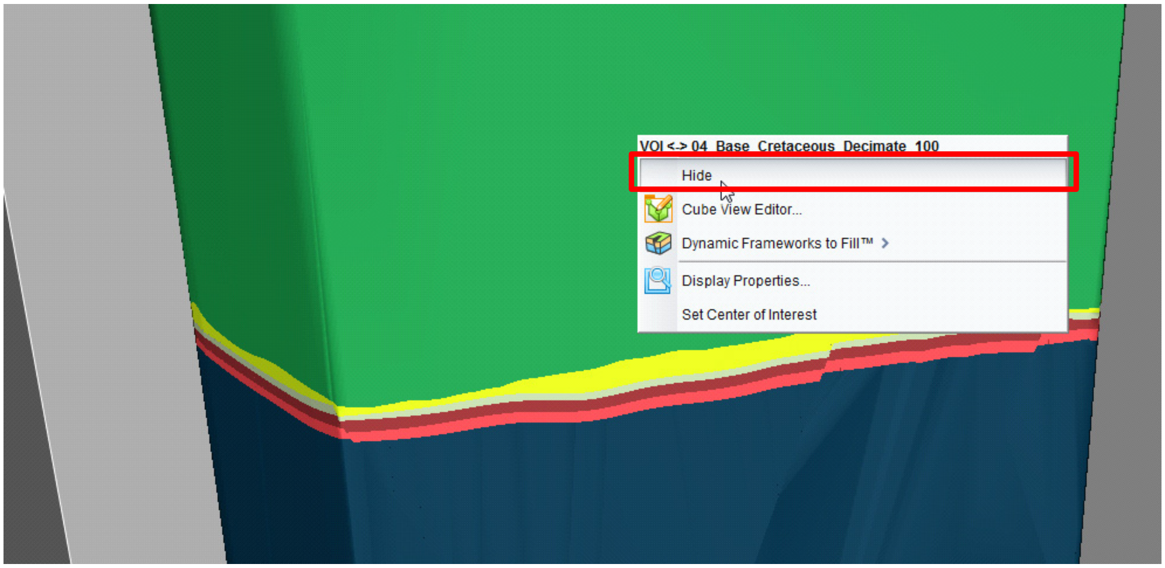
16. Now visualize the **FW STRAT LAYERS** compartments in *Cube* view: turn off your **FW FAULT BLOCKS**, and turn on all the **FW STRAT LAYERS** compartments.

Your **FW STRAT LAYERS** should look similar to the ones below.

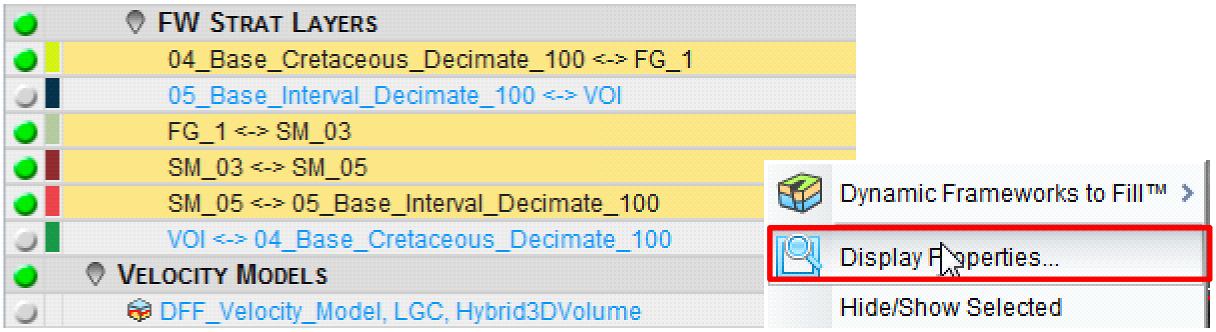


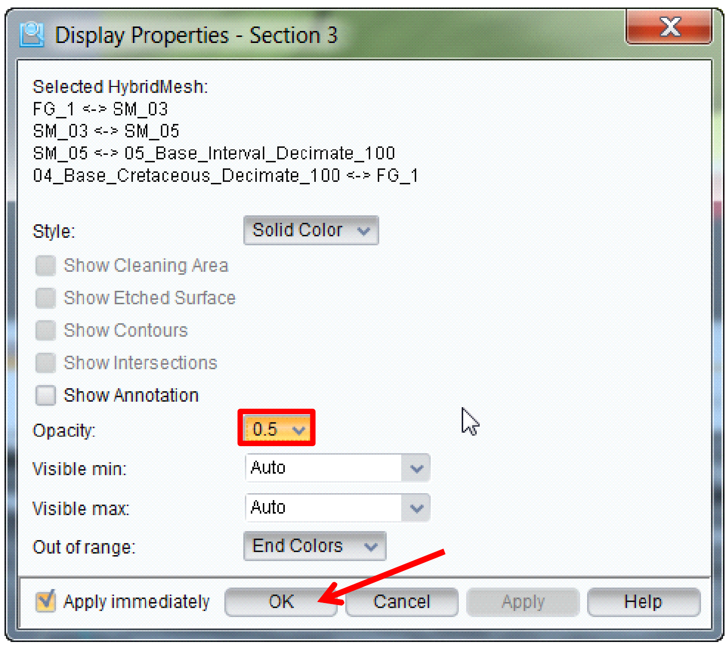
The upper compartment, for interval **VOI <-> 04_Base_Cretaceous**, is created from the top of the VOI to the top of the reservoir. The same goes for the compartment made for the **05_Base_Interval <-> VOI interval**, with it going from the base of the reservoir to the bottom of the volume. Since these compartments are outside of the reservoir area, you will need to turn them off or hide them from *Cube* view, they are not going to be taking into account for volumetric calculations.

17. In *Cube* view, turn off the upper and lower **FW STRAT LAYERS** Compartments. **MB3** on the upper most compartment and select **Hide**, repeat this process in the lower most compartment to hide it.

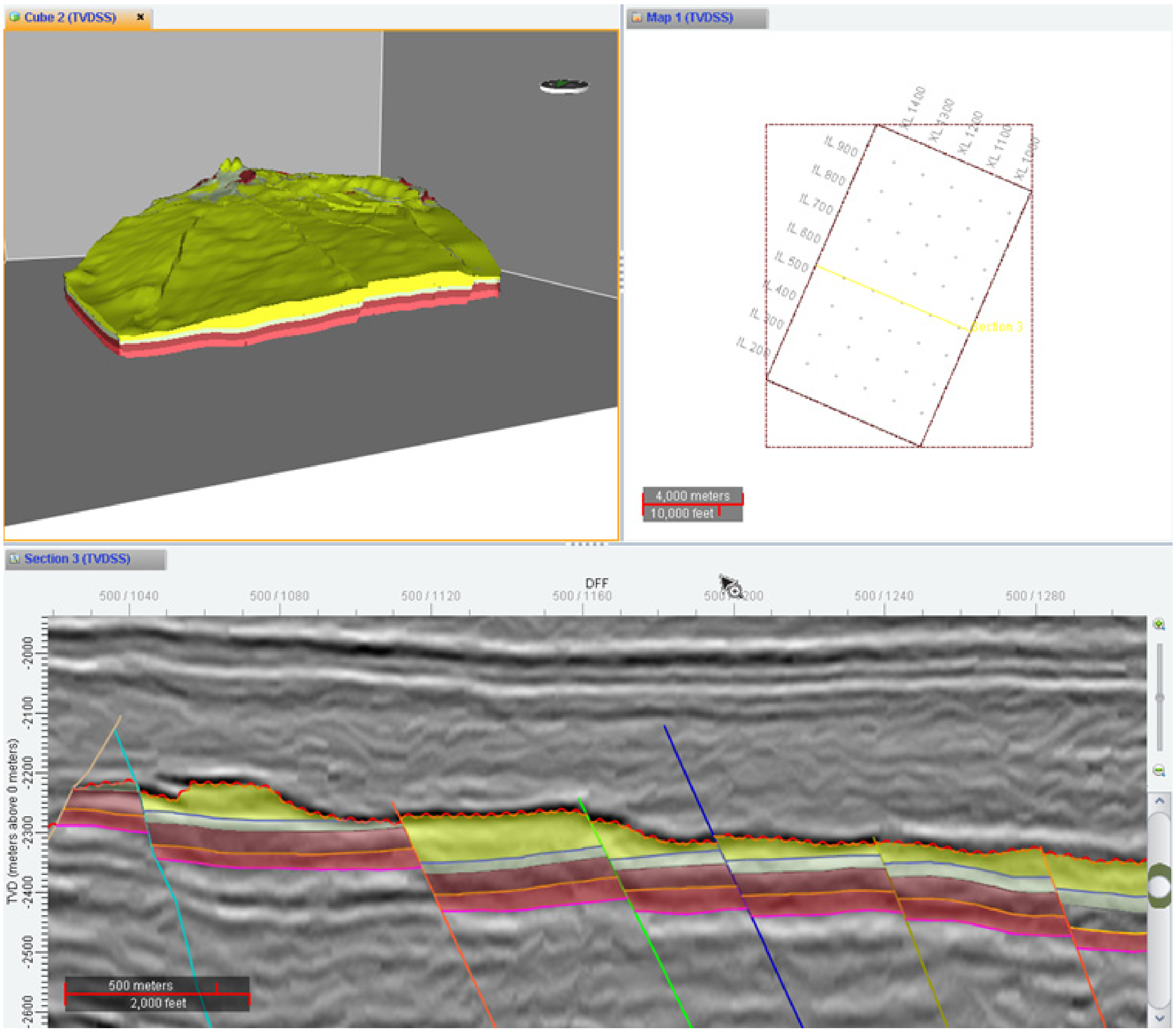


18. In *Section* view, turn on the same compartments being displayed in *Cube* view. Then, from the *Inventory* task pane multi-select the stratigraphic compartments, **MB3** on one of them and then select **Display Properties**. Change the opacity to **0.5** so you can see the seismic under the compartments fills.



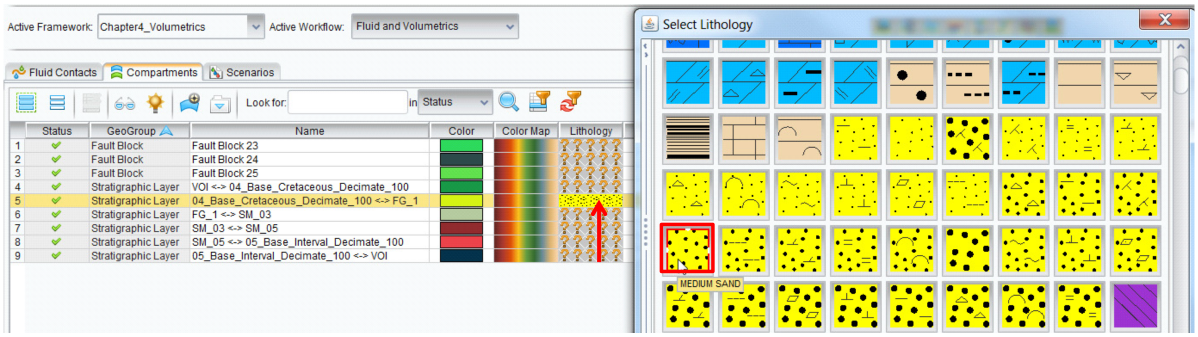


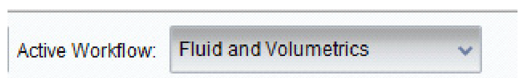
Your views should look similar to the ones below.



In the *Dynamic Frameworks to Fill Workspace* window, along with the options to change the Color and Color Map, you can designate if the compartments contain a certain lithology. In this area, there is a general coarsening up within the reservoir, and you can display this within the compartments.

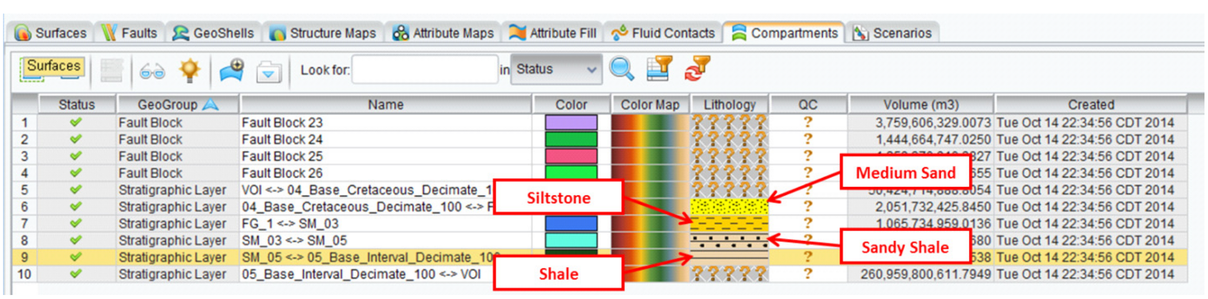
19. In the *Dynamic Frameworks to Fill Workspace* window, in the *Compartments* tab, there is a *Lithology* column. On the **04_Base_Cretaceous <-> FG_1** compartment **MB1** on the box in the *Lithology* column to activate the *Select Lithology* dialog box. Select **Medium Sand** and click **Close**.



