DecisionSpace® Geosciences Fundamentals of Geology Volume 1

HALLIBURTON | Landmark

Part Number 200061 Revision F

March 2015

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Preface
Fundamentals of Geology

The DecisionSpace® Geosciences software provides an elegant approach to integrated prospect evaluation and development. The goal of DecisionSpace Geosciences is to help interpreters quickly and accurately map oil and gas plays, prospects, and fields. The software accomplishes this by integrating a wide range of data types with a narrow range of probable solutions, constrained by geology, geophysics, petrophysics, and reservoir models. Integrating geological and geophysical interpretations allows you to map and analyze your projects accurately, build sealed structural frameworks and reservoir models, and plan wells in both traditional and unconventional scenarios.

Overview of DecisionSpace Geosciences Courses

The following are available as DecisionSpace Geosciences courses.

- DecisionSpace Geosciences: Getting Started (one day)
- DecisionSpace Geosciences: Integrated Interpretation and Mapping using Dynamic Frameworks to Fill (three days)
- DecisionSpace Geosciences: Fundamentals of Geophysics (two days)
- DecisionSpace Geosciences: Fundamentals of Geology (two days)
- DecisionSpace Geosciences: Fundamentals of Petrophysics (one day)
- DecisionSpace Geosciences: Practical Velocity Modeling (three days)
- DecisionSpace Onshore Well Planning (three days)
- DecisionSpace Offshore Well Planning (three days)
- Stochastic Modeling and Geostatistics for Reservoirs, Principles and Methods (three days)
- DecisionSpace Geosciences: Stimulation (one day)

- DecisionSpace Geosciences: Well Tie Workflow (one day)

This manual accompanies the instruction provided in the *DecisionSpace Geosciences: Fundamentals of Geology* course, revision 5000.10. The manual is both a teaching tool and a practical, hands-on reference. Because DecisionSpace Geosciences is very extensive and flexible, it is not possible to cover all features, functions, and courses of any particular course in a single manual. Therefore, we provide key examples and descriptions, with exercises that are directed toward common geoscience workflows.

After you have worked your way through the course, you will find the manual is a quick and easy-to-use reference for investigating topics of interest.

Leveraging Data with DecisionSpace Geosciences and Dynamic Frameworks to Fill

DecisionSpace Geosciences is a unified workspace, wherein geoscientists and engineers can leverage their skills in a collaborative environment to discover and evaluate assets.

Within this collaboration space, you can access and manage geoscientific and engineering data by leveraging database connectivity and multi-user interpretation tools across the DecisionSpace platform (i.e., OpenWorks, EDM, and corporate data stores).

Well-tie and velocity modeling tools enable on-the-fly conversion of time to depth (and vice versa), ensuring that all data can be interpreted and used in a common domain.

The co-location of seismic data, interpreted horizons and faults, well picks, fault picks, and log curves accelerates cross-domain interpretation. Cross-domain data integration provides essential cross-validation of the overall interpretation, mapped surfaces, and property maps.

The DecisionSpace Geosciences platform possesses several particularly powerful strengths.

Close integration between geological and geophysical interpretation tools — tied directly to dynamically updateable framework-based mapping tools — provides an order-of-magnitude increase in core exploration and development workflows.

Our goal is to enable you to develop your skills through hands-on training to a level that will give you sufficient experience, with supporting materials, to achieve substantial productivity gains. You will achieve breakthrough changes in efficiency and accuracy through cross-domain data visualization and new paradigms in integrated interpretation and mapping capabilities. This new approach to integrated interpretation and mapping is incorporated in Dynamic Frameworks to Fill.

Using Dynamic Frameworks to Fill

In DFF, integrated geologic and geophysical interpretation tools leverage framework surfaces in their respective workflows. For example you will have the ability to create and edit fault picks from ‘predicted’ seismic faults in *Correlation* view, which then triggers an update of DFF. In DFF you will have the following advanced technologies at your disposal:

- An advanced topology engine that properly grids surface data in the context of fault blocks (with an associated ability to digitize fault polygons), unconformity-bounded regions, and AOI polygons.
- Conformance technology that models surface picks, guided by seismic horizons.
- An advanced topology engine that properly extracts zone properties for wells with incomplete penetrations that will also handle multiple traversals of the same zone for horizontal wells.
- Multi-surface framework and property map updates tied to changes in data or edits to existing interpretation. This is enabled by the ability to:
    - Associate multiple data sources (e.g., picks, seismic horizons, pointsets for structural surfaces, raw and calculated log curve data for property maps) with a given surface or property map.
    - Update all surfaces and property maps when input data are changed by data import (i.e., new wells are drilled and additional surface pick and log curve data are available) or interpretations are changed (e.g., horizon or surface picks, and raw or calculated log curves for property maps).
    - Update all dependent surfaces when primary surfaces (e.g., parent surfaces in conformance relationships, or fault planes cutting a surface) are altered in a multi-surface framework.

Design Background of Dynamic Frameworks to Fill

The direct tie between data, interpretations, and mapping is the key theme in the design of DFF. The DecisionSpace Geosciences environment facilitated the design of DFF as an integrated interpretation and mapping system tied directly to a next generation, framework-based mapping system. As a result, DFF ties directly back to raw interpretive data such as horizons, surface picks, and log curves.

By contrast, other framework or earth model construction systems emphasize the use of static grids (and point sets) as their starting point for model building. This reflects an increasingly outmoded manner of thinking about framework construction, which assumes that interpretation is the realm of interpreters and framework building is the realm of (earth) model builders. Given the historical bias toward separating interpretation and framework (model) construction, many competitive products designed their framework building tools with a strong emphasis on the use of static grids and point sets, two input types that possess no ability to update according to changes made to the original data that the interpretation was based upon. Many model builders who use these competitive products accept the fact that interpreters will supply interpretations in the form of point sets or static grids. Consequently, these products have tools to manipulate static grids to make the model look correct. In other words, they have tools to locally warp grids to make indentations or bumps. The grids only update where they are pushed or pulled by the modeler, rather than the latest interpretation. There is no way to update the entire trend of a surface based on changes to source data.

Dynamic Frameworks to Fill supports the proposition that the industry would prefer that edits to a framework model are based on changes to the original interpretation. The key point is that DFF takes a data centered approach to the framework construction process that fully involves the professional interpreter. The benefit of this approach is that the framework QC process can compare framework surface geometries directly to original seismic, horizon, and top data to verify its accuracy.

The Structure and Content of the Fundamentals of Geology Course

This two-day course will give you a practical introduction to the Fundamentals of Geology for DecisionSpace Geosciences course. The manual is organized in two volumes. The content of the two volumes is summarized below.

Volume One

Volume One comprises the following chapters and content.

Chapter 1: DecisionSpace Geosciences Settings

- Create stratigraphic columns.
- Visualize GIS data in DecisionSpace Geosciences.
- Create and visualize well lists and learn how to hide some wells from the list.
- Learn about using a Deviation Survey Point/Position Log
- Annotate wells and reposition or rotate annotation

Chapter 2: Well Correlation View

- Create a *Well Correlation* view from a well list.
- Create a *Well Correlation* view from a *Section* view.
- Create a *Well Correlation* view from a *Map* view.
- Arrange wells in *Correlation* view.
- Display Well layouts for wells in *Correlation* view.

Chapter 3: Surface Interpretation and Mapping with Dynamic Frameworks to Fill

- Create and edit a surface pick.
- Create a surface using surface picks.
- Map while interpreting with DFF.
- Use Single-Pick Mode.
- Use predicted tops from DFF surface maps.
- Create and edit fault picks.

Chapter 4: Mapping with Dynamic Frameworks to Fill

- Create a unified structural framework.
- Integrate 2D and 3D seismic interpretation data.
- Use advanced mapping tools.
- Perform on-the-fly time-depth conversions.

Volume Two

Volume Two comprises the following chapters and content.

Chapter 5: Interpreting Lithology and Petrophysics by Zones in Dynamic Frameworks to Fill

- Interpret lithologies and create litho-facies logs and lithology strips.
- Calculate Porosities.
- Calculate water saturation, bulk volume water and hydrocarbon pore volume and pay.
- Test the petrophysical model in wells before applying the equation.
- Create intervals in Dynamic Frameworks to Fill to populate with petrophysical attributes.
- Understand the value of the dynamic nature of frameworks when changing petrophysical attributes.

Chapter 6: Volumetrics

- Create sealed spaces (compartments).
- Learn about volumetrics and fluid contacts.
- Learn about volumetrics charts.
- Create custom reservoirs.

Chapter 7: Final Framework to Earth Modeling

- Investigate the benefits of Framework integration.
- Convert log curves to point sets.
- Analyze property data.
- Create an Earth Modeling Grid.
- Map facies.
- Create Lithotype Proportion Maps.

Appendix A: Geological Mapping

- Create a surface grid, using either the Refinement Gridding algorithm or the B-Spline Gridding algorithm.
- Create a one-step grid and contour map using Auto Contour.
- Create a quick contour map, including fault polygons (Polygon/Centerline) as an option.
- Customize contours, using the contouring options.

Appendix B: Wellbore Analyzer

- Compute the intersections between wells and various data to create surface picks or log curves.

Appendix C: Horizontal Well Correlation

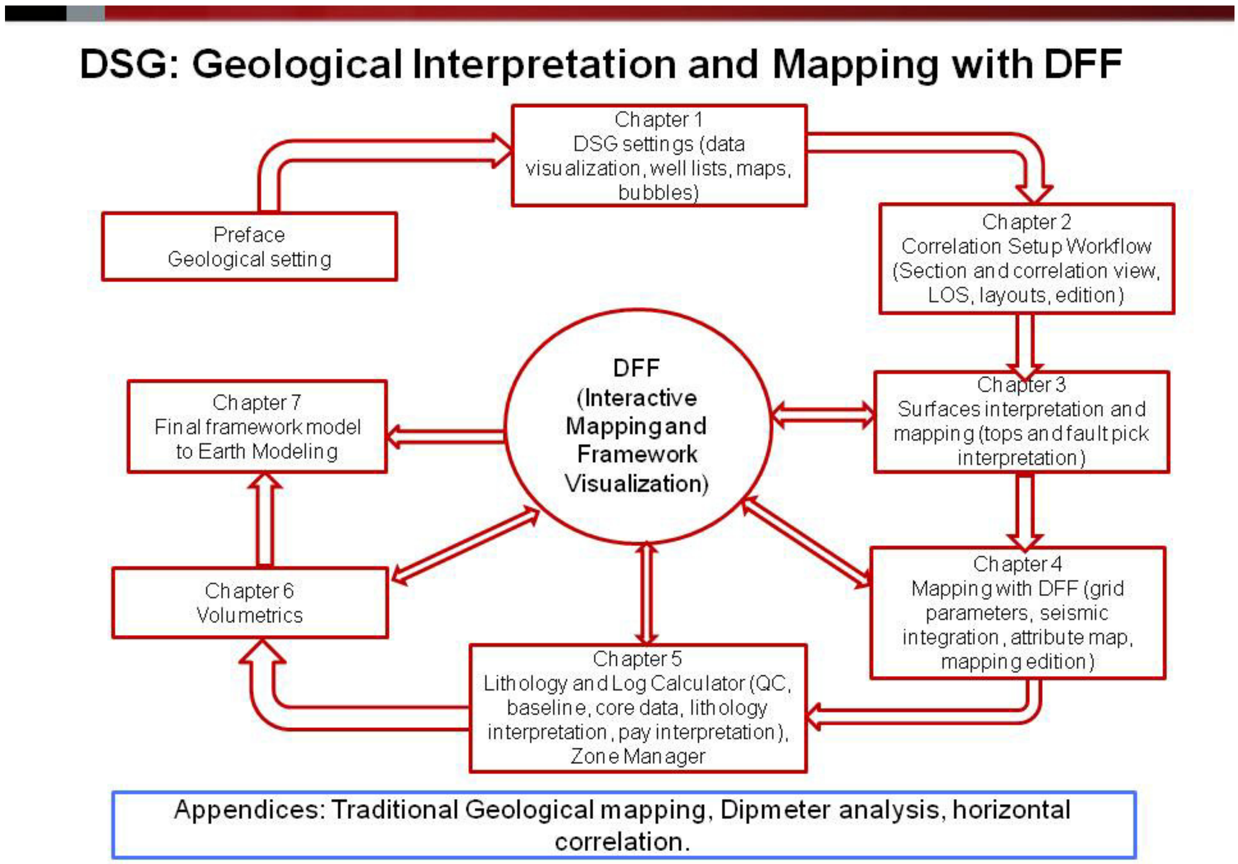
- Set up a DSG session for geosteering with HWC.
- Create a predicted curve in the HWC task pane and a Framework reference surface.
- Learn how to use inter-well points in the HWC workflow to update structures.
- Stretch and squeeze a predicted curve for interpretation.
- Geosteer a well using HWC.
- Update the framework structure while drilling the well (real-time).
- Use target line drawing functionality to edit the well trajectory and generate a Geosteering report.

Appendix D: Dipmeter Analysis

- Visually and statistically evaluate wellbore dipmeter data in depth *Section* views.

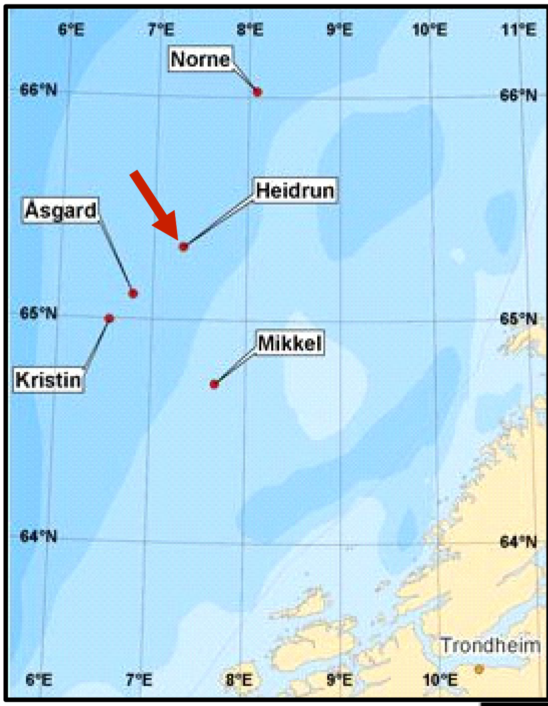
The Workflow of the Course

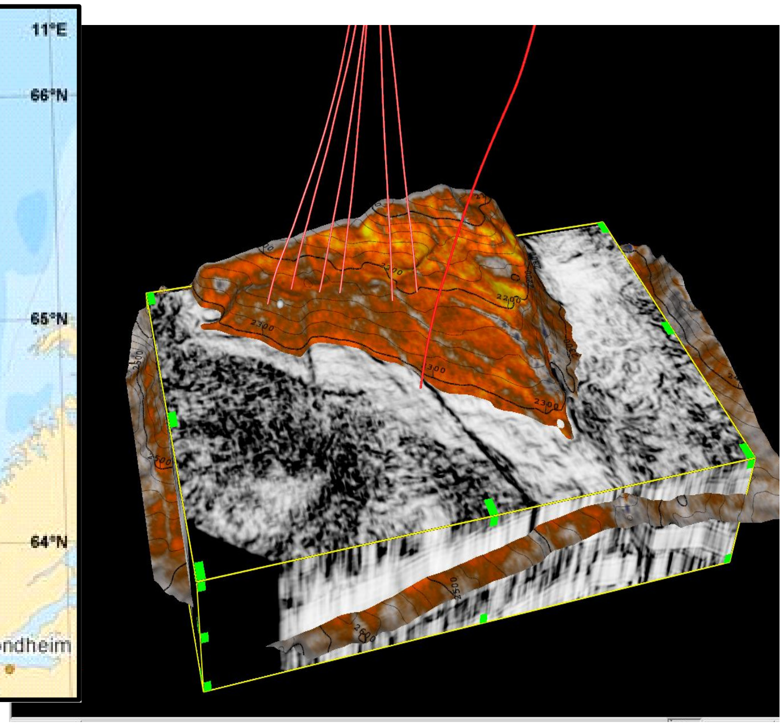
To the extent possible, the manual is organized to reflect the course objectives and the natural workflow you will find most useful. The following figure summarizes the high-level workflow.



The Dataset for this Class: Heidrun Field

Heidrun in the Norwegian Sea (map below) has been producing oil and gas since October 1995.





The Heidrun field is located on Haltenbanken in the Norwegian Sea in water depth of about 350 meters. The field was developed with a floating concrete tension-leg platform, installed over a subsea template with 56 well slots. The northern part of the field is developed with subsea facilities. This heavily faulted reservoir comprises Lower and Middle Jurassic sandstones. The recovery strategy for the field is pressure maintenance using water injection and injection of excess gas.

The Heidrun field has yielded some 660 million barrels of oil since it came on stream, with a current flow of about 150,000 barrels per day. At its peak it produced over 300,000 barrels per day from the Fangst group.

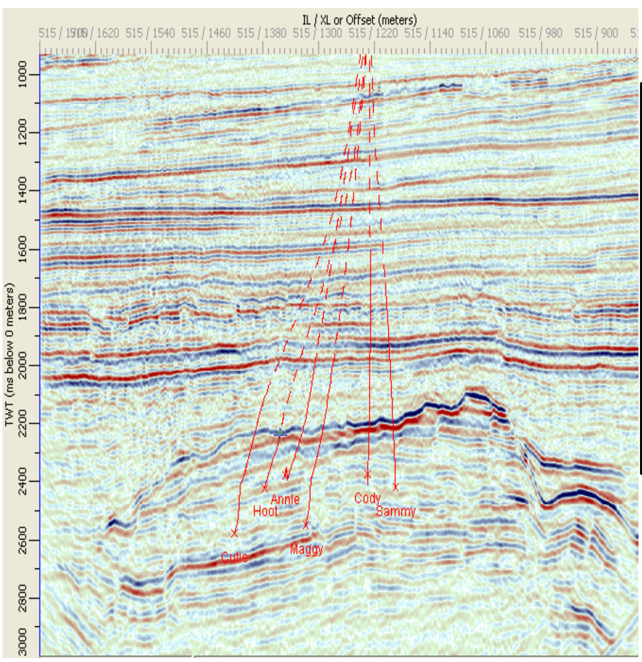
Its annual gas output totals roughly 1.3 billion cubic meters. Purposeful efforts to improve oil recovery have boosted estimated oil reserves in the field to about 1,130 million (1.13 billion) barrels.

Original discovery was on a high-amplitude-gas bright spot, but most of the production is from non-bright seismic signatures of the oil leg, which makes up about 80% of the total production.

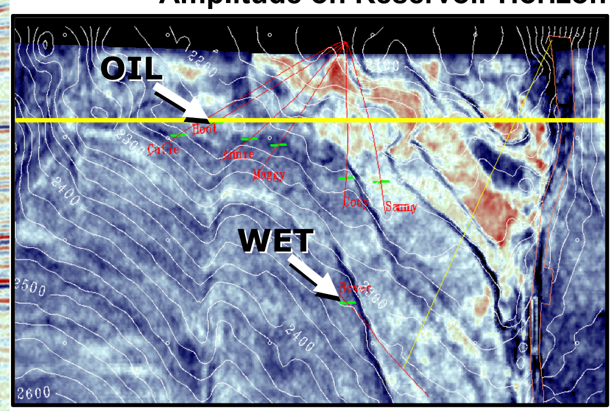
The Heidrun structure is a large southwest-plunging horst block on the southwest flank of the Nordland ridge and was formed during the Cimmerian extensional tectonic phase in the Late Jurassic-Early Cretaceous. The Heidrun reservoirs are severely truncated at the northern edge of the structure and are sealed by Cretaceous shales.

The Heidrun Jurassic reservoir rocks, the Fangst Group, and the Tilje and Aare formations were deposited on the southeastern flank of the developing northeast Atlantic rift domain. Despite an over-all transgressive regime, the interval was characterized by a high, coarse, clastic influx from the elevated rift shoulders. The shallow depth of burial (less than 2500 m) has limited compaction effects. Reservoir quality in the clean Fangst sands is somewhat enhanced by dissolution, and the sands exhibit maximum permeabilities higher than 10 Darcys and porosities in excess of 30%.

Seismic-stack signature does not change much from oil pay to non-pay, as seen in the amplitude map on the pay horizon (below).



Amplitude on Reservoir Horizon

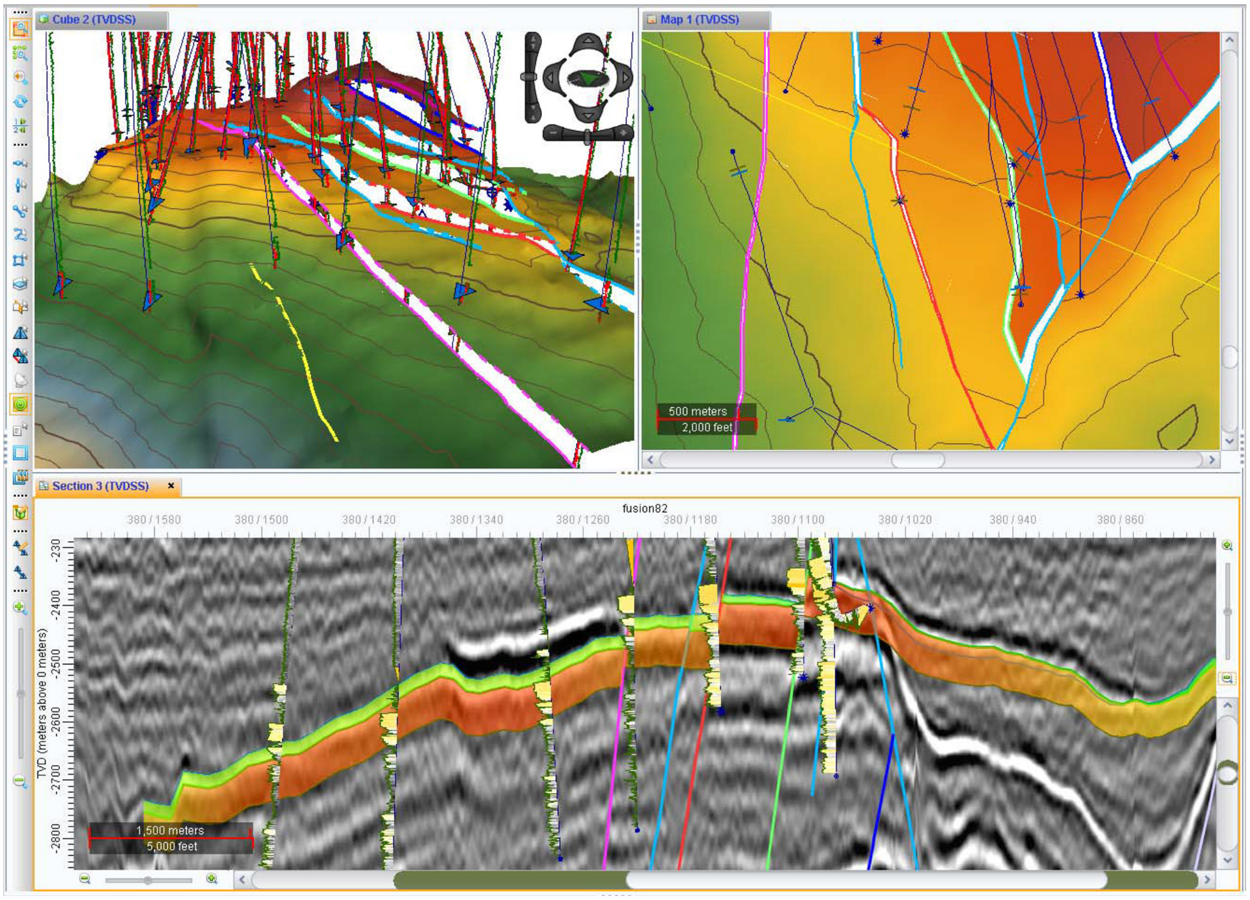


Shows location of gas cap, but not oil pay

Red = high amplitude
Blue = low amplitude

Geological Interpretation and Mapping with DFF

Rather than using a number of independent tools to create a series of maps, in this course you will experience and learn how to use Dynamic Frameworks to Fill, a tightly integrated interpretation and mapping system, to create your maps. This integrated system enables geologists and geophysicists to construct and automatically update multi-surface structural frameworks (i.e., structure maps) and property maps in a straightforward manner. This will be useful for geoscience interpreters and model-building specialists alike. You will see that the workflow-based approach detailed in this manual automates much of the complex model-building process, and brings advanced structure mapping into the mainstream.



Chapter Organization and Conventions of this Manual

The chapters that compose this manual examine key workflows within DecisionSpace Geosciences.

General Organization of Chapters

Where the content permits it, the chapters in this book conform to the following organizational structure. You will find that topic introductions are useful quick references.

- **Introduction:** The focus and learning goals of the course are defined and exercise topics are introduced. Sometimes a diagram is presented that pictures the workflow you will encounter; at other times a few sentences of description suffice.

- **Overview:** Overview sections are intended to call attention to the theory and functionality related to the chapter topic. Though some dialogs are displayed, these overview sections are not written as step-by-step exercises. Your instructor may demonstrate the overview material, or may simply ask you to use DecisionSpace to explore the overview topics.

- **Exercises:** The exercises are the core of the manual. Most of the manual comprises the detailed steps that are necessary to achieve learning goals. To guide your learning, you will find diagrams and screen captures in abundance. The exercises may include current topic descriptions of varying length, with accompanying notes.

Exercises that contain **bold** font require your interaction (with keyboard and mouse). Overviews are for reading.

Note on Exercises

Each exercise comprises a series of steps that build a workflow, helps you select parameters, executes the flow, or analyzes the results. Many of the steps provide detailed explanations of how to correctly select parameters and make good use of the functionality of interactive processes.

The numbered paragraphs are steps that will guide you through the command path. As you proceed through the exercises, note the options that you find on the dialogs, but stay near the prescribed path. This will enable you to complete the exercise in the allotted time and produce results similar to those shown in the accompanying figures.

DecisionSpace Geosciences is a sophisticated application with a user-friendly interface. When you work with DecisionSpace Geosciences you will often note that it provides multiple interpretation paths. For the sake of clarity and to keep you moving through the course, only one path, or method, is described in each exercise. The authors hope that after this class you will return to your workplace and explore the solution paths that are easiest and most intuitive for you. To enable you to effectively cover course material we ask that you follow the instructions in the manual and use the solution paths described herein.

As you progress through the exercises, familiar parameters and obvious instructions may not be shown in workflow steps. For instance, in many workflows the instruction to click the OK button after parameter selection is sometimes implied by the context. In these cases we often omit that instruction, to avoid monotony.

The screen captures you will see throughout this manual are chosen to best illustrate the point at hand. Because of variations in path and session state that occurred during the writing of the exercises, screen captures may not always match the image on your monitor. Window size, display scale, colorbar content and limits, interpretation display characteristics, and so forth, can easily be changed. Header text in the main viewer can vary, as the manual uses a few incremental releases of the application.

Personalized Outputs

In this course you may need to personalize and identify your work. You will save certain data with your initials as part of the output name. This could be a horizon you interpreted, an attribute volume you generated, or a session file. For example, if your name is Aaron Buster Chapman, you might save some of your data by naming it ABC. The creators of this manual don't know your name, so we use the letters "YOU" to refer to your initials. When you see the letters "YOU," substitute your initials.

Interpretation ID automatically generates data versions in OpenWorks. The use of five alpha-numeric characters in data-version nomenclature is mandatory at the start of your session. For this manual, it is 01STA. Do not assume that by adding your initials, or interpretation ID, to the name of an entity you define the data as yours. Including your initials in the data name only assists you in the selection of data, not in defining ownership. Ownership is defined through the interpretation, also known as interpreter.

By using your initials you make your saved sessions easy to identify. In addition, your horizons and other interpretations will be easy to find among the other files that are saved in this project.

The session (saved-state) files are very helpful if you go astray in one of the exercises or encounter a hardware or software problem. If either of those circumstances occurs you can restart your session at your previous saved point.

The manual uses the following common conventions in describing how to access and use various features of DecisionSpace Geosciences. You are probably familiar with most of them.

The Conventions of this Manual

Windows, dialogs, and boxes	DecisionSpace Geosciences has user interfaces that appear as windows on your workstation. The terms ‘window’ and ‘dialog’ are often used interchangeably, but the term dialog is usually reserved for windows that require user interaction in the form of parameter selection or information input. ‘Box’ is usually a smaller window, such as a warning box or message box. ‘Box’ can also be an area inside a window that is defined by a rectangular line.
Dialog Names	The titles of windows, dialogs, some tabs, and occasional boxes are *italicized* when they appear in text. Typically, dialog names appear in a bar at the top of a window (this is also known as the window title).
Mouse Buttons **MB1**, **MB2**, **MB3**	The manual does not instruct you to press mouse buttons. Instead, you will see instructions to press or use MB1, MB2, or MB3, where MB1 is mouse button 1, and so forth. Mouse buttons are numbered from left to right. **MB1** means click the left mouse button, **MB2** means click the middle mouse button, **MB3** means click the right mouse button. If your computer is set up for a left-handed mouse, the mouse buttons are reversed in direction. Mouse buttons may not work properly if Caps Lock or Num Lock are on. **MB1** is used for most selections.

Menu Options	Menu options and push-button names are bolded when they appear in a step (an instruction for an action). For example, when you see the instruction “**Close** the dialog,” it is an instruction to click the Close button.
Type or enter	Type all terms that appear in quotes and bolded. For example, when you see the expression, *Enter “***2300***” in XYZ field,* you should type 2300 in the prescribed place. Context will often suggest that you need to change an instruction. For example, when you read “**YOURINITIALS**” or “**YOU**”, you are expected to type your initials.
<**key**>	Press the indicated key on the keyboard. For example, <**Enter**> is an instruction to press the Enter key.
Select, Click, Choose, or Highlight	Move the cursor to the specified option or object and press, then release, the mouse button. Unless otherwise specified, use **MB1**.
Click and drag	Press the mouse button and hold it down while moving the cursor. Then release the button. This is also called press and drag, or **MB1-drag**.
Shift and drag	Hold the shift key while pressing the mouse button. Hold the mouse button down while moving the cursor around the option you want, then release the button.
Double-click	Click the button twice, rapidly, without moving the mouse. The first click highlights the option or object beneath the cursor; the second click is equivalent to pressing the **OK** button to accept the selection.
Conditions for bold font	We use bold font to make the exercises easier to follow. Bolded text means the text is an instruction that requires user action, such as an instruction to click a button or an icon, enter text, highlight list items, and so forth.

Notes:

This manual follows the popular usage of “data” as singular or plural. You will see both “data is” and “data are”.

Chapter 1
DecisionSpace Geosciences Settings

In this chapter you will explore the data that is available in your project. You will be able to familiarize yourself with the area, wells, stratigraphic column, production, and so forth, before starting your geological interpretation. You will learn how to import data and GIS maps into DecisionSpace Geosciences, how to visualize GIS maps and data, and how to integrate well and seismic data. You will also learn how to create new stratigraphic columns, how to display well data along the wellbore path, and how to visualize production data as a bubble map.

Topics Covered in this Chapter

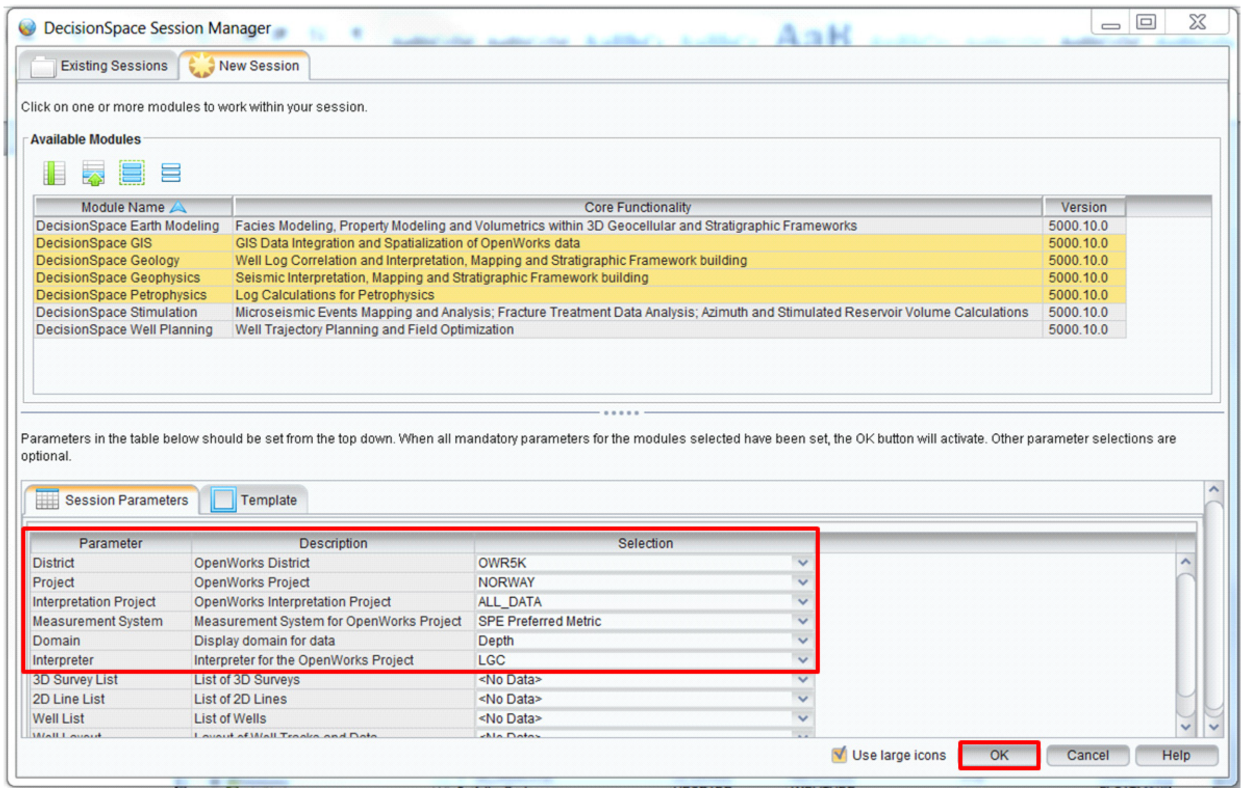
In this chapter you will learn how to:

- Create stratigraphic columns.
- Visualize GIS data in DecisionSpace Geosciences.
- Create and visualize well lists and learn how to hide some wells from the list.
- Use a Deviation Survey Point/Position Log.
- Annotate wells and reposition or rotate annotation.

Exercise 1.1: Creating Well Lists, Visualizing Well Lists in Map View, and Hiding Wells from a List

Though there can be thousands of wells in a study area, you may want to view only the wells that contain a certain type of log, or wells that are located in a small region of the study area. There are several ways to create well lists containing only the wells that you want to see.

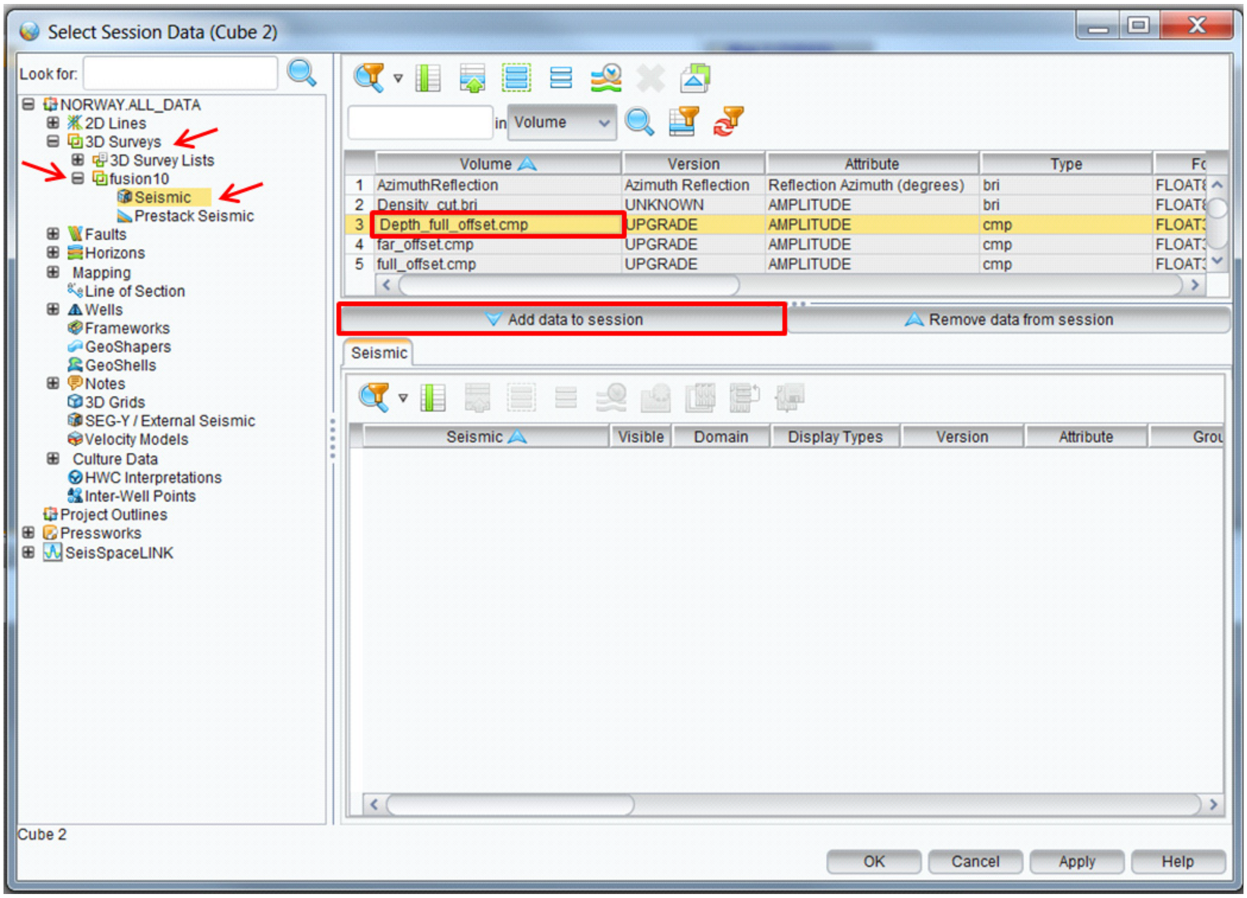
1. Open the *DecisionSpace Session Manager* and select the modules and session parameters identified in the following image. Note that the last item on the *Session Parameters* tab is a List of Stratigraphic Columns that will load when the session is created.