> **Note**
>
> If you don't see the *Compartments* tab, change the *Active Workflow* to either **All Workflows** or **Fluid and Volumetrics**.
>
> 
>

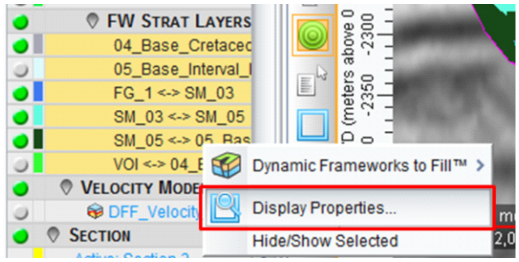
20. Similarly, define lithologies for the other compartments as follows:

- FG_1 <-> SM_03: **Siltstone**
- SM_03 <-> SM_05: **Sandy Shale**
- SM_05 <-> 05_Base_Interval: **Shale**



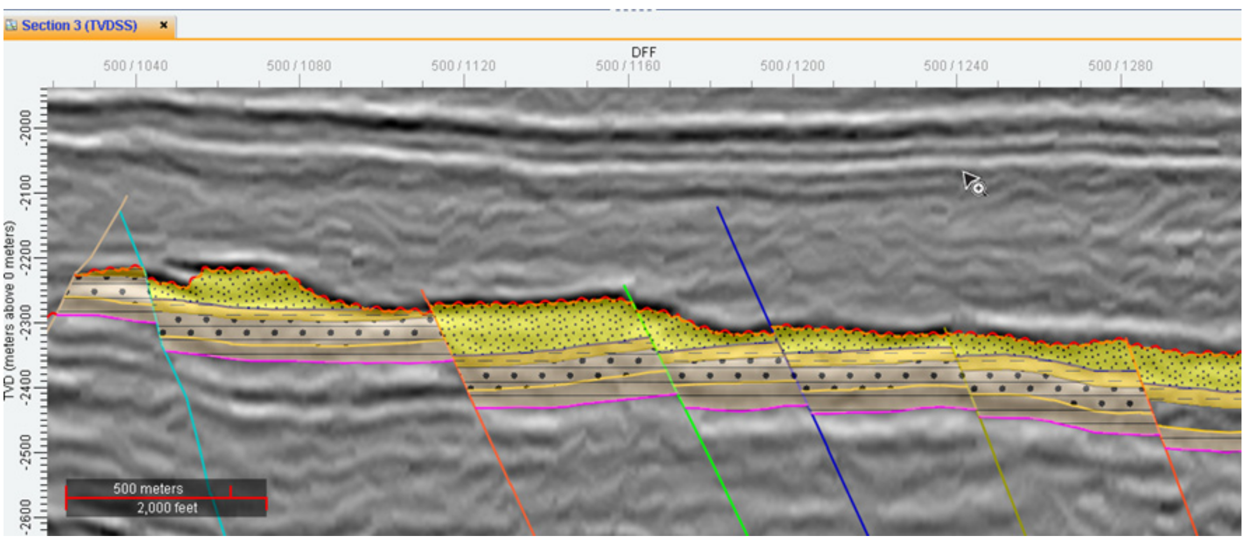
You will now display those lithologies in *Section* view. Being able to display them in *Section* view provides a very useful visual aid for both geologists and geophysicists to grasp the general patterns of a reservoir quickly.

21. Activate your *Section* view, if it is not already active, and in the *Inventory* task pane, select all of your **FW STRAT LAYERS**, **MB3** and select **Display Properties**.



22. In the *Display Properties* dialog box, under *Style* select **Lithology**, then click **OK** to close the window.

    This will display the lithologies that you designated for the compartments in the *Dynamic Frameworks to Fill Workspace* window. Your *Section* view should look similar to the one below.



It is extremely useful to be able to see the areal extent of the reservoir to identify facies, especially when trying to get a good idea of the general migration of the reservoir through time, as well as when you are planning prospective well locations.

23. Activate *Map* view. Turn on the following stratigraphic compartments:

    a. 04_Base_Cretaceous <-> FG_1

    b. FG_1 <-> SM_03

    c. SM_03 <-> SM_05

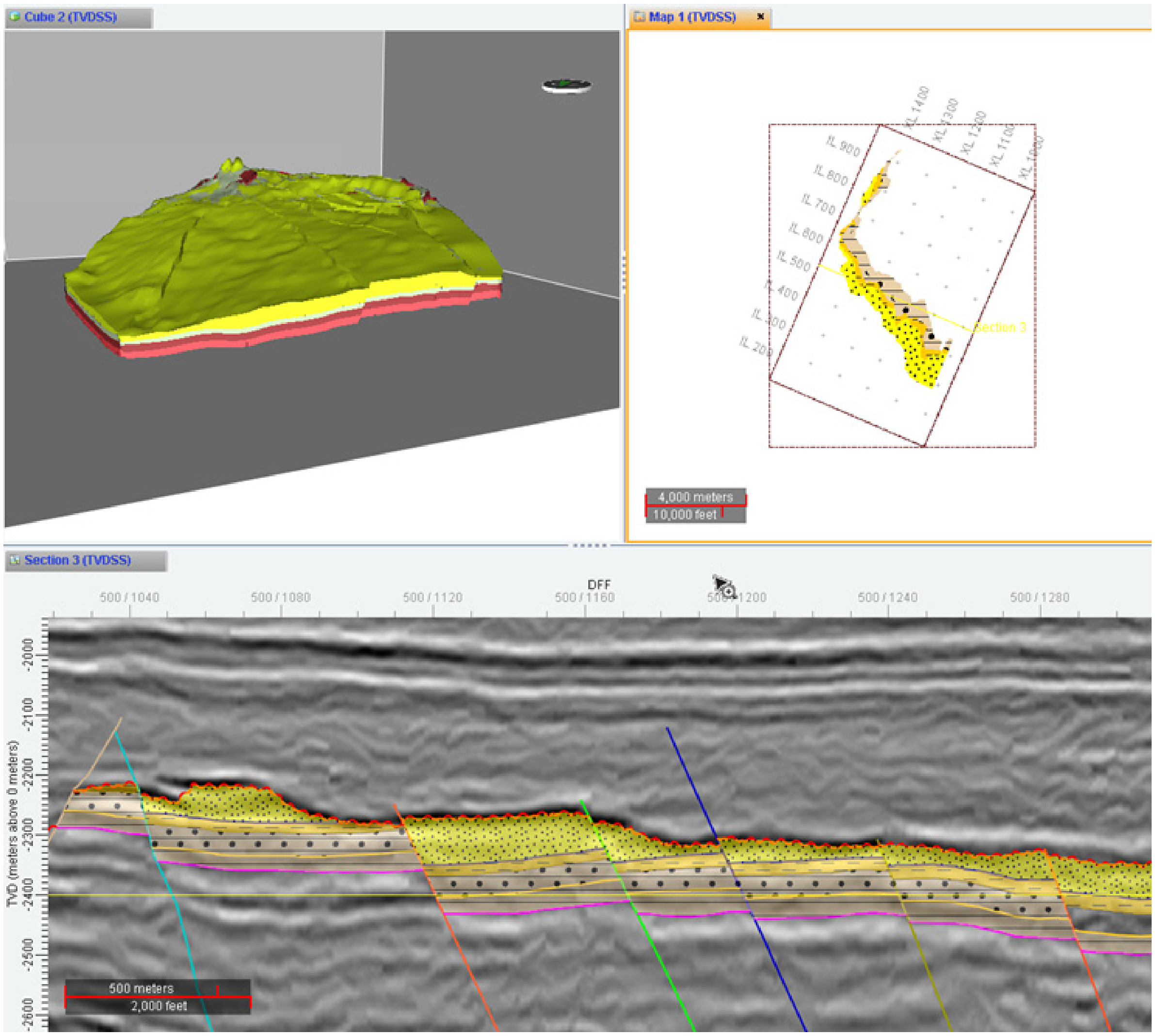
    d. SM_05 <-> 05_Base_Interval

24. Repeat the previous step to display the compartments by lithology in *Map* view (**MB3** then select **Display Properties**). Turn on **Map Intersection View** () (located right underneath the main menu), and navigate to the **"-2400" TVD** slice to see the lithology changes of the reservoir at that depth. Notice that a yellow line appears in *Section* view at -2400 meters TVD.

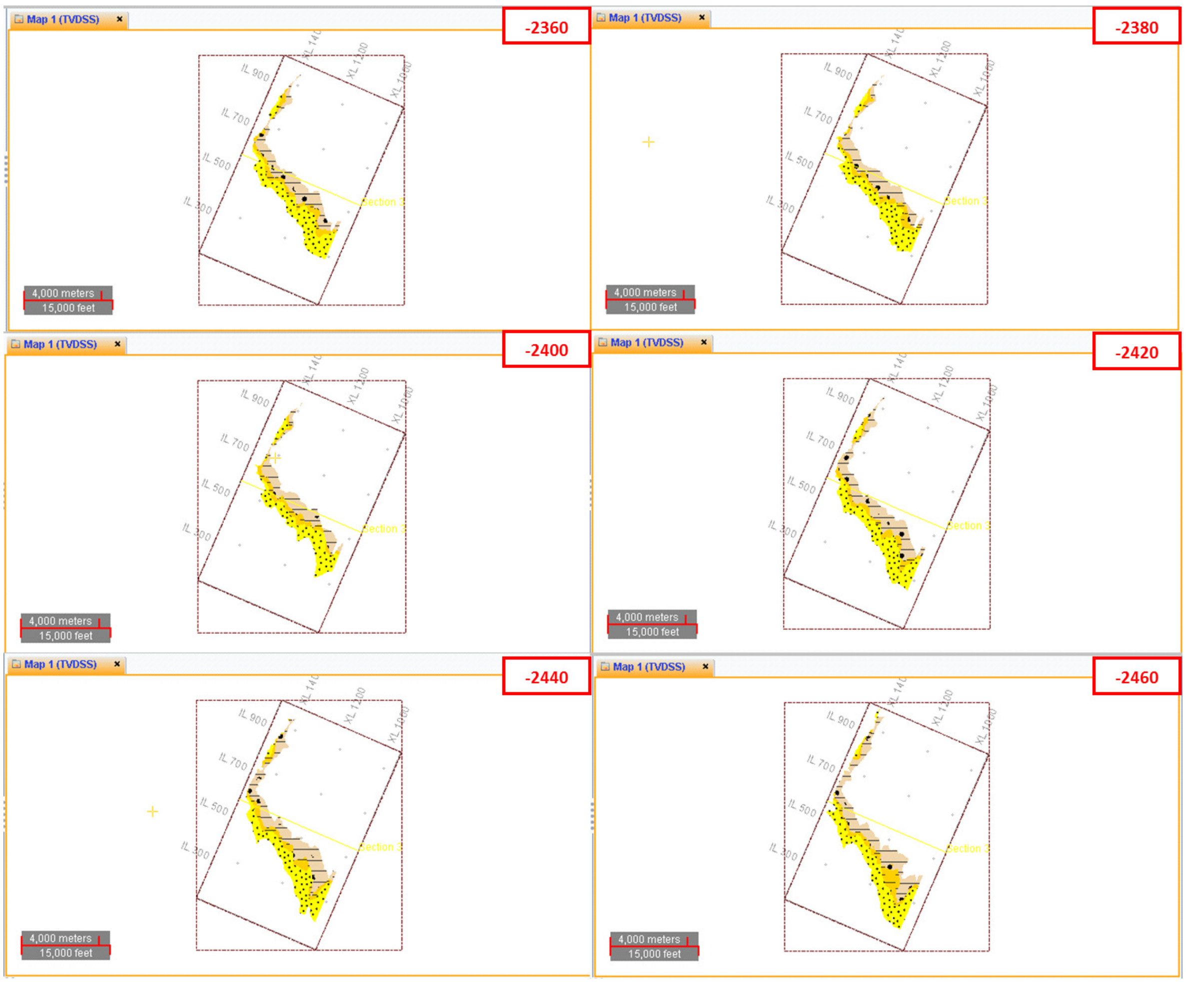
    Map Intersection View off: 

    Map Intersection View on: 

Your views should look similar to the ones below.



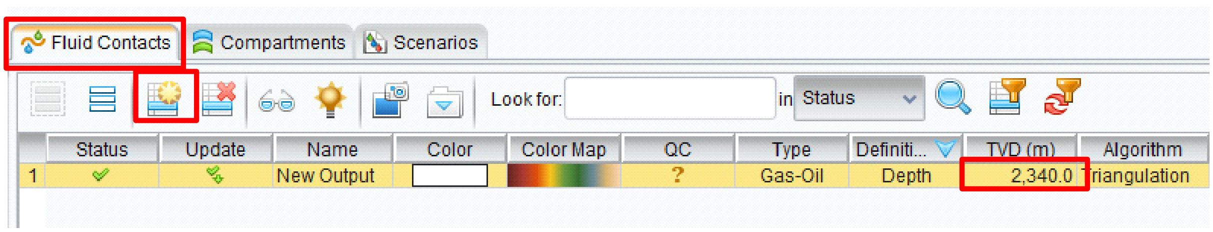
25. Observe the changes in the reservoir facies and migration by setting the *Map* view to step forward/backward every “20” slices. Use the arrows to move up or down in depth.