2. Your session will start with no data, so you will manually add data to the session. Click the **Select Session Data (**  **)** icon to open the *Select Session Data* dialog.

3. In the left panel of the *Select Session Data* dialog, select **3D Surveys > fusion 10 > Seismic.**

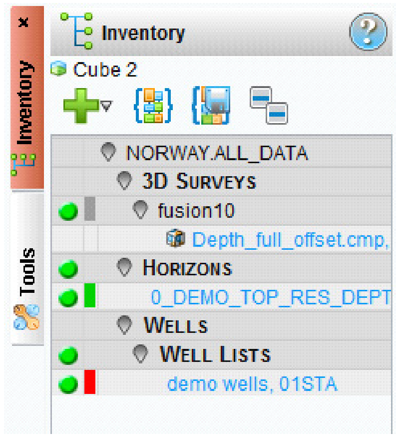
4. In the right panel select **Depth_full_offset.cmp** and click the **Add data to session** button.



5. In the left panel select **Wells > Well Lists**, and then select **demo wells, O1STA** from the right panel. Click the **Add data to session** button.

6. Finally, in the left panel select **Horizons > Horizons.** Select **0_DEMO_TOP_RES_DEPTH** from the right panel and select the **Add data to session** button. Click **OK.**

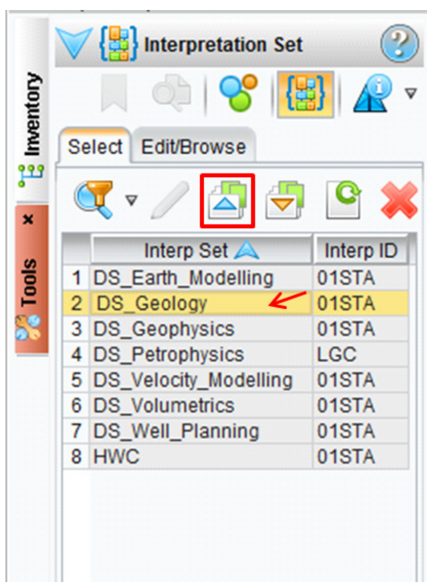
The three data objects that you chose in the *Select Session Data* dialog will appear in your *Inventory* task pane.



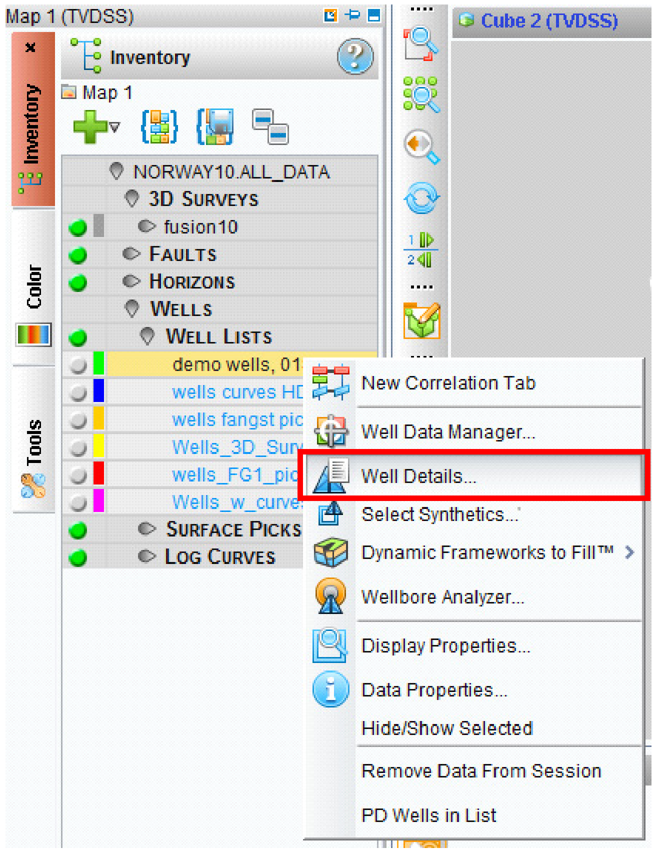
So you do not have to go back to *Select Session Data* dialog every time you start a new session, you can save the data that you just added as an ISet. Simply click the **Save ISet from Inventory (** **)** icon after you pull the data you want in the ISet into your session.

An ISet has already been created for this chapter, which includes the data that you just brought into your session.

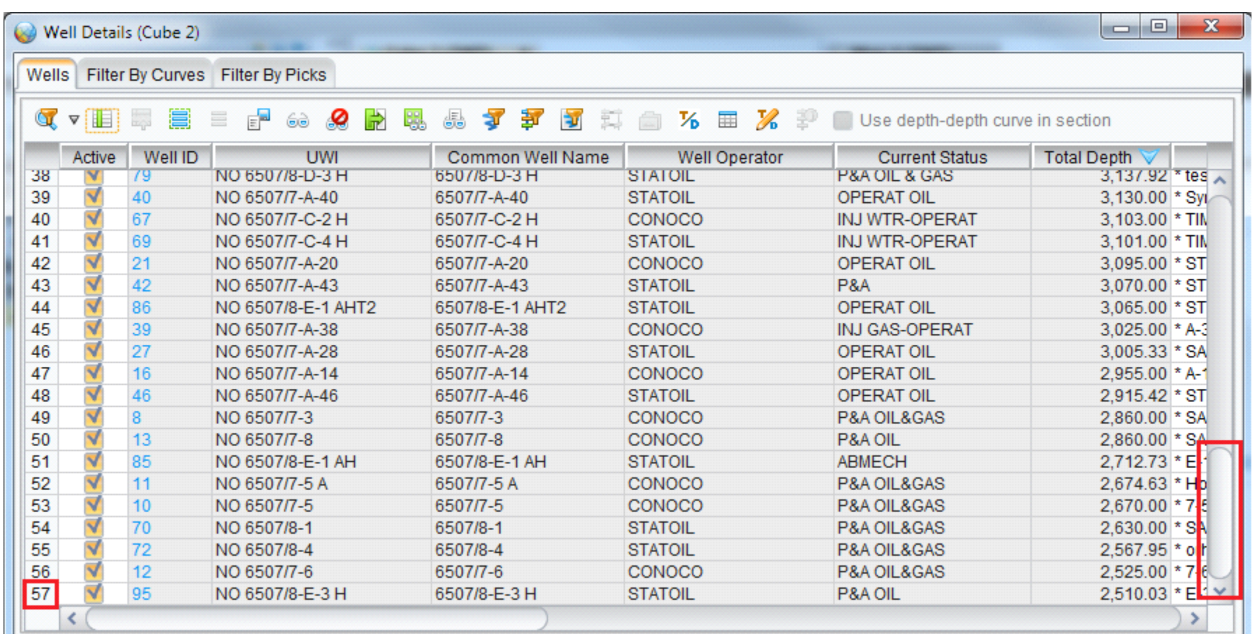
7. On the *Tools* task pane, click the **Interpretation Set** (ISET) icon ( ) and select **DS_Geology**. Click the **Load Data to Session** icon ( ). This will load all of the data that is available in the ISet.



8. While in *Map* view, put your cursor over **demo wells, 01STA** and **MB3 > Well Details** in the *Inventory* task panel to open the *Well Details* dialog.



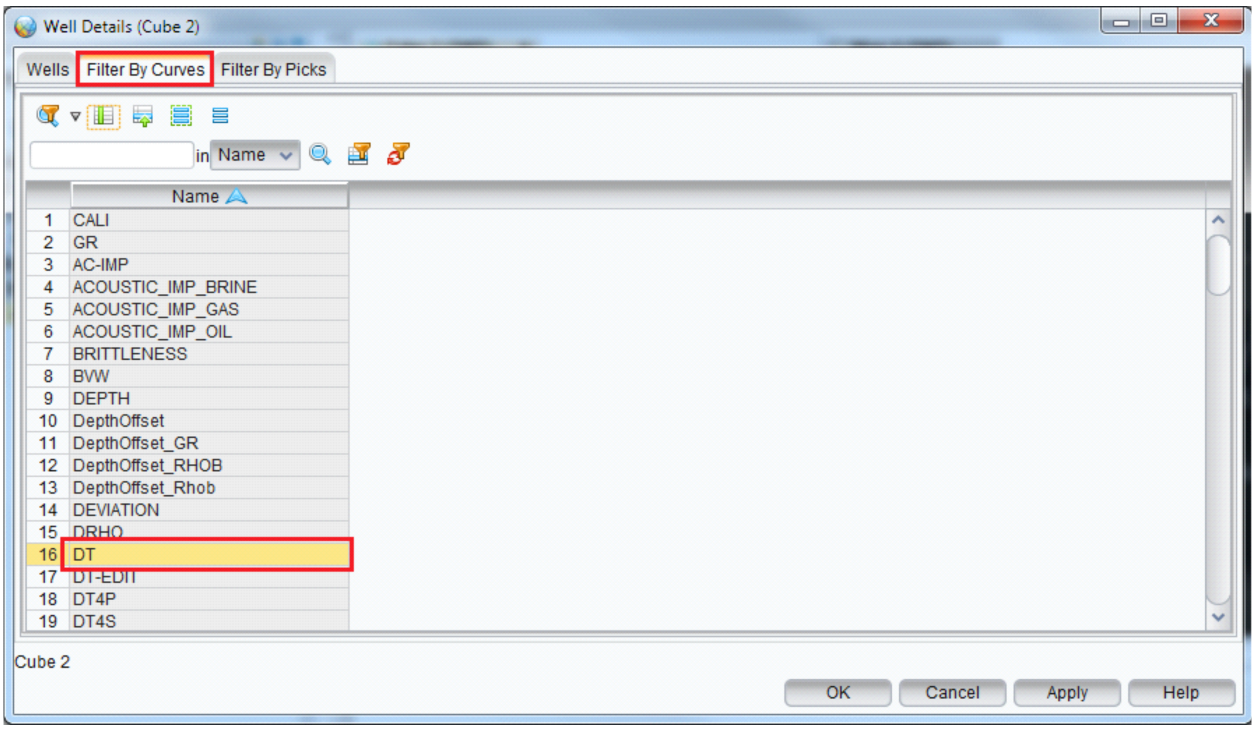
In the *Wells* tab of the *Well Details* dialog you will see that 57 wells are in the demo wells list.



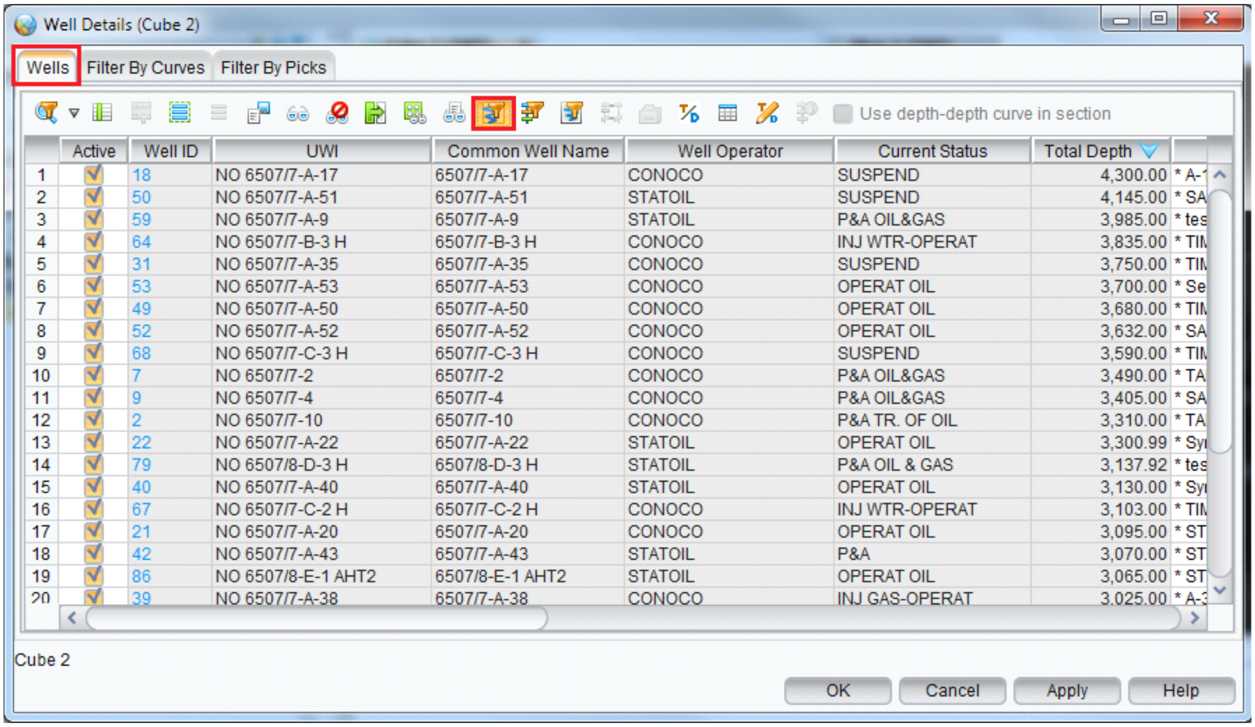
Note:

The *Well Details* dialog provides information about the selected wells lists. It lets you make a number of changes, including creating lists; filtering well lists by picks, log curves, and rasters; choosing a preferred time-depth curve; choosing a preferred synthetic; and so forth.

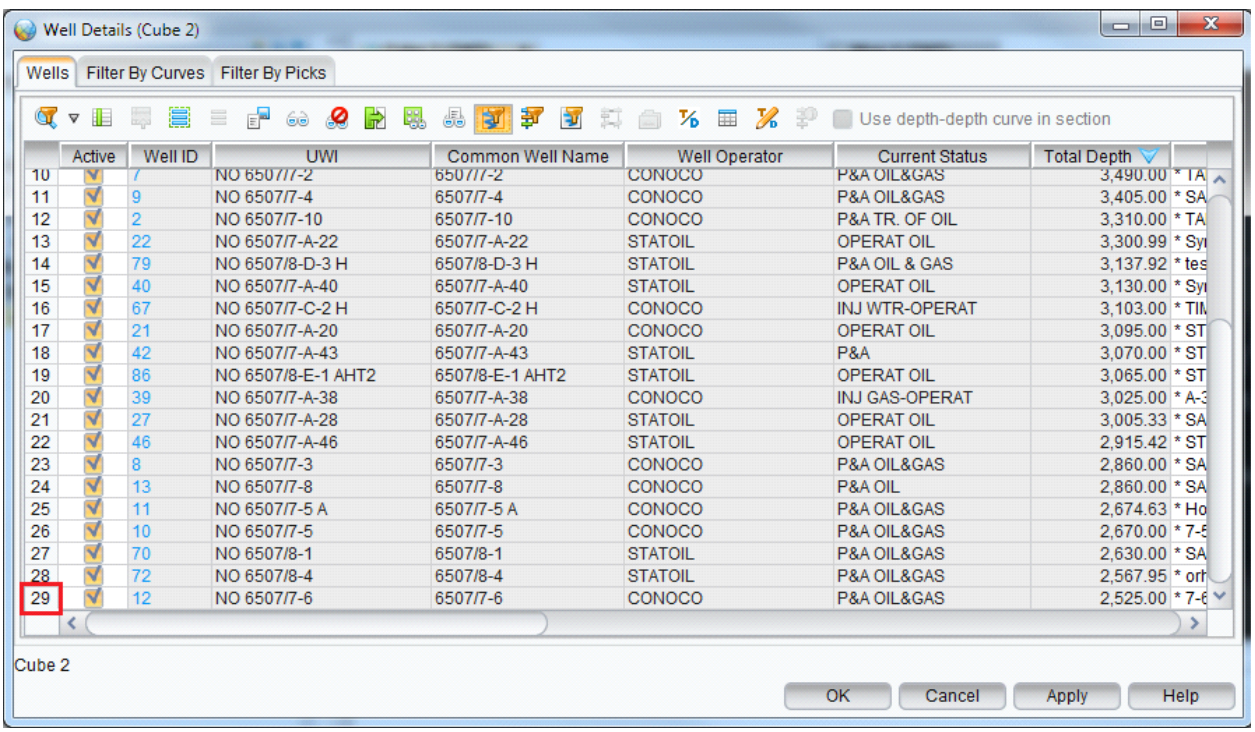
9. In the *Well Details* dialog, click the ***Filter By Curves*** tab, then select **DT** in the Name column.



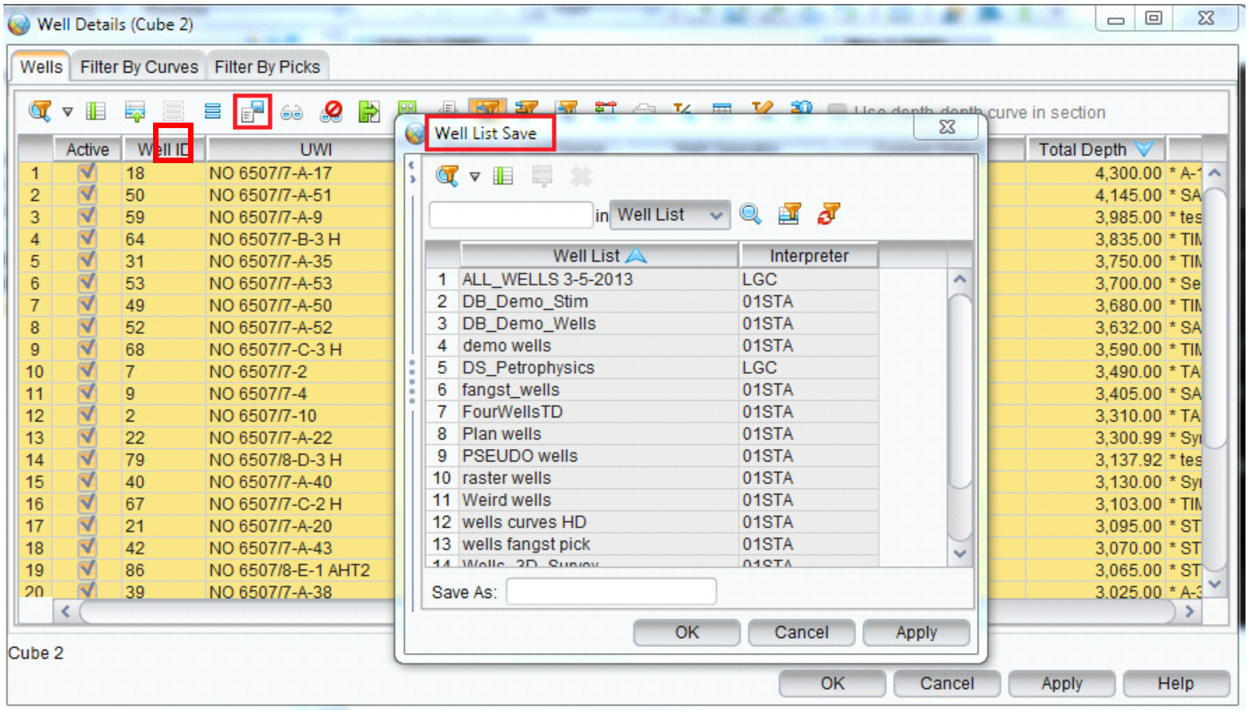
10. Return to the *Wells* tab of the *Wells Details* dialog, and click the **Curve Filter** ( ) icon to display only those wells that have DT curves.



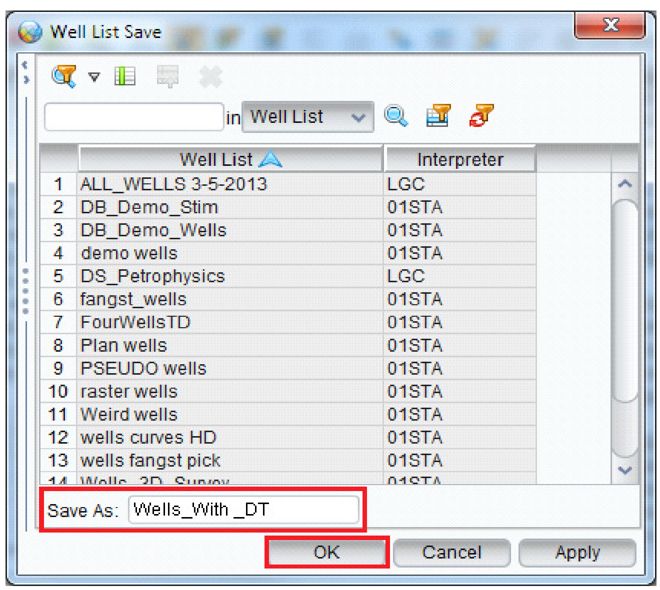
Only 29 wells have DT curves, as shown in the following image.



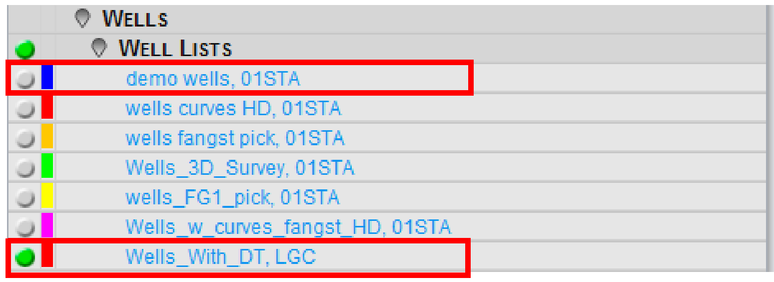
11. To save these wells as a well list, click the **Select All** ( ) icon and then click the **Save as List** ( ) icon. The *Well List Save* dialog opens.



12. In the Save As: field of the *Well List Save* dialog, enter "**Wells_With_DT"** and click **OK.**



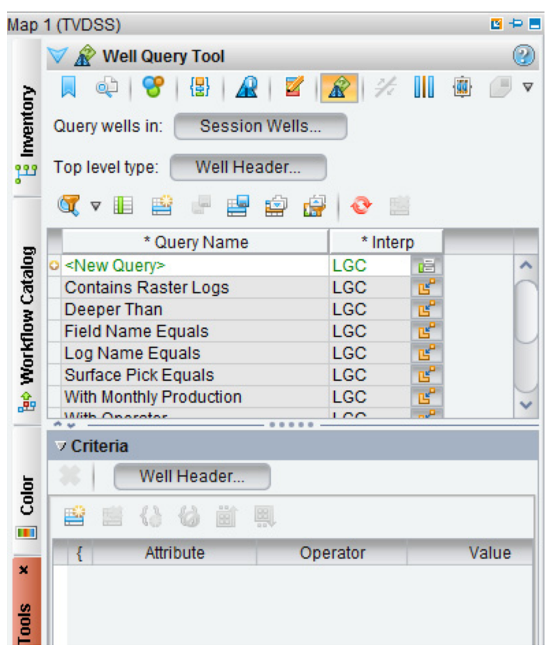
13. In the *Inventory* task pane you will see the newly created well list **Wells_With_DT, YOU** listed under Well Lists. Toggle off **demo wells, 01STA** and toggle on the **Wells_With_DT** wells list.



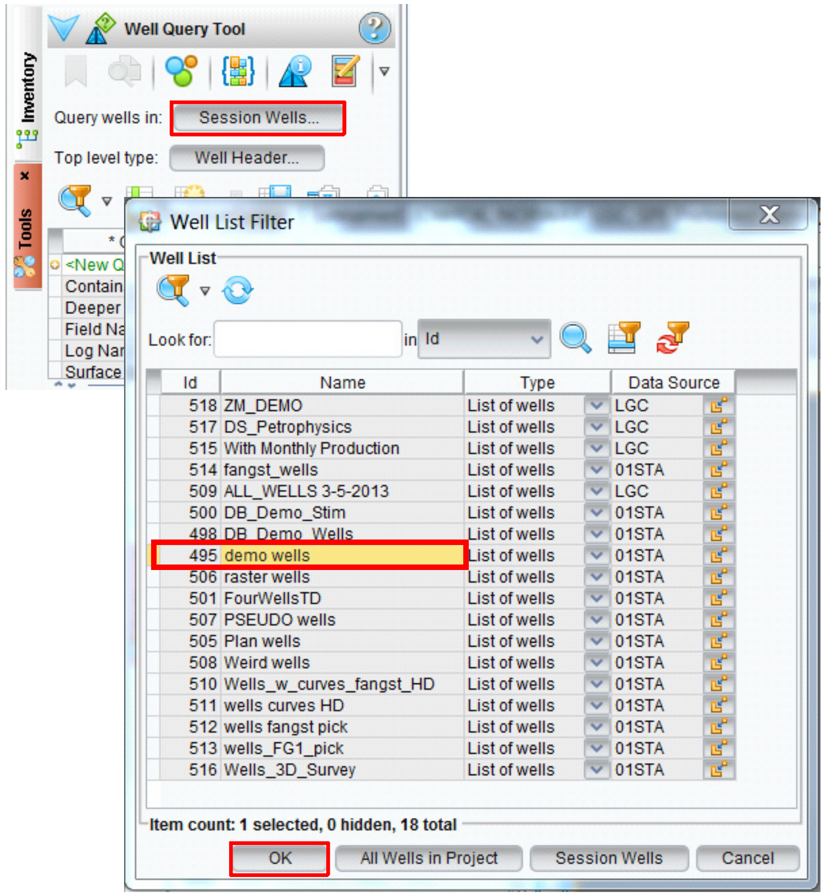
Creating a Well List from the Well Query Tool

As you learned in the previous exercise, you can filter the wells by the well logs or the surface picks present for a particular well in Well Details. With the *Well Query Tool,* you can filter wells by many other options, such as Total Depth, Field, Lat Long, Operator, and so forth.

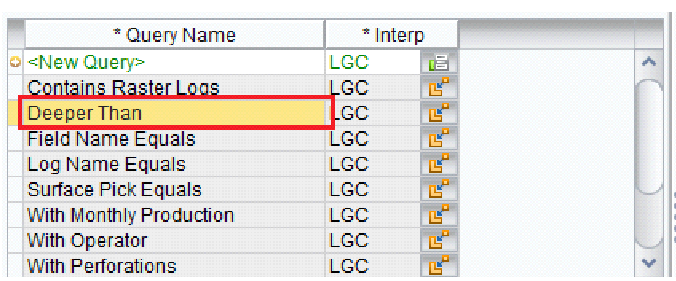
14. On the *Tools* task pane, click the **Well Query Tool** () icon to open the *Well Query Tool* task pane.



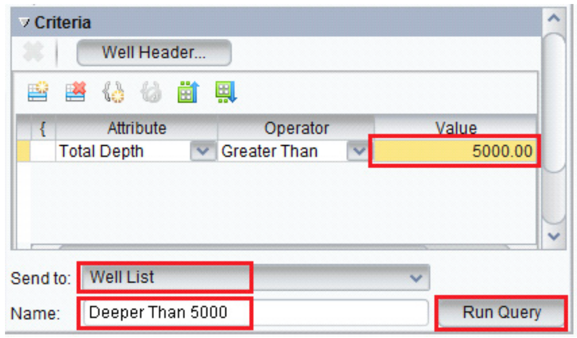
15. In the *Well Query Tool* task pane, click **Query wells in: Session Wells...** to open the *Well List Filter* dialog. In the *Well List Filter* dialog, select **demo wells** and click **OK**.



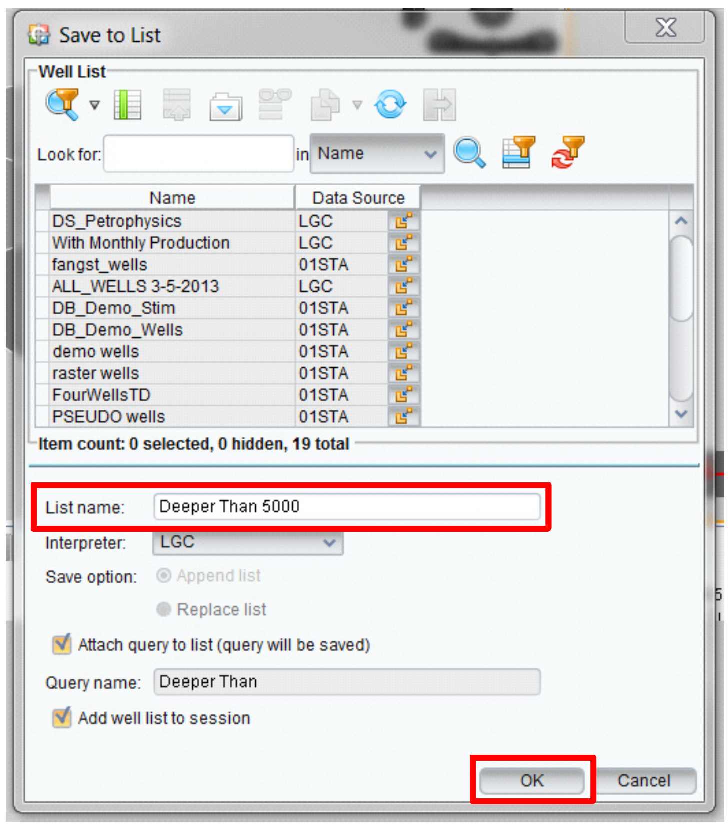
16. In the **Query Name** column, select **Deeper Than.**



17. In the *Criteria* panel enter **"5000"** in the **Value** column. On the **Send to** pull-down menu select **Well List.** In the Name field enter **"Deeper Than 5000".** Click **Run Query**.

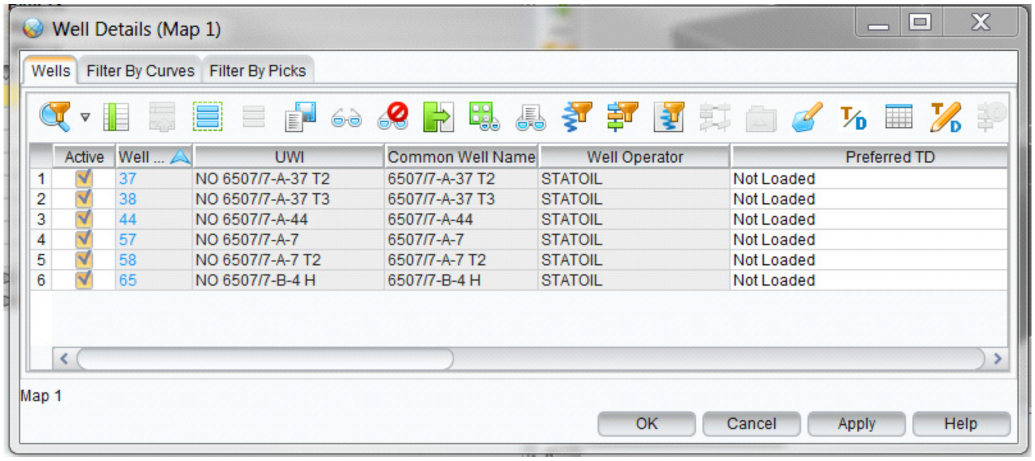


18. The *Save to List* dialog opens. You will see that List name is shown as Deeper Than 5000. Click **OK.** The new well list will be saved and available in the *Inventory* task pane.



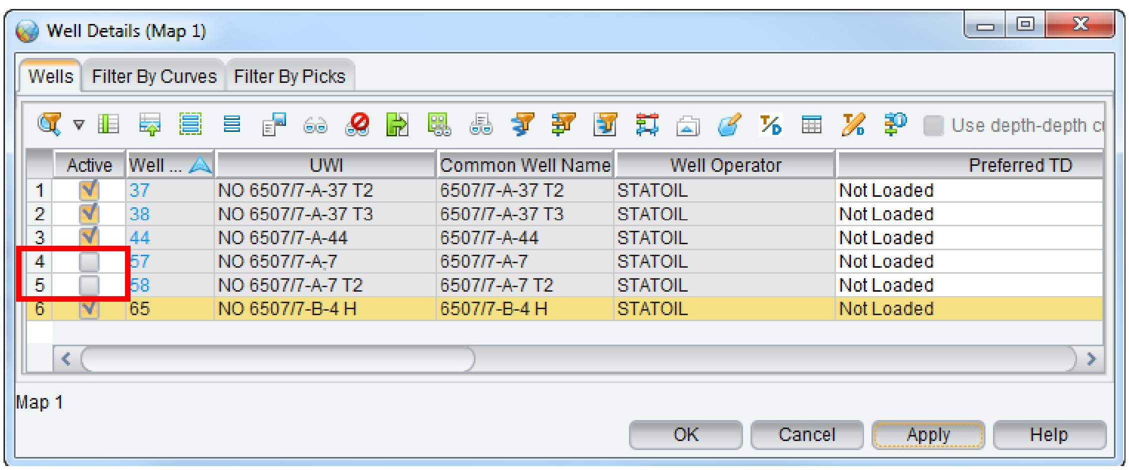
19. In the *Inventory* task pane, toggle on **Deeper Than 5000,YOU** and toggle off **Wells_With_DT,YOU**.

20. In the *Inventory* task pane, put your cursor on the well list **Deeper than 5000,YOU** and **MB3** > **Well Details.** The *Well Details* dialog will show that only six wells are deeper than 5000 m.

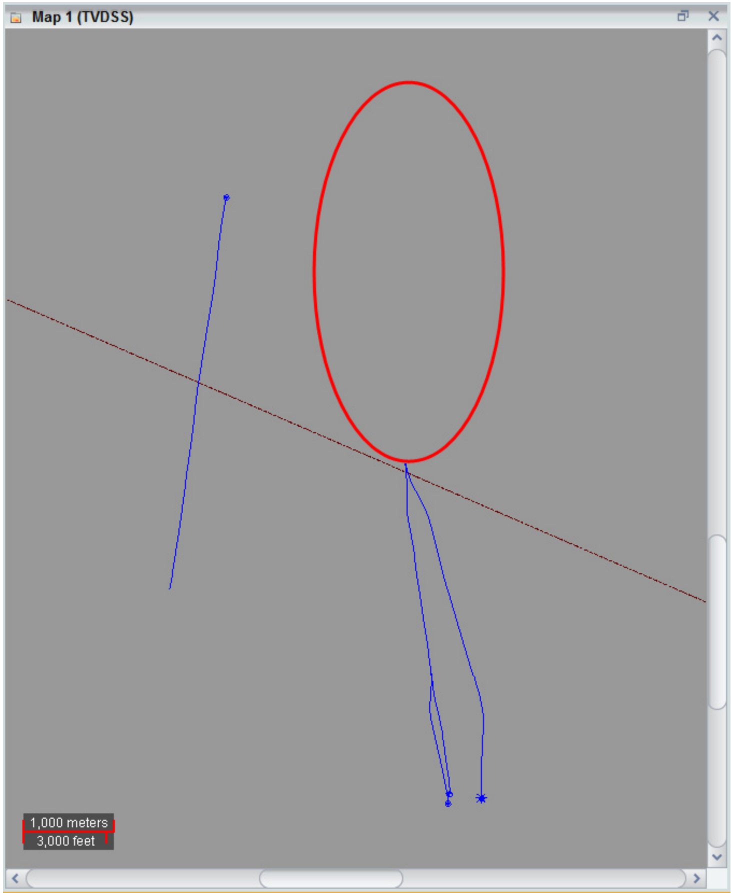


Hide Some Wells from List

21. In the Active column of the *Well Details* dialog, uncheck several wells and click **OK.**



Unchecked wells are hidden from display.