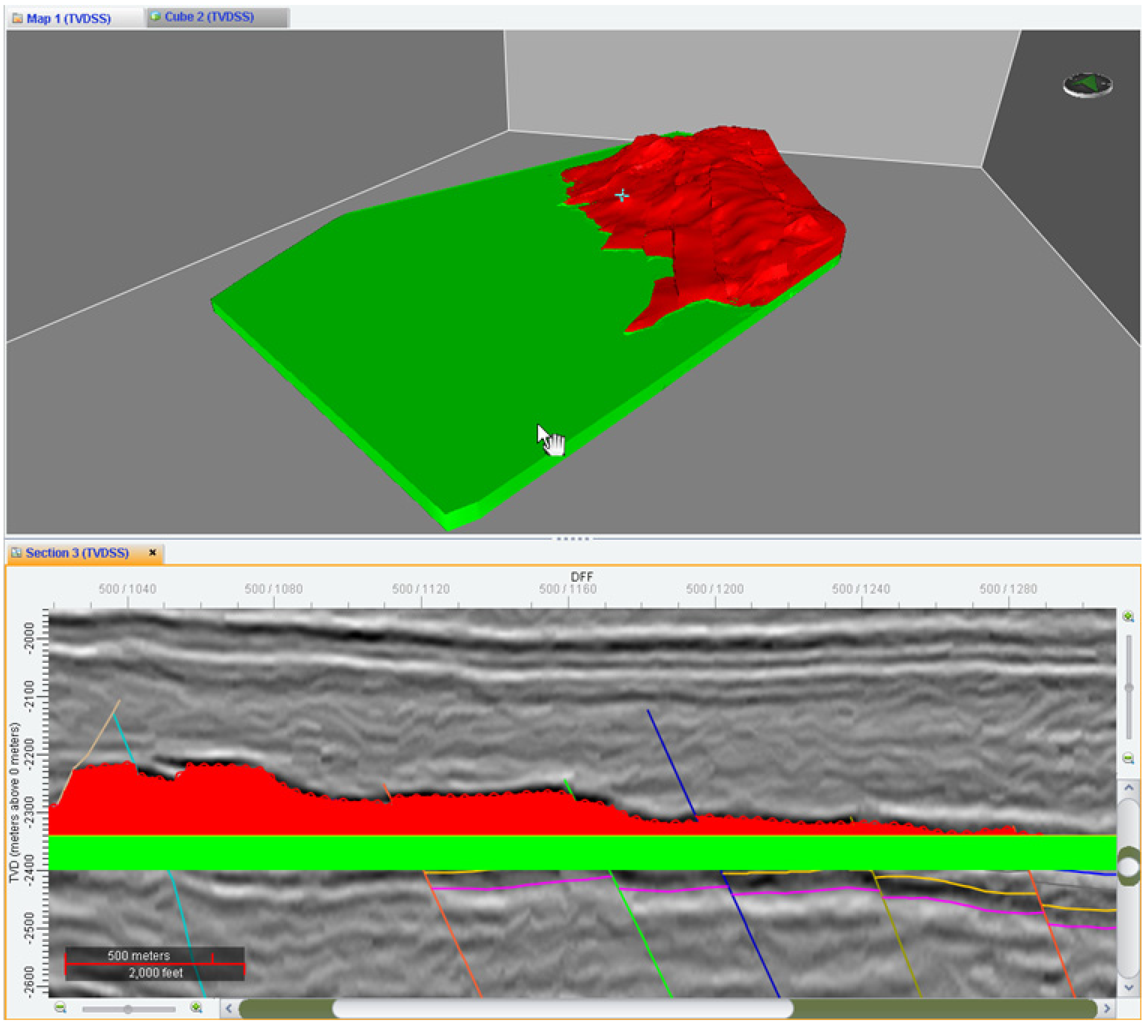
Fluid Contacts

In the following steps, you will add fluid contacts into the frameworks to create fluid compartments.

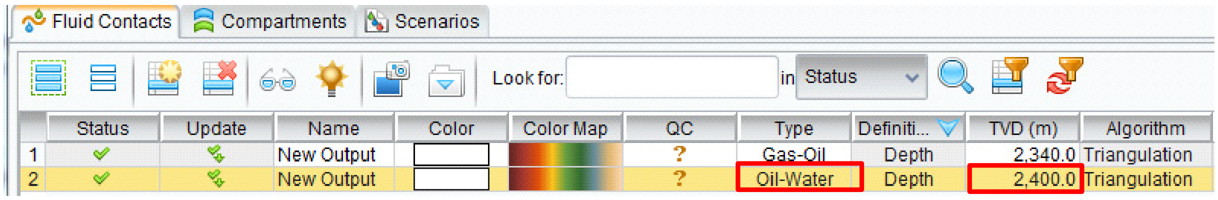
26. In the *Dynamic Frameworks to Fill Workspace* window, go to the *Fluid Contacts* tab. Click on the **Add a new model entry** ( ) icon and change TVD (m) depth to **2340**, press <**Enter**>. Your framework should update automatically. Notice that by default, the fluid contact is associated to Gas-Oil.

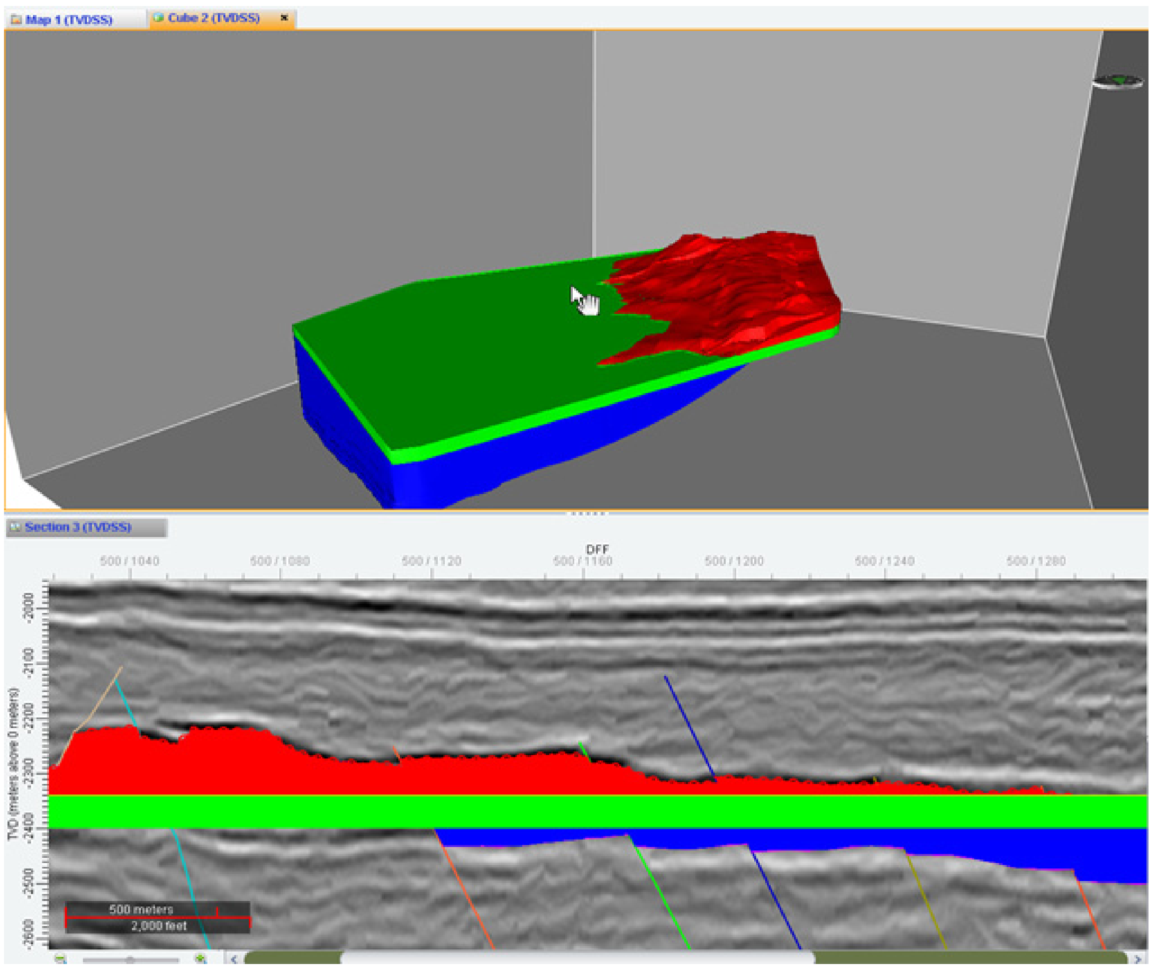


27. Activate *Cube* view. Turn off all the current displayed compartments and turn on all the **FW FLUID COMPARTMENTS**. If desired, also turn on the **FW FLUID COMPARTMENTS** in *Section* view. Your display should look similar to the picture below:



28. Similarly, add a second fluid contact, this time change the *Type* of contact to **Oil-Water** at **2400** meters TVD depth. Display the results in *Section* and *Cube* views.

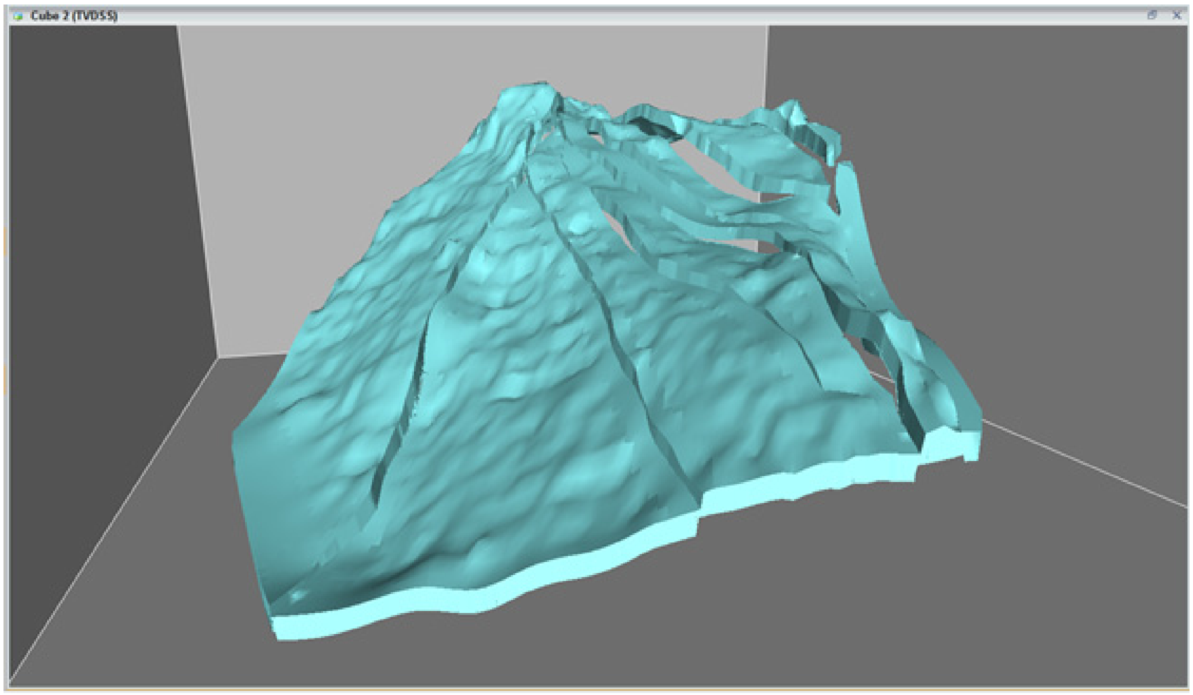




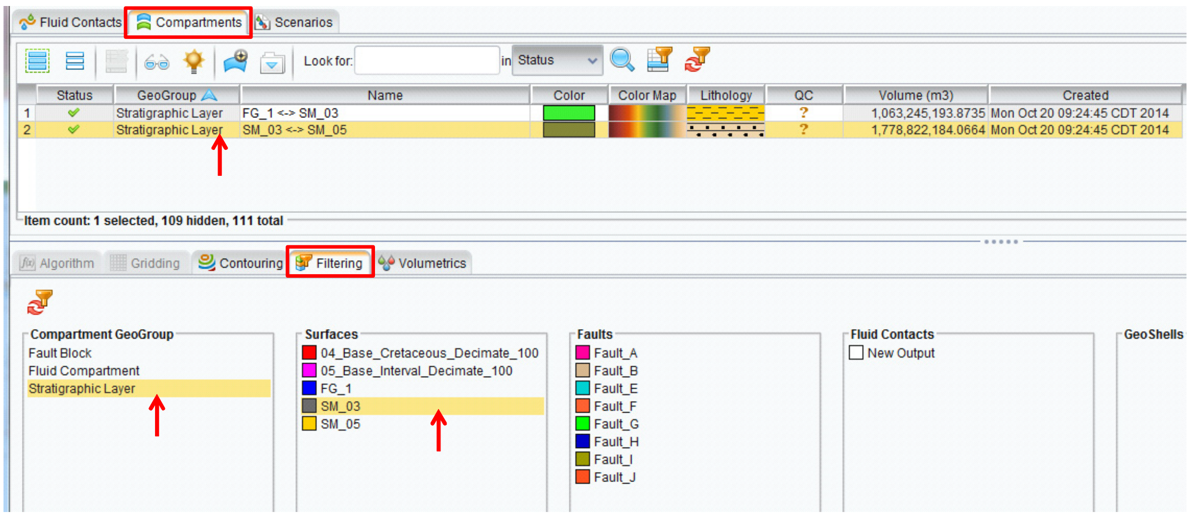
Volumetric Calculation

Finally, you will use the compartments to calculate volumetric to determine the amount of potentially available oil. You can perform volumetric calculations on the compartments you created earlier in the *Dynamic Frameworks to Fill Workspace* window. You will be doing these calculations on the **SM_03 <-> SM_05** interval.

29. Maximize *Cube* view; turn off all the objects from your *Inventory* task pane. Turn on only the S**M_03 <->SM_05** FW STRAT LAYER.



30. In the *Dynamic Frameworks to Fill Workspace* window, navigate to the *Compartments* tab. Select the **SM_03 <-> SM_05** interval. Notice that at this point you are seeing a lot of compartments in the list. You can use the *Filtering* action tab to quickly locate the compartment you are looking for. In the *Filtering* action tab, select **Stratigraphic Layer** under the *Compartment GeoGroup* section. Under the *Surfaces* section, select **SM_03**. The list of compartments will update showing only the stratigraphic layers related to **SM_03**.



The system is now calculating the Gross Rock Volume using “Direct Polyhedral Volume Calculation” technology. This means that the gross rock volume is computed directly from the compartment geometry, which is a significant improvement over traditional slicing techniques.

Decision Space Geosciences volumetric technology is based on framework compartment objects and is also referred to as Visual Volumetrics due to the visual control you have during volume calculations.

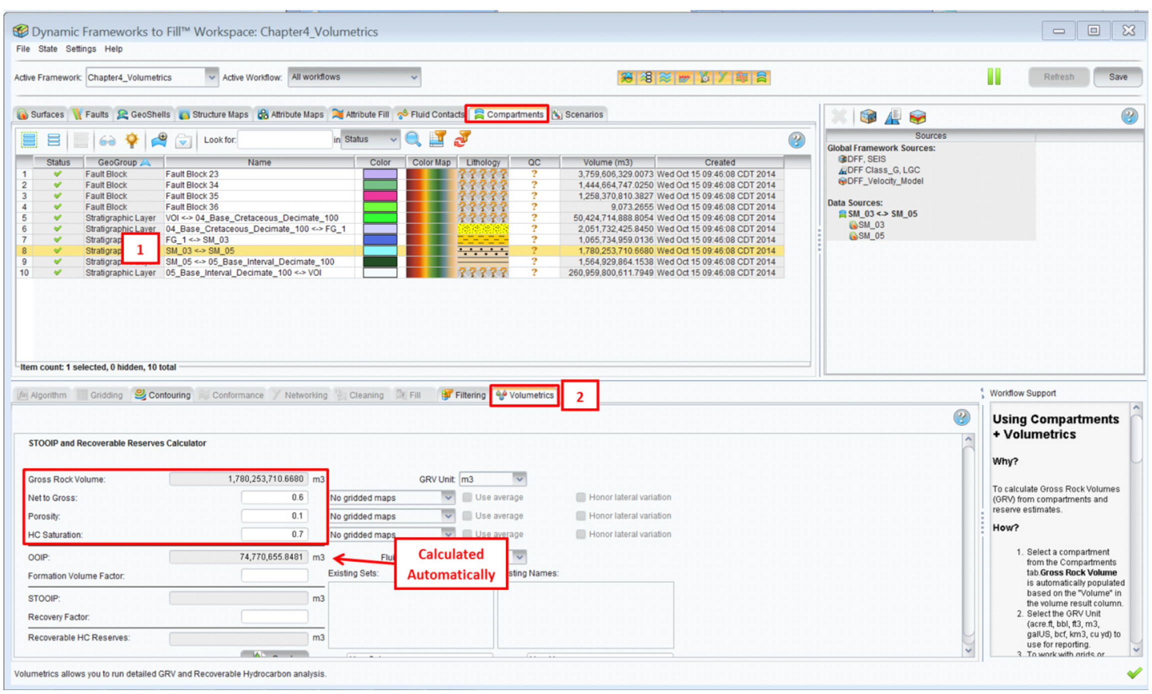
Compartments are framework objects that are created on the fly by auto-detecting sealed spaces in the framework bound by framework objects (surfaces, faults, geoshells and fluid contact planes) and/or the framework limits. Volumes are calculated directly from compartments (sealed spaces) and from thickness grids derived from these sealed compartments.

Compartments enable the new highly accurate deterministic volumetric workflows, where the gross rock volume is calculated through the “Direct Polyhedral Volume Calculation” technology. This technique is based on the mathematical definition of a polyhedron volume and the number of polyhedrons that fit within specific compartment geometry. OOIP, STOOIP, and Recoverable Reserves calculations can be run against already computed compartment gross rock volumes using gross thickness grids. The completed calculations are permanently saved in OpenWorks with ID and date, as well as the parameters used.

These methods represent significant improvements in accuracy, performance, and usability over traditional slicing methods or subtraction of grids derived from individual surfaces. There is also support for multiple scenarios and time-lapse analysis.

31. Go to the *Volumetrics* action tab and define the parameters as follows:

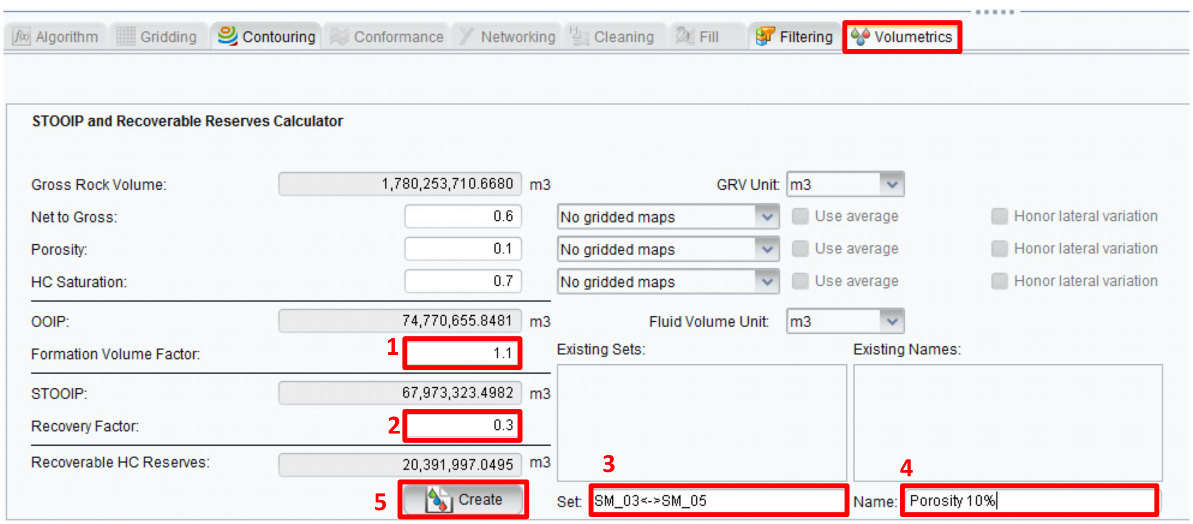
   - Net to Gross: **0.6**
   - Porosity: **0.1**
   - HC Saturation **0.7**



The OOIP will be automatically calculated once you have entered the values for Net to Gross, Porosity, and HC Saturation. This will happen whether you are in Dynamic, Auto Refresh or Manual.

32. Continuing in the *Volumetrics* action tab, designate the values for *Formation Volume Factor* as “1.1”, and for *Recovery Factor* as **“0.3”**. STOOIP will be calculated upon designating the Formation Volume Factor, and Recoverable HC Reserves will be calculated automatically upon designating the Recovery Factor.

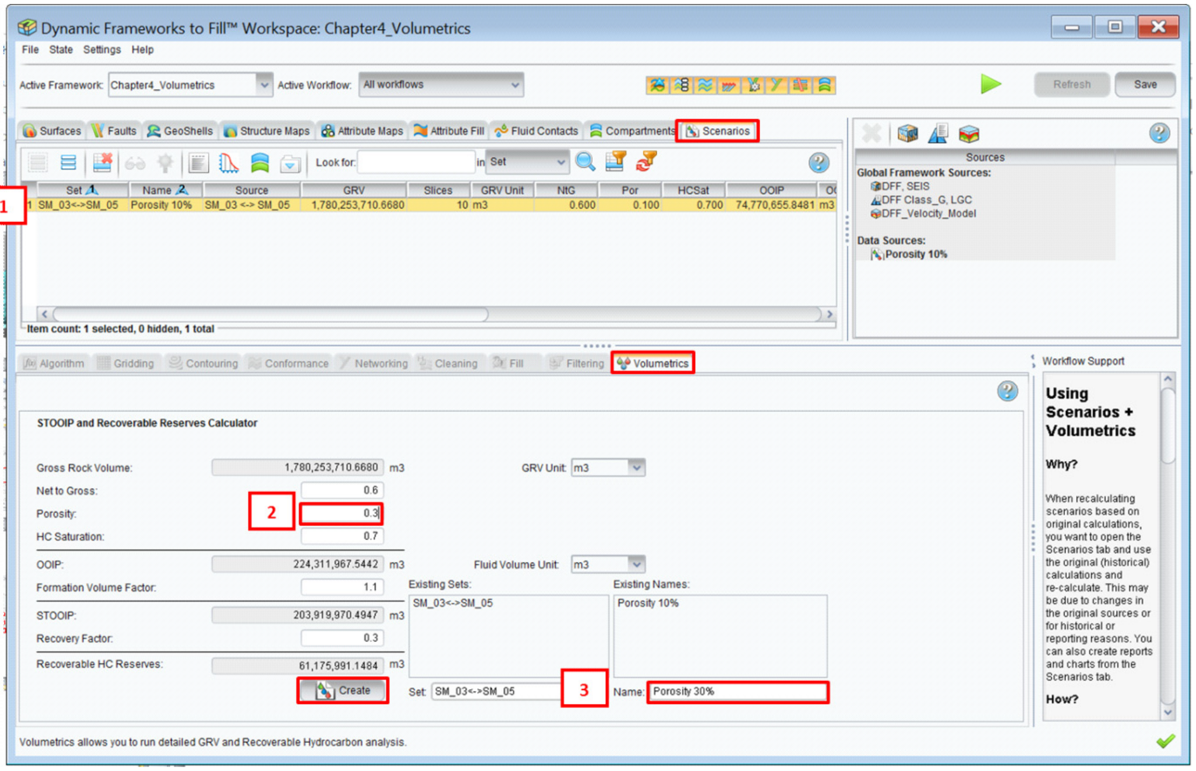
33. You can now save the calculations using the *Set* and *Name* fields. This interface allows the creation of multiple volumetric scenarios. You can change any of the parameters above and run a new calculation or you can opt for select another compartment and run calculations. It doesn't matter how many volumetric interactions you run, you can save all the interactions and organize them in proper Sets and Names. For this specific example, for the Set name use the compartment name **“SM_03<->SM_05”** and Name as **“Porosity 10%”**. Click **Create**.



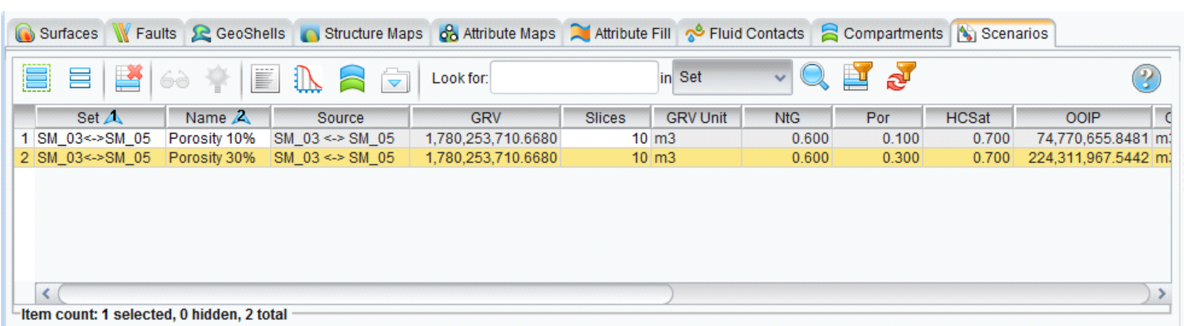
Once you click the Create button, the software will store the calculations. You can see them in the *Scenarios* tab. Here you can click on any of the calculations you have made and see the parameters that were used as well as alter those parameters from the *Volumetrics* action tab.

34. In the *Dynamic Frameworks to Fill Workspace* window, navigate to the *Scenarios* tab, and select the newly created volumetric calculations for **SM_03<->SM_05**.

35. In the *Volumetrics* action tab, change the *Porosity* value from 0.1 to "0.3". Make sure *Formation Volume Factor* is set to **1.1** and *Recovery Factor* to **0.3**. Keep *Set* the same, but change the *Name* to "Porosity **30%**". Click **Create**.

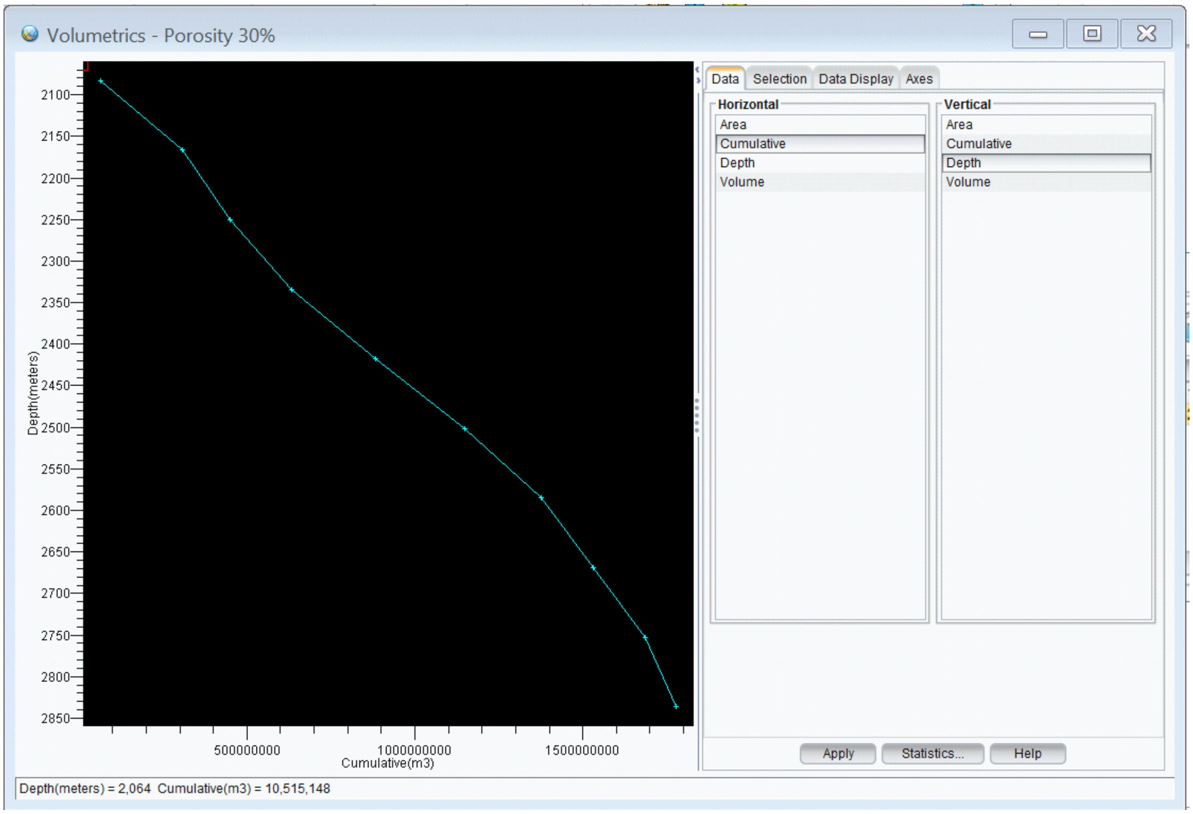


The new volumetric calculation will appear in the *Scenarios* tab, with the same *Set* name, but with the *Name* changed.