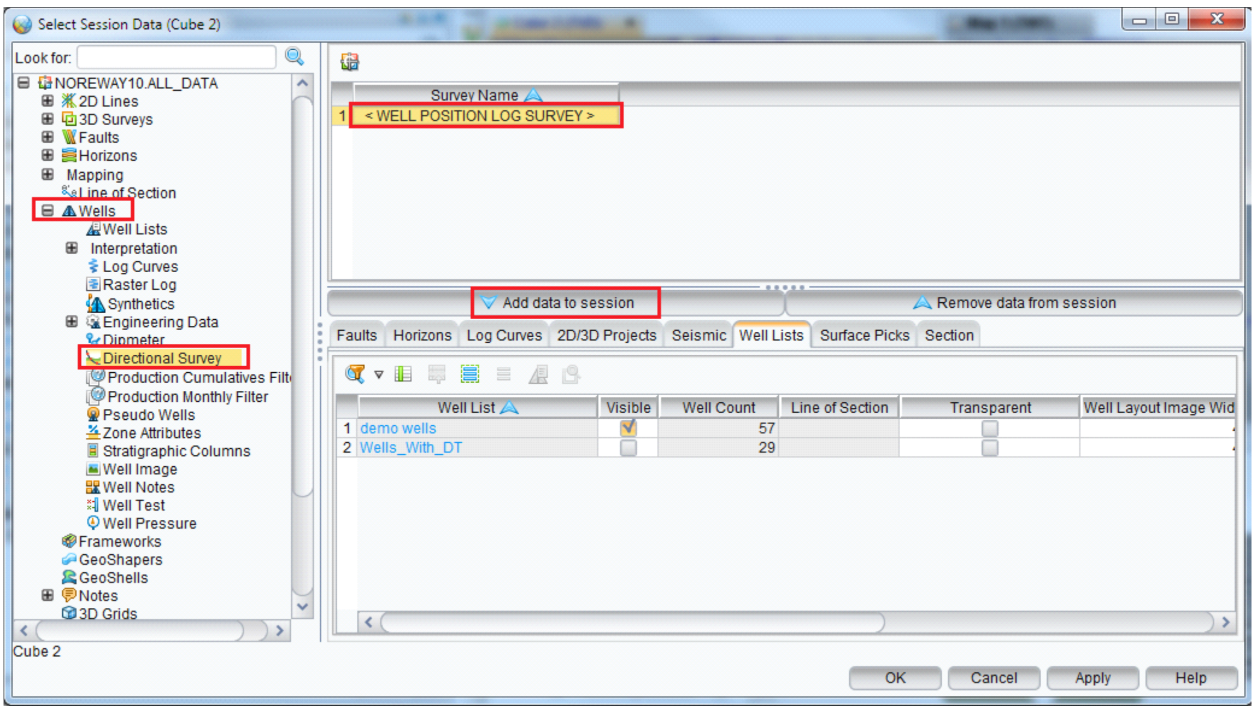


Exercise 1.2: Deviation Survey Point/Position Log

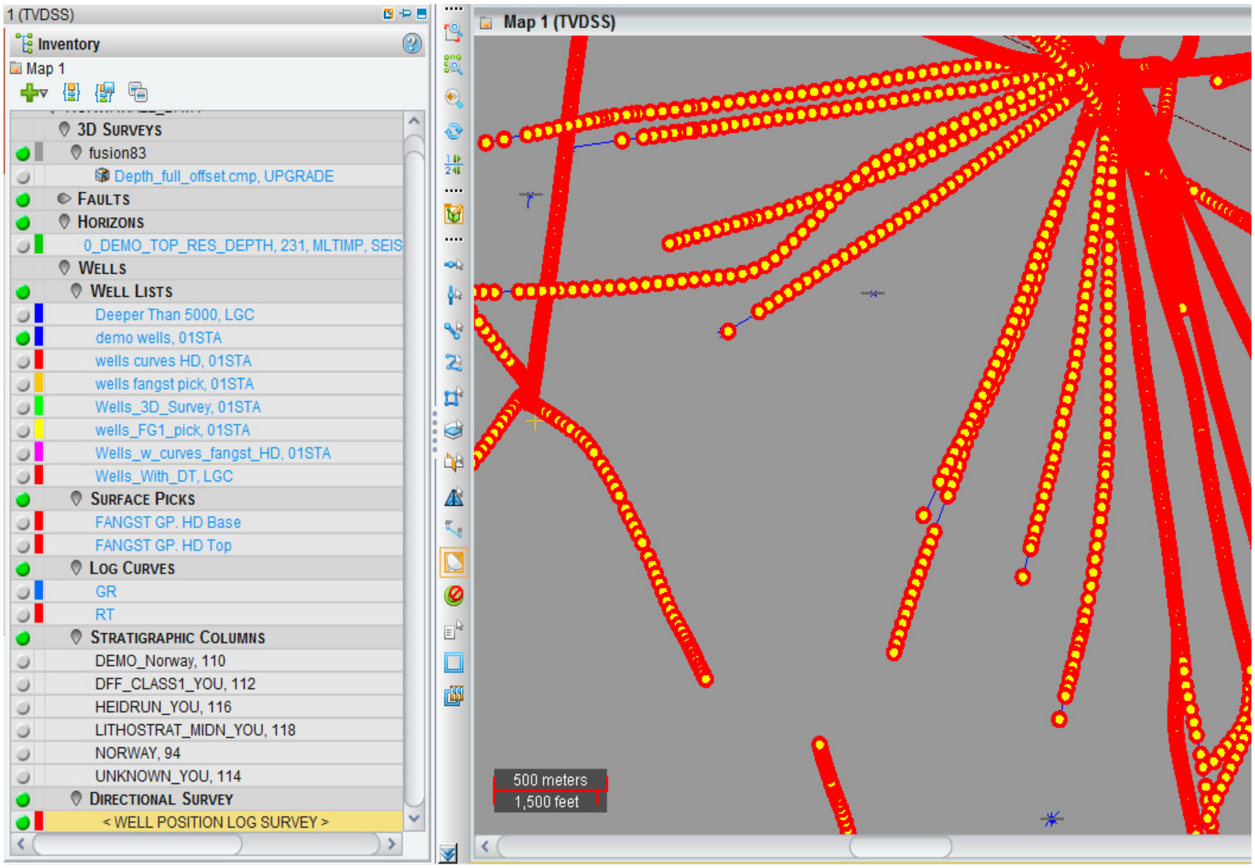
Being able to view Directional Survey points in *Map* view along the well bore is very helpful in determining significant points within a deviated well. In this exercise you will display directional survey points along the well bore in *Map* view and observe the information you can see from these points.

1. Activate the *Map* view and toggle on the **demo wells** well list.

2. Launch the *Select Session Data* dialog. On the left panel of the *Select Session Data* dialog click **Wells > Directional Survey,** and on the upper right select **<WELL POSITION LOG SURVEY>.** Click the **Add data to session** button. Click **OK**.

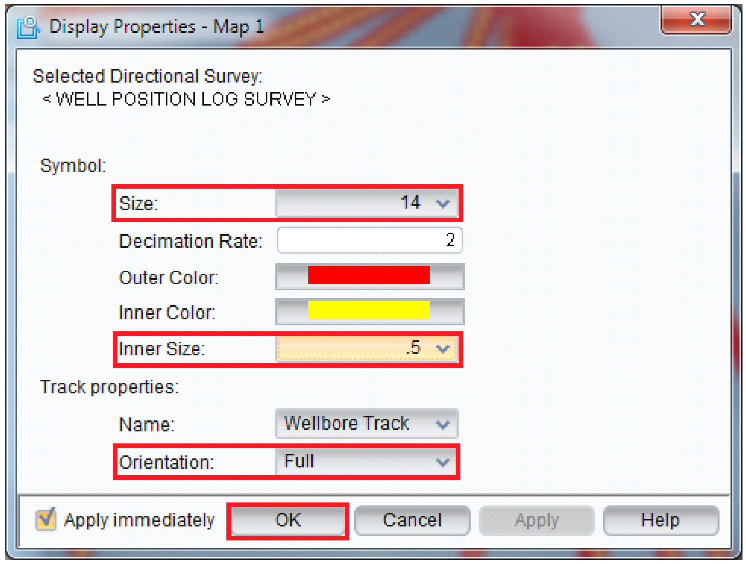


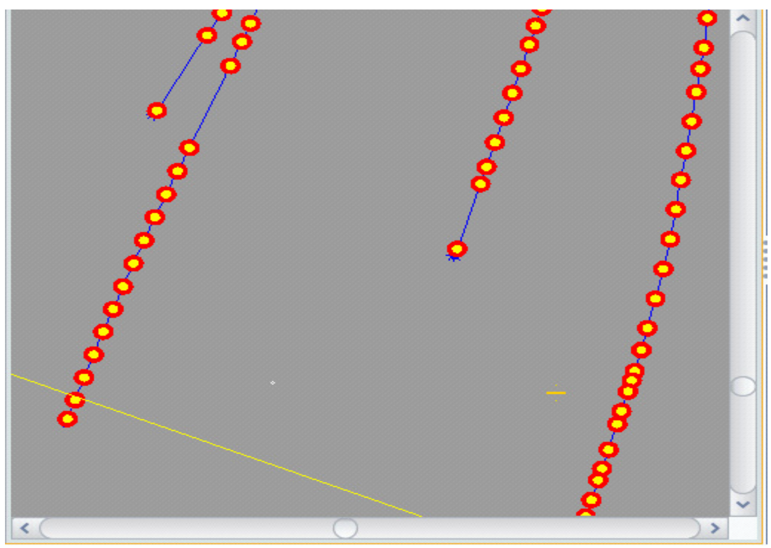
3. The **WELL POSITION LOG SURVEY** is listed in *Inventory,* and data is displayed in *Map* view. Zoom the ***Map* view** to a suitable magnification for viewing the data.



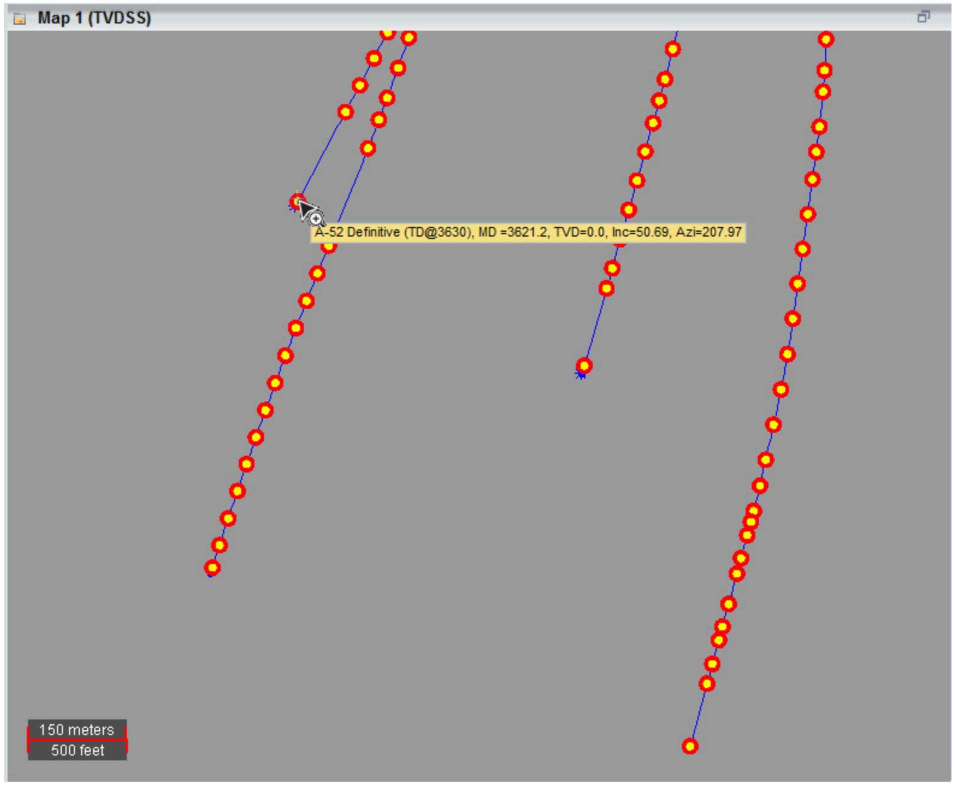
4. In the *Inventory,* put your cursor over **<WELL POSITION LOG SURVEY>** and **MB3 > Display Properties** to open the *Display Properties* dialog.

5. On the Size: pull-down menu select **14.** On the Inner Size: pull-down menu, select **.5.** On the Orientation: pull-down menu ensure **Full** is selected. Click **OK**





If you want to know survey information related to any survey point, hold your cursor over the survey point. Information such as Directional Survey Name and Total Depth of well is displayed, followed by the specifics of that survey point, including Measured Depth, True Vertical Depth, Inclination, and Azimuth.



Note:

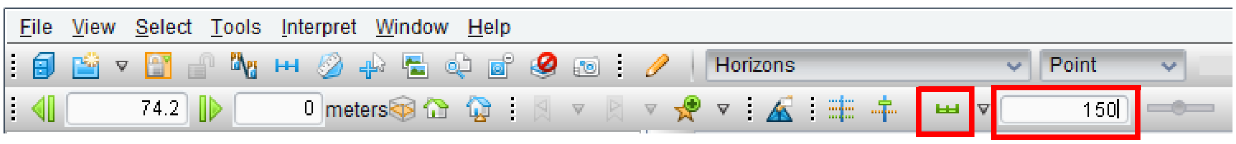
In *Cube* view, directional surveys can be displayed through a Well Layout

Exercise 1.3: Display Well Data Along Wellbores in Map View

Previously, you learned how to display Directional Survey Points in *Map* view. You can display many other features along the well bore as well, including casing, perforation, and log curves. This functionality better allows you to see if there are any patterns that correspond to key areas in your maps.

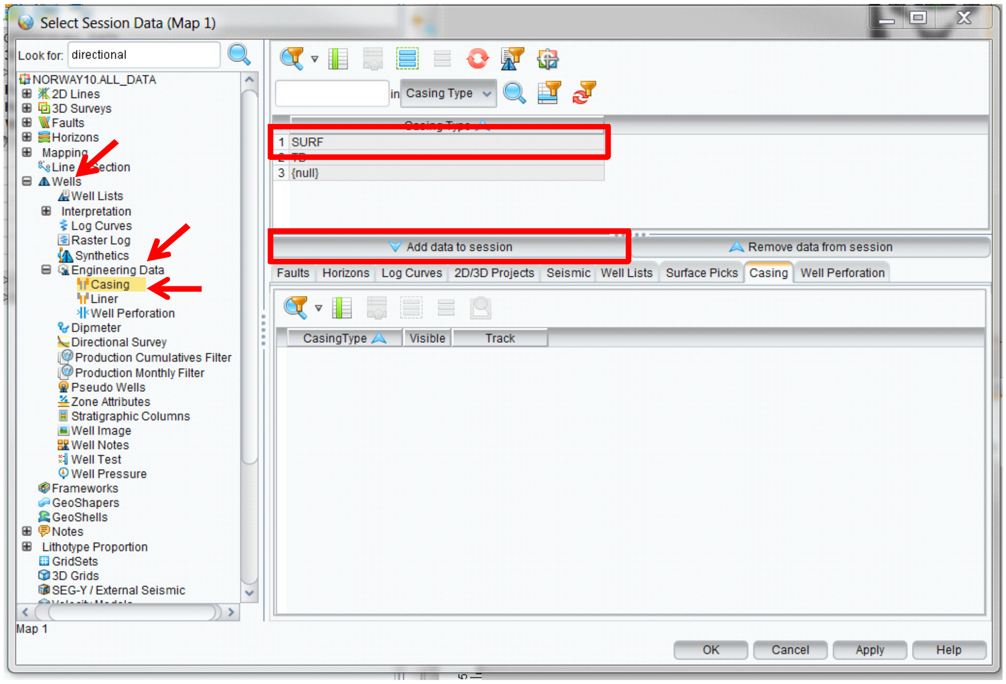
1. In the *Inventory* task pane, put your cursor on **<WELL POSITION LOG SURVEY>** and **MB3 > Remove Data from Session.** Put your cursor on **Wells_With_DT** and **MB3 > Remove Data from Session.**

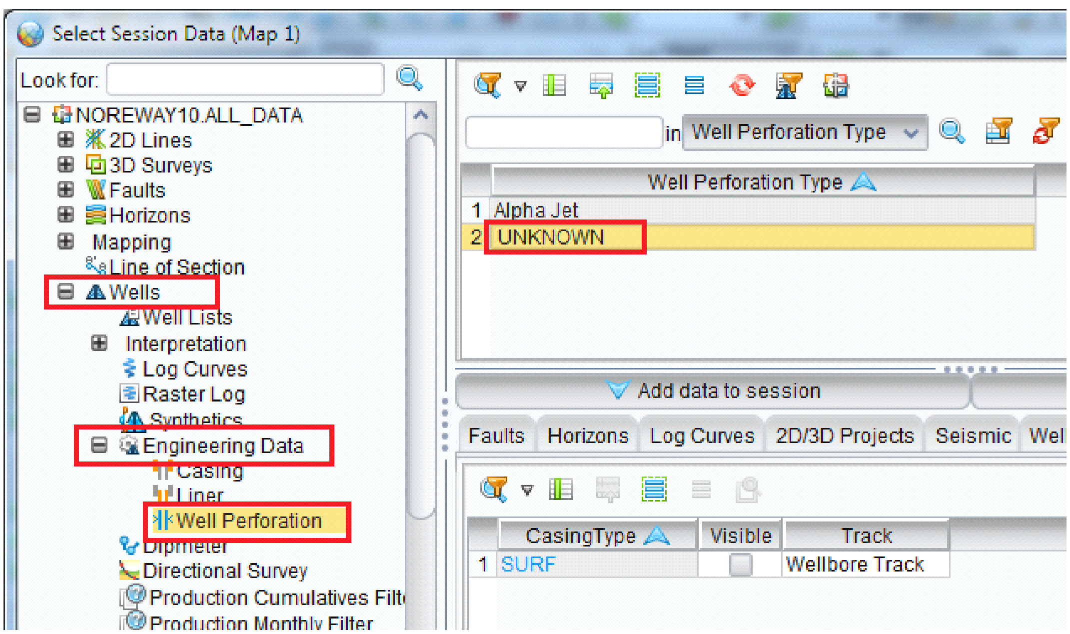
2. In *Map* view, toggle off all **data** except the well list **demo wells.** On the top tool bar, change well width option to **Distance** and enter “**150”** in the distance amount field.



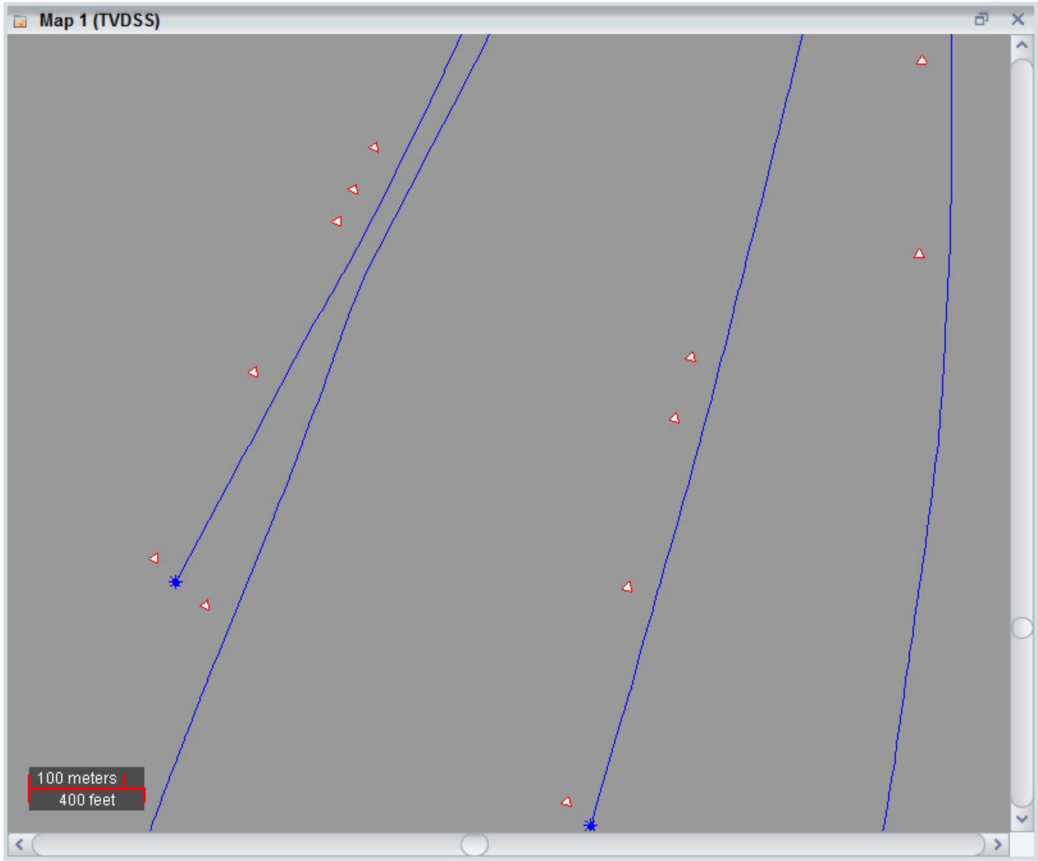
3. Click the Select Session Data () icon. In the *Select Session Data* dialog, under Wells > Engineering Data, add following to the session:

   - Select **Casing Type** column, click **SURF** and then click the **Add data to session** button.
   - Select **Well Perforation UNKNOWN** and click **Add data to session** button. Click **OK**.


Select Session Data (Map 1)
Look for:
directional
NORWAY10.ALL_DATA
2D Lines
3D Surveys
Faults
Horizons
Mapping
Wells
Well Lists
Interpretation
Log Curves
Raster Log
Synthetics
Engineering Data
Casing
Liner
Well Perforation
Dipmeter
Directional Survey
Production Cumulatives Filter
Production Monthly Filter
Pseudo Wells
Zone Attributes
Stratigraphic Columns
Well Image
Well Notes
Well Test
Well Pressure
Frameworks
GeoShapers
GeoShells
Notes
Lithotype Proportion
GridSets
3D Grids
SEG-Y / External Seismic
Map 1
in
Casing Type
1 SURF
3 {null}
Add data to session
Remove data from session
Faults
Horizons
Log Curves
2D/3D Projects
Seismic
Well Lists
Surface Picks
Casing
Well Perforation
CasingType
Visible
Track
OK
Cancel
Apply
Help

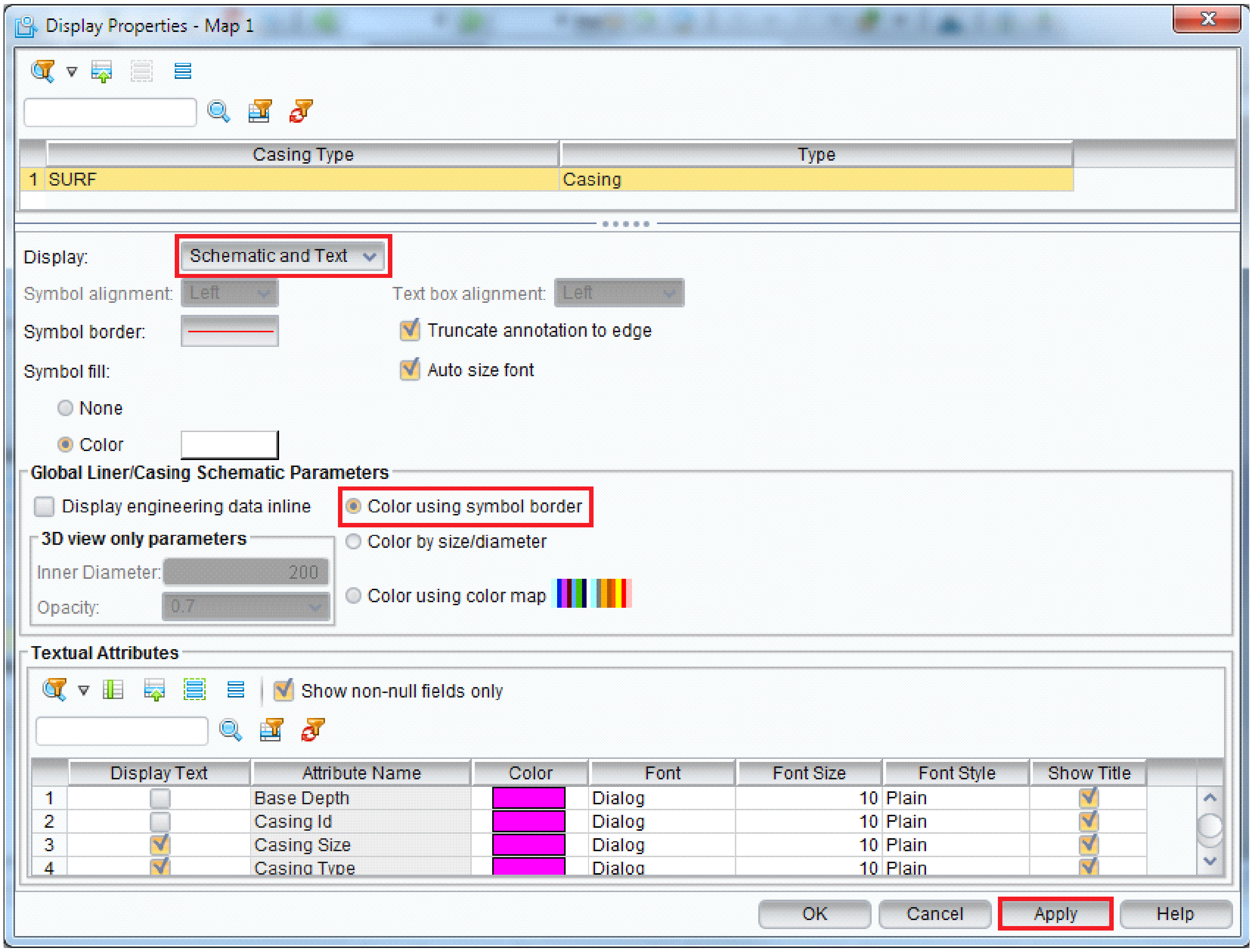

Select Session Data (Map 1)
Look for:
NOREWAY10.ALL_DATA
2D Lines
3D Surveys
Faults
Horizons
Mapping
Line of Section
Wells
Well Lists
Interpretation
Log Curves
Raster Log
Synthetics
Engineering Data
Casing
Liner
Well Perforation
Dipmeter
Directional Survey
in
Well Perforation Type
1 Alpha Jet
2 UNKNOWN
Add data to session
Faults
Horizons
Log Curves
2D/3D Projects
Seismic
CasingType
Visible
Track
1 SURF
Wellbore Track

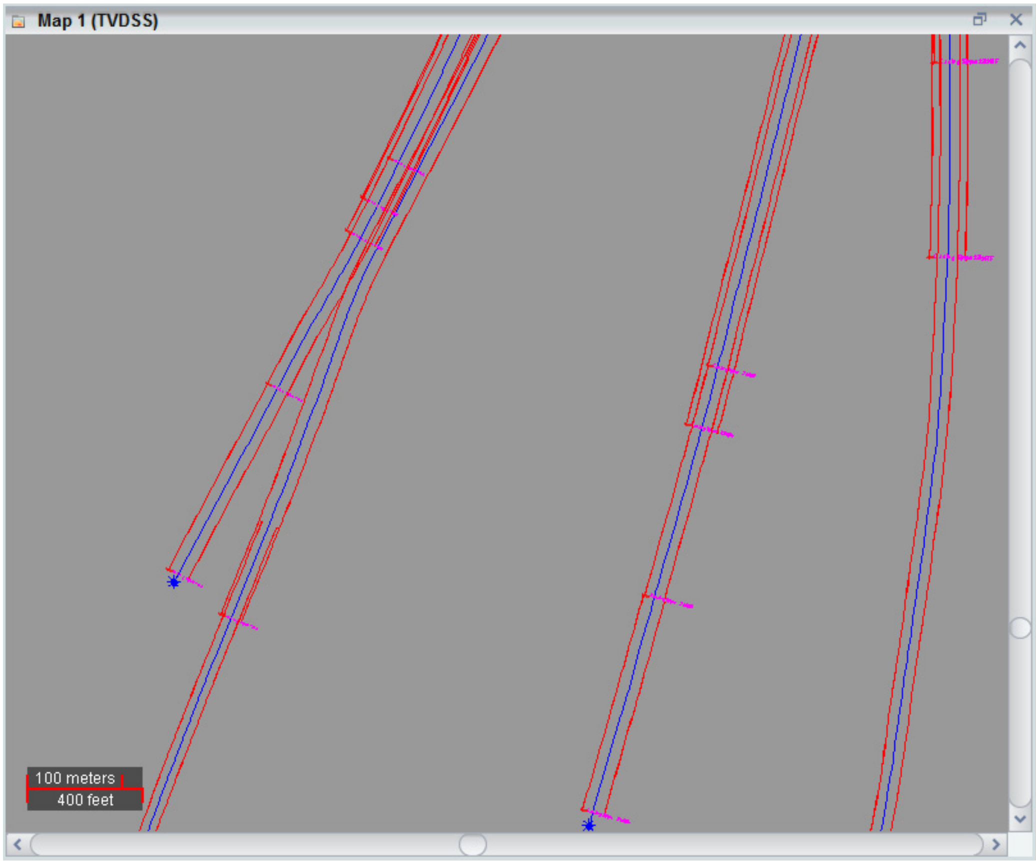
4. In the *Inventory* task pane, toggle on the **SURF** under CASING. In *Map* view, zoom in, as shown below.



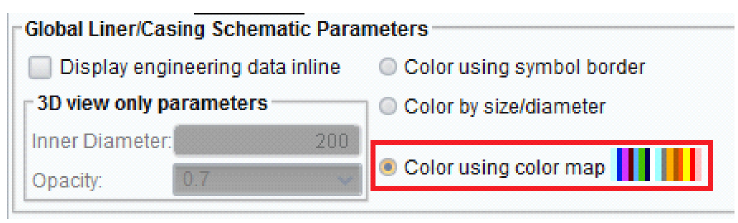
5. With your cursor over SURF in the *Inventory* task pane **MB3 > Display Properties** to open the *Display Properties* dialog.

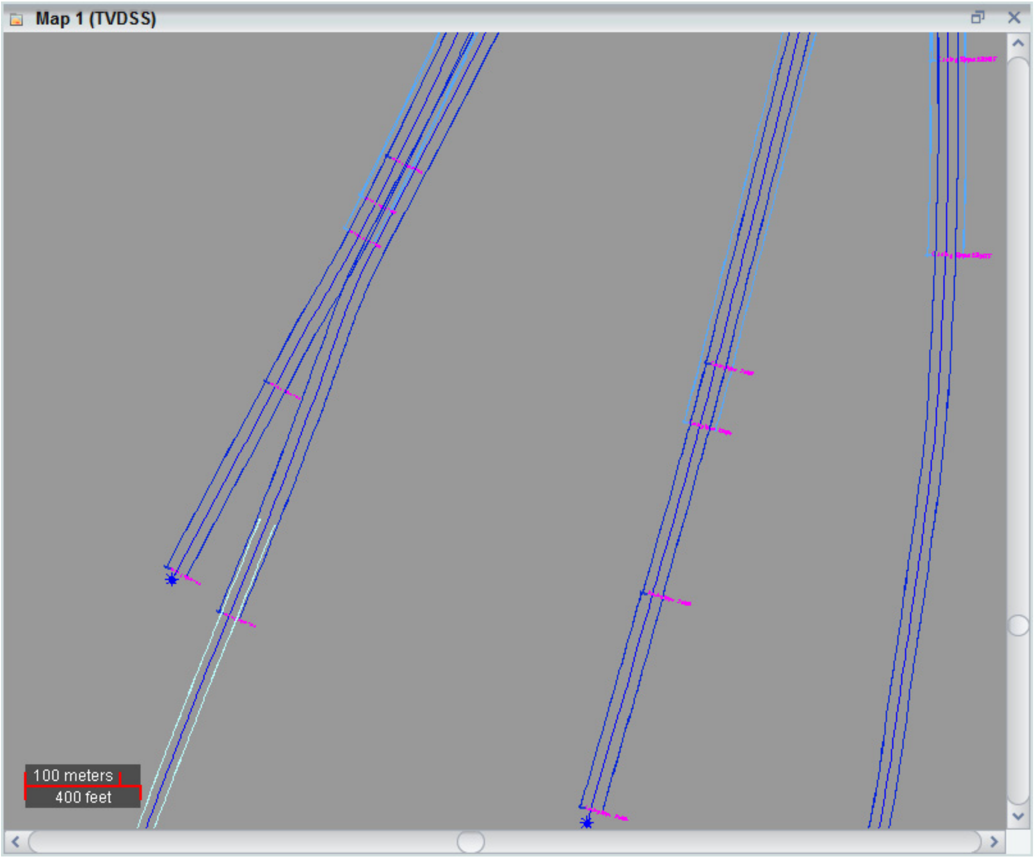
6. On the Display: pull-down menu, select **Schematic and Text.** In *Global Liner/Casing Schematic Parameters* section, toggle on **Color using symbol border**. Click **Apply.**





7. In the *Global Liner/Casing Schematic Parameters* panel of the *Display Properties* dialog, toggle on **Color using color map** and click **OK.** Notice your Wells displayed in *Map* view.



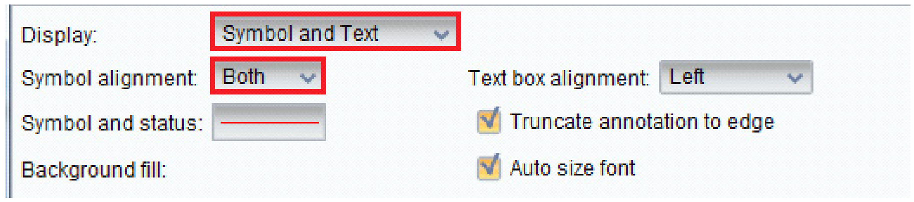


Note:

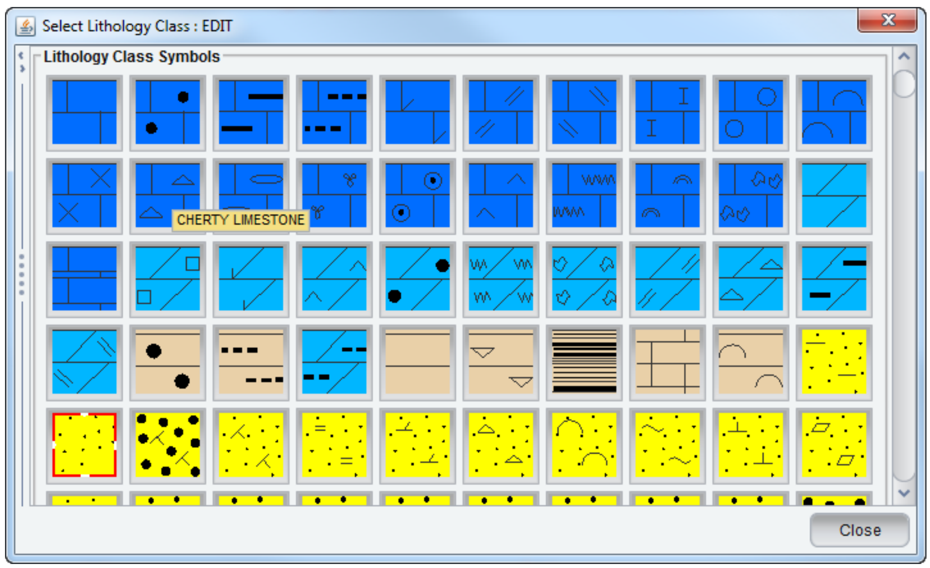
The *Global Liner/Casing Schematic Parameters* panel contains parameter settings that affect all casing data, regardless of whether it is selected in the table at the top of the *Display Properties* dialog.

8. In the *Inventory,* toggle on **UNKNOWN**, under Well Perforation. Put your cursor on **UNKNOWN** and **MB3 > Display Properties** to open the *Display Properties* dialog.

9. On the Display: pull-down menu, select **Symbol and Text**. On the Symbol alignment: pull-down menu, select **Both**, to display the perforations on both sides of the wellbore.

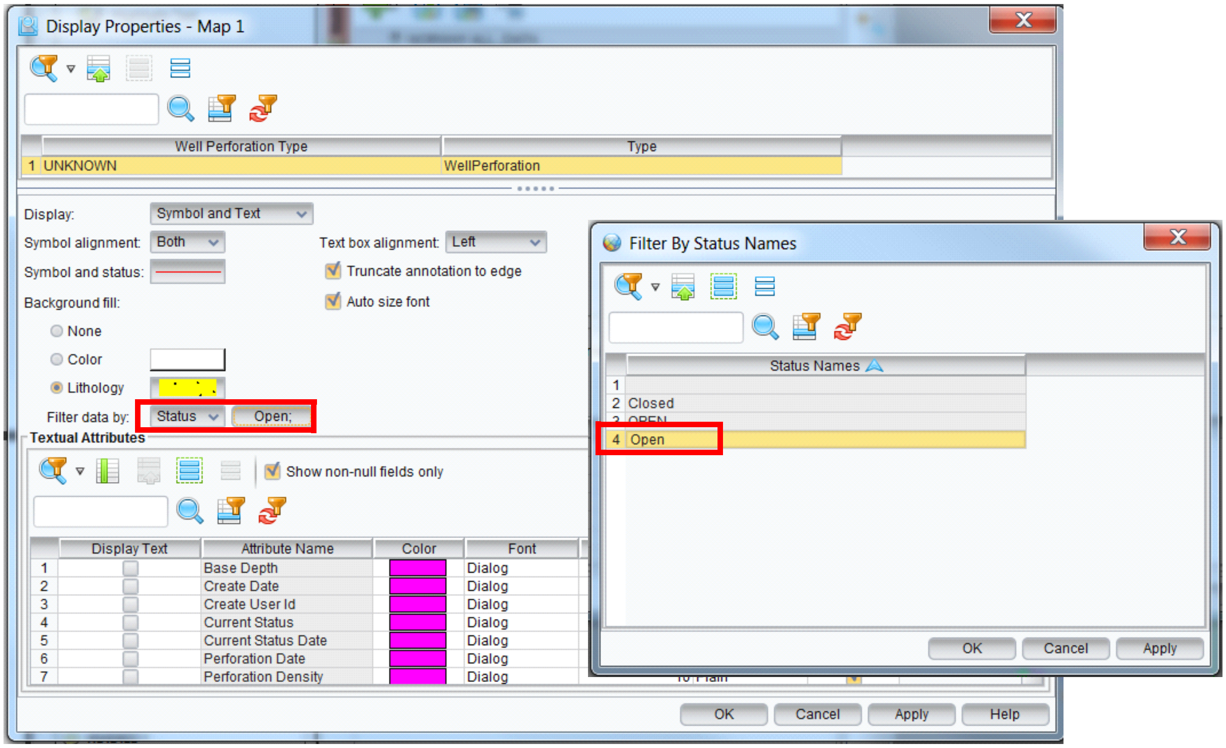


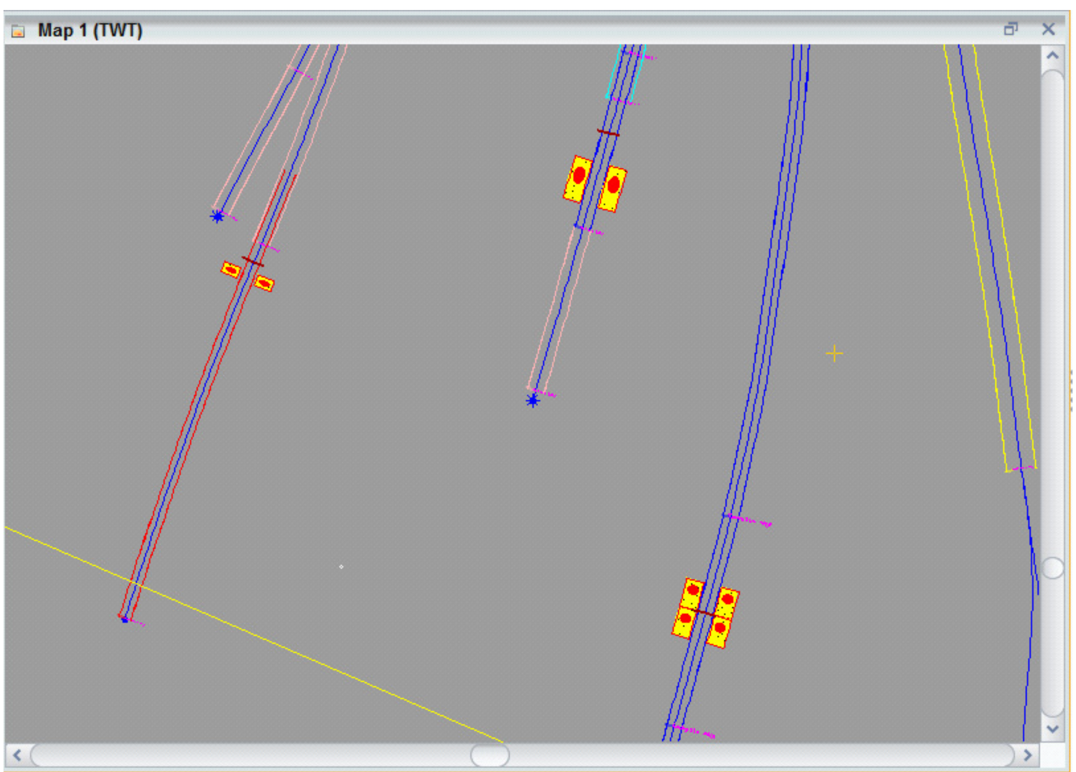
10. Under Background fill: toggle on **Lithology** and click **lithology swatch.** In the resulting *Select Lithology Class* dialog select a **Sandstone** lithology and click **Close.**



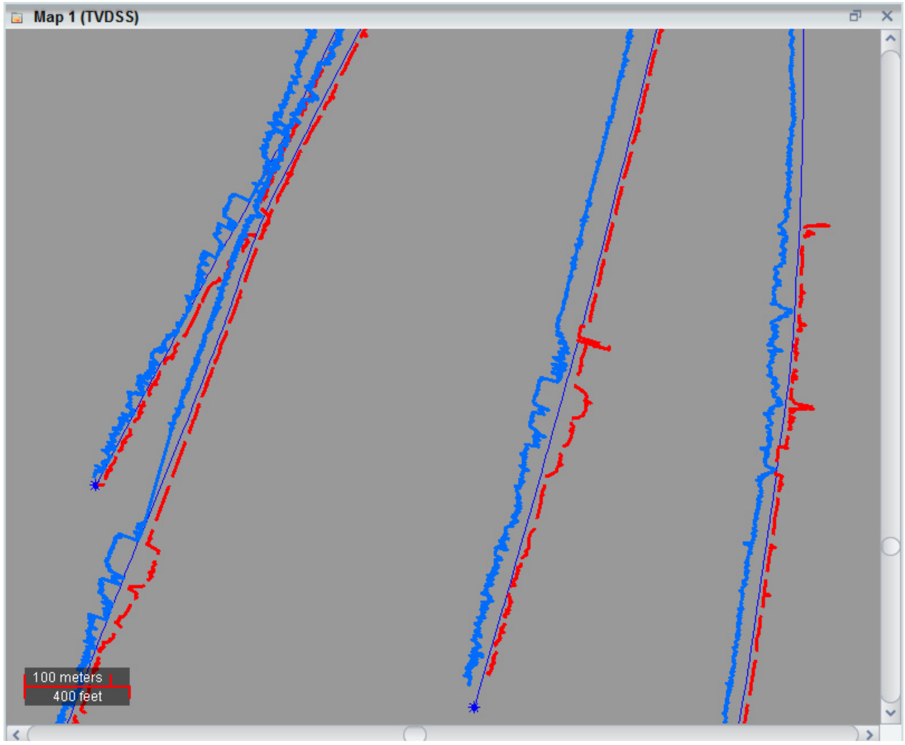
11. On the Filter data by: pull-down menu, select **Status** and then click the **All...** button, to open the *Filter By Status Names* dialog. Select

Open (do not select all-caps OPEN) and click **OK.** Click **OK** in the *Display Properties* dialog.

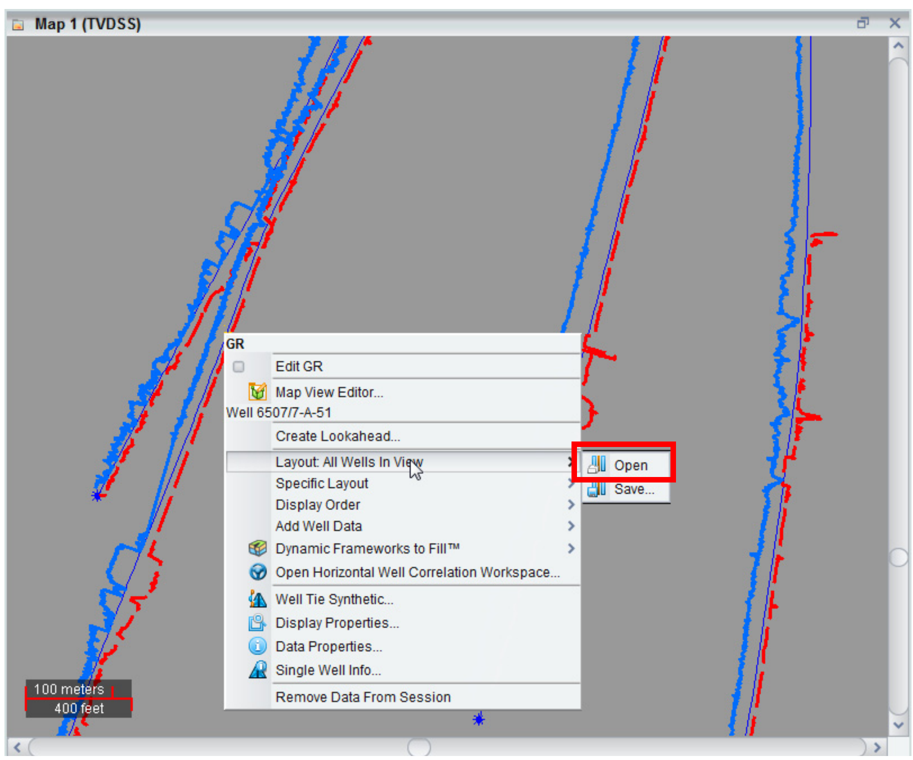




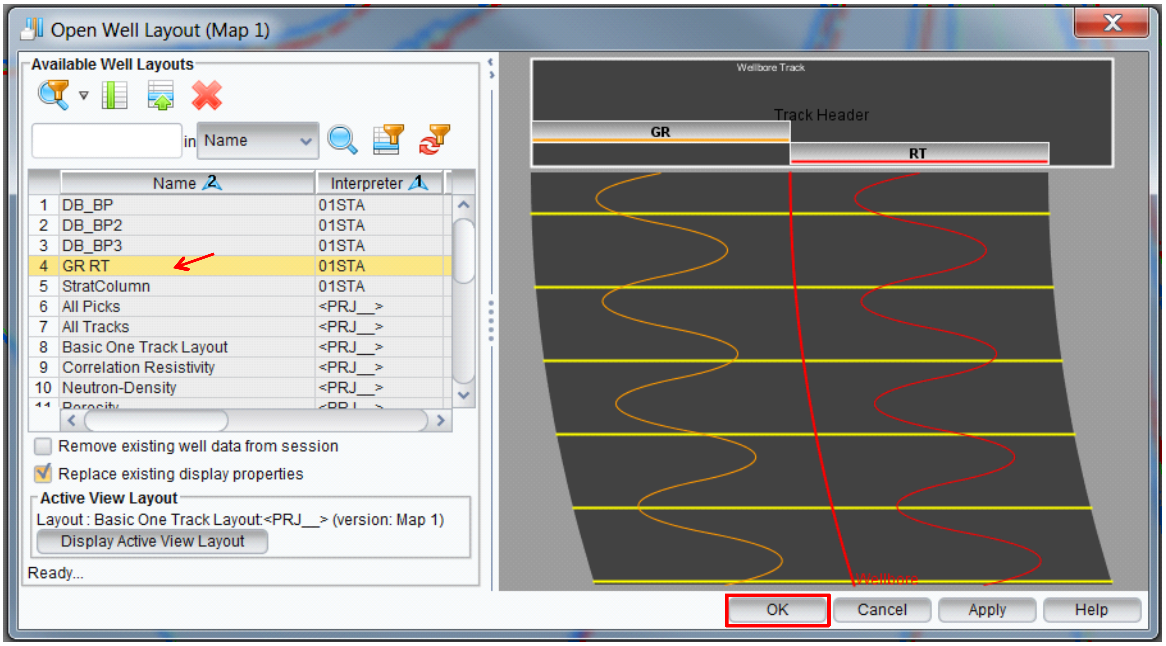
12. In the *Inventory,* toggle off the data type **CASING** and the data type **WELL PERFORATION.** Now toggle on log curves **GR** and **RT.**

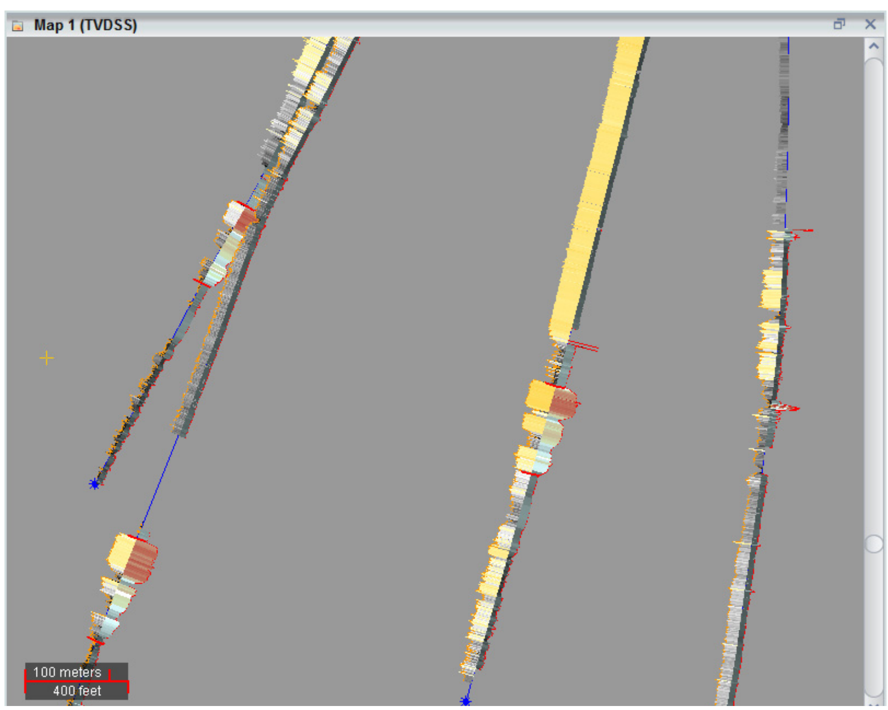


13. In *Map* view, put your cursor on any wellbore and **MB3 > Layouts: All Wells In View > Open,** to open the *Open Well Layout* dialog.



14. In the Available Well Layouts panel of the *Open Well Layout* dialog, select **GR RT,01STA**. Click **OK.** The wells displayed in *Map* view will honor the applied Well Layout.





Exercise 1.4: Well Annotation, Repositioning, and Rotating

Being able to move the add notation of key information in *Map* view is very important, especially when you make presentation-ready maps. In this exercise you will move annotation for the wells in *Map* view.

The Move Well Annotation functionality allows you to:

- Resolve any overlapping text issues.
- Align text with a wellbore.
- Unclutter the *Map* view display.
- Improve presentation.

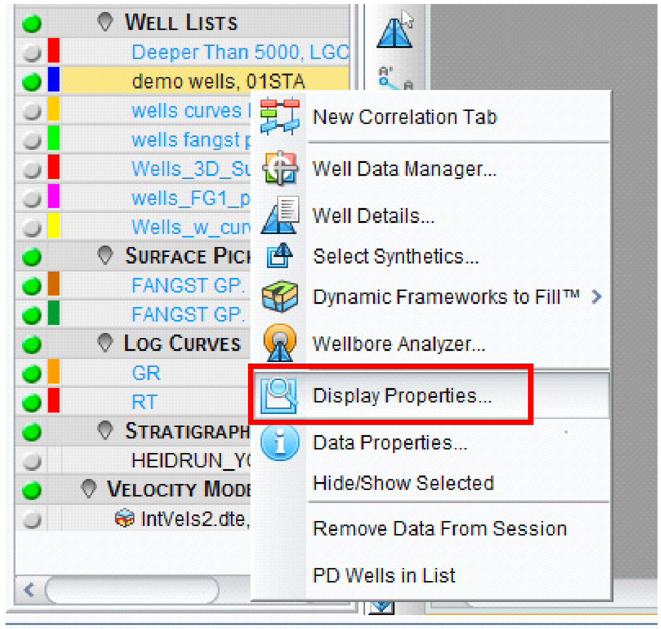
Note:

The Move Annotation feature is for well header information only.

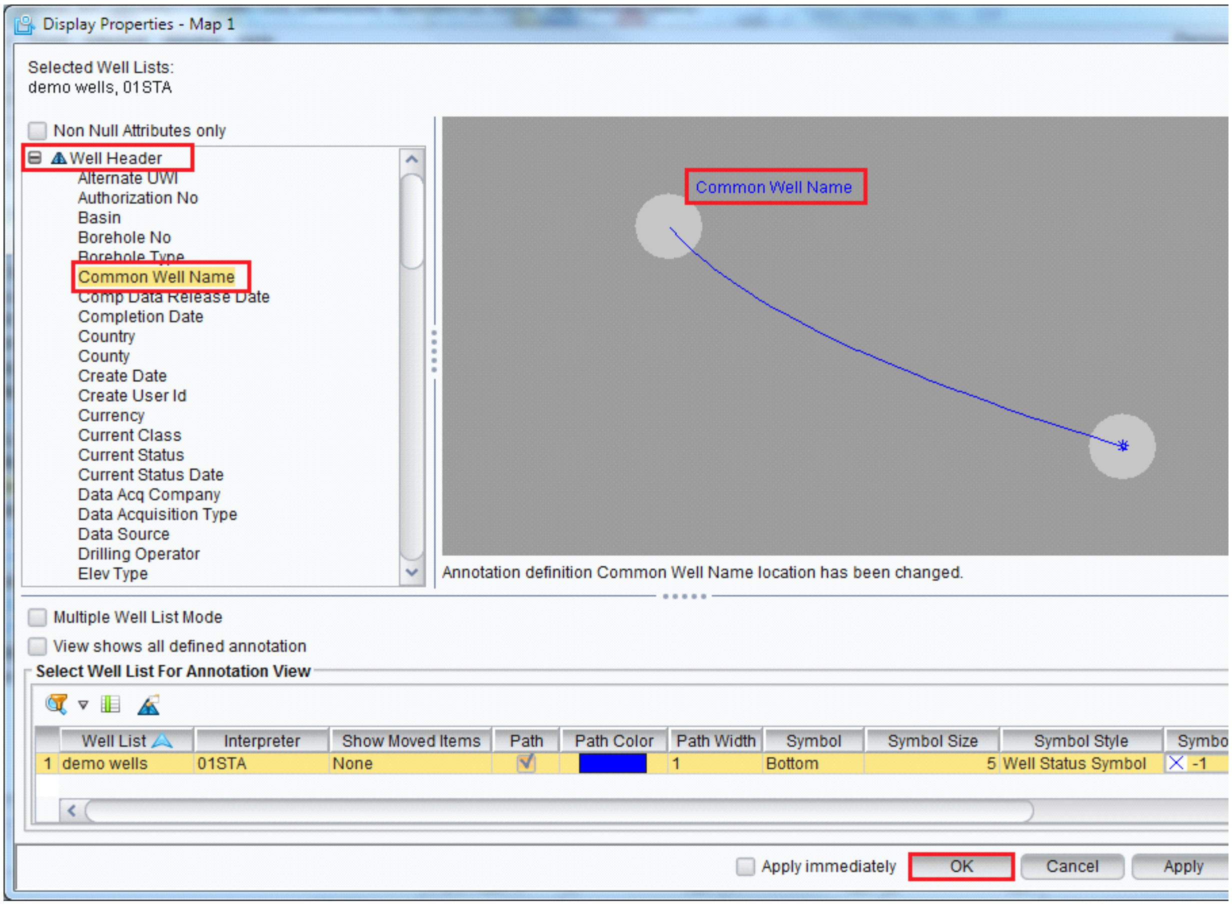
1. Put your cursor on data type **CASING** and **MB3 > Remove Data From Session**. Then put your cursor on **WELL PERFORATION** and **MB3 > Remove Data From Session**.

2. Activate the *Map* view and display only the well list **demo wells** in *Map* view. Toggle off all other data types.

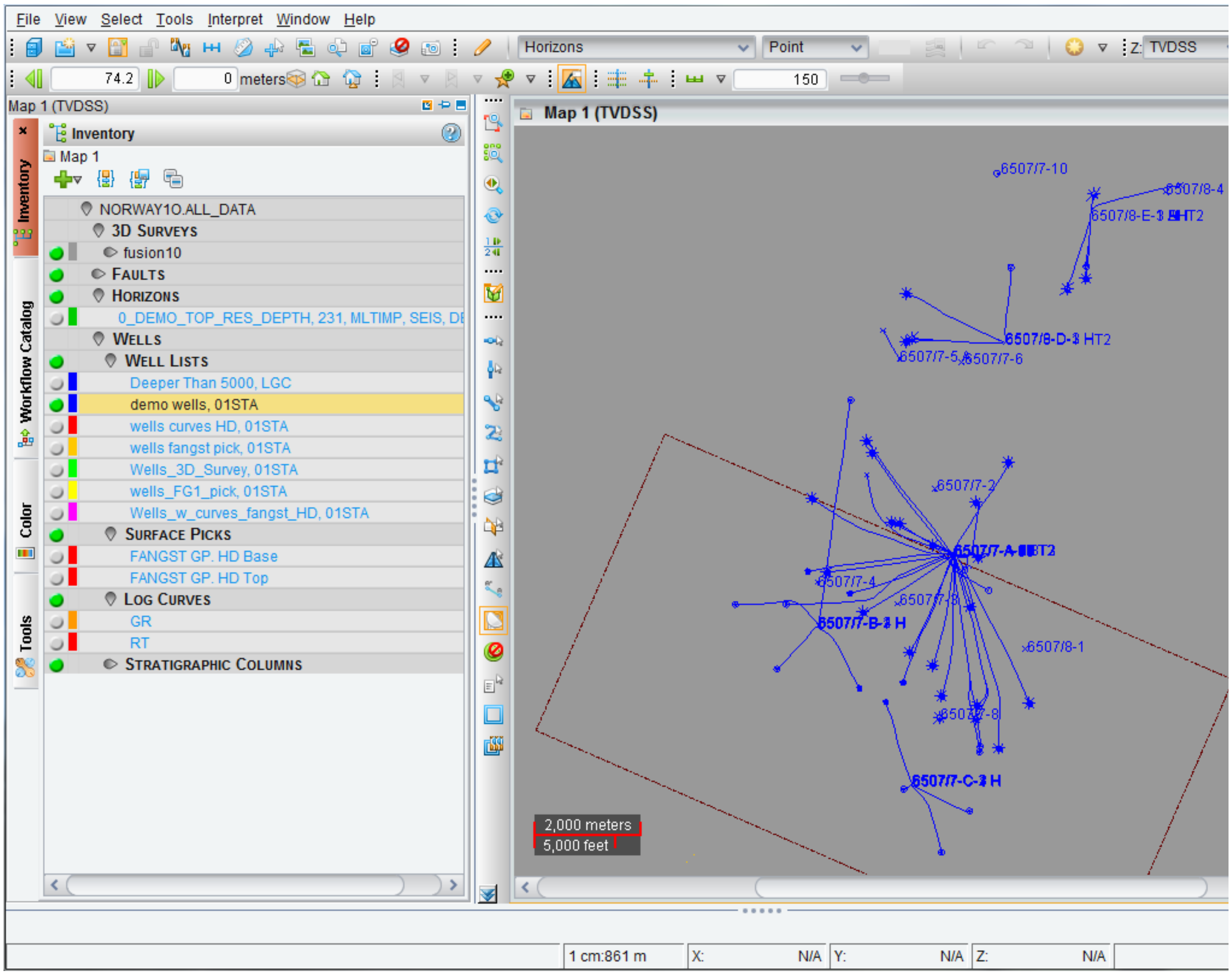
3. In the *Inventory,* put your cursor on **demo wells** and **MB3 > Display Properties** to open the *Display Properties* dialog.



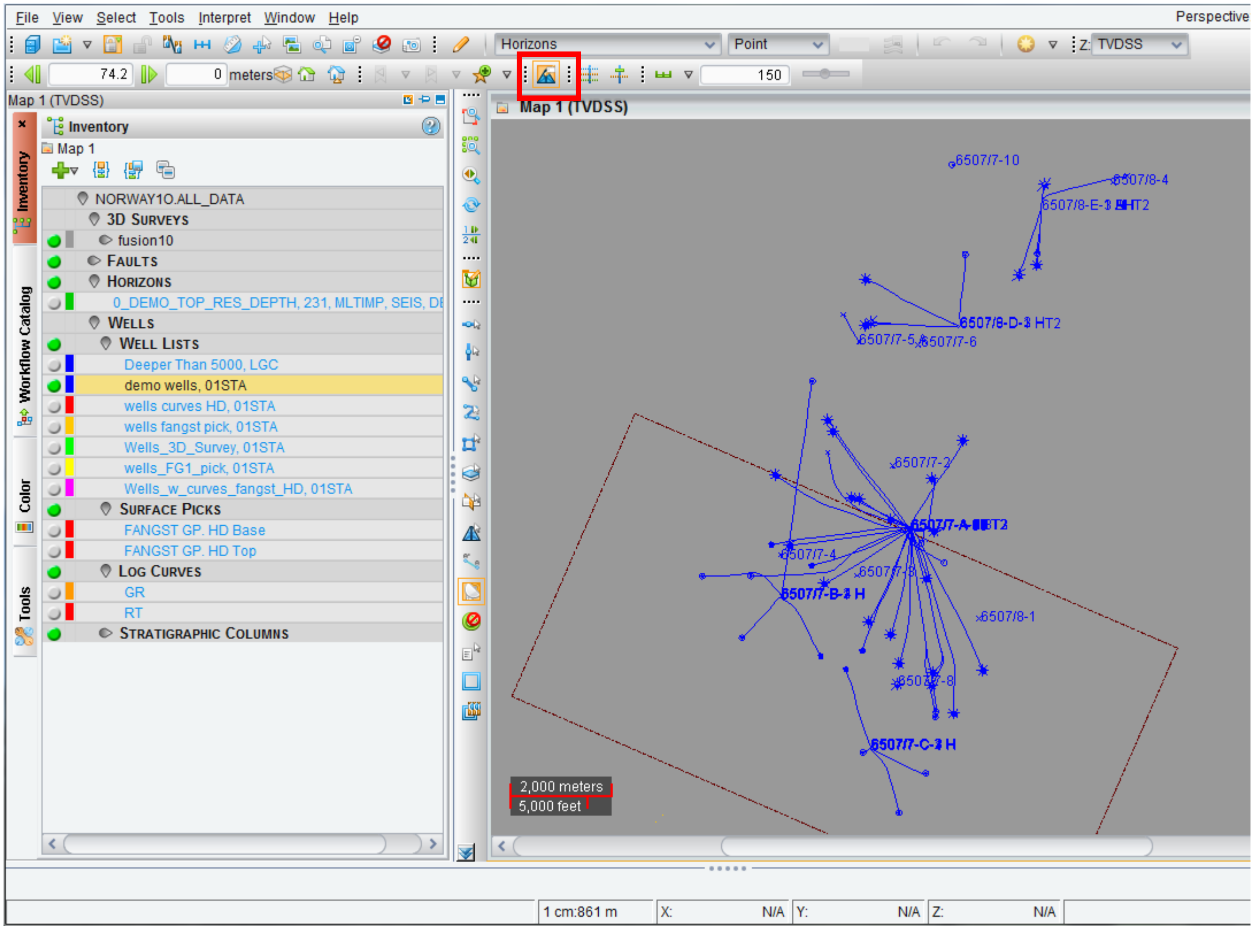
4. In the *Display Properties* dialog, click the **Expand (** **)** icon to expand the **Well Header** tree and drag the **Common Well Name** to the well top position. As you drop the **Common Well Name,** the *Edit Well Header Annotation Attributes* dialog will open. Click **OK,** and then click **OK** in the *Display Properties* dialog.



You will see that the wells in *Map* view are now annotated with common well names.

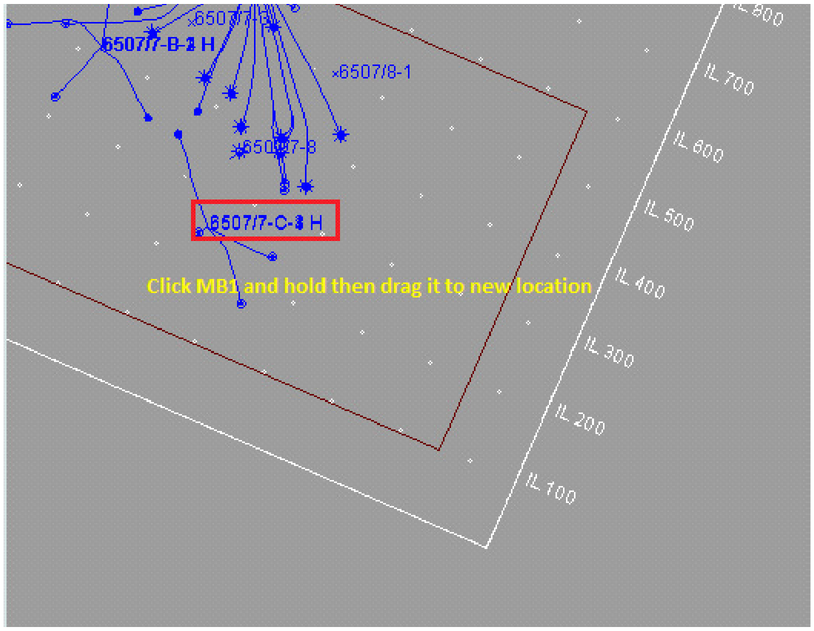


5. Click the **Move Well Annotation** ( ) icon.

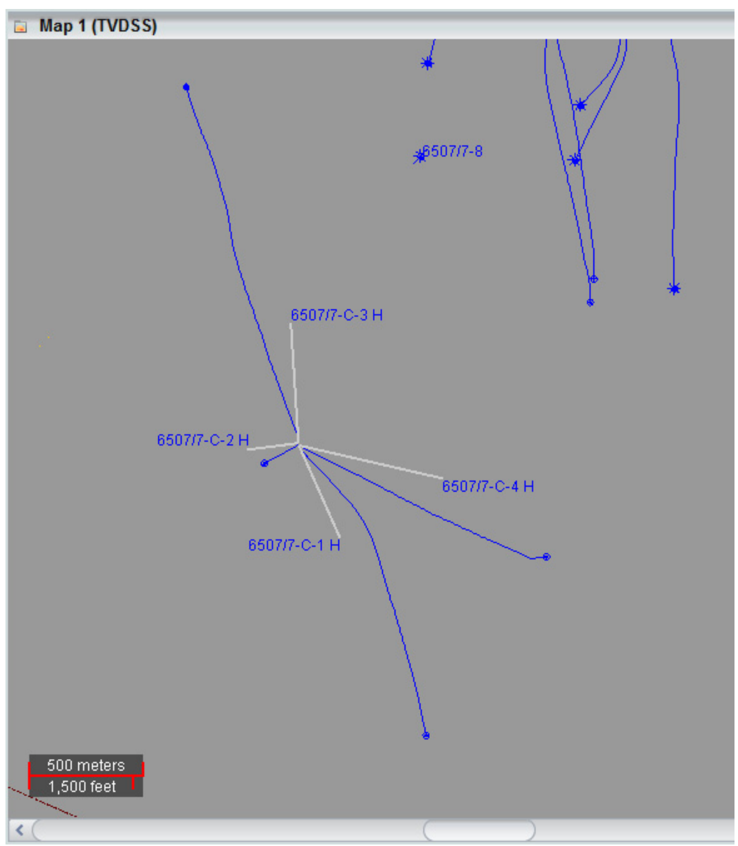


After you click the Move Well Annotation icon and move your mouse pointer over your previously selected well annotation (in this case, Common Well Name) the mouse pointer will change into this pointer shape ( ).

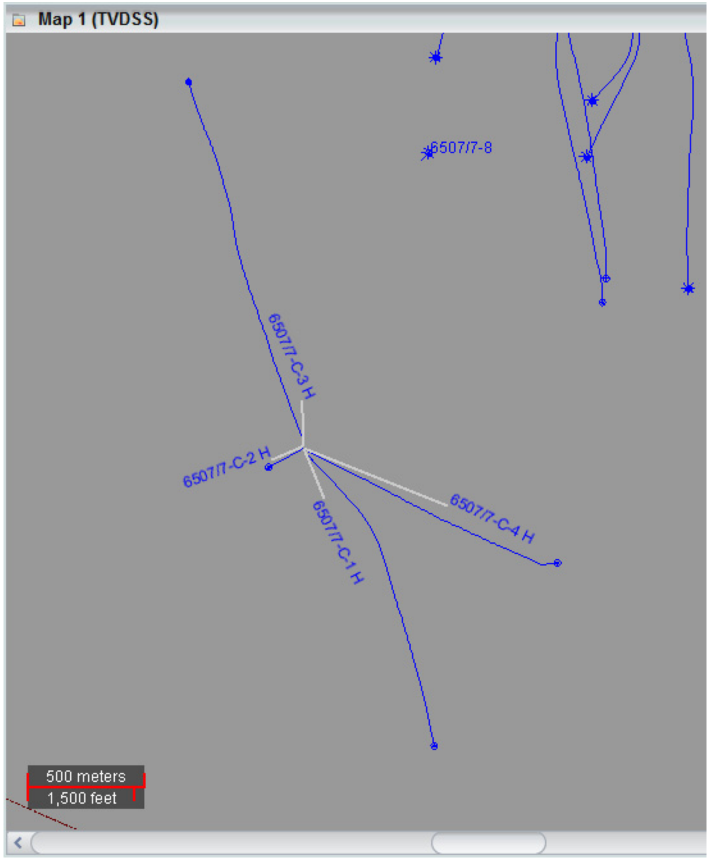
6. When your mouse pointer changes to (☝), drag-and-drop the **well annotation** to the new location



The following image shows *Map* view after moving the annotation to a new location.

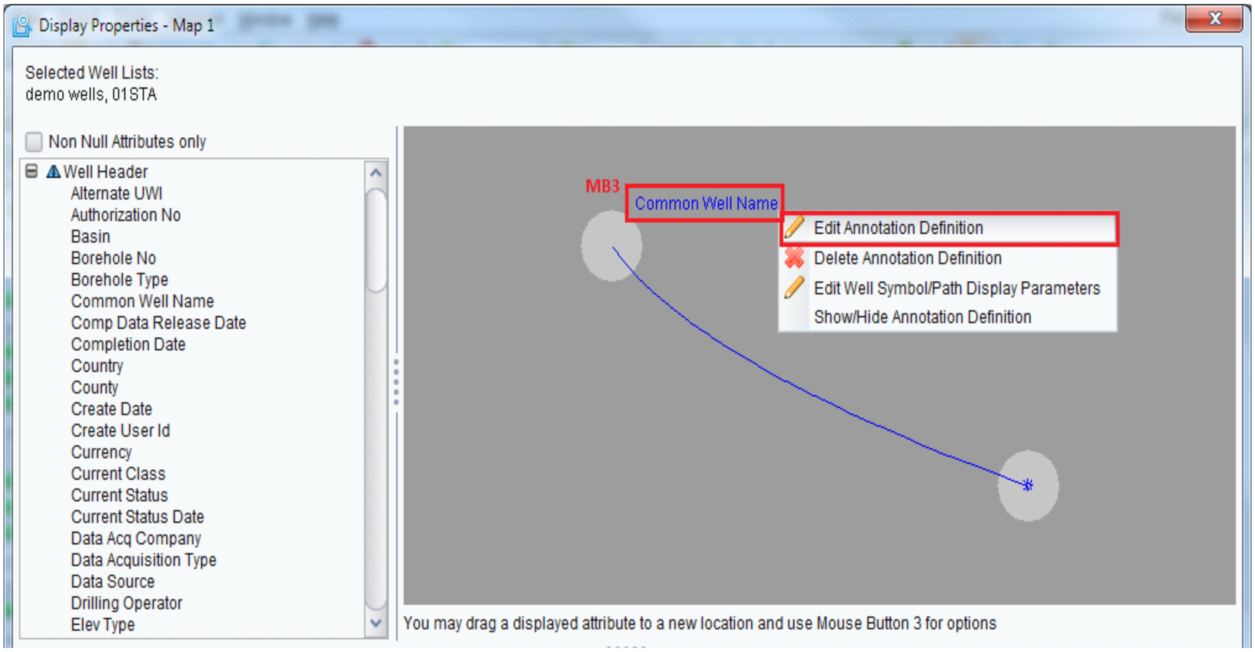


7. To rotate well annotation, move your mouse pointer over the **well annotation,** until the pointer changes to ( ). **MB1 + Shift** and drag to rotate the well annotation. Make sure the Move Well Annotation ( ) icon is **active**.



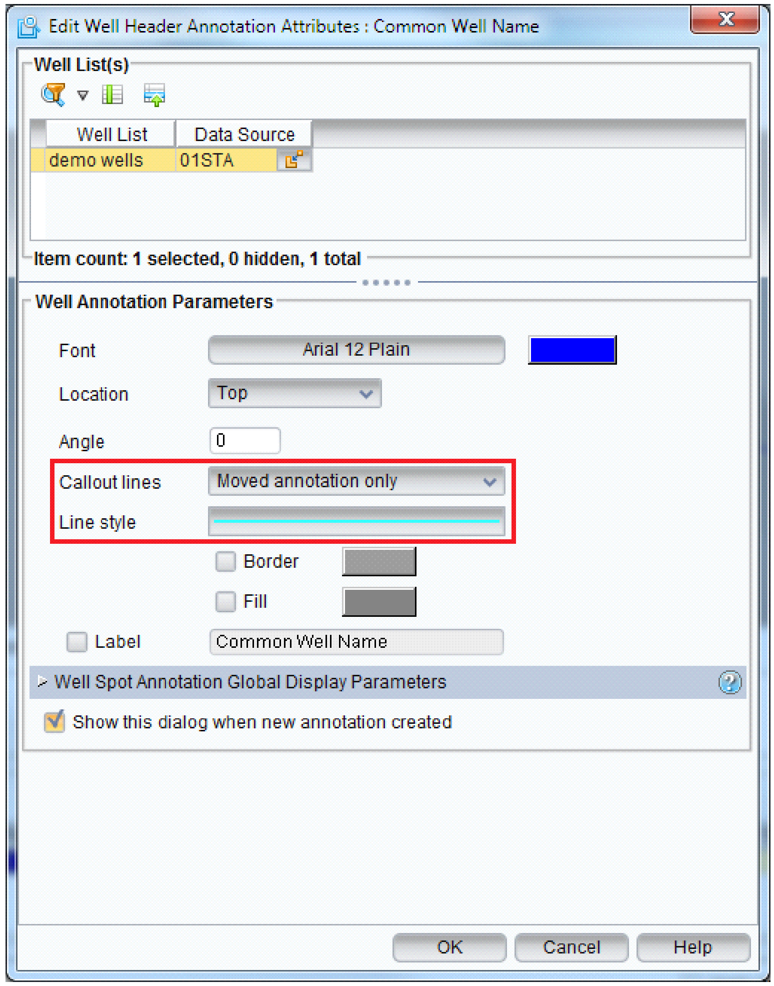
8. You can change the Well Annotation in the *Display Properties* dialog. Put your cursor on the well list **demo wells** and **MB3 > Display Properties**.