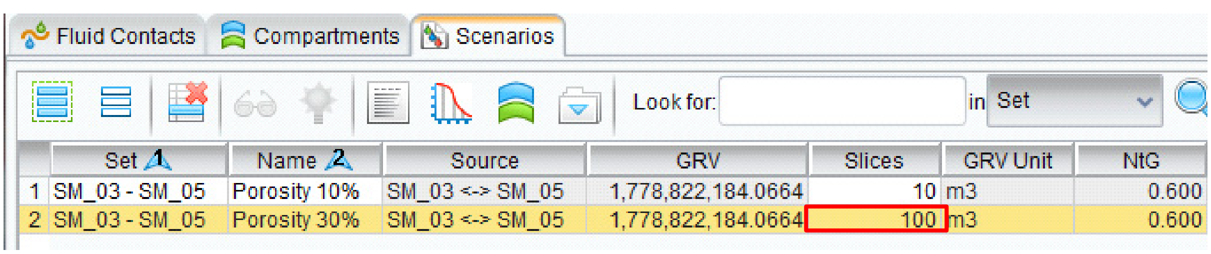


36. From the *Scenarios* tab, you can also view cross plots of information for the calculations. To create these volumetric charts select the **Porosity 30%** scenario, and then click the **Chart** ( ) icon.

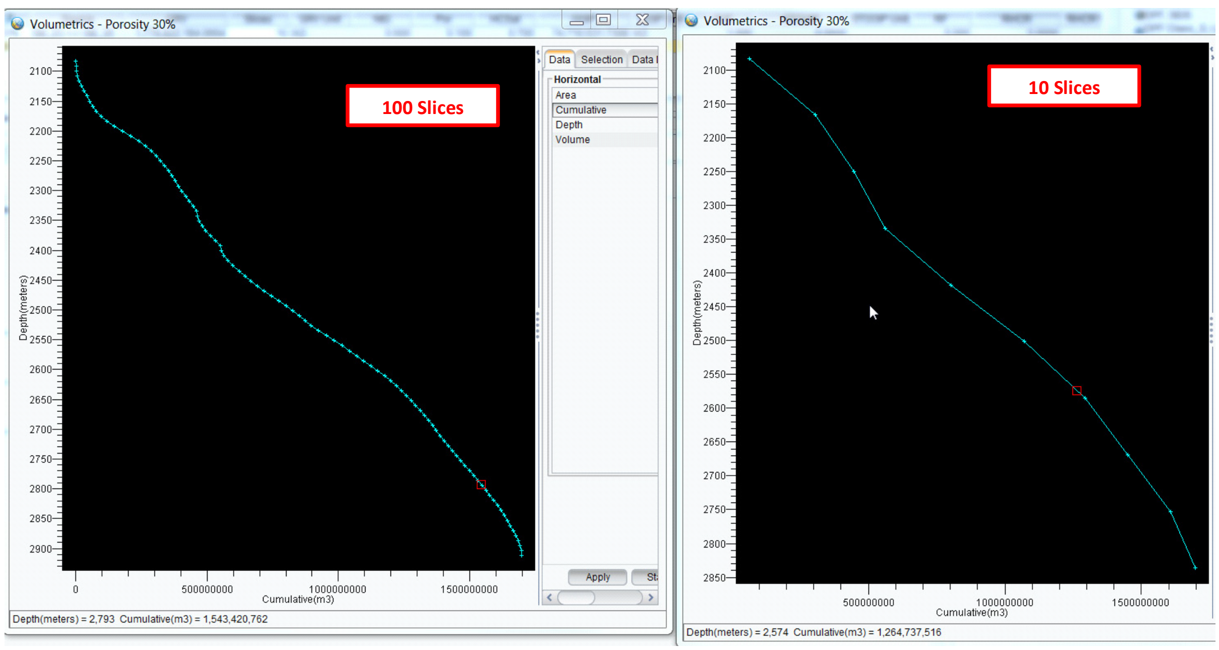
The Volumetrics chart with the default 10 slices for Porosity 30% displays. Notice the different combinations of attributes that you can plot in the horizontal and vertical axis. Experiment with different attributes, but you must click **Apply** in order for the chart to reflect those changes. Leave this chart open; in the following step you will create another chart with 100 slices to compare both of them.



37. In the *Scenarios* tab, highlight **SM_03<->SM_05- Porosity 30%, look** for the *Slices* column and change its value to **100**, press <**Enter**>. Click the **Chart** ( ) icon.

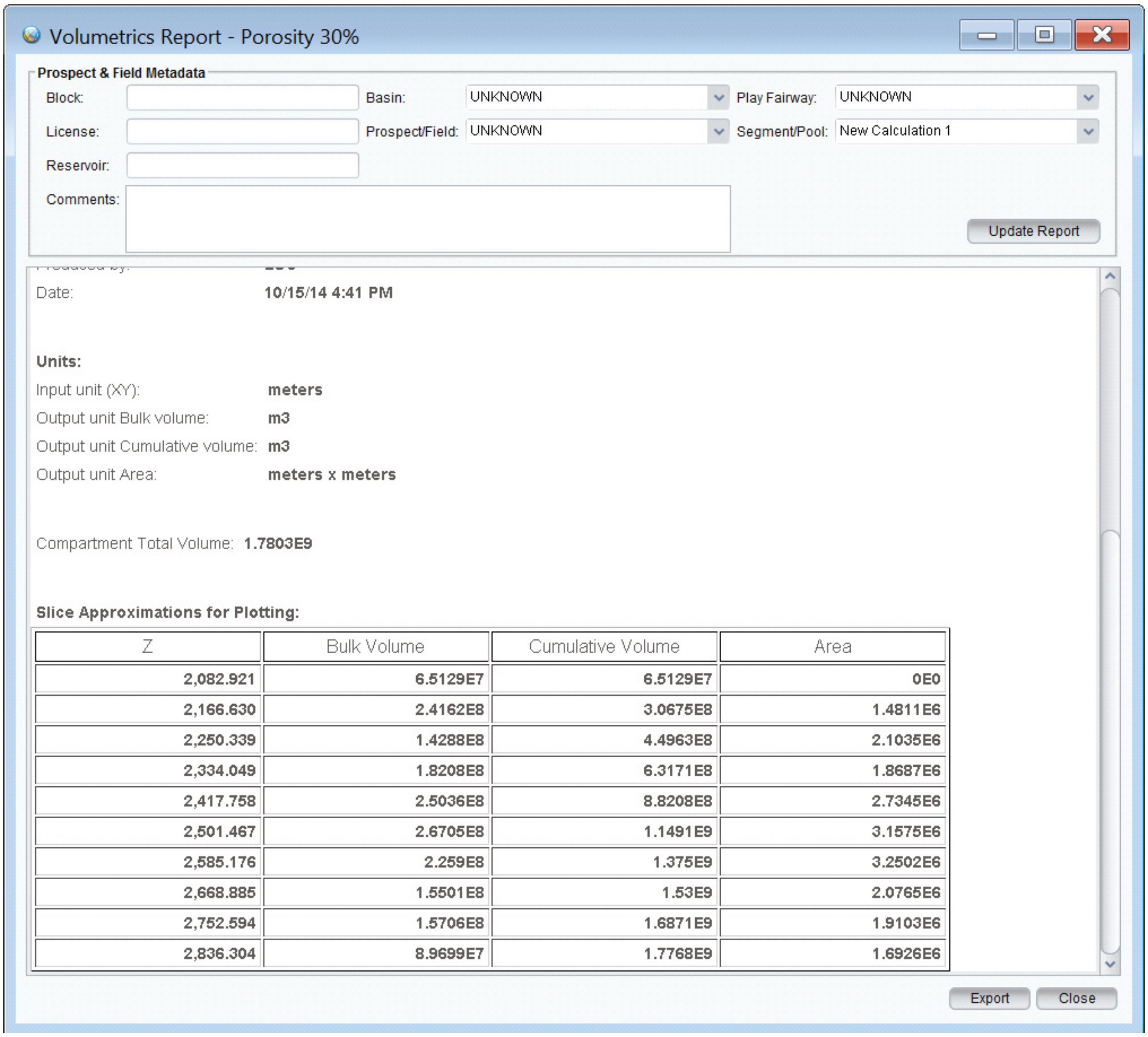


38. Compare the volumetrics charts of 100 and 10 slices and notice the differences between both of them. The 100 slices took more calculation time but the representation of the structure profile is more accurate.



39. To generate a report, click the **Launch volume calculation result report** ( ) icon in the *Scenarios* tab.

The report includes **Prospect** and **Meta Field** data that you can enter interactively, as well as all the compartment calculations, parameters and STOOIP, etc. In addition, the report displays the slice approximations for plotting charts. Scroll down to view the report details.



This concludes the exercise of compartments and volumetrics calculation. In the last exercise, you will create a Geocellular Model.

Exercise 4.5: Creating a Geocellular Model

In this final section, you will convert your framework into a Stratigraphic Geocellular Model that can be taken into the Earth Modeling module of Decision Space Geosciences. During the class, you have seen the powerful tools available within Decision Space Geosciences to dynamically map and create frameworks. This is done by having a tight integration of geological and geophysical workflows in a unique and unified environment. Traditionally, Geocellular Models are not tied to the interpretation data, but by extending the reach of the Dynamic Frameworks to Fill into the Earth Modeling workflows, Decision Space Geosciences is starting to close this gap, and eventually will fully connect Geocellular Models with raw interpretation data.

Limiting your Framework

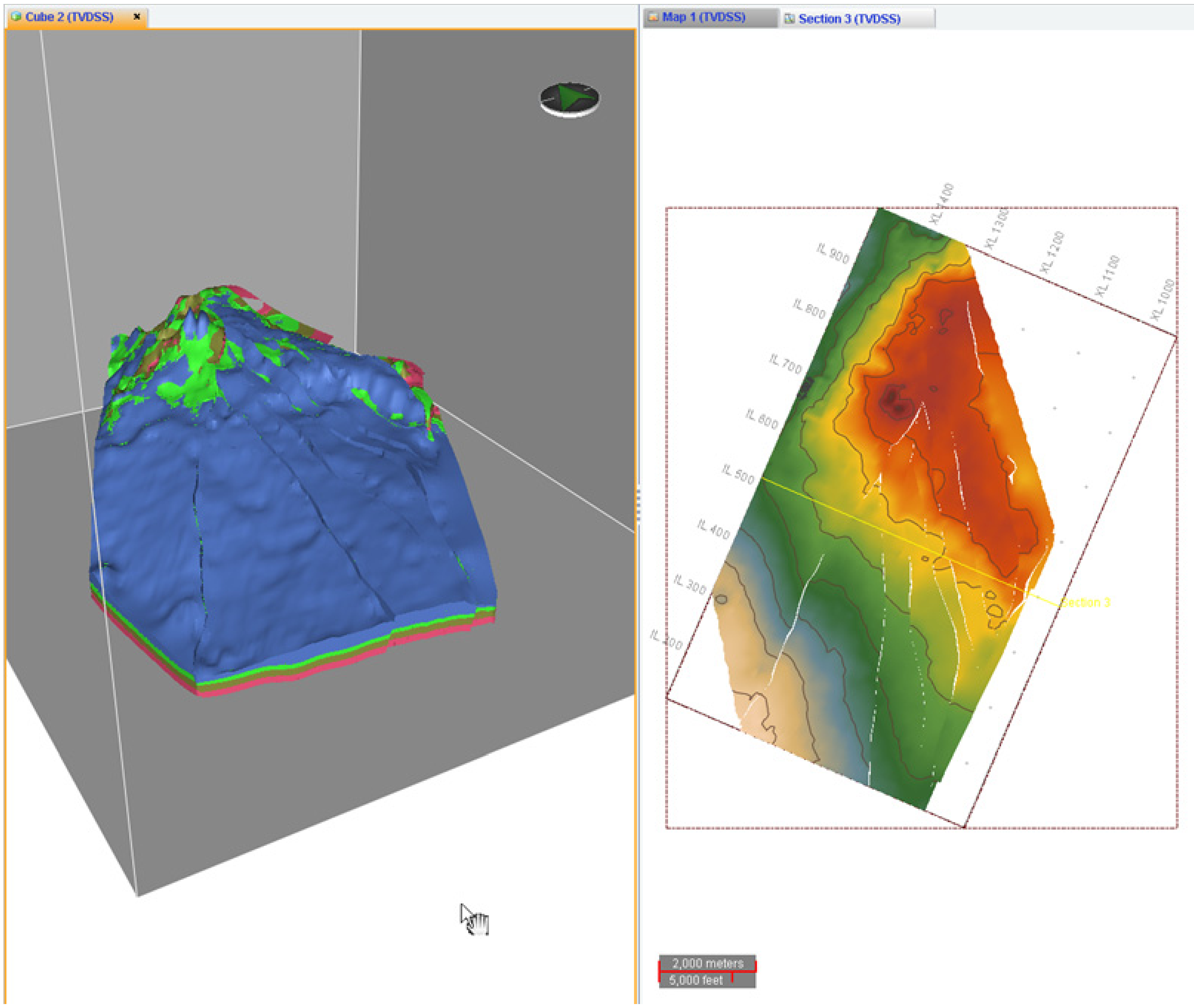
Very often, the frameworks you build will become very large and complex. Creating geocellular models may become a large task. If you do not want to create a model over the entire framework you can create an area of interest using a polygon. The process of being able to limit your framework is applicable not only when creating geocellular models, you may want to limit the framework in other situations like: the seismic has some areas with low resolution, you want to model exclusively within a specific block or lease, etc. In the following steps, you will create a polygon, and use it as an area of interest for your framework.

1. Split the screen between *Cube* and *Map* views. In *Cube* view display the following **FW STRAT LAYERS** compartments:

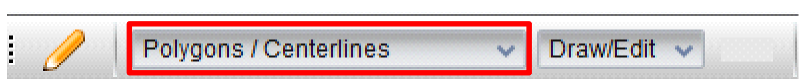
   - **04_Base_Cretaceous <-> FG_1**
   - **FG_1 <-> SM_03**
   - **SM_03 <-> SM_05**
   - **SM_05 <_> 05_Base_Interval**

2. In *Map* view, turn the map intersection off () and display only the framework surface **04_Base_Cretaceous**.

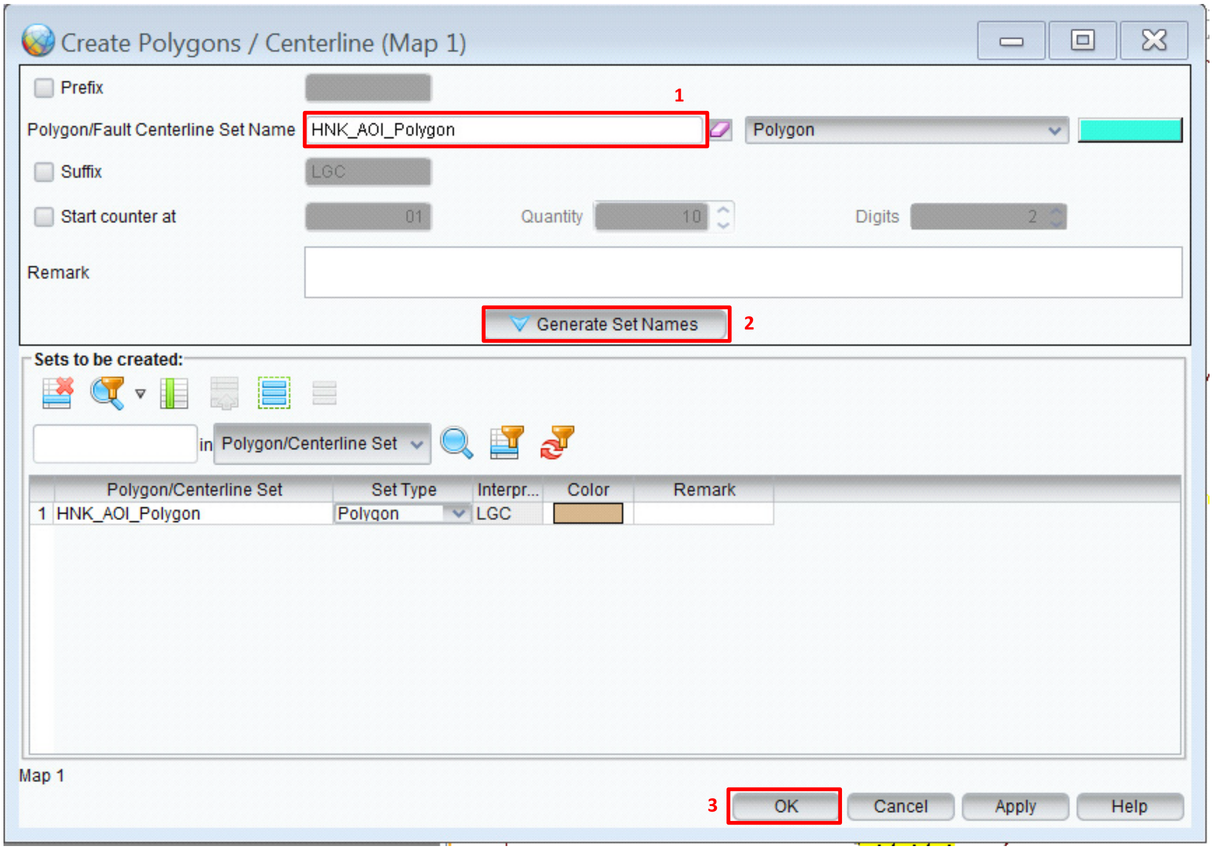
Your views should look similar to the ones below.



3. Make sure that *Map* view is active, and within the *Interpretation* task pane select the *Interpretation data type* as **Polygons / Centerlines**. The *Interpretation* task pane will activate with Polygons / Centerlines active.

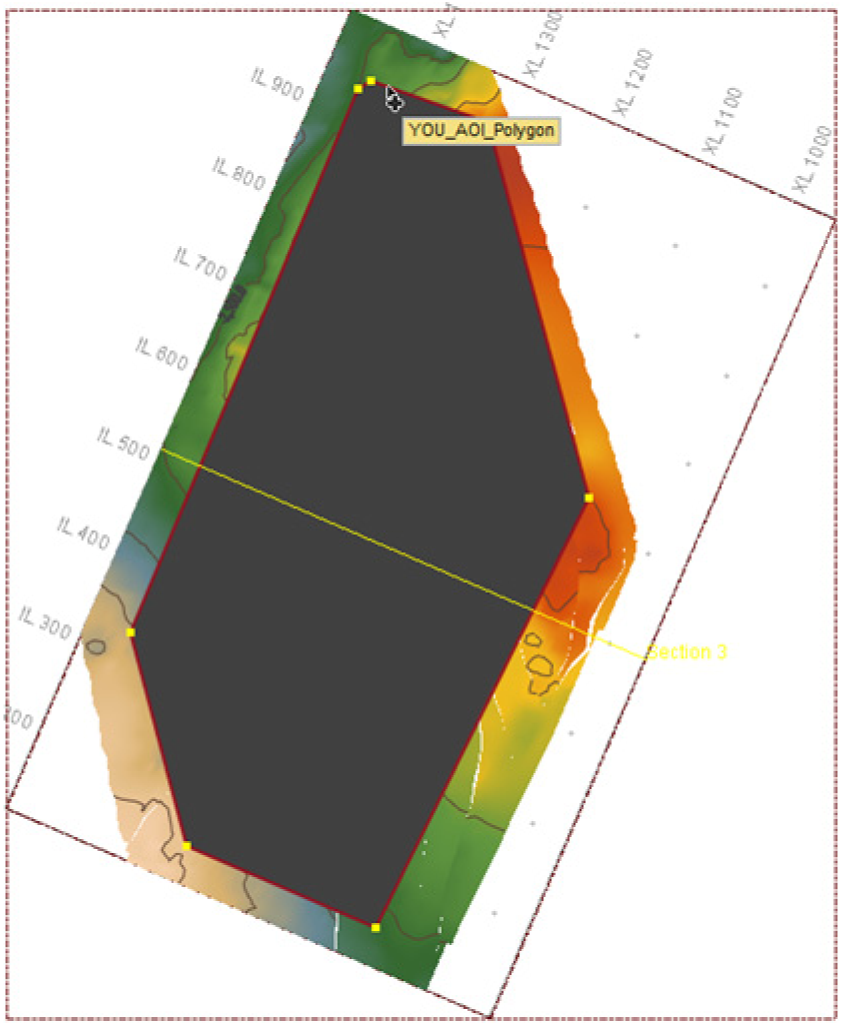


4. Click the **Launch Create Polygons / Centerlines dialog** ( ) icon. In the *Create Polygons/Centerlines* dialog box name the Polygon "**YOU_AOI_Polygon**". Click the **Generate Set Names** button, and then click **OK**.



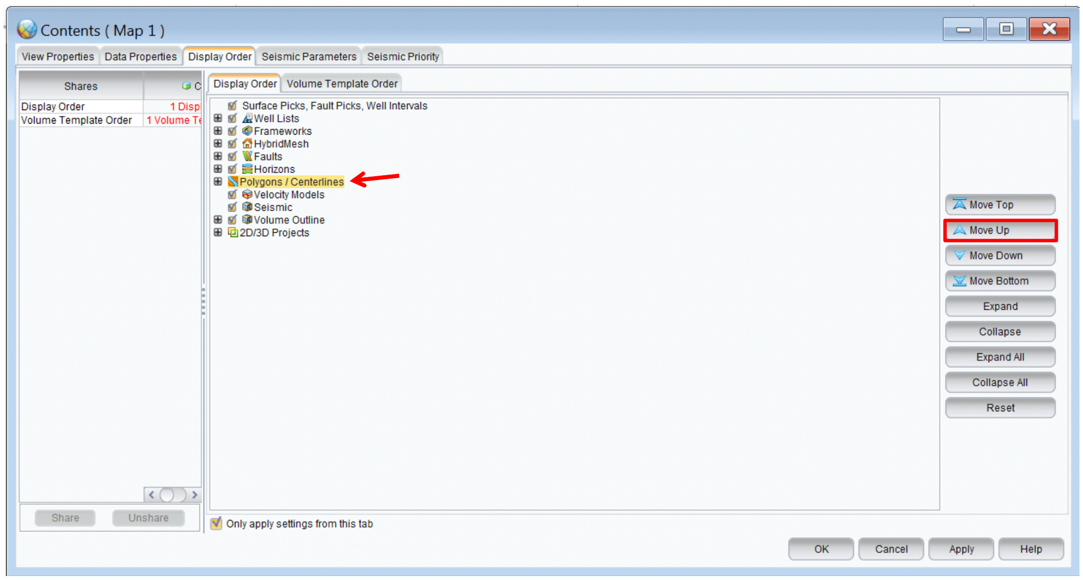
5. The newly created polygon will appear in the *Interpretation* task pane. Activate **Interpretation Mode** ( ), so you can begin to draw your AOI Polygon.

6. **MB1** in *Map* view to begin drawing your polygon, when you want to close the polygon **MB2**. Draw the polygon similar to the picture below. Once finished, turn Interpretation mode off.



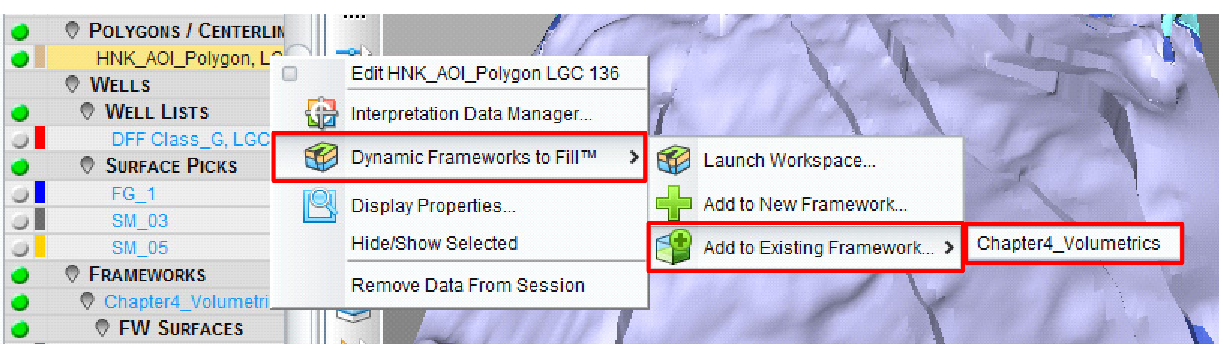
Note

Deactivating Interpretation mode may cause your polygon to disappear in view. This is due to the display order, View > Display Order, because the Polygons / Centerlines objects are below the objects currently being displayed in your view.

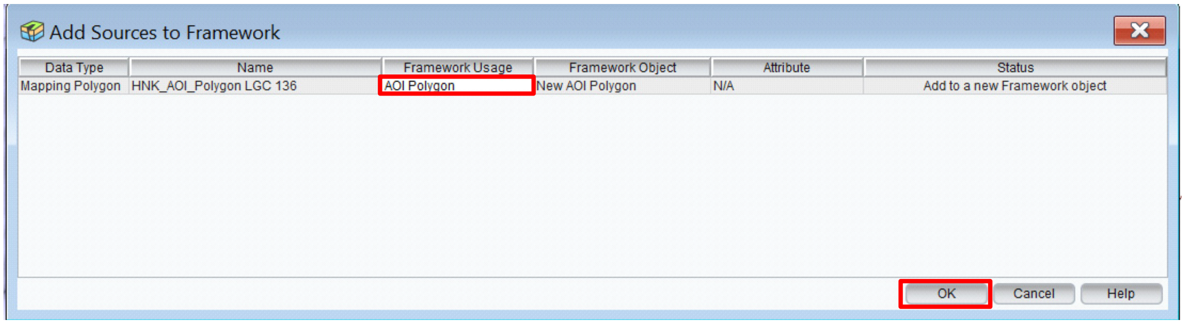


7. The new polygon will appear in the *Inventory* task pane, under **POLYGONS / CENTERLINES**.

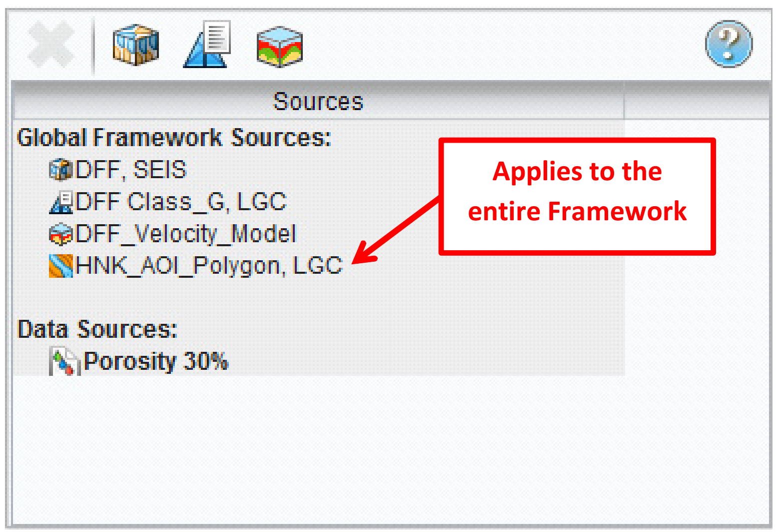
8. Change your framework to **Dynamic, Manual**, **MB3** on **YOU_AOI_Polygon** and then select **Dynamic Frameworks to Fill > Add to Existing Framework > Chapter4_Volumetrics**.