9. In the *Display Properties* dialog put your cursor on **Common Well Name** and **MB3** > **Edit Annotation Definition** to open the *Edit Well Header Annotation Attributes* dialog.



In the *Edit Well Header Annotation Attributes* dialog you can change the various parameters of the annotation such as font size, style, and color; you can also change the line style and color of callout lines**.**

10. On the Callout Lines pull-down menu in the *Edit Well Header Annotation Attributes* dialog, select **Moved annotation only.** For Line Style click **Line Style Swatch**. In the *Select Line Style* dialog you will select **Line Color, Line Width,** and **Line Style** and click **OK.** On the *Edit Well Header Annotation Attributes* dialog click **OK**.



Note:

Callout lines are the lines that appeared in *Map* view when, using the Move Well Annotation feature, you moved your Common Well Name. They connect the Well Annotation to the appropriate well.

Exercise 1.5: Bubble Mapping

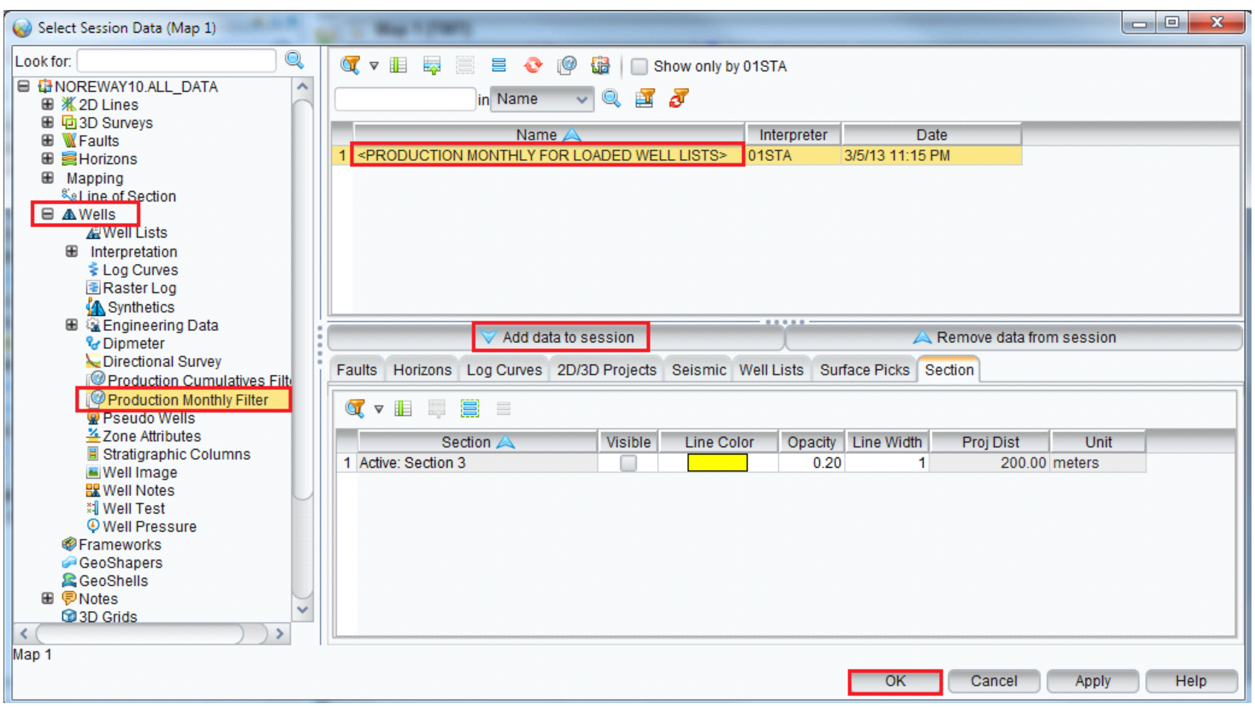
Bubble mapping lets you represent production values or point sets as bubbles in the view. Bubbles portray independent attributes, expressed as size, color, and Z Values (in *Cube* view).They can be displayed in both time and depth domains.

Use bubble displays to show formation production, where larger bubbles indicate greater production. You may also use color to show the amount of production. For example, you may choose to size bubbles by oil production and to use a color map for gas production, where wells with light green bubbles have produced small amounts of gas and dark green bubbles have outstanding gas production.

> **Note:**
>
> Only one bubble is allowed per zone in a wellbore.

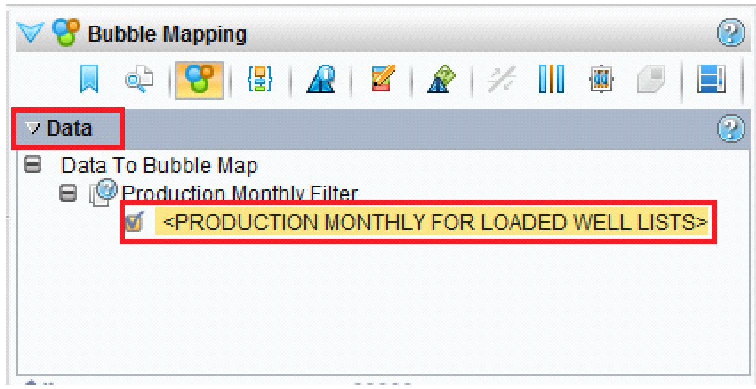
Bubble Mapping is available from the *Tools* task pane in *Map*, *Section*, *Correlation*, and *Cube* views.

1. In the left panel of the *Select Session Data* dialog, select **Wells > Production Monthly Filter <PRODUCTION MONTHLY FOR LOADED WELL LISTS>.** Click **Add data to session**. Click **OK**.

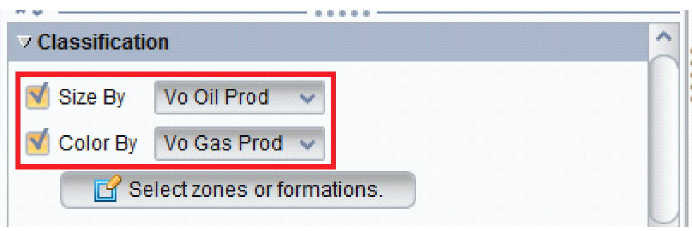


2. On the *Tools* task pane, click the **Bubble Mapping** () icon.

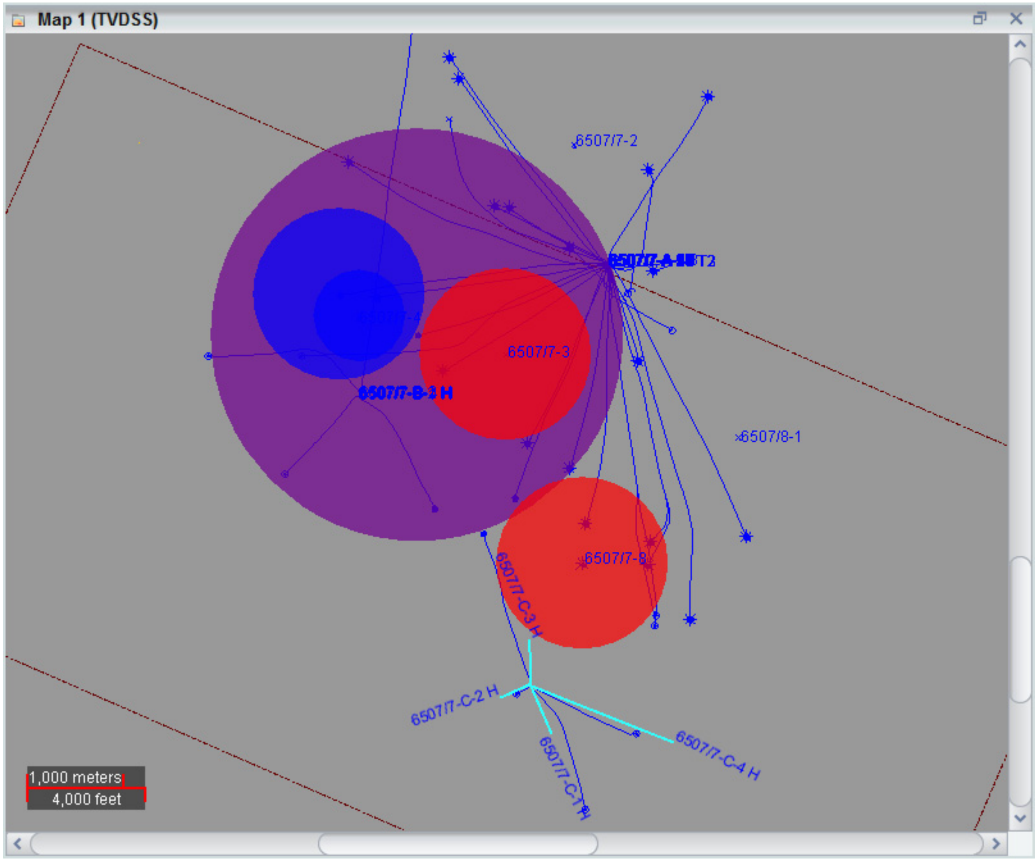
3. On the *Data* panel of the *Bubble Mapping* panel click **<PRODUCTION MONTHLY FOR LOADED WELL LISTS>**.



4. In the *Classification* panel, toggle on **Size By** and select **Vo Oil Prod** from the related pull-down menu. Then toggle on **Color by** and select **Vo Gas Prod** from the related pull-down menu.

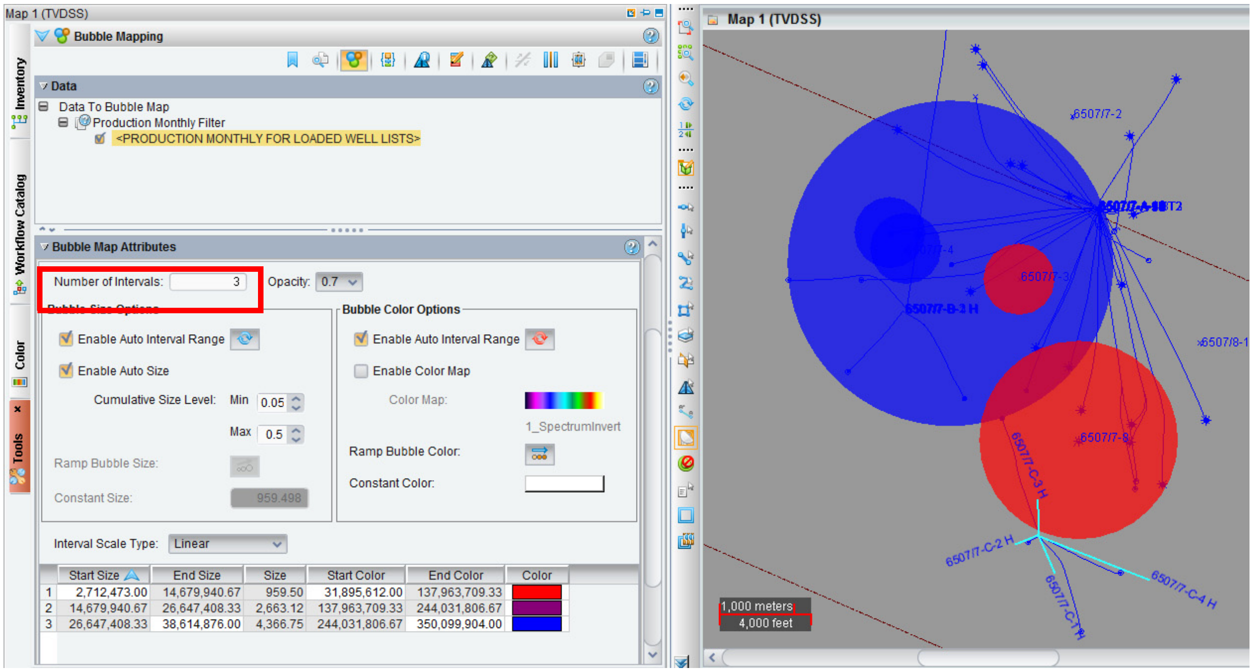


When you finish setting parameters in *Classification* panel your *Map* view will look like the following image.



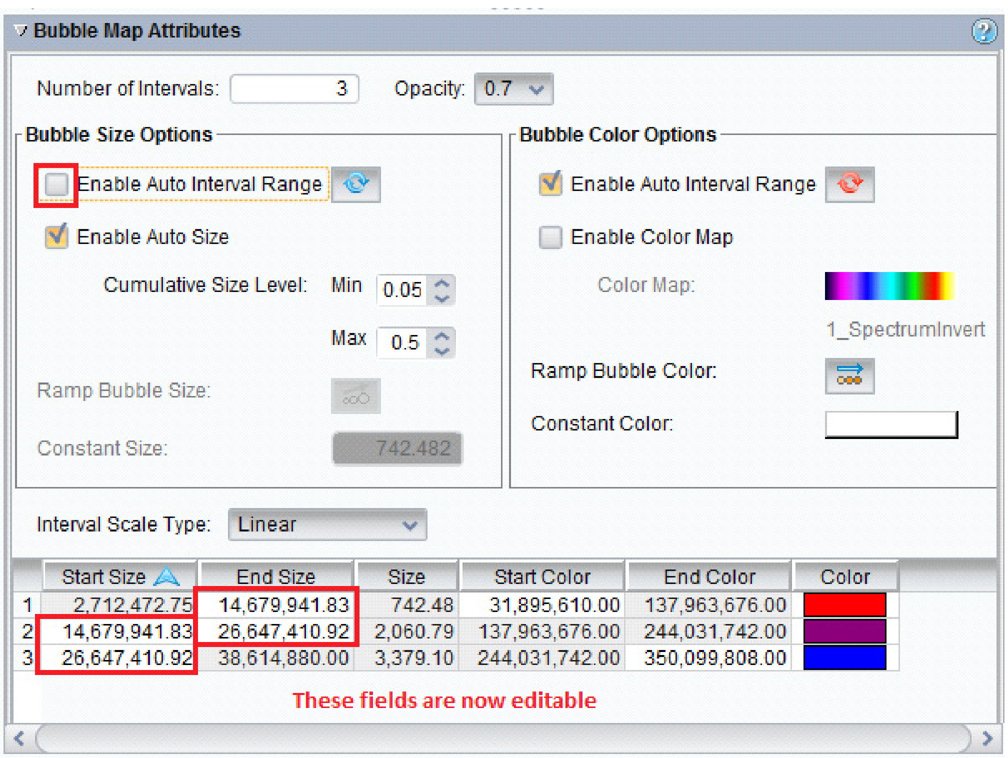
In the *Bubble Mapping* task pane the *Bubble Map Attributes* panel enables you to change attributes of bubble maps such as intervals, size, and color.

5. In the *Bubble Map Attributes* panel, change the Number of Intervals field to **“3”.** In the lower portion of this panel you will see that changes reflected in the table are immediately reflected in the *Map* view.

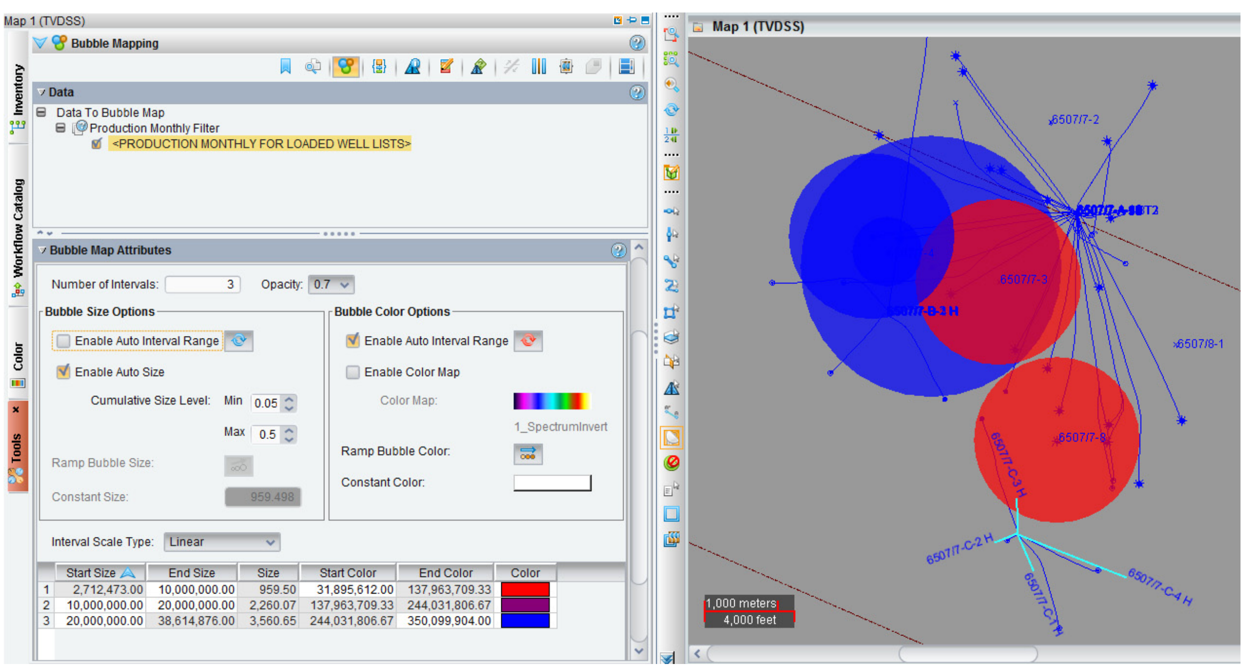


Compare this image with the image associated with the previous step to see the changes in the Bubble Map in *Map* view.

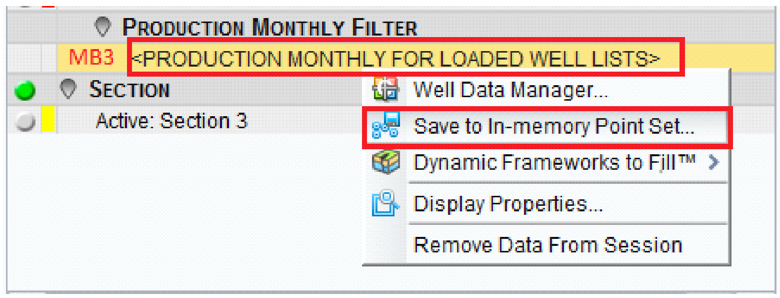
6. In the *Bubble Map Attributes* panel, toggle off **Enable Auto Interval Range**. You can now manually change the intermediate Start and End Sizes of the bubbles, but now the first Start size and the last End size are not editable.



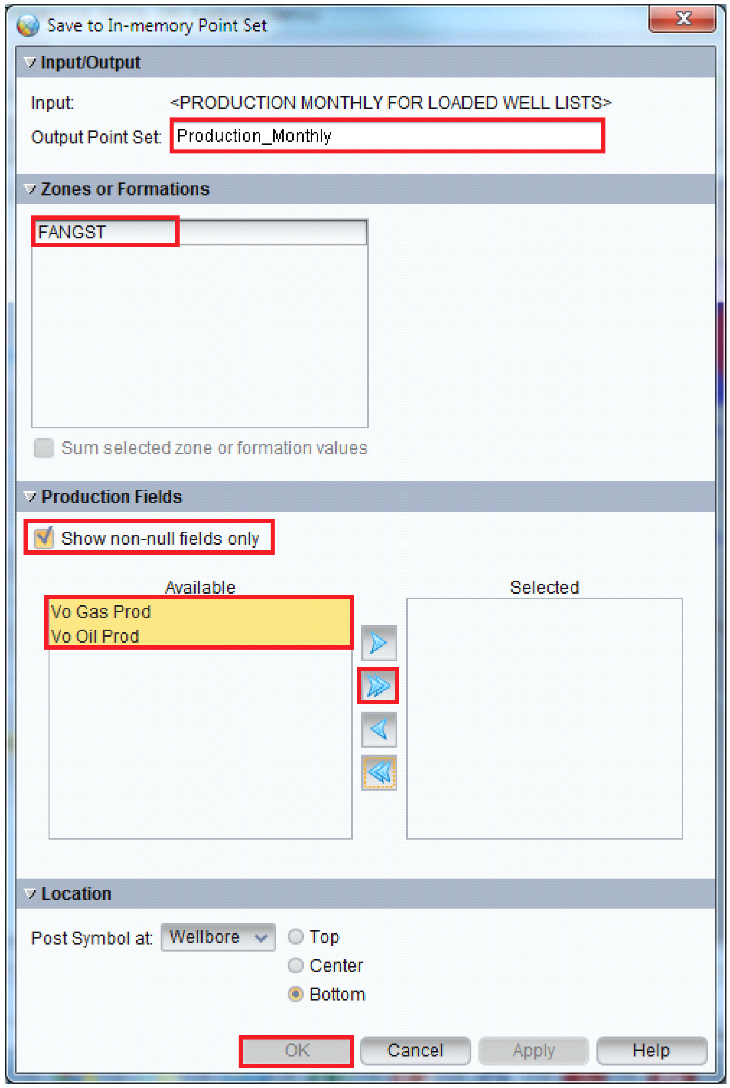
7. In the table below, change the **End Size** of the first row and **Start Size** of the second row to **"10,000,000".** In addition, change the **End Size** of the second row and **Start Size** of third row to **"20,000,000".** Your *Map* view will reflect the changes.



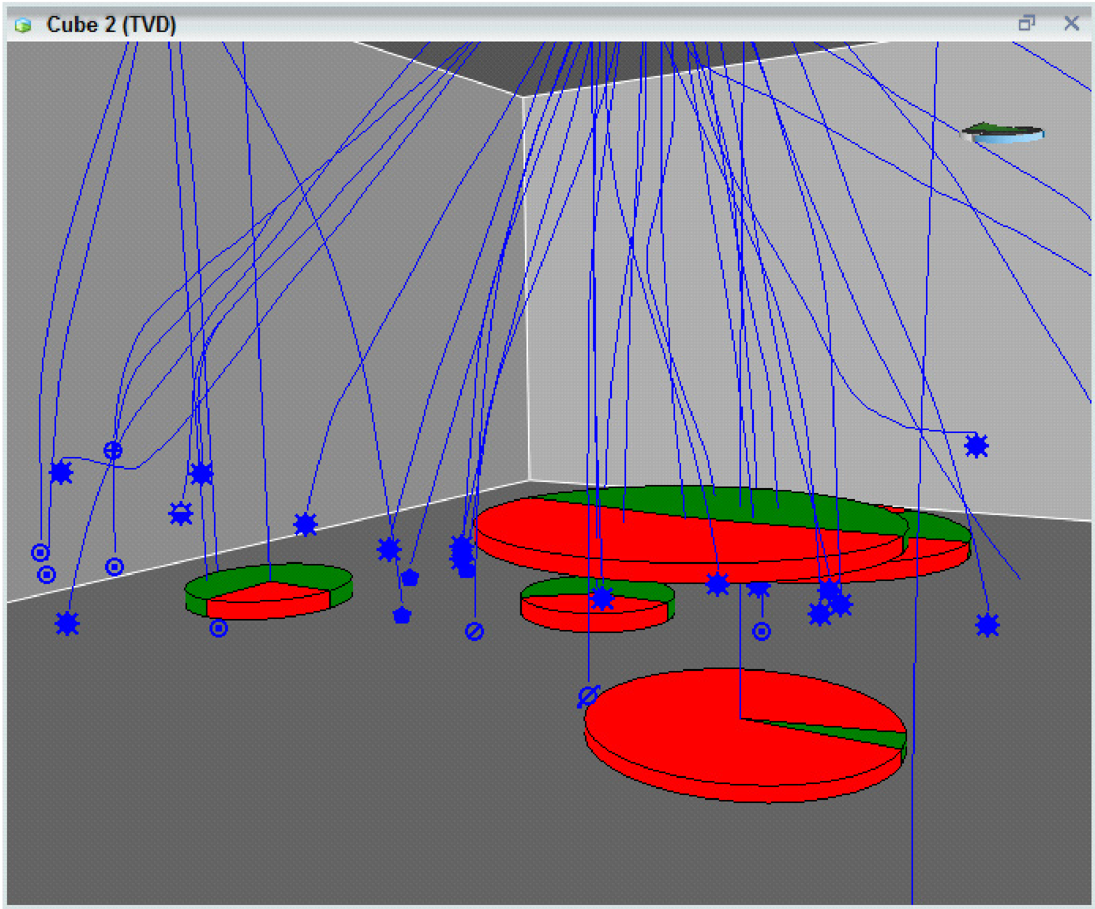
8. You can save the monthly production data as a point set. In the *Inventory* task pane, put your cursor on <**PRODUCTION MONTHLY FOR LOADED WELL ISTS >** and **MB3 > Save to In-memory Point Set...** This will open the *Save In-memory Point Set* dialog.



9. In the Output Point Set field, enter "**Production_Monthly".** In the *Zones and Formations* panel, click **FANGST.** In the *Productions Fields* panel, toggle on the **Show non-null fields only** and move **Vo Gas Prod** and **Vo Oil Prod** from the Available box to the Selected box. Click **OK.**

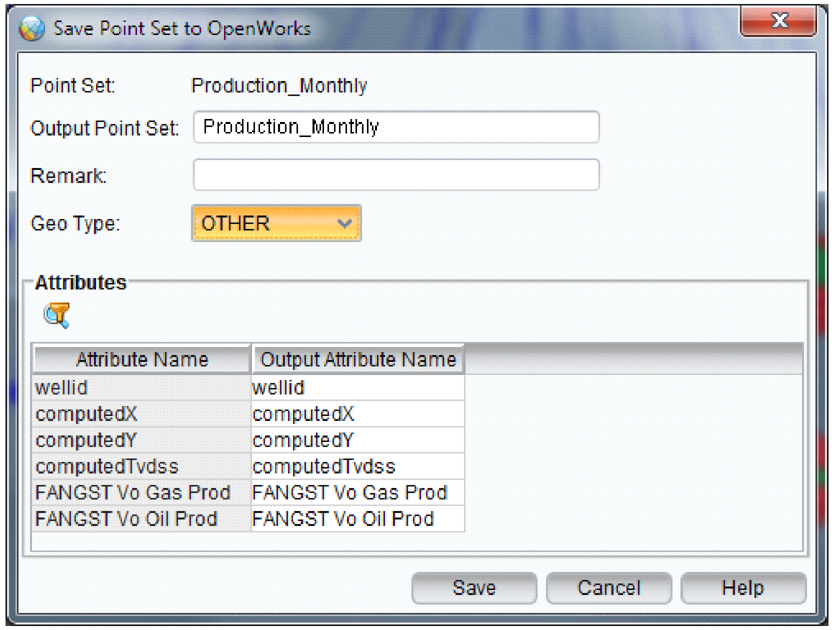

Save to In-memory Point Set
Input/Output
Input: <PRODUCTION MONTHLY FOR LOADED WELL LISTS>
Output Point Set: Production_Monthly
Zones or Formations
FANGST
Sum selected zone or formation values
Production Fields
Show non-null fields only
Available
Selected
Vo Gas Prod
Vo Oil Prod
Location
Post Symbol at: Wellbore
Top
Center
Bottom
OK
Cancel
Apply
Help

10. The new data type, Point Sets, is added to the *Inventory.* Activate the ***Cube* view** and display the **Production_Monthly** point set.

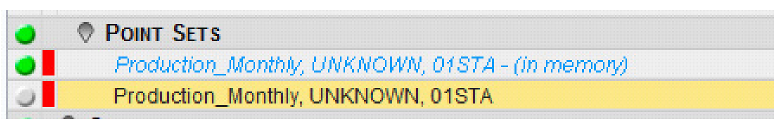


11. To save the point set data to OpenWorks, for use outside of the current session, highlight the point set name in *Inventory* and **MB3 > Save to OpenWorks**. The *Save Point Set to OpenWorks* dialog is displayed.

12. In the Output Point Set field of the *Save Point Set to OpenWorks* dialog enter "**Production_Monthly"** and click **Save.**

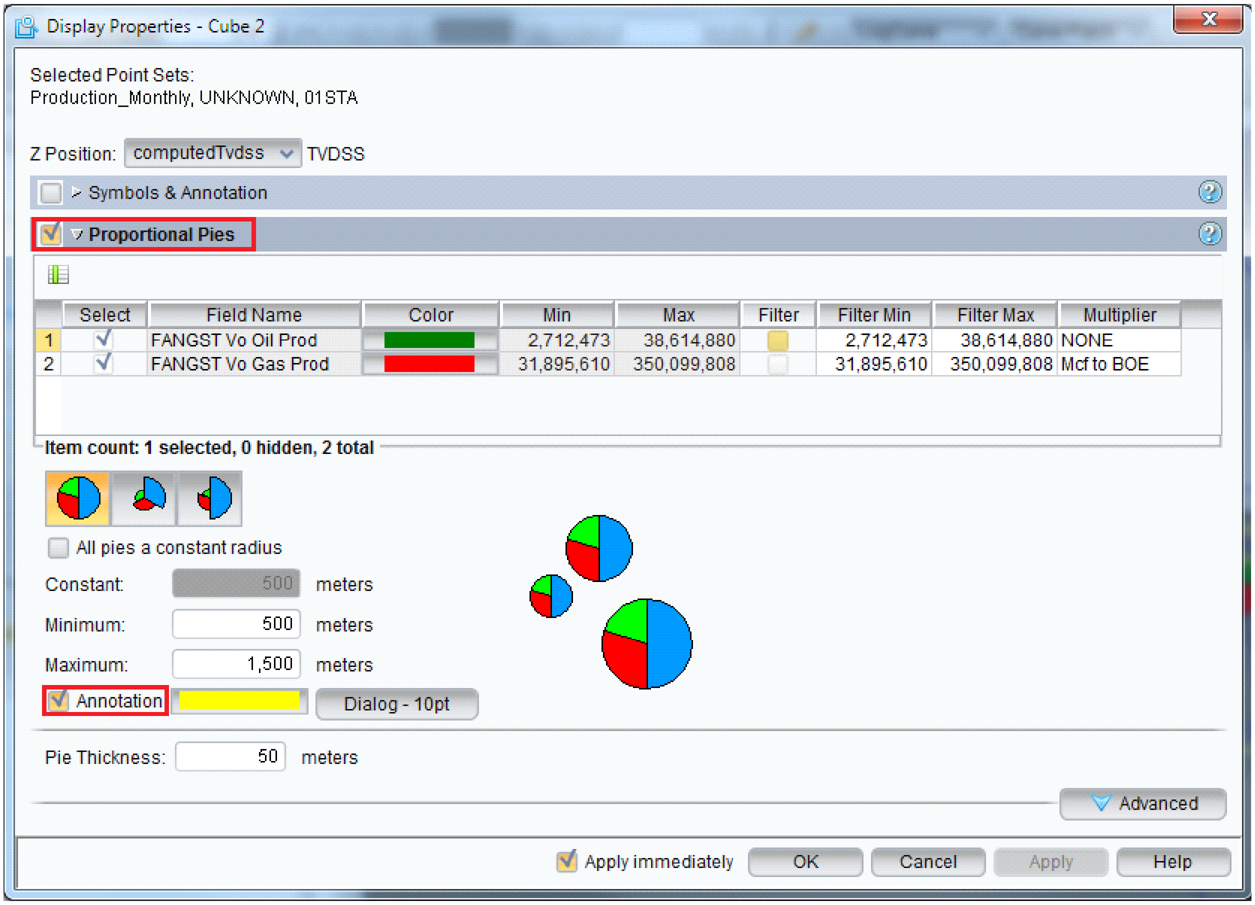


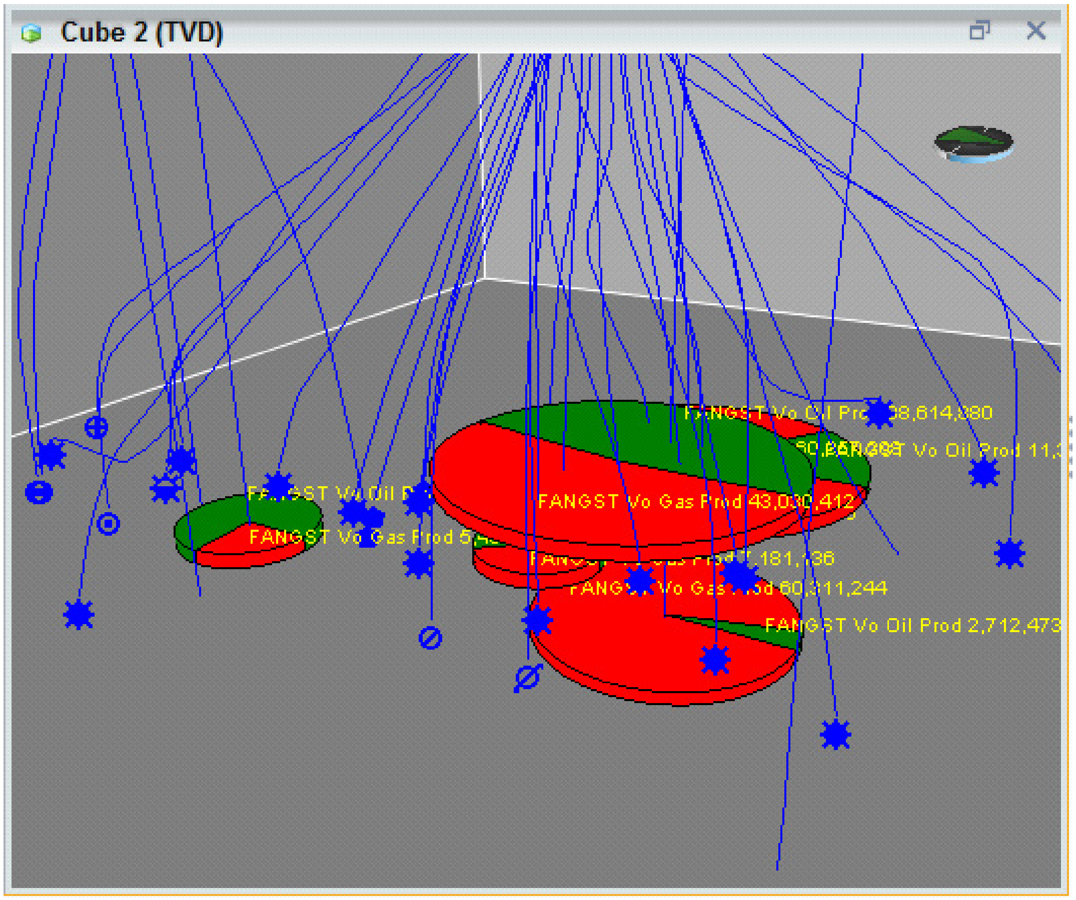
Now you have two point set files in *Inventory.* You can easily differentiate the two.



13. To remove the **Production_Monthly, UNKNOWN, 01STA - (in memory)** put your cursor on it in the *Inventory* and **MB3 > Remove Data From Session**.

14. In the *Display Properties* dialog, toggle on **Proportional Pies.** Click **Proportional Pies** to open the panel. Toggle on **Annotation**. Click **OK.**


Display Properties - Cube 2
Selected Point Sets:
Production_Monthly, UNKNOWN, 01STA
Z Position: computedTvdss TVDSS
Symbols & Annotation
Proportional Pies
Select Field Name Color Min Max Filter Filter Min Filter Max Multiplier
1 FANGST Vo Oil Prod 2,712,473 38,614,880 2,712,473 38,614,880 NONE
2 FANGST Vo Gas Prod 31,895,610 350,099,808 31,895,610 350,099,808 Mcf to BOE
Item count: 1 selected, 0 hidden, 2 total
All pies a constant radius
Constant: 500 meters
Minimum: 500 meters
Maximum: 1,500 meters
Annotation
Dialog - 10pt
Pie Thickness: 50 meters
Advanced
Apply immediately
OK
Cancel
Apply
Help



You have learned how to make custom well lists, how to display data along a wellbore in *Map* view, and how to display production data in *Cube* and *Map* view. These methods help you organize and evaluate your project data.