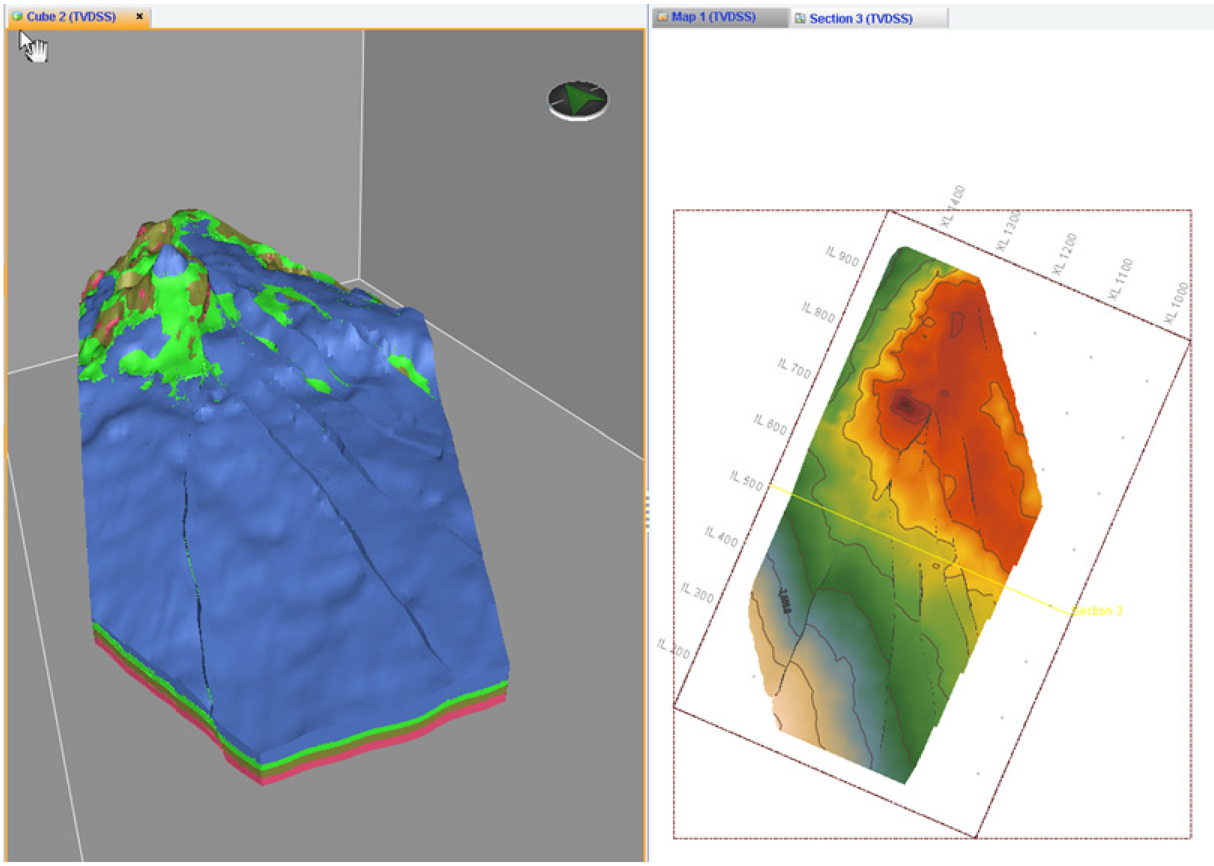
9. The *Add Sources to Framework* dialog box displays. In the *Framework Usage* column, specify to use it as an **AOI Polygon**. The *Framework Object* will automatically update to be a New AOI Polygon. Click **OK**.



10. The AOI Polygon appears in *Global Framework Sources*, meaning that it is applicable to the entire framework as opposed to a specific object within the framework.



11. Refresh your framework, and when it finishes, your framework should now be trimmed according to **YOU_AOI_Polygon**.



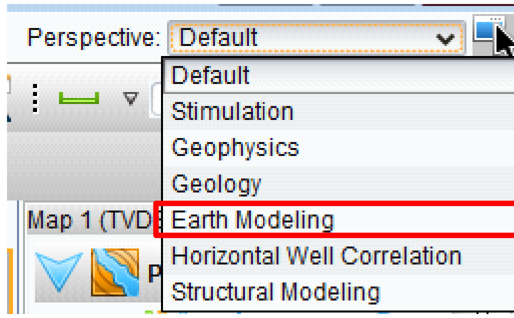
> **Note**
>
> You may get a hazard symbol in your *Faults* tab, this means that your AOI polygon did not include any data for that particular fault, and therefore was unable to draw it. Expanding your polygon to include a portion of the fault will give the framework enough data to create it.

Creating a Geocellular Model

Now that you know how to limit your framework to only include specific areas, you can create a geocellular model of that specific area of your framework.

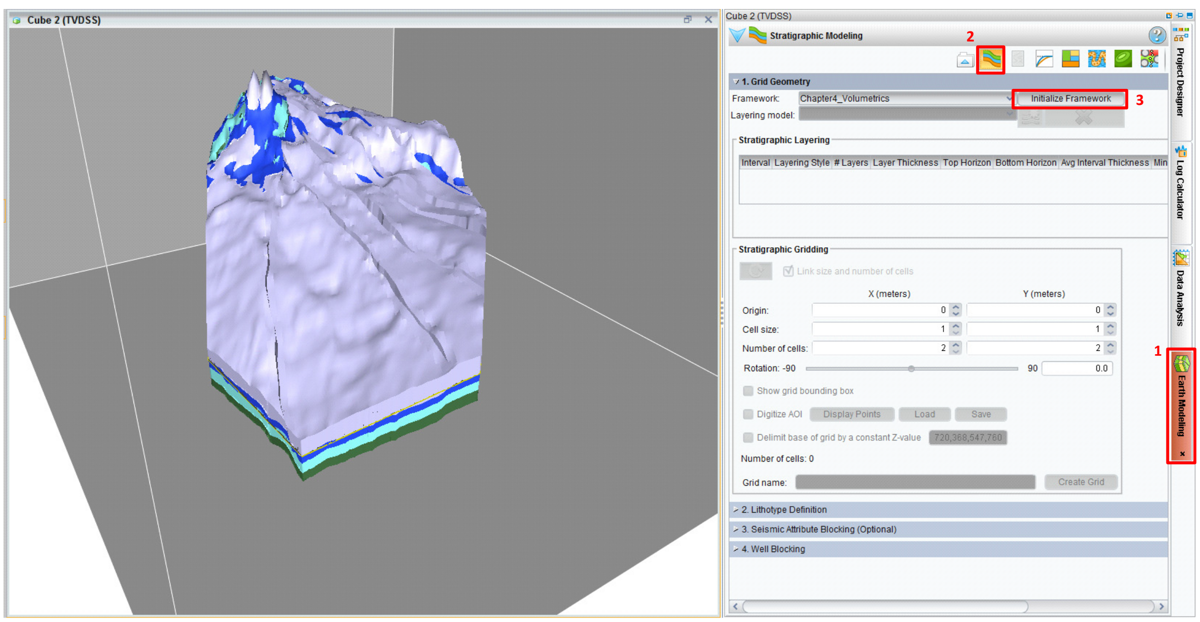
12. Maximize your *Cube* view. For the remainder of the exercise we will only be working in *Cube* view.

13. Because you are about to create a Geocellular Model, switch to the **Earth Modeling** prospective, so you can see all the necessary task panes.



14. Navigate to the *Earth Modeling* task pane, and click the **Stratigraphic Modeling** ( ) icon to load your framework for modeling. Expand the task pane so you can easily read the options.

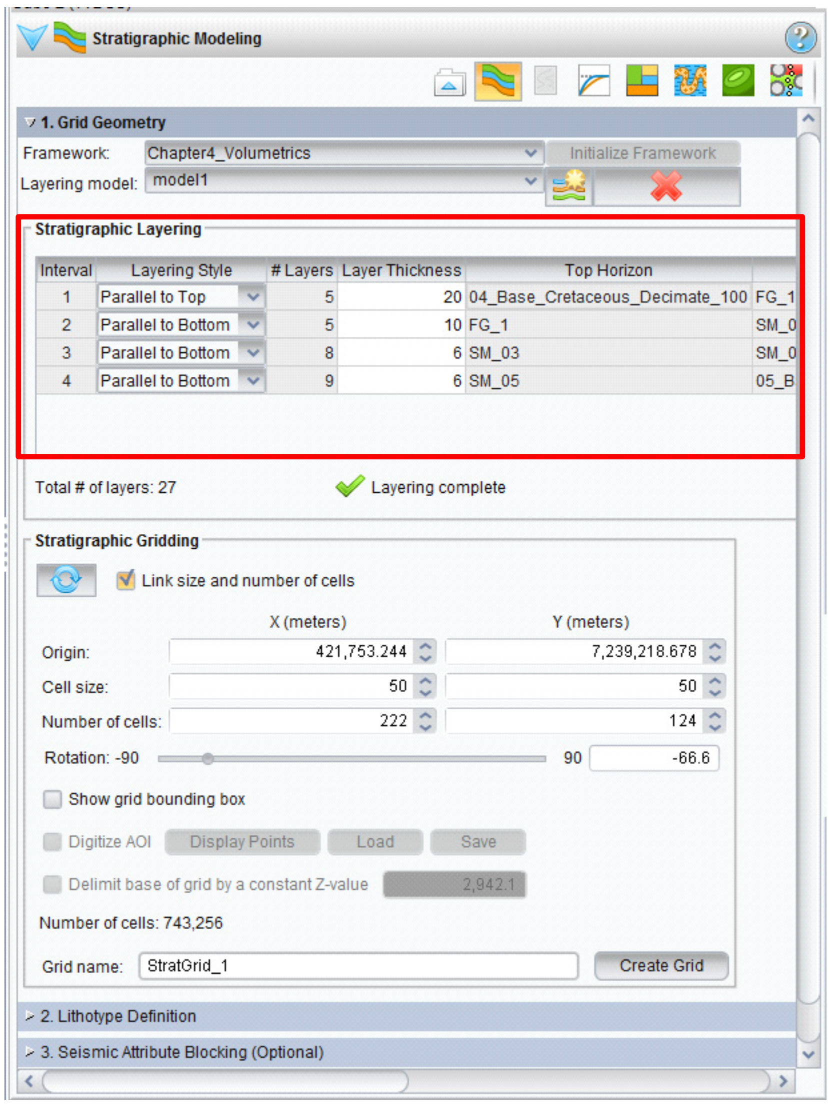
15. Within *Stratigraphic Modeling* expand the *Grid Geometry* sub-panel. Click the **Initialize Framework** button.



The *Grid Geometry* sub-panel of the *Stratigraphic Modeling* task pane enables you to select a framework with its embedded layering scheme. You can specify layering style, number of layers and thickness within each interval, and finally, create a geocellular grid.

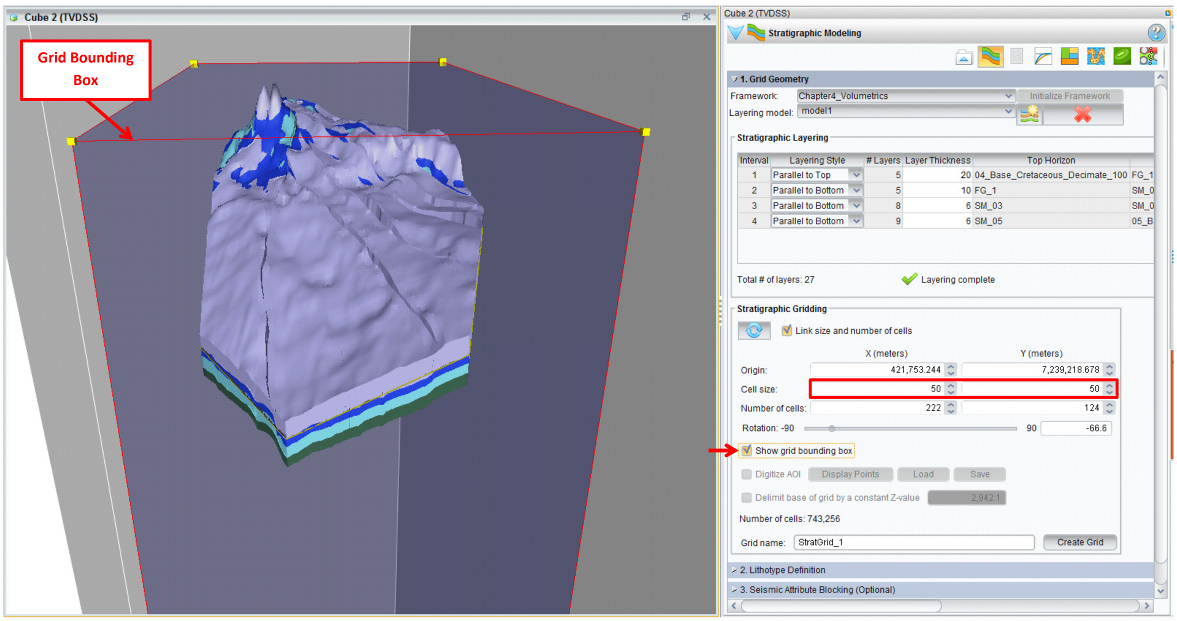
16. The system detects how many layers are in the framework. In this example, four intervals were found. Set the layering style as shown in the picture below.

17. The **04_Base_Cretaceous** layer has thousands of Layers when you change the layering style to Parallel to Top. Adjust the *Layer Thickness* for each interval so that no more than 20 layers will be generated. To reduce the number of layers per interval, you need to increase *Layer Thickness*. You can change the *Layer Thickness* values as shown in the picture below.