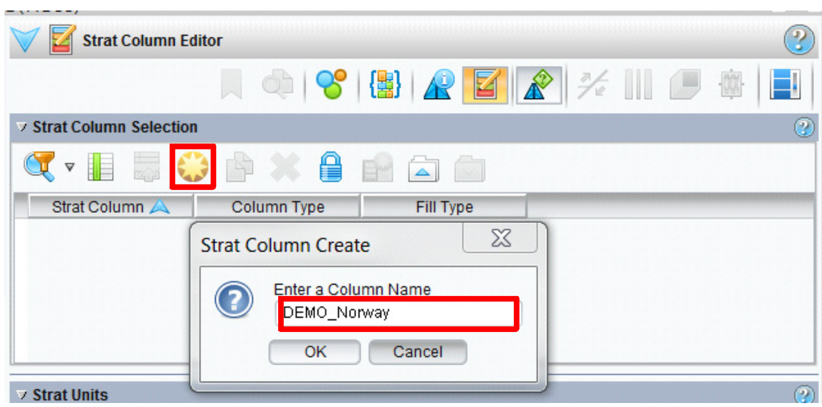
The rest of this chapter comprises Exercise 1.6, Creating a New Strat Column with a New Strat Unit, and Exercise 1.7, Visualizing GIS Data in DecisionSpace. These optional exercises demonstrate additional methods for evaluating your data.

Exercise 1.6 (Optional): Creating a New Strat Column with a New Strat Unit

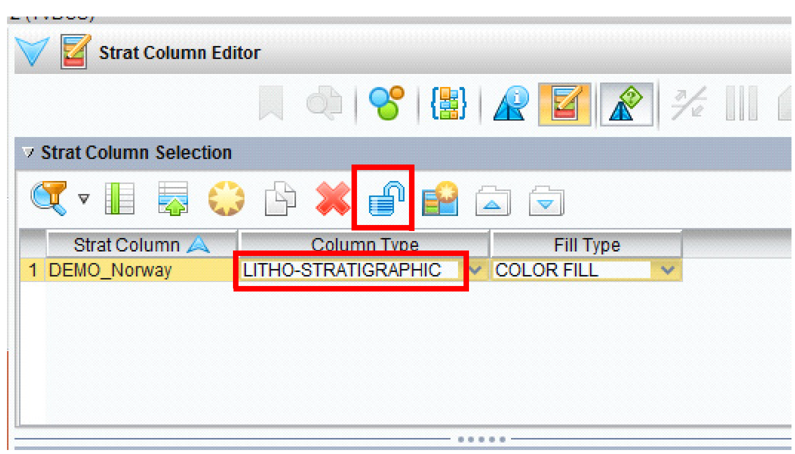
In this exercise, we will create a new stratigraphic column with the FANGST and BAAT formations as two parents. The GARN, NOT, and ILE formations are children of FANGST, while ROR, TILJE, and AARE formations are children of BAAT.

1. In the *Tools* task pane, select the **Strat Column Editor** icon to activate the *Strat Column Editor* task pane.

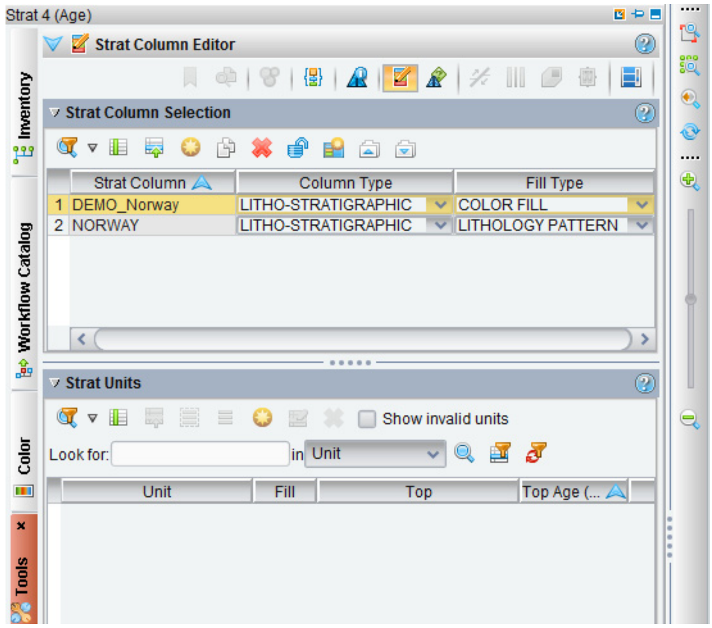
2. In the *Strat Column Selection* panel of the *Strat Column Editor,* click the **Create a new stratigraphic column** ( ) icon. When the *Strat Column Create* dialog appears, enter the name "**DEMO_Norway**" and click **OK**.



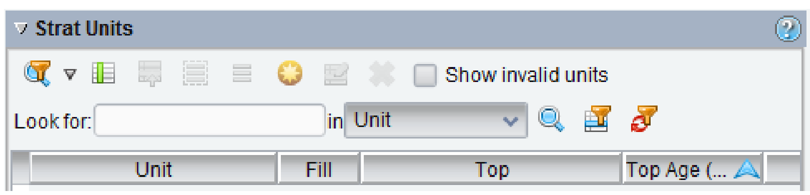
3. With DEMO_Norway highlighted, click the **Click to unlock table editing** icon. Change the Column Type to **LITHO-STRATIGRAPHIC** and retain the Fill Type as (the default) **COLOR FILL**.



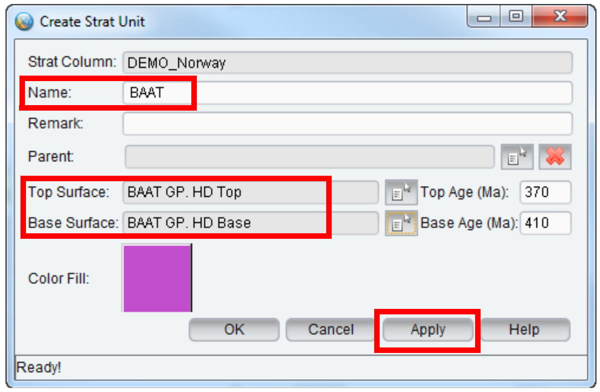
With DEMO_Norway highlighted in the *Strat Column Selection* panel of the *Strat Column Editor*, you will see that the *Strat Units* panel is empty. This is because you have not added any strat units to the newly created strat column.



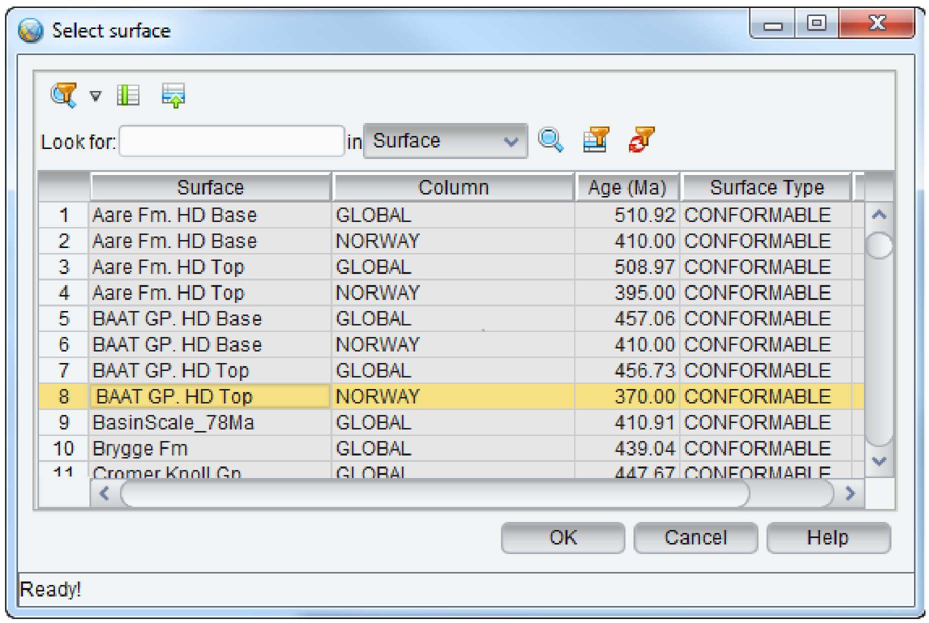
4. Click the **Create New Strat Unit** ( ) icon in the *Strat Units* panel.



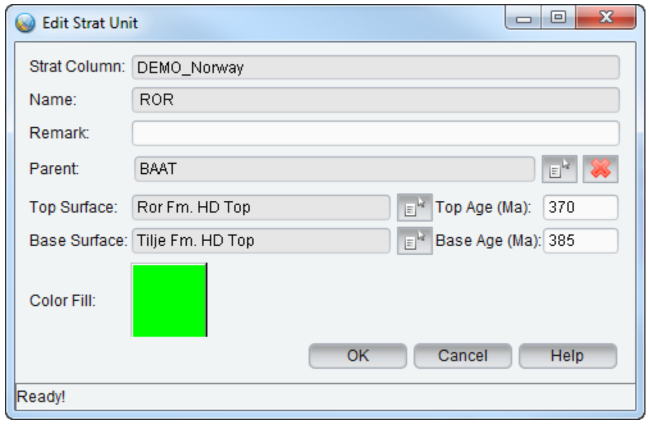
5. In the *Create Strat Unit* dialog, enter “**BAAT”** in the Name text field. To select the Top Surface**,** click the **Select surface from table** icon ( ). When the *Select surface* dialog opens, select **BAAT GP.HD TOP, NORWAY** and click **OK.** In a similar fashion select the Base Surface, **BAAT GP.HD BASE, NORWAY.** In the *Create Strat Unit* dialog, click **Apply** to add the new unit to the Strat Units list.

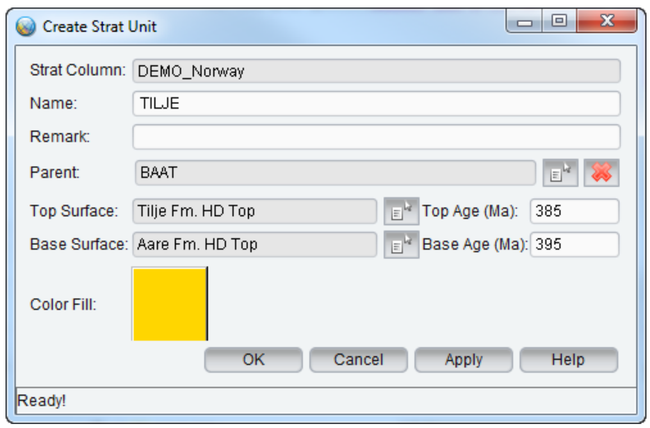


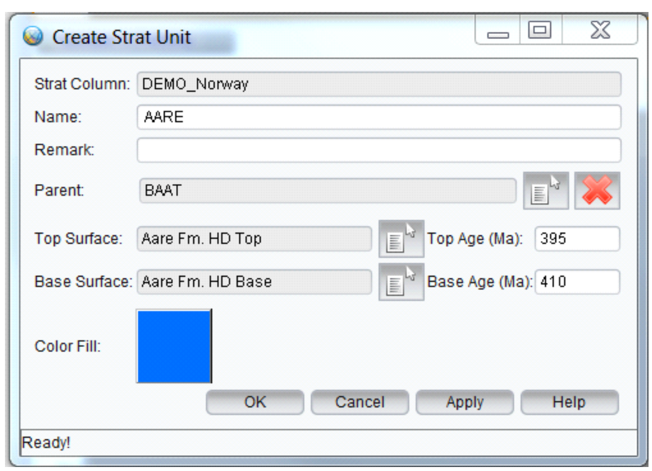
The *Select surface* dialog shows all of the options that are available when you select the Top Surface pull-down menu shown in the previous image.



6. Next add **ROR**, **TILJE,** and **AARE** as New Strat Units, as in the following images. Ensure that all Surfaces selected are associated with Column NORWAY, not GLOBAL. The NORWAY surfaces will have the correct Age in the *Select Surface* dialog.

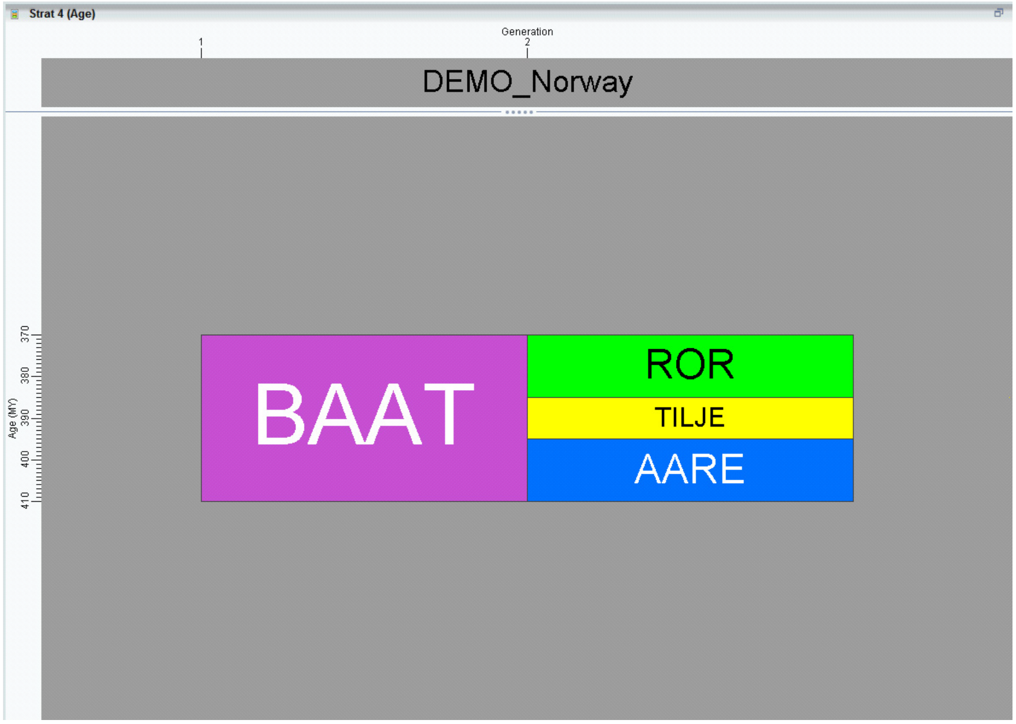




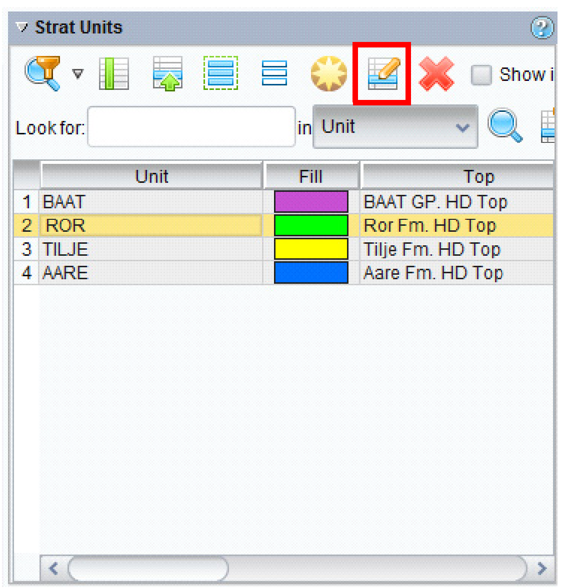


7. Click **OK** to close the *Create Strat Unit* dialog.

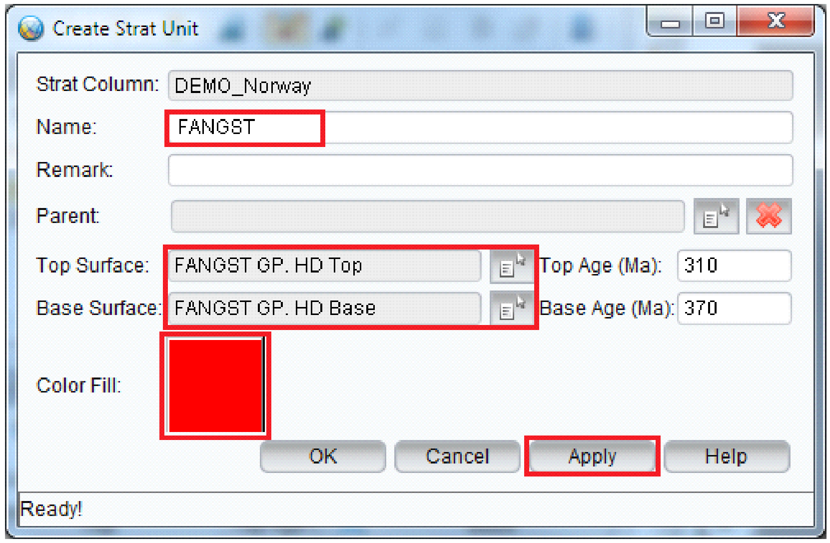
The *Strat Column* view is updated, as shown below.



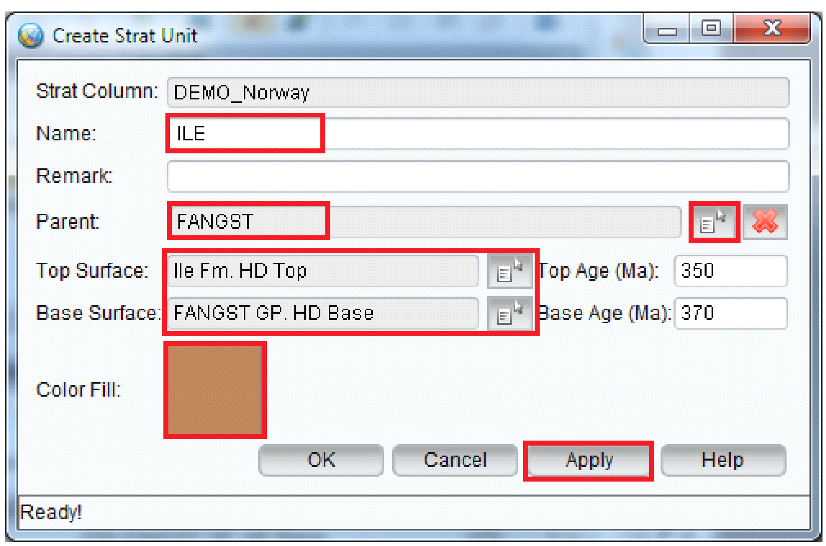
8. To change any of the *Strat Units* parameters, click the **Edit** () icon. Click **OK** to close the dialog.

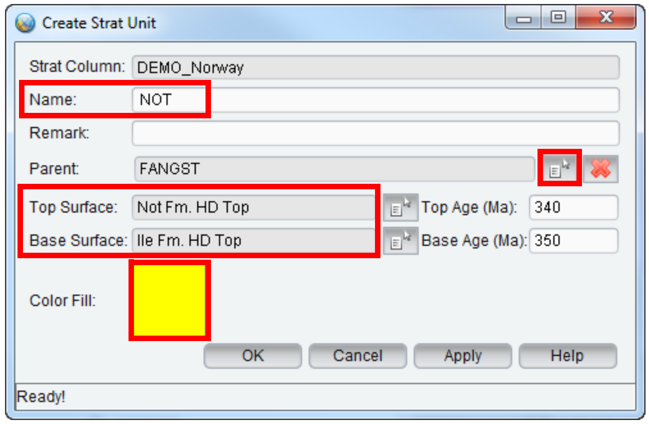


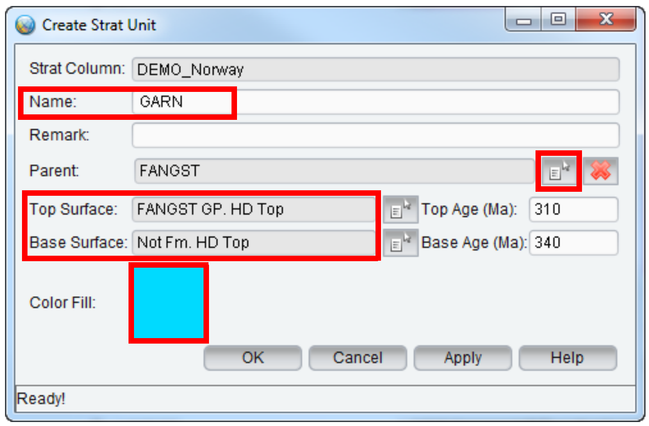
9. Click the **Create New Strat Unit** ( ) icon, and in the *Create Strat Unit* dialog, enter “**FANGST”** in the Name: text field. To select the Top Surface**,** click the **Select surface from table** icon ( ). When the *Select surface* dialog opens, select **FANGST GP.HD TOP, NORWAY** and click **OK.** In a similar fashion select the Base Surface, **FANGST GP.HD BASE, NORWAY.** Click **Apply.**



10. Next add **GARN, NOT,** and **ILE** as new Strat Units, as in the following images. Ensure that all surfaces selected are associated with Column NORWAY, not GLOBAL. The NORWAY surfaces will have the correct age in the *Select Surface* dialog. Click **Apply**.

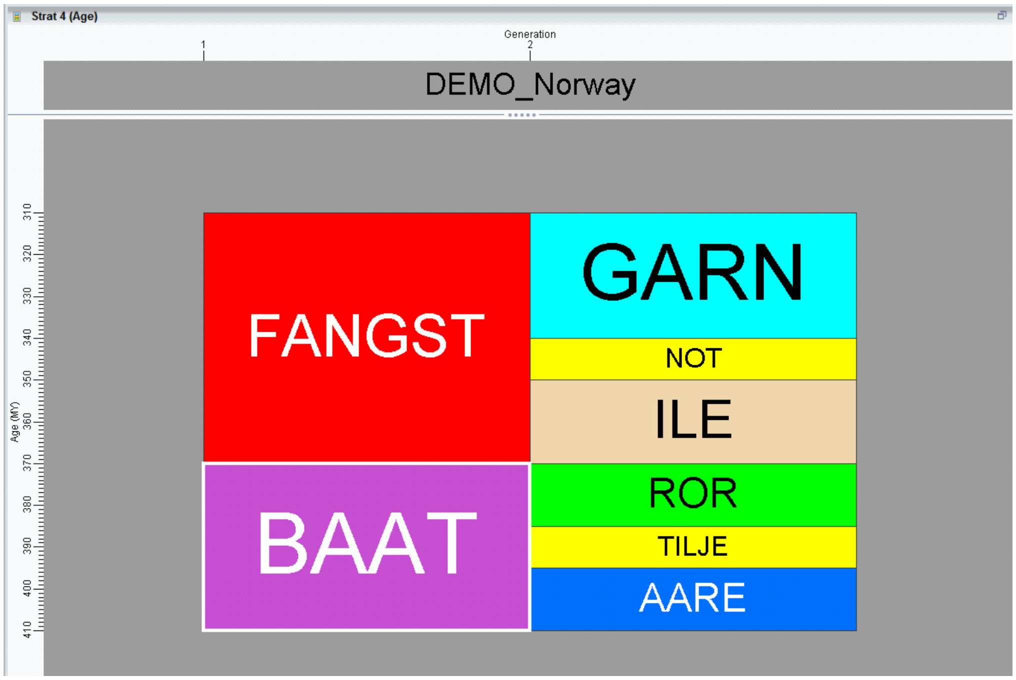






11. Click **Cancel** in the *Edit Strat Unit* dialog to close the window when you are finished.

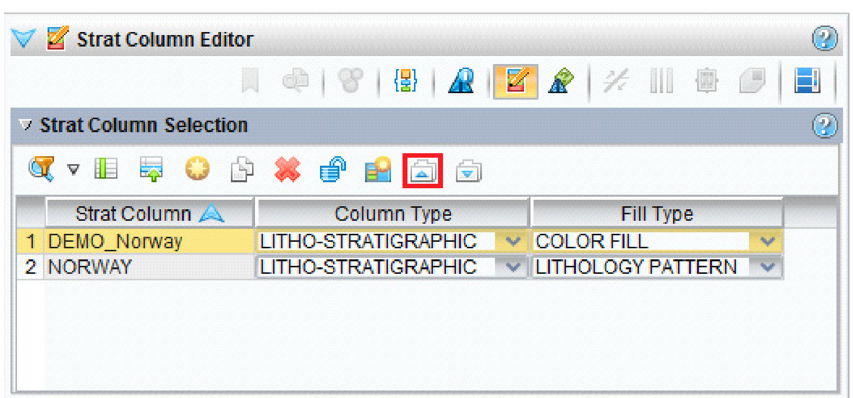
The completed stratigraphic column is updated in the *Strat Column* view.



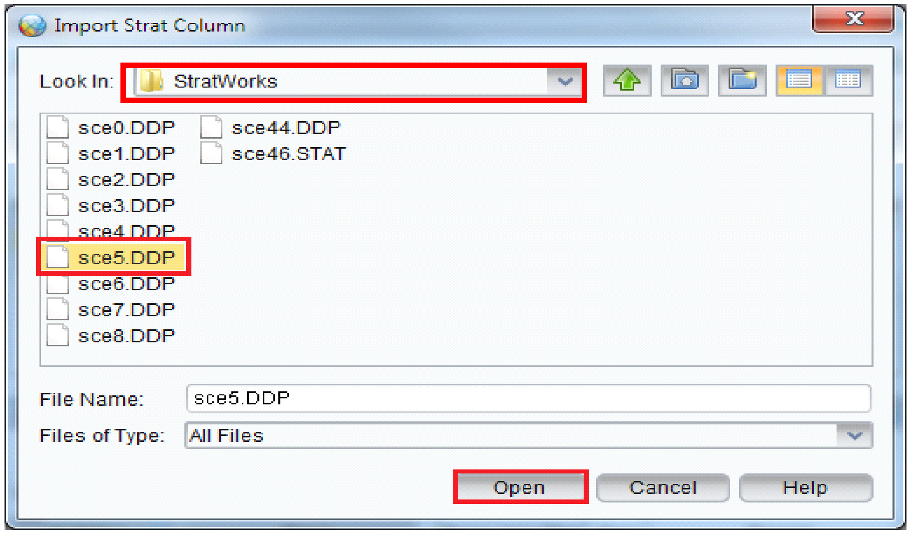
Importing a Stratigraphic Column

You can import a stratigraphic column into your project from another project or a third party (as long as that third party column contains a strat unit, top, base, parent, color, lithology pattern, surface, and age). Alternatively, you can export a stratigraphic column from your project to a strat column (.sce) or text (.txt) file format for use in another project. Both strat column (.sce) and text (.txt) file formats can be imported.

12. To import, click the **Import Strat Column** ( ) icon at the top of the *Strat Column Selection* panel**.**



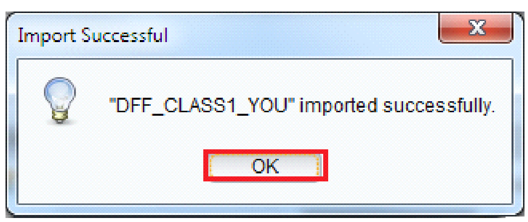
13. In *the Import Strat Column* dialog, navigate to **.../OW_PROJ_DATA/NORWAY/StratWorks,** where the stratigraphic column is located. Select the file named **sce5.DDP** and click **Open**.

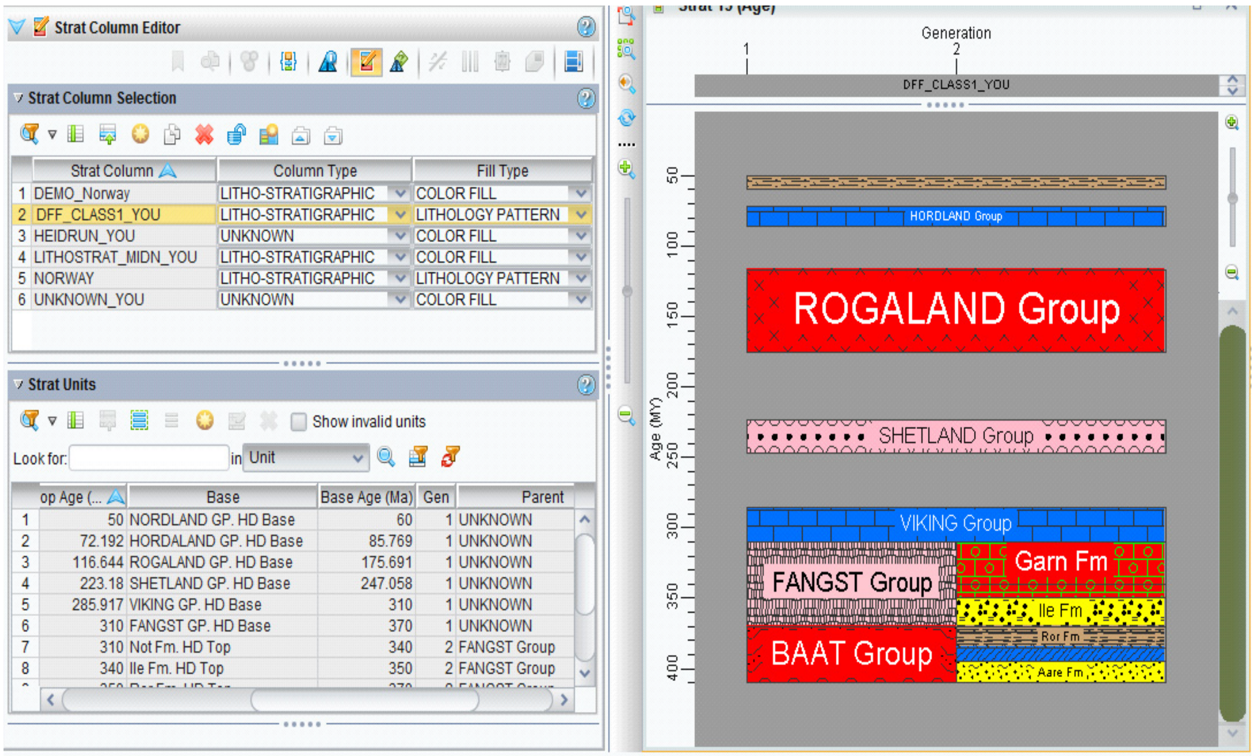


14. In the Strat Column Name: field of the *Input* dialog, change the default text to the following and click **OK.**

- DFF_CLASS1 to **DFF_CLASS1_YOU**
- UNKNOWN to **UNKNOWN_YOU**
- HEIDRUN to **HEIDRUN_YOU**
- LITHOSTRAT_MIDN to **LITHOSTRAT_MIDN_YOU**

15. When you finish with the last *Input* dialog, an *Import Successful* window will be displayed. Click **OK.** You will see that all of the imported Stratigraphic Columns are now listed in the *Strat Column Editor* task pane in the *Strat Column Selection* panel.





16. To export a stratigraphic column, select **DFF_CLASS1_YOU**, then click the **Export Strat Column** ( ) icon at the top of the *Strat Column* panel. In the *Export Strat Column* dialog, navigate to the folder where you want to save the stratigraphic column. You can keep the default name or rename it in the **File Name** text field.

17. Select either **Strat Column (.sce)** or **Text (.txt)** as the file type, then click **Save** to export the file.

Exercise 1.7 (Optional): Visualizing GIS Data in DecisionSpace

DecisionSpace GIS allows you to manage Geographic Information System (GIS) data in the context of DecisionSpace Geosciences and OpenWorks. The tool uses the ArcGIS Engine Runtime from Environmental Systems Research Institute, Inc. (ESRI) to manage the GIS data.

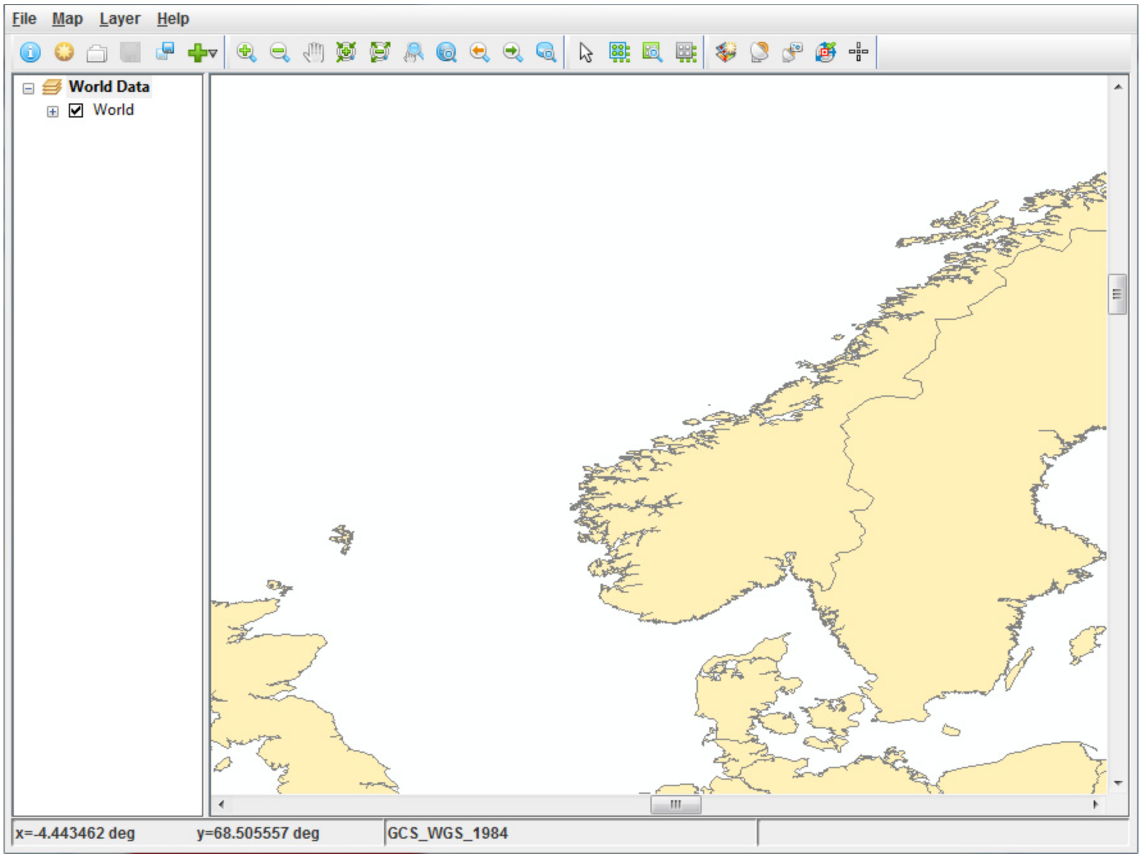
DecisionSpace GIS allows you to perform the following tasks in GIS view:

- Manage GIS data inside and outside the boundaries of a particular OpenWorks project.
- Spatialize OpenWorks data, save it to a shape file, and display it.
- Select and view GIS data such as shapefiles, image files, and layers.
- Display the data from geodatabases such as SDE and file geodatabases, and connect and display the data from GIS Servers such as ArcGIS, ArcIMS, and WMS.
- Report on GIS data in a data store.
- Use cursor tracking between the GIS view and the DecisionSpace software views.
- Send Map files to the DecisionSpace software.
- Send a message (via the Pointing Dispatcher™ service) to DecisionSpace software applications to load and display certain well data, 2D lines, and 3D survey data.
- Export shapefiles (.shp) with the desired projection.
- Export data into the .gdb format.

Note:

When the DecisionSpace GIS module is selected for a DecisionSpace session, you will be able to load and display ESRI Map documents (.mxd), shapefiles (.shp), image files, and so forth, directly into the session through the DecisionSpace Software data selector. Moreover, you can directly load and display the data from SDE databases.

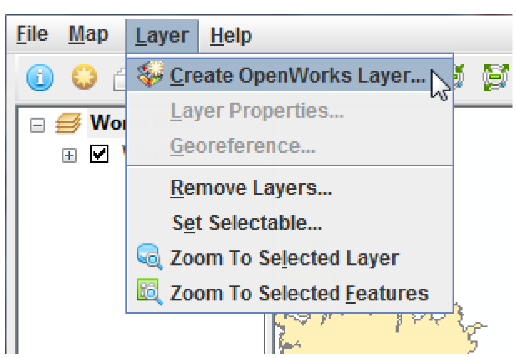
1. On the main menu, select **Tools > GIS** to launch *DecisionSpace GIS.*



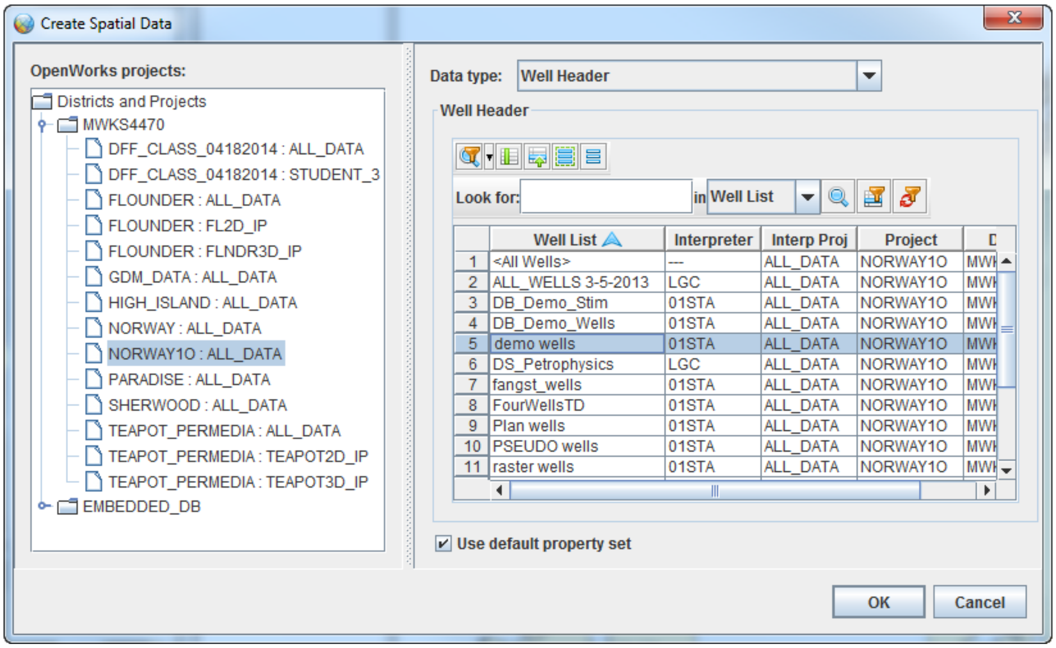
2. In the *DecisionSpace GIS* window, on the main icon bar, click the **CartoSnap** icon ( ).