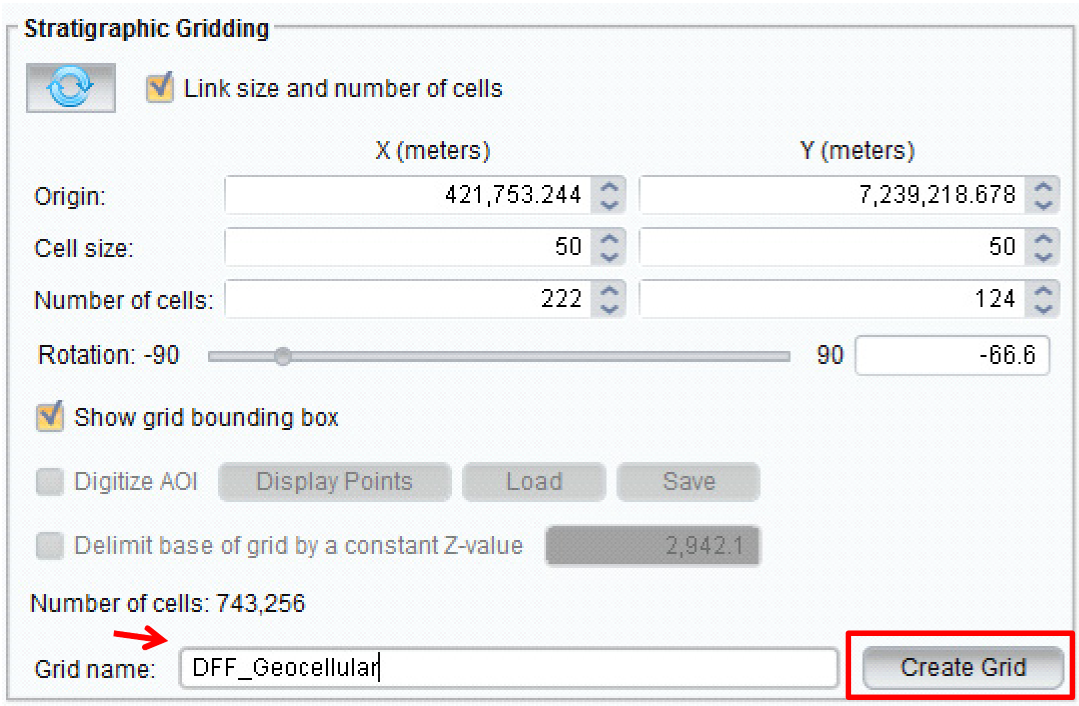
18. In the *Stratigraphic Gridding* area, confirm the cell size of **50 meters x 50 meters**. Check the **Show grid bounding box** and note the update to your active *Cube* view.

Cube view shows a red framed box. In **Select/Drag Mode**, you can resize the bounding box to define a regularly shaped AOI by dragging the grab handles. In other words, you can subset the framework prior to making the geocellular grid. However, in previous steps, you limited the framework already using an AOI Polygon. Do not modify the bounding box here; just be aware that the functionality is there as another option to limit the framework before building a geocellular model. Uncheck the **Show grid bounding box**.



> **Note**
>
> You can also bound your framework, only for the geocellular model, by selecting the option to **Digitize AOI** in *Map* view. When you do this you will see a change in the bounding box in *Cube* view.

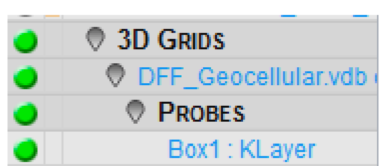
19. For *Grid name*, rename your grid **DFF_Geocellular**, and then click the **Create Grid** button.



Note

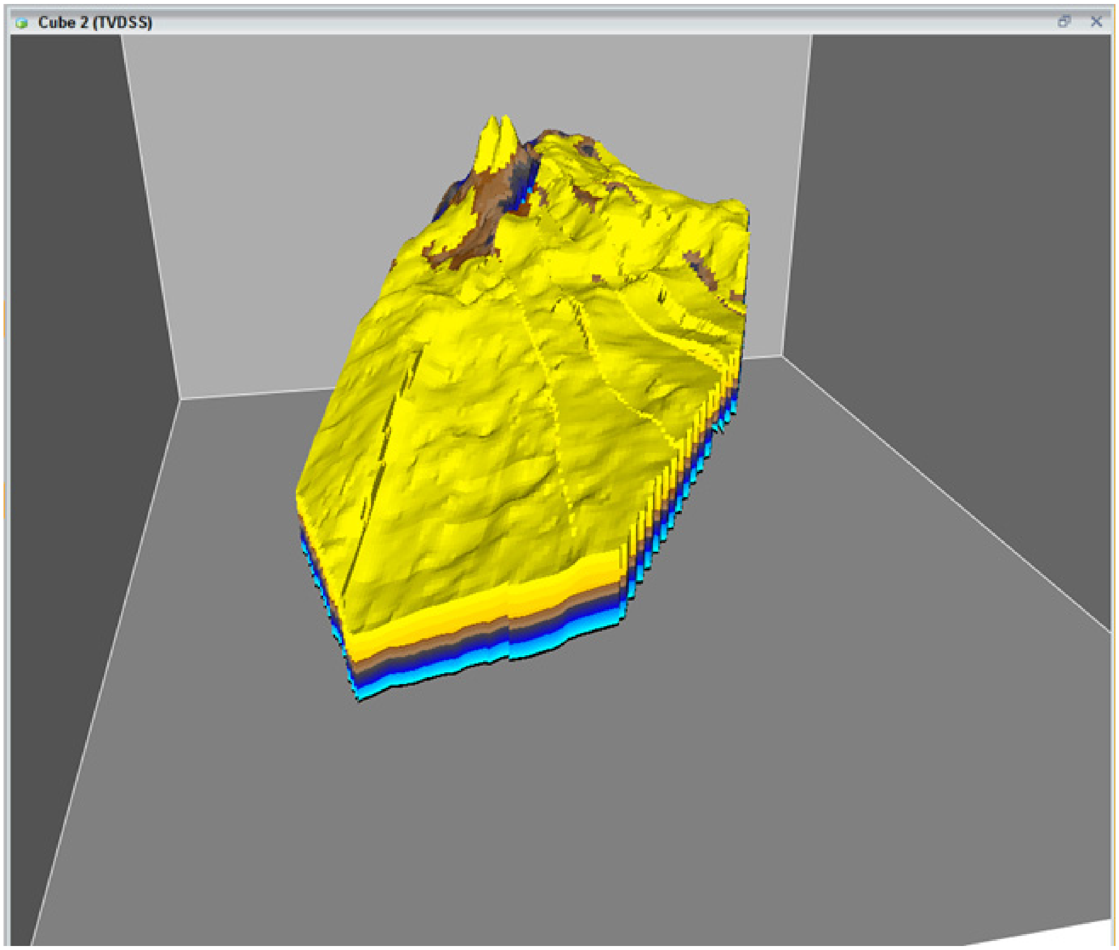
With the number of cells at roughly one million, the conversion will run fairly quickly, so you can see the results. Some models are now approaching up to a billion cells. It would take some time for the software to build a model that size, perhaps several hours overnight.

Once the process is complete, notice that your *Inventory* pane includes a new entry for data type **3D GRIDS** with an automatically created box probe under that.

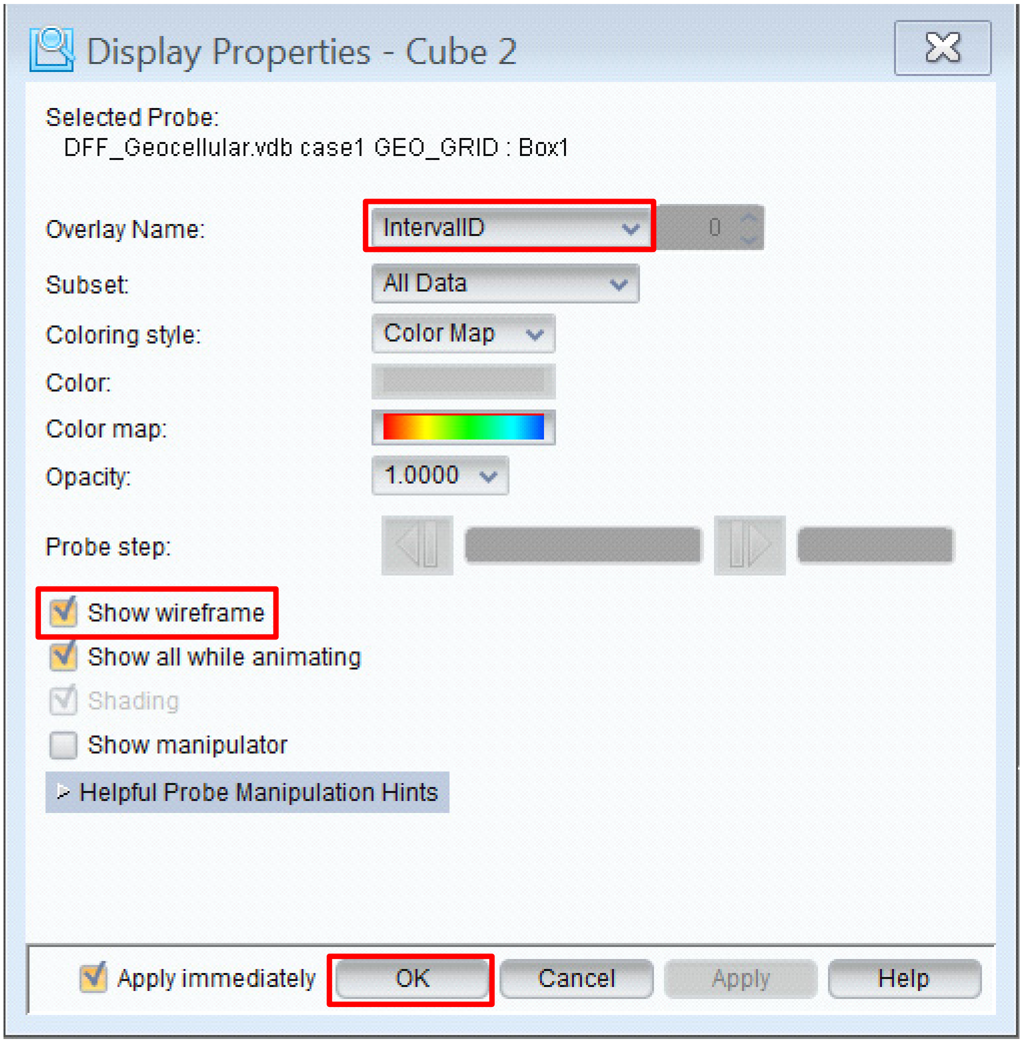


20. If the bounding box is still displayed, uncheck the **Show grid bounding box** option in the task pane. Also, turn off all the framework components. Turn on only the **Box1:KLayer** probe, located under **3D GRIDS** in your *Inventory* pane.

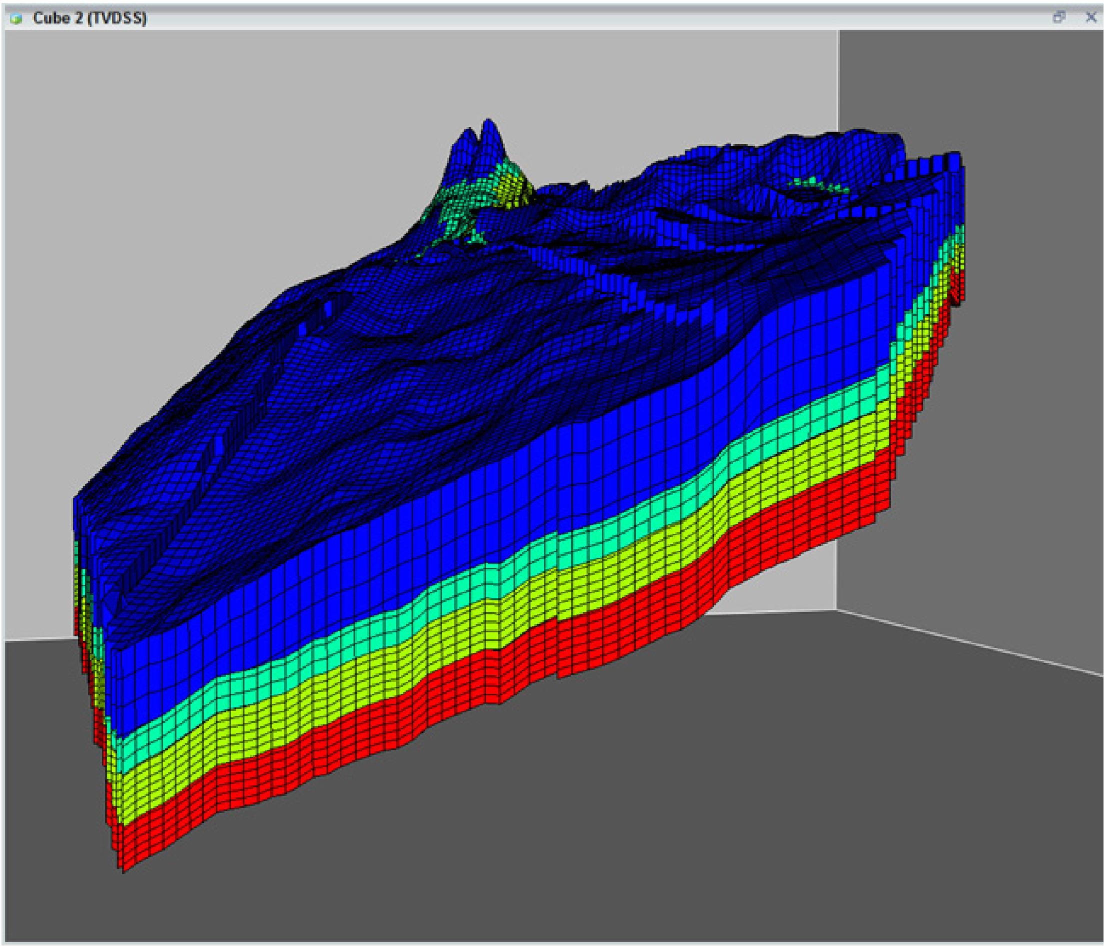
Your view should look similar to the one below.



21. On the 3D grid probe object, **MB3** and then select **Display Properties**. In the *Display Properties* dialog box, turn on **Show wireframe**. Also, change *Overlay Name* to **Interval ID** to view the intervals present in the grid. Click **OK** to close the dialog box.



22. Zoom in and exam your 3D grid, so you can better see the intervals and wireframe.



This is the first step in the *Earth Modeling* workflow. Other training classes detail the steps you should take to correctly and efficiently model the Earth using stochastic (probabilistic) method.

Review

This chapter focused on intervals formed by framework components and how you can use them dynamically.

The activities in this chapter included:

- Identifying intervals within the framework
- Populating those intervals with multiple attributes
- Mapping the attributes per interval
- Learning further display control techniques with respect to frameworks
- Running log calculator while applying dynamic updates to the framework
- Working with fluid contacts for volumetric calculations, also applied dynamically to the framework
- Identifying framework compartments
- Creating AOI Polygons
- Converting a framework to a geocellular grid representation (for reservoir modeling)