> **Note:**
>
> CartoSnap allows you to set the coordinate reference system (CRS) in the map to the CRS of the OpenWorks project selected in the DecisionSpace software.

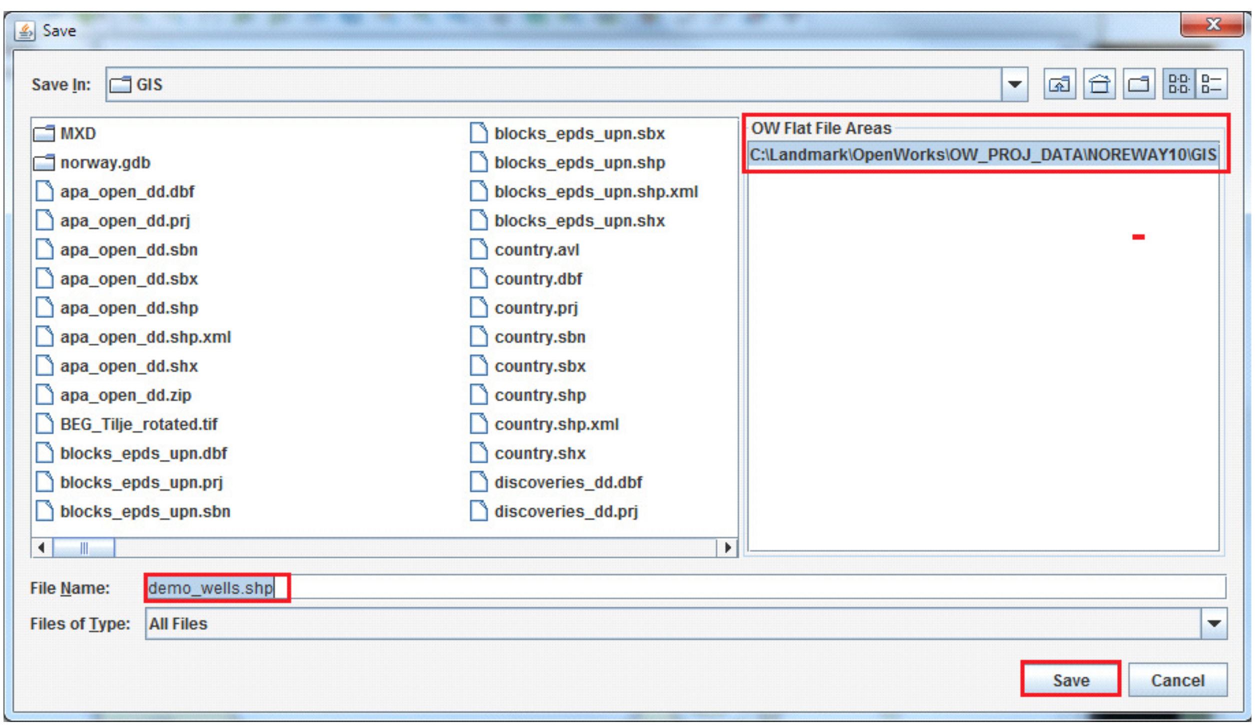
3. On the *DecisionSpace GIS* window menu bar, click **Layer > Create OpenWorks Layer.**



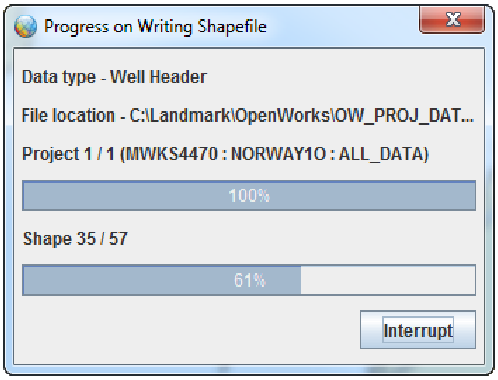
4. In the *OpenWorks projects* panel, select **NORWAY10: ALL_DATA.** In the *Well Header* panel, select **Well Header** in the Data type: pull-down menu. Then in the Well List column, select **demo wells** and click **OK**.



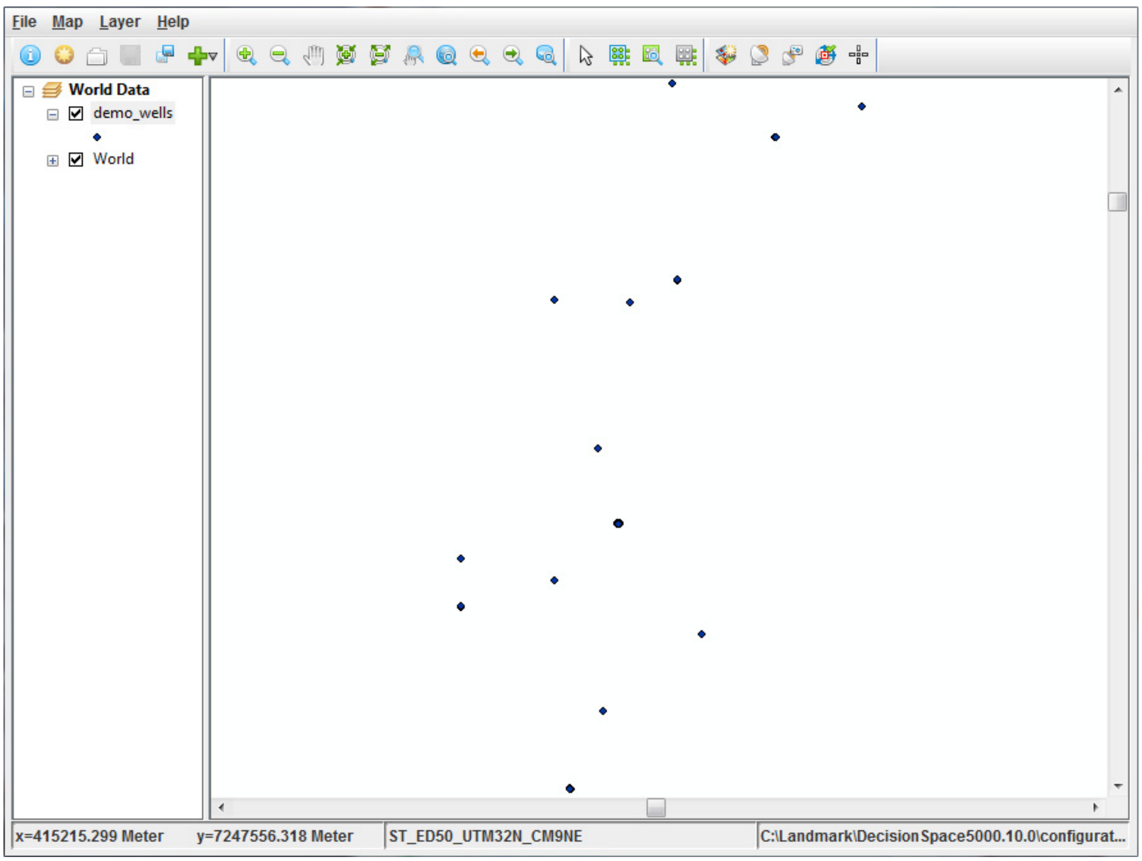
5. The *Save* dialog opens. In the *OW Flat File Areas* panel, accept the default (**.../OW_PROJ_DATA/NORWAY10/GIS**), and in the File Name field, enter **"demo_wells.shp".** Click **Save.**



6. The *Progress on Writing Shapefile* window displays.

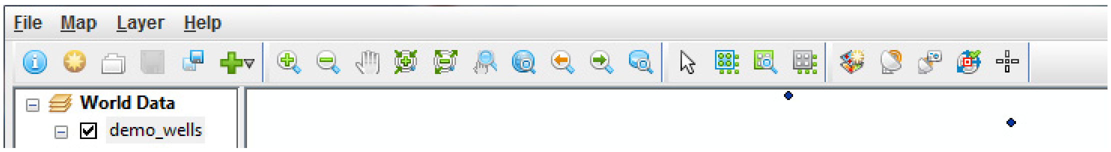


7. In the DecisionSpace GIS window, note that demo wells are now in the *Inventory*. Put your cursor over demo_wells and **MB3 > Zoom to Selected Layer**.

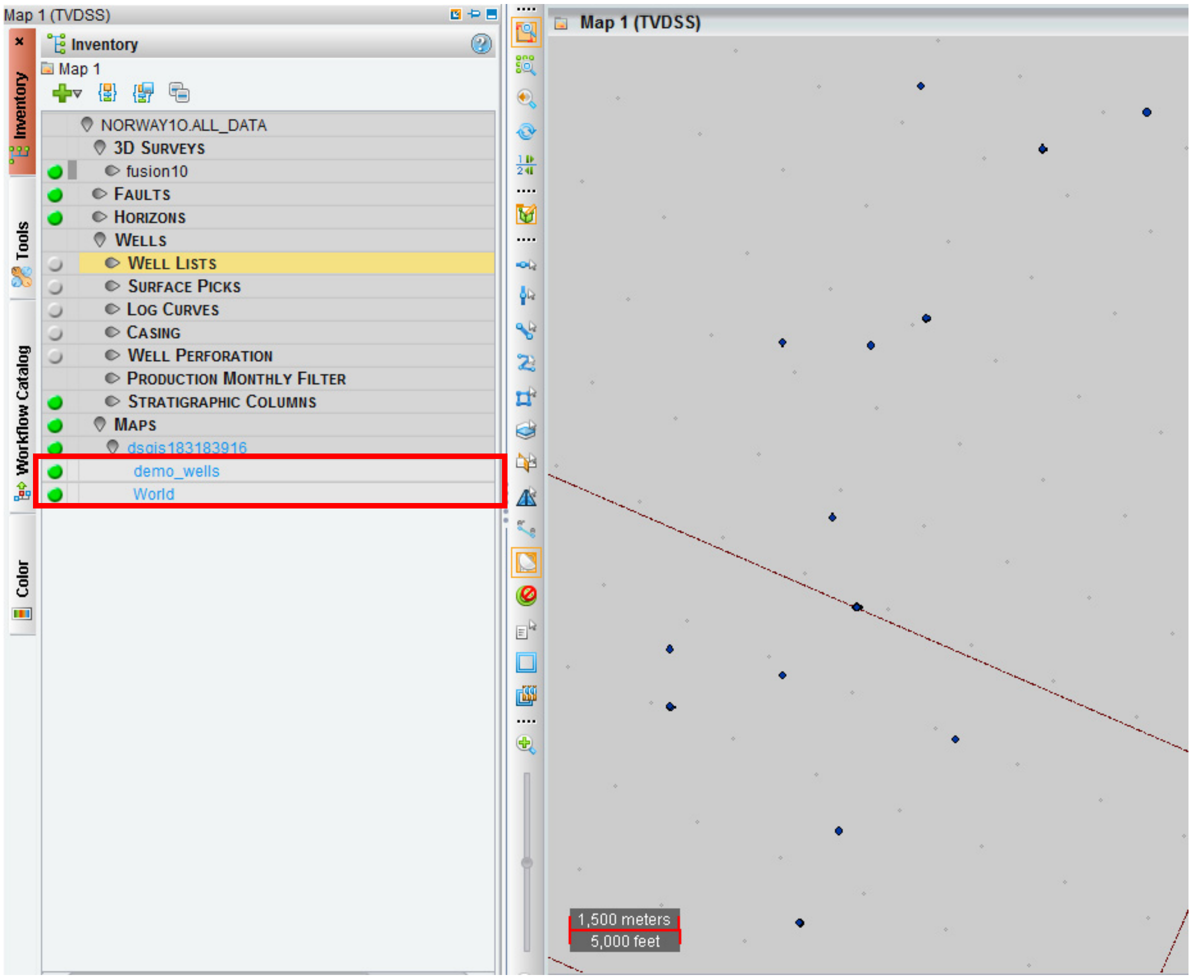


> **Note:**
>
> Zoom into and toggle on the items in the DecisionSpace GIS window, according to what you would like to see in DecisionSpace Geosciences. Items that are toggled off or are outside of the current view will not be sent to *Map* view with the Broadcast.

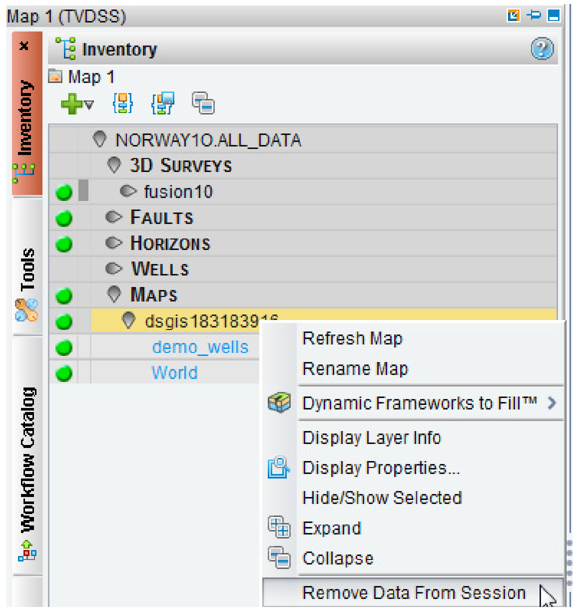
8. Make sure *Map* view is active. In the *DecisionSpace GIS* window, click the **Broadcast Map Document** ( ) icon. This will send **demo_wells** to the *Map* view of *DecisionSpace*.



The well list, demo_wells, and the map, World, are shown in the *Inventory* panel under Maps.

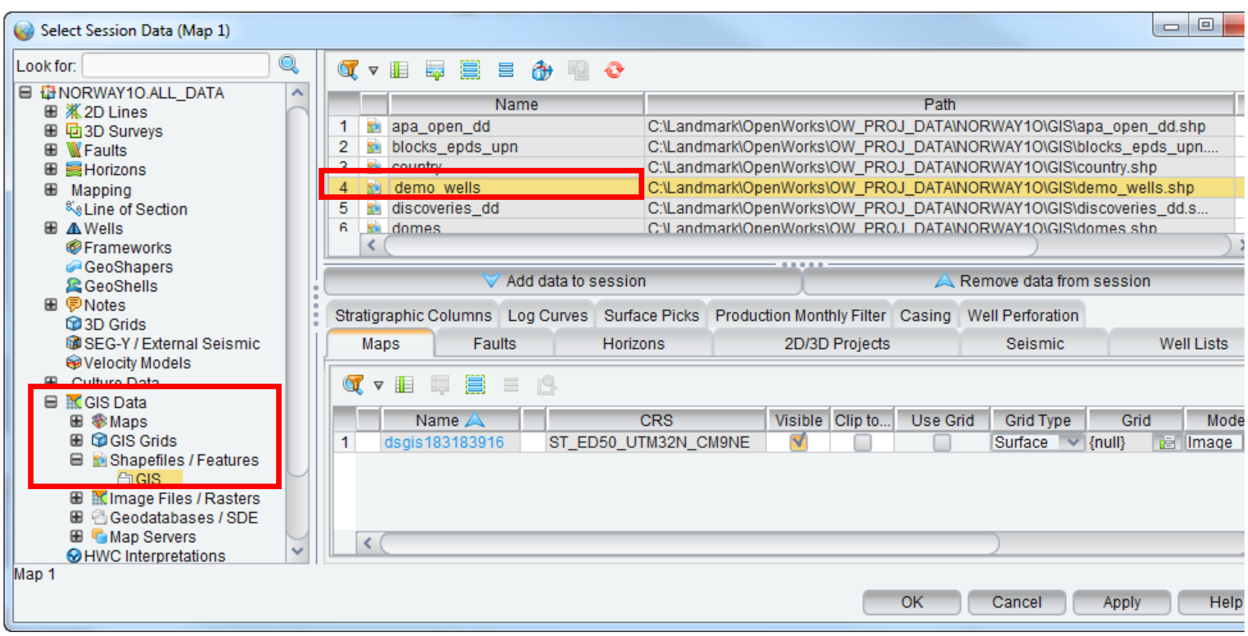


9. You can also add Shapefiles directly from the *Select Session Data* dialog. First, remove the GIS data from the *Inventory* task pane. With your cursor on **dsgis#########**, **MB3 > Remove Data From Session.**

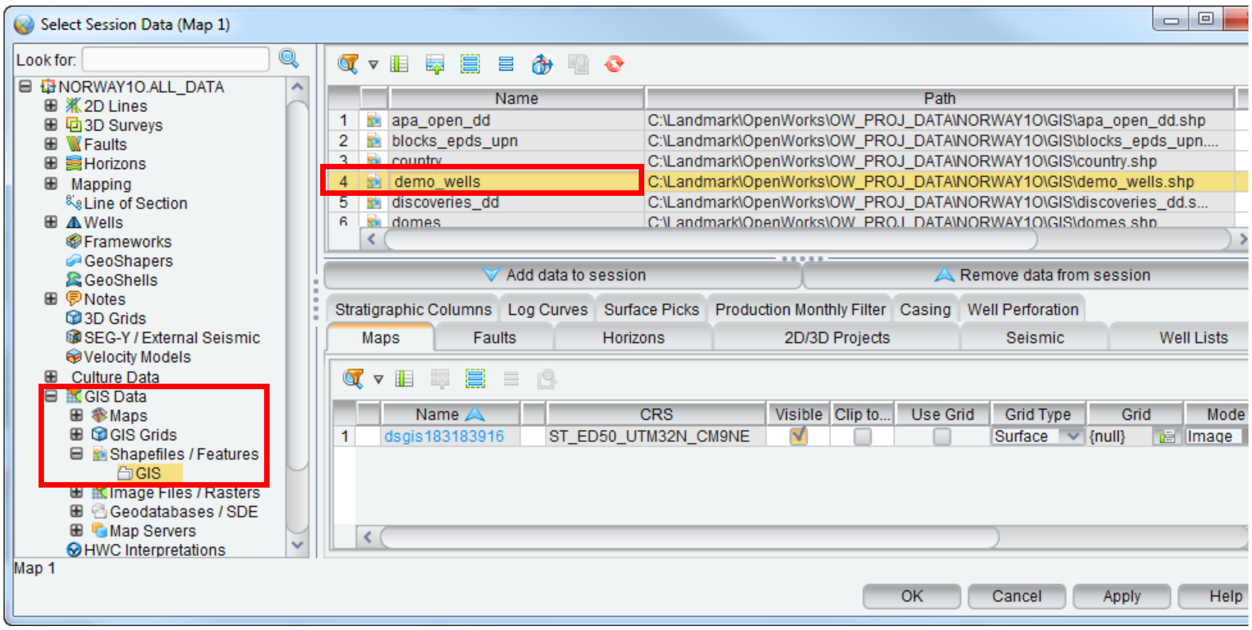


10. In the main toolbar, click the **Select Session Data** () icon.

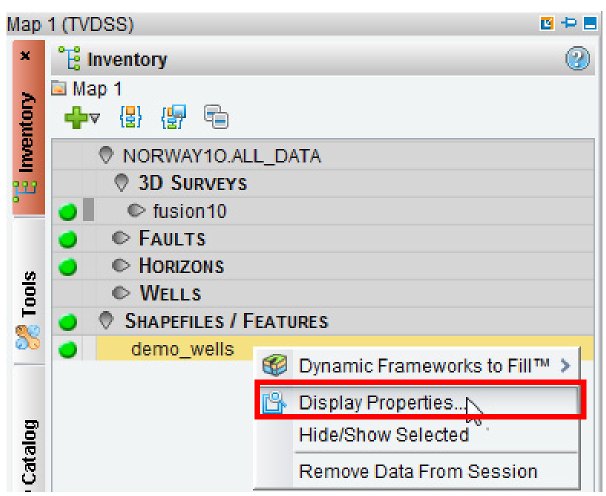
11. In the left panel of the *Select Session Data* dialog, select **GIS Data > Shape Files/Features > GIS,** then in the right panel of the dialog, select **demo_wells** click **Add data to session.** Click **OK**.



> **Note:**
>
> This demo_wells.shp is the same shape file that you created in Step 6.

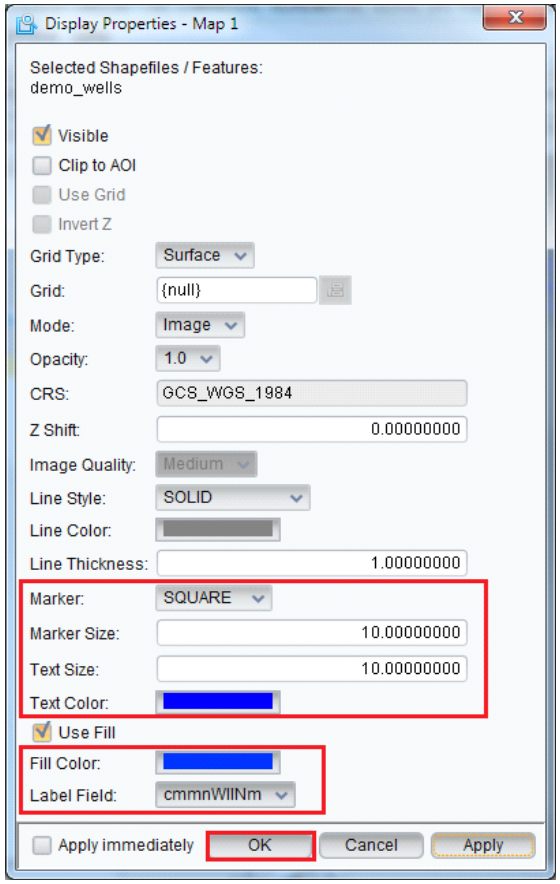


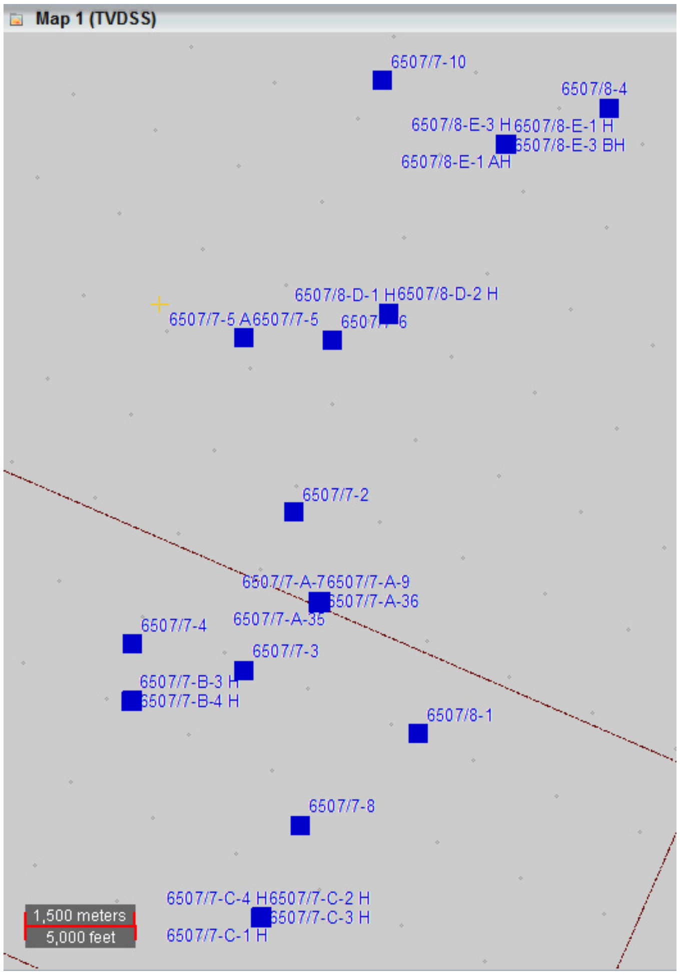
12. In the *Inventory* task pane, put your cursor on **Shapefiles/Features > demo wells** and **MB3 > Display Properties...**



13. On the Marker: pull-down menu in the *Display Properties* dialog, select **SQUARE**. In the Marker Size text field enter **"10"** and in the **Text Size** field enter **"10"**. Select Text Color **blue** and Fill Color **blue.** In the Label

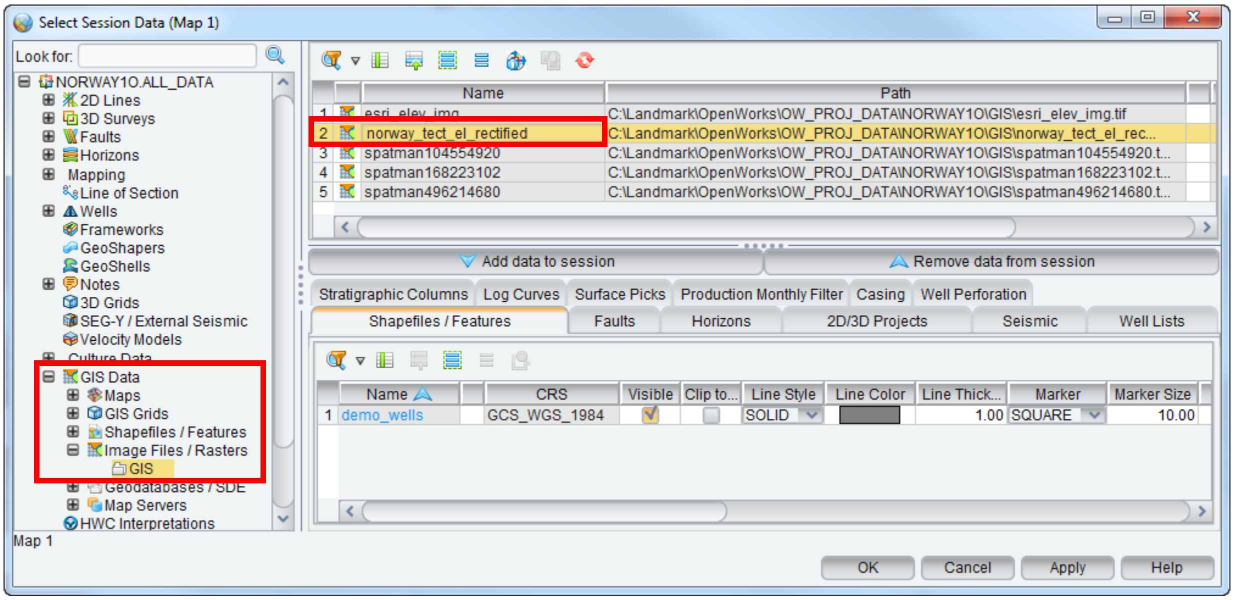
Field pull-down menu, select **cmmnWllNm** (Common Well Name). Click **OK.**



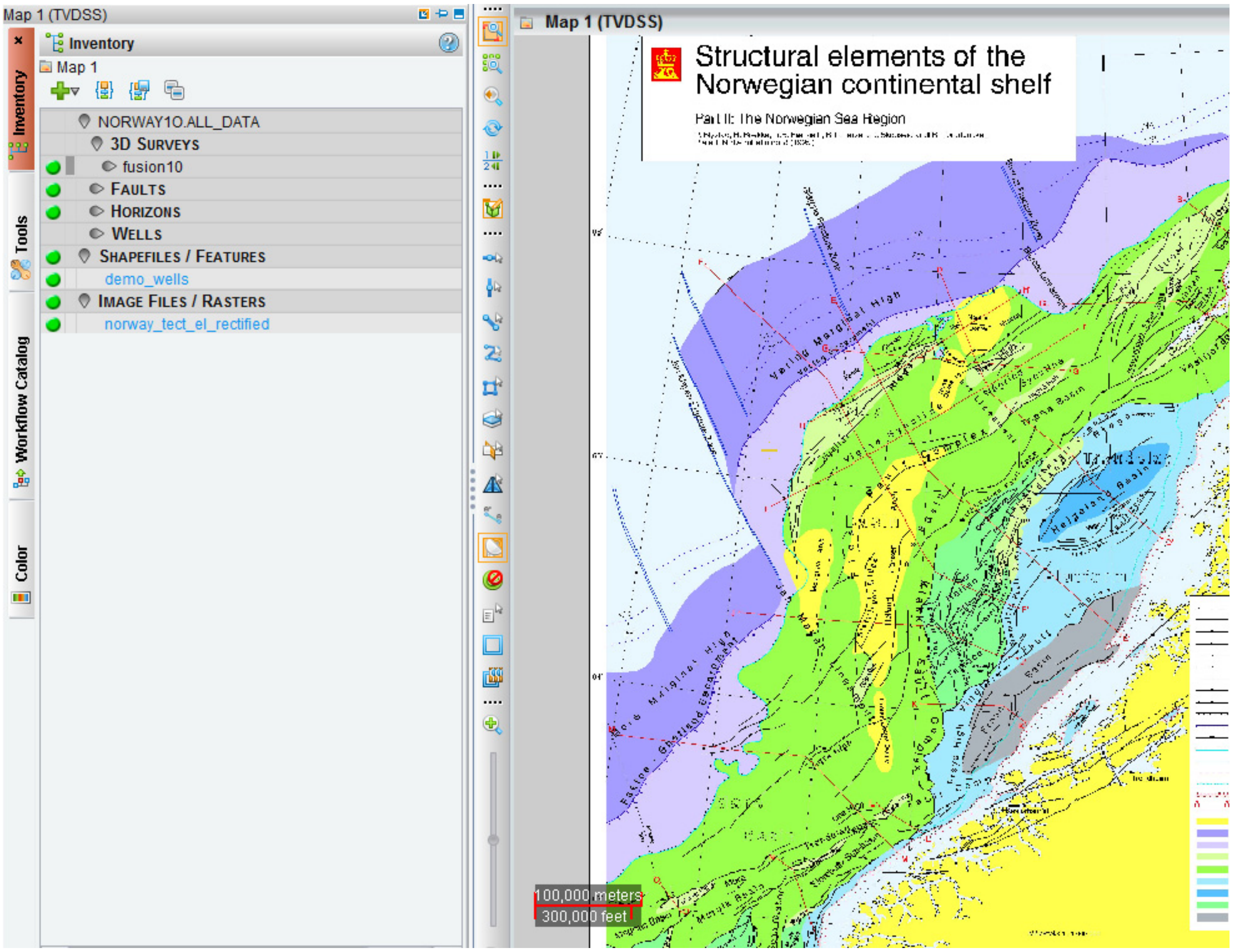


14. In the main toolbar, click the **Select Session Data** () icon.

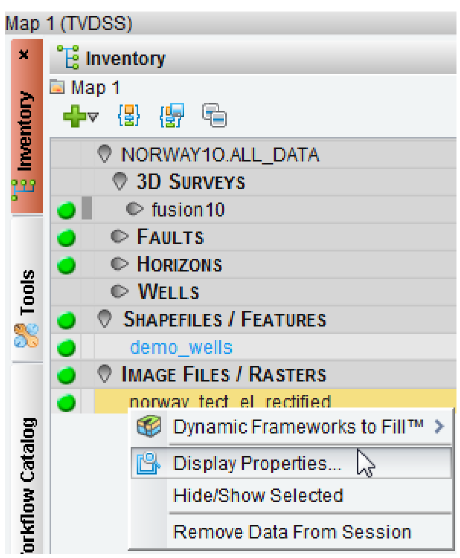
15. In the left panel of the *Select Session Data* dialog, select **GIS Data > Image Files /Rasters > GIS.** In the right panel, select **norway_tect_el_rectified**. Click the **Add data to session** button and click **OK**.



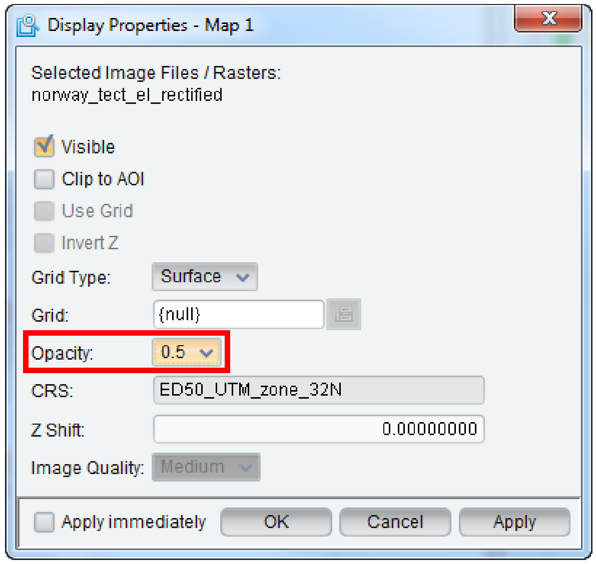
norway_tect_el_retified is a tectonic map of Norway.

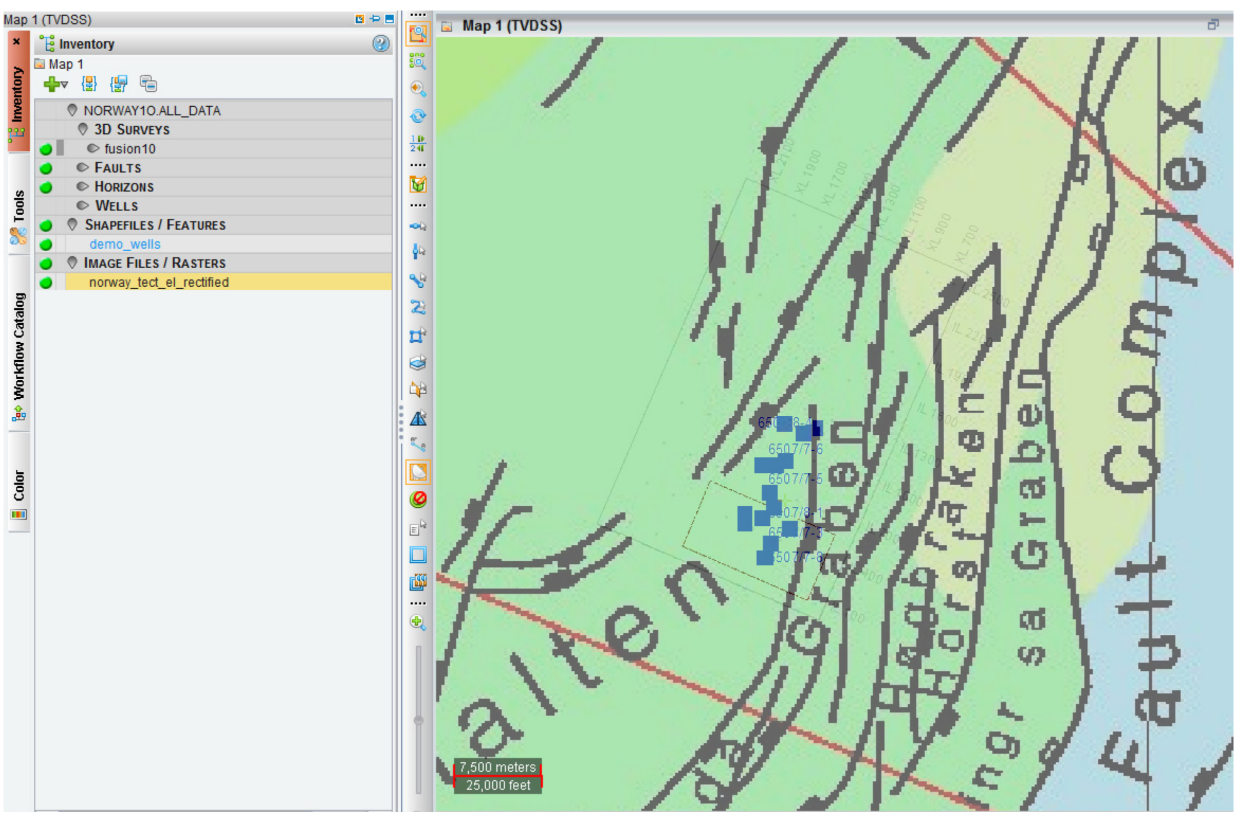


16. In the *Inventory* task pane, put your cursor on **norway_tect_el_retified** and **MB3 > Display Properties...**



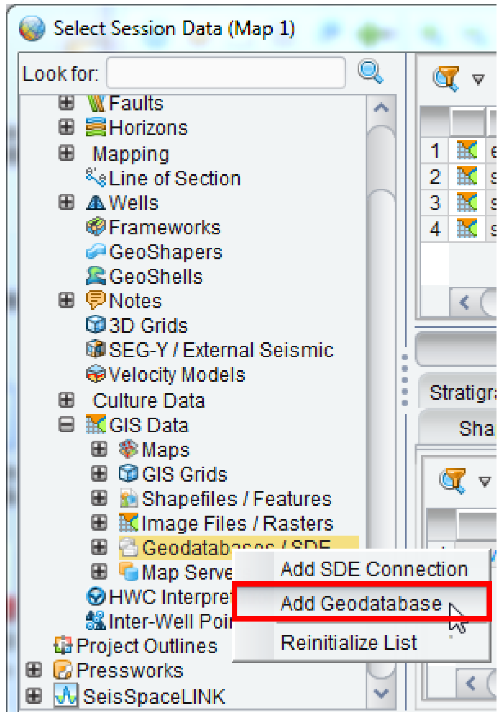
17. In the *Display Properties* dialog set Opacity: to **0.5** and click **OK.** You will see the tectonic features residing inside the **AOI.**



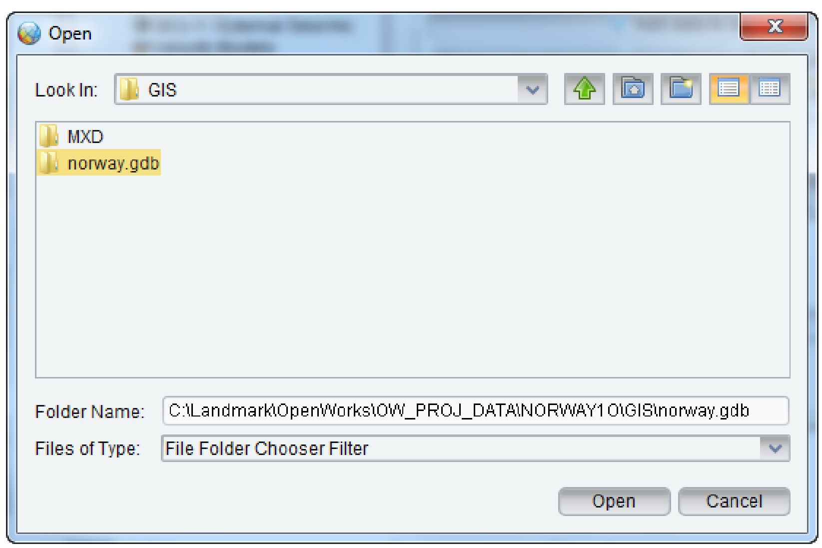


18. In the *Inventory* task pane of the *Map* view, toggle off **Image Files/Rasters norway_tect_el_rectified.**

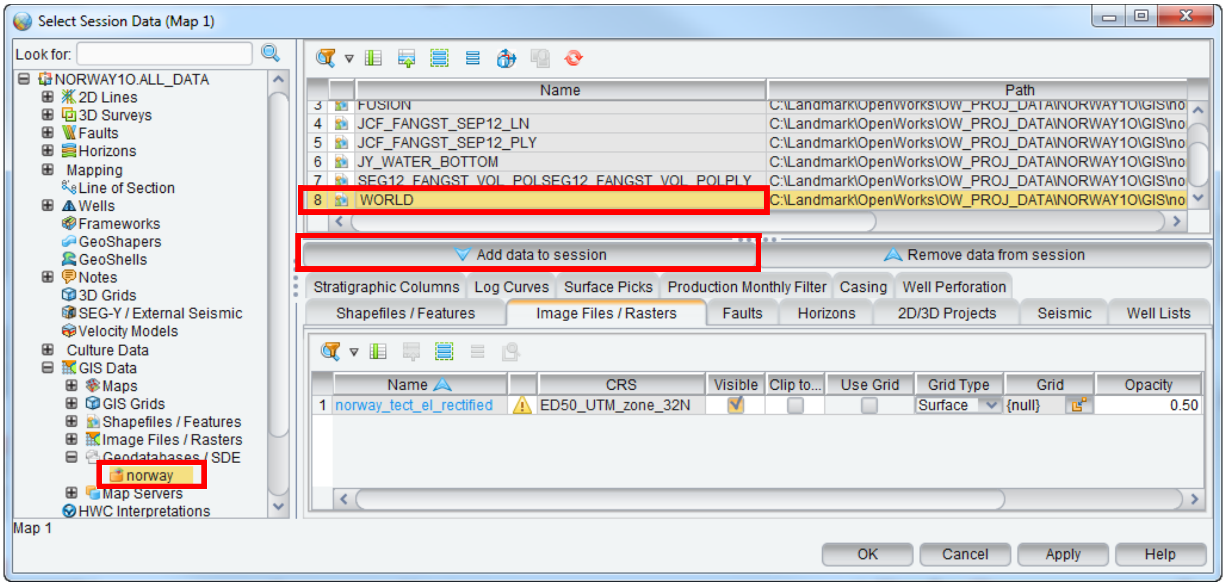
19. In the main toolbar, click the **Select Session Data** ( ) icon. In the left panel of the *Select Session Data* dialog, put your cursor on **GIS Geodatabase / SDE** and **MB3 > Add Geodatabase**.



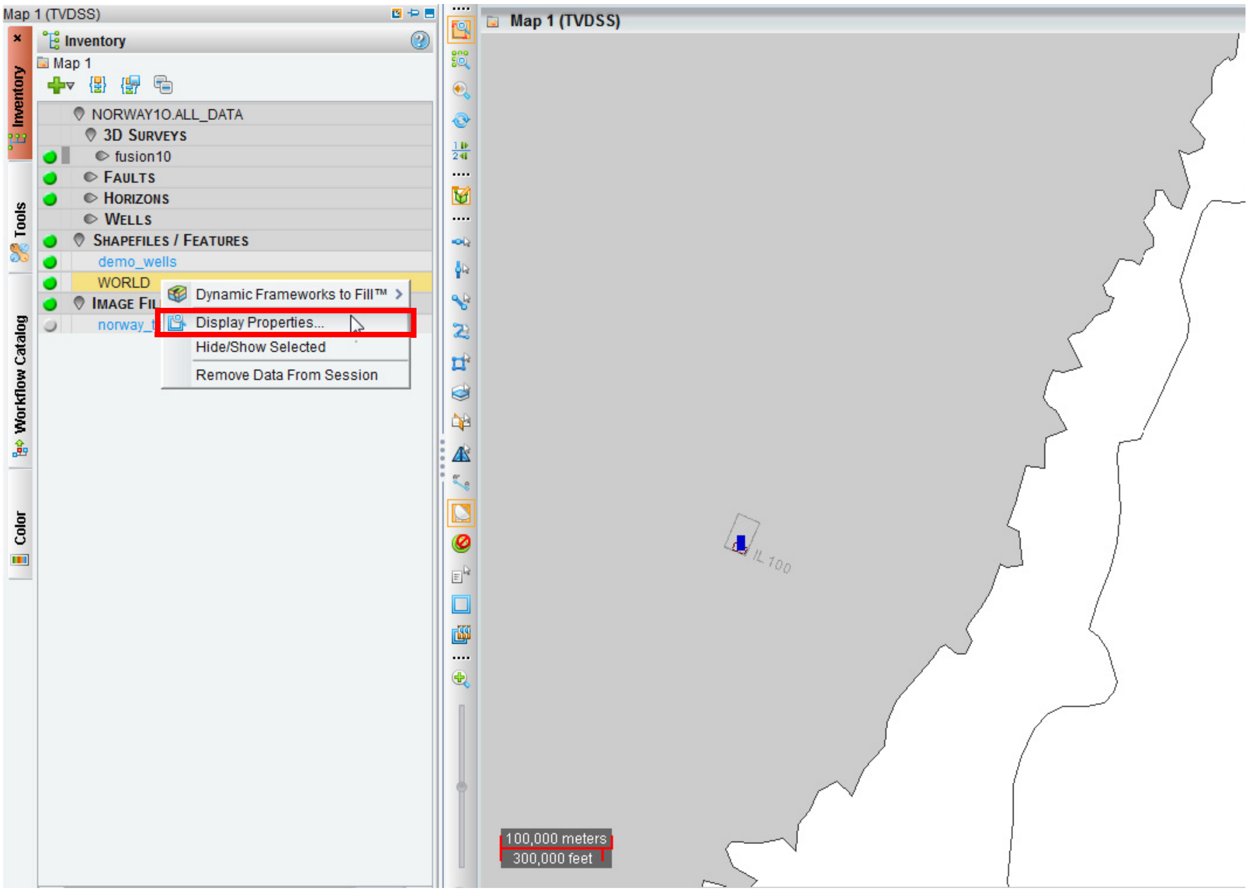
20. In the *Open* dialog, navigate to the Geodatabase folder **...OpenWorks/OW_PROJ_DATA/NORWAY10/GIS/.** In the GIS folder, select **norway.gdb** and click **Open.**



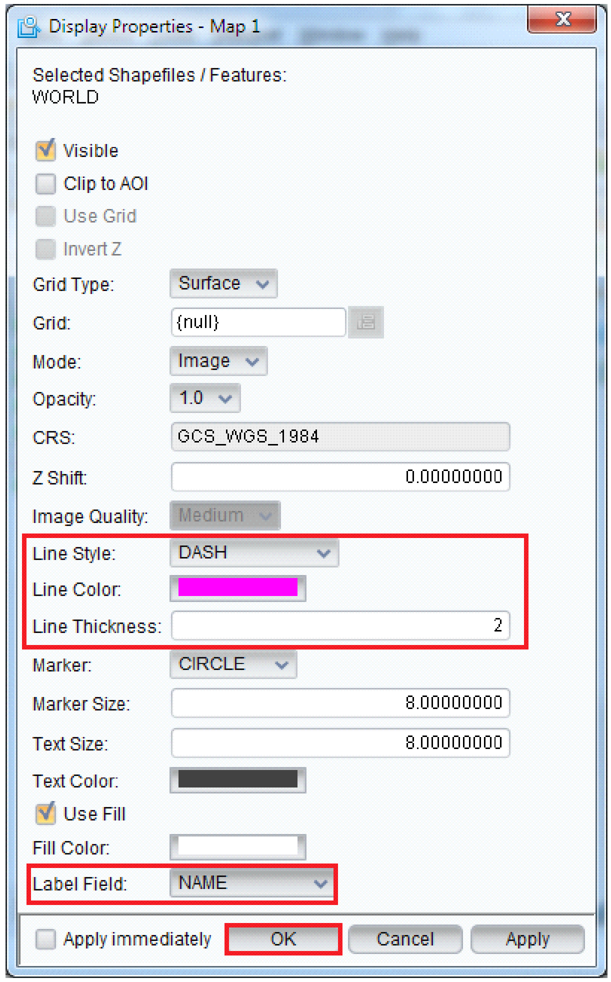
21. In the left panel of the *Select Session Data* dialog, select **GIS > Geodatabases/SDE > norway.** In the right panel of the dialog, select **WORLD,** and then click the **Add data to session** button. Click **OK.**

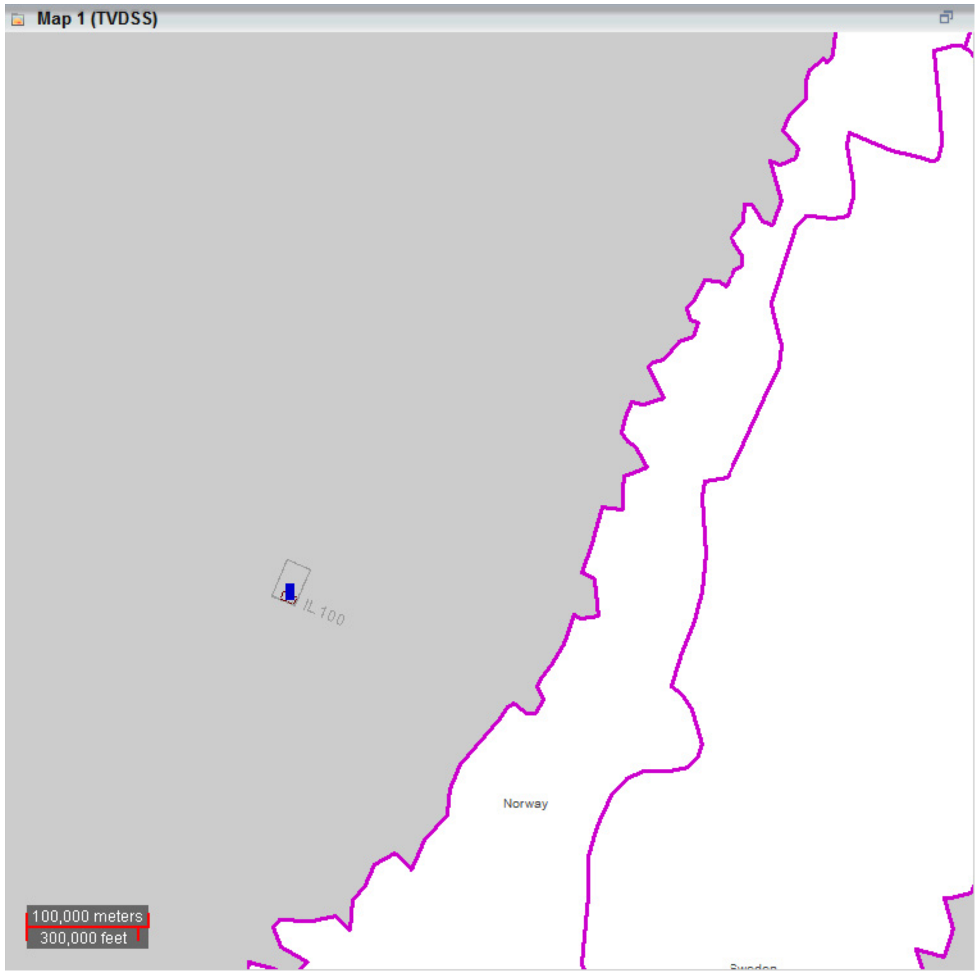


22. In the *Inventory* task pane of the *Map* view, put you cursor on **WORLD** and **MB3 > Display Properties...**



23. In the *Display Properties* dialog, set the Line Style to **DASH,** Line Color to **magenta,** Line Thickness to **“2”** and Label Field to **NAME.** Click **OK.**





24. In the main toolbar, select **File** > **Exit**. Do not save the session.

Chapter 2
Well Correlation View

DecisionSpace Geosciences allows you to create *Well Correlation* views, in which wells are displayed with custom well data layouts that enable you to interpret and edit well picks. You can create *Correlation* views by manually selecting the wells you want to include, or by automatic selection from an existing *Section* view. All wells present in the selected *Section* view will be part of the correlation. You may display your *Correlation* view in depth or time domains. *Correlation* view tabs let you handle well pick interpretation with ease and clarity. By default, this view displays evenly spaced well data, allowing you to interpret picks. Since well correlation does not include the x,y values, you can proceed with your correlation work in a display area separate from the other views. The *Well Correlation* view does not appear by default, but can easily be added through the New Correlation icon.

Because there is no seismic data to clutter the view, and wells can be evenly spaced and their separation adjusted, *Well Correlation* view enables you to interpret picks with more ease and detail. The option is now available to space wells proportionally in this view, giving a read-out of the distance between the displayed wells, for a more realistic view of the stratigraphy.

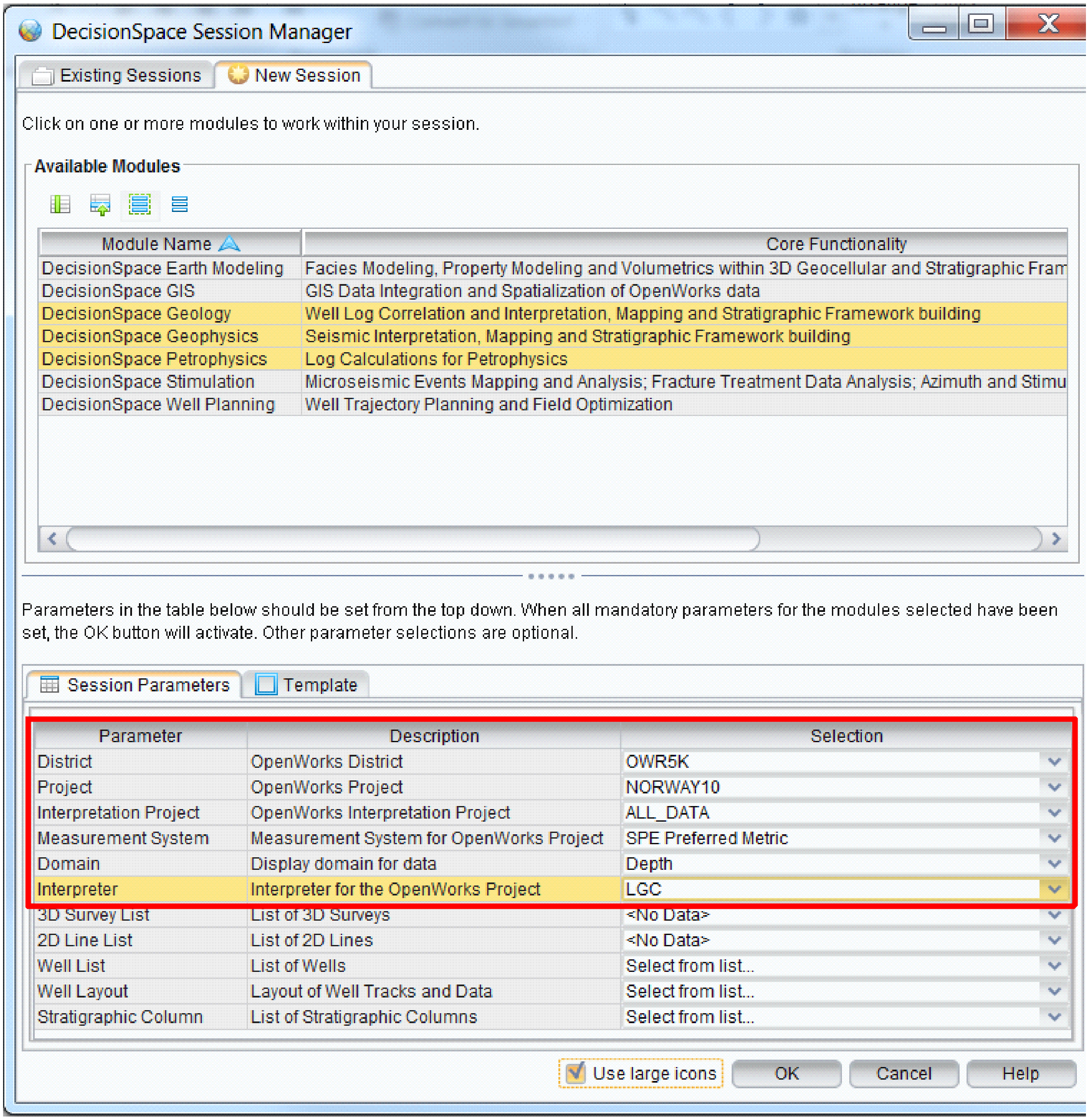
Topics Covered in this Chapter

In this chapter you will learn how to:

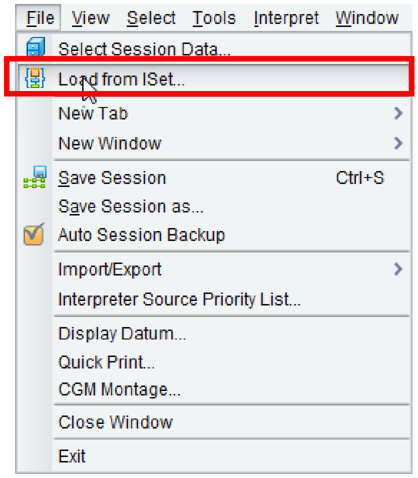
- Create a *Well Correlation* view from a well list.
- Create a *Well Correlation* view from a *Section* view.
- Create a *Well Correlation* view from a *Map* view.
- Arrange wells in *Correlation* view.
- Display Well layouts for wells in *Correlation* view.

Starting a New DecisionSpace Geosciences Session

1. In the *New Session* tab of the *DecisionSpace Session Manager,* select the **Geology, Geophysics,** and **Petrophysics** modules. Under the *Session Parameters* tab make sure the Selection list corresponds to the list shown below. Click **OK**.



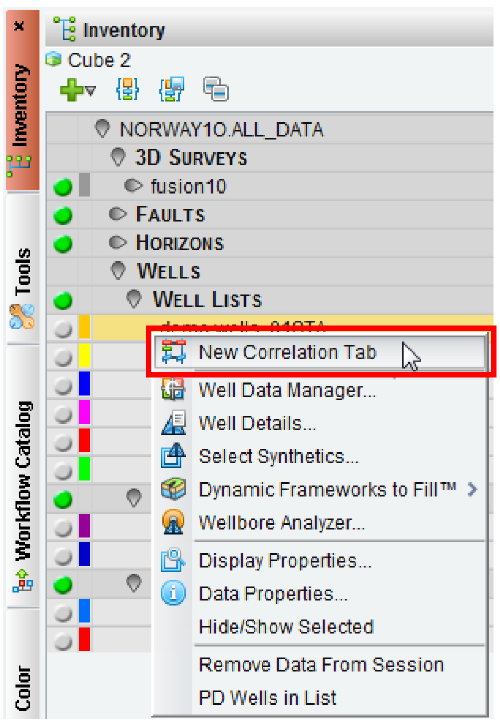
2. Select **File > Load from ISet.** The *Interpretation Set* task pane will become active. In the Interp Set column, select **DS_Geology**. Click the **Load Data to Session** icon ().

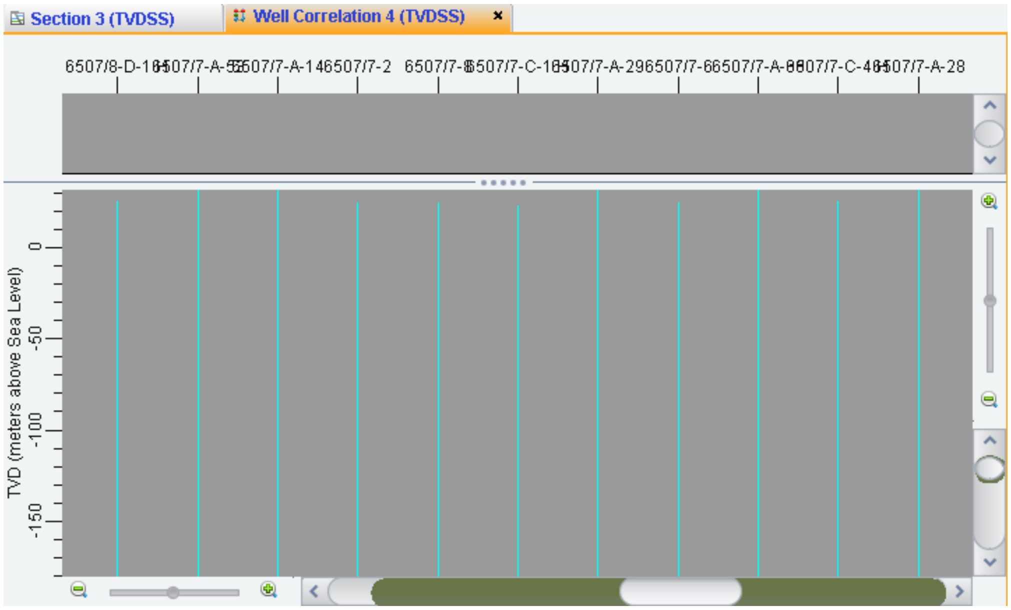


Exercise 2.1: Creating a Well Correlation View from a Well List

Typically, you will want to see all of the wells in your well list in *Correlation* view. However, it is also possible to view only certain wells from that well list. In this exercise you will learn how to open *Correlation* views that display all wells in a well list, as well as how to use well details to open a view containing only specific wells.

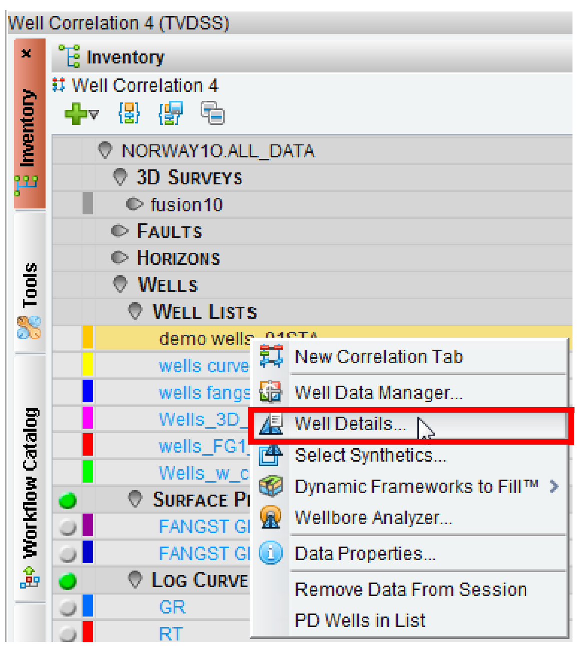
1. In the *Inventory* task pane place your cursor on well list **demo wells, 01STA** and **MB3 > New Correlation Tab.** This will open a *Well Correlation* view, displaying all of the wells in the **demo wells, 01STA** well list.



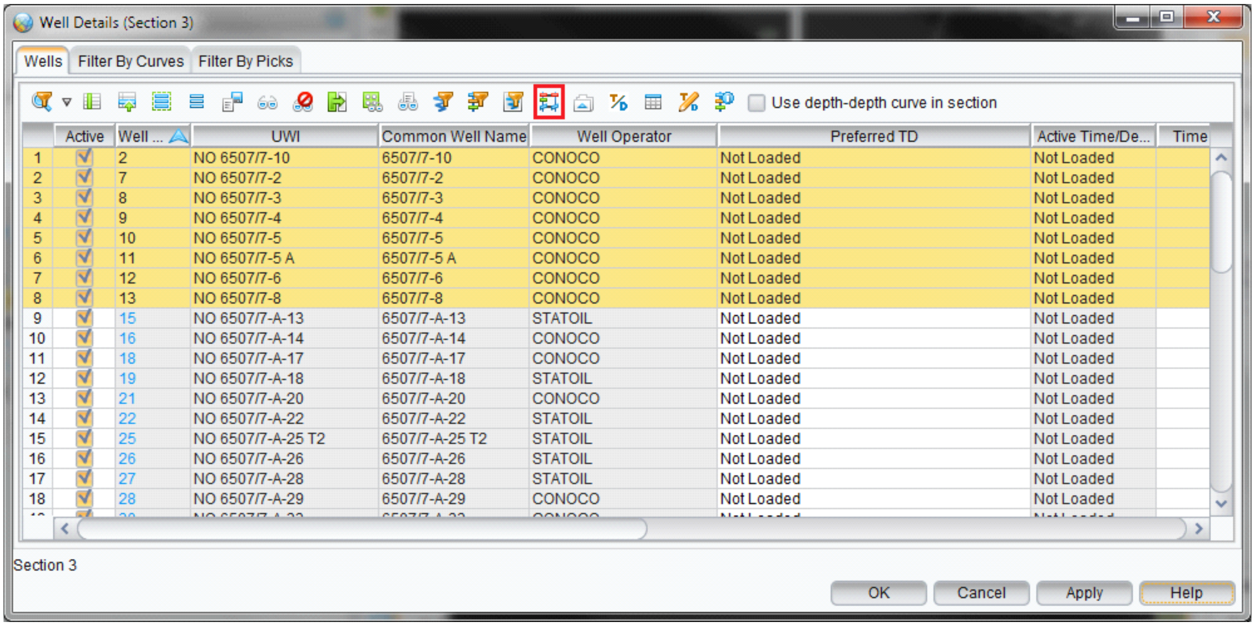


You can also create a *Well Correlation* view from the *Well Details* dialog.

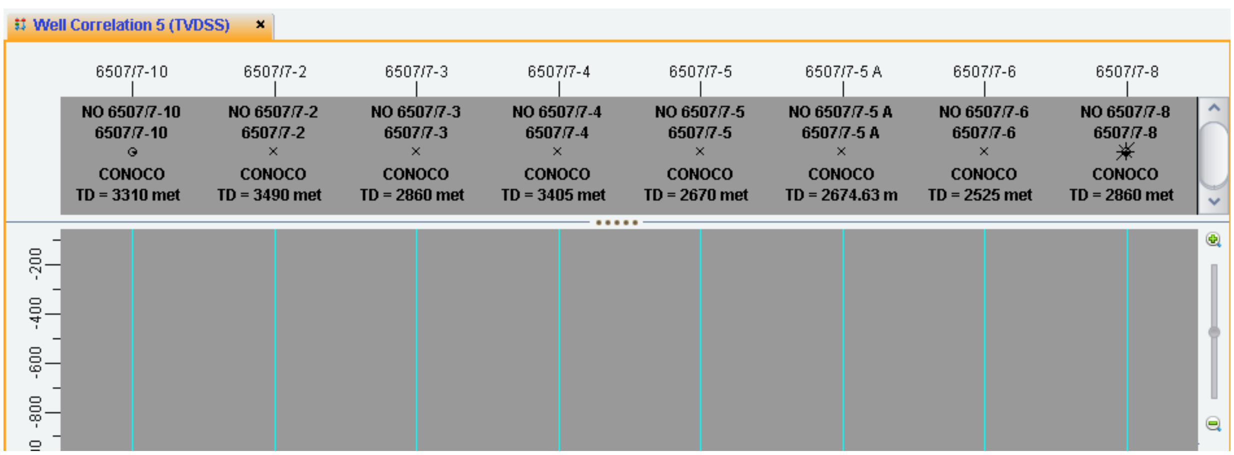
2. To open the *Well Details* dialog, put your cursor over **demo wells, 01STA** in the *Inventory* and **MB3 > Well Details...**



3. The *Well Details* dialog is displayed. Select a few wells and click the **Display Selected Wells in New Correlation View** icon ( ).



The selected wells will be displayed in a new *Correlation* view in a new window.

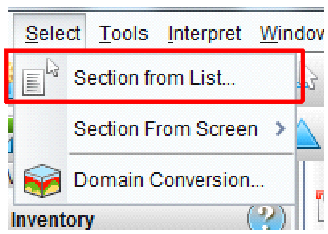


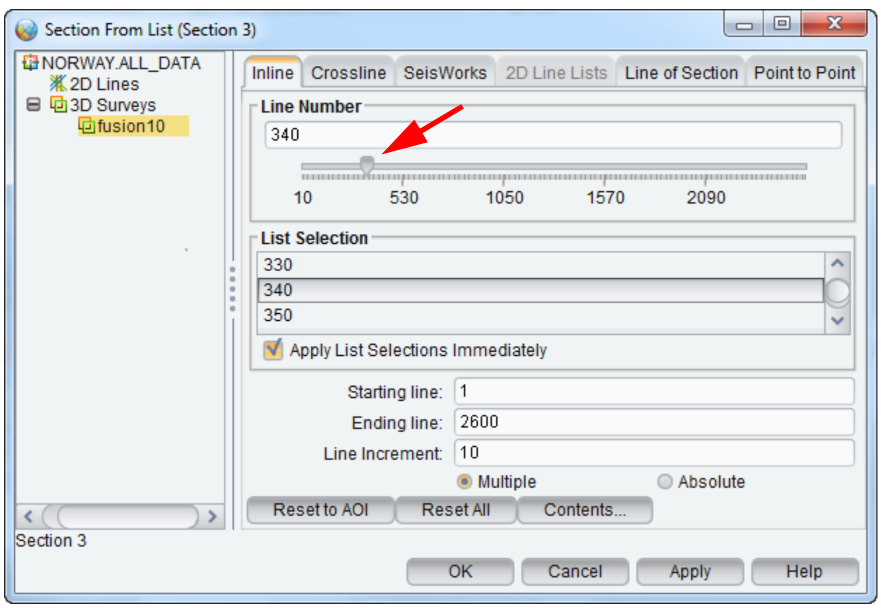
4. In the new *Correlation* view, select **File > Close window**. Click **OK**. Close the *Well Details* dialog as well.

Exercise 2.2: Creating a Well Correlation View from a Section View

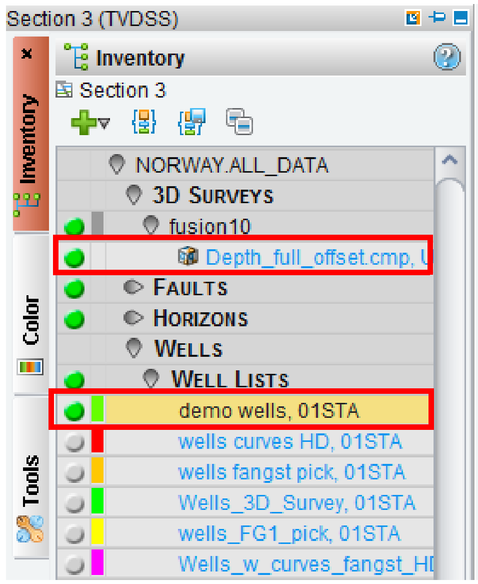
When viewing your wells in *Section* view, is important that you are able to see how your wells correspond to the structure depicted in your seismic. Being able to see the details necessary to make your interpretation can be difficult in *Section* view. In this exercise you will learn how to open a *Correlation* view (where it is easier to make interpretations) from your *Section* view.

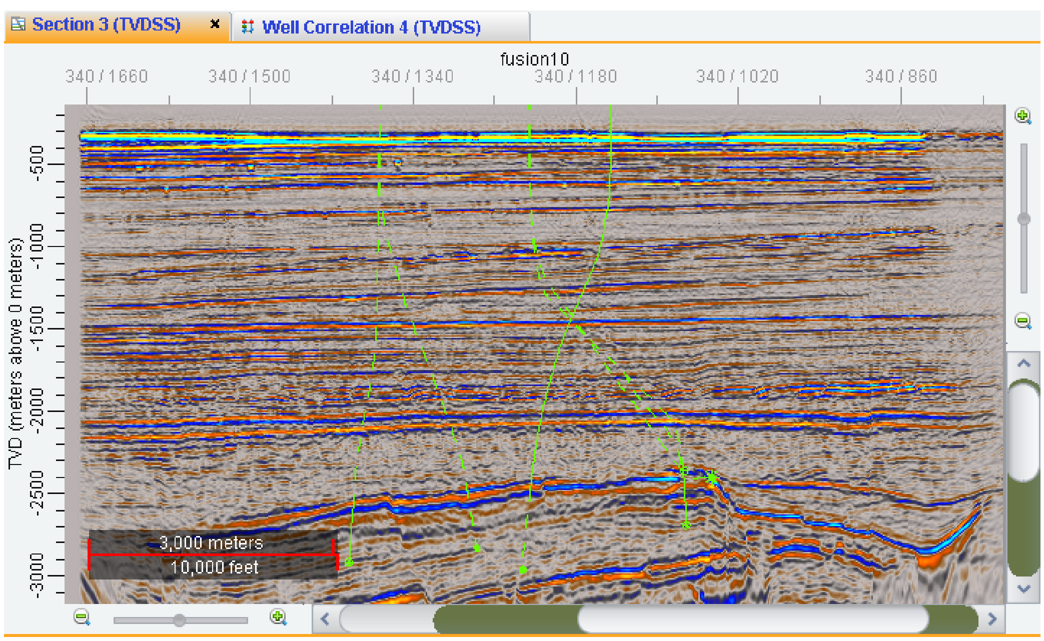
1. Activate the *Section* view, then choose **Select > Section From List.** On the *Section From List* dialog, click the ***Inline*** tab and choose **line 340**. Click **OK**.



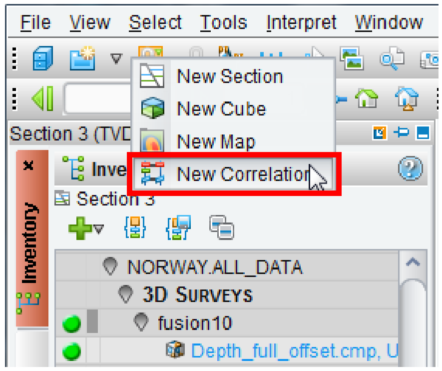


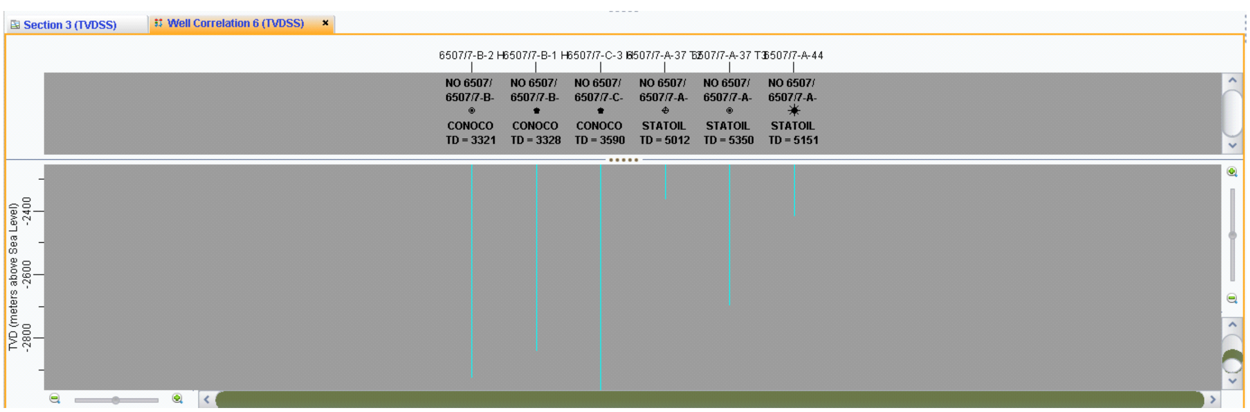
2. In the *Inventory* task pane, toggle on volume **Depth_full_offset.cmp, UPGRADE** under 3D Surveys, fusion10 and well list **demo wells, 01STA.** Toggle off all other **data types**.





3. From the New Tab pull-down menu, select **New Correlation** to create a new *Correlation* view displaying all of the wells that are currently displayed in the selected *Section* view.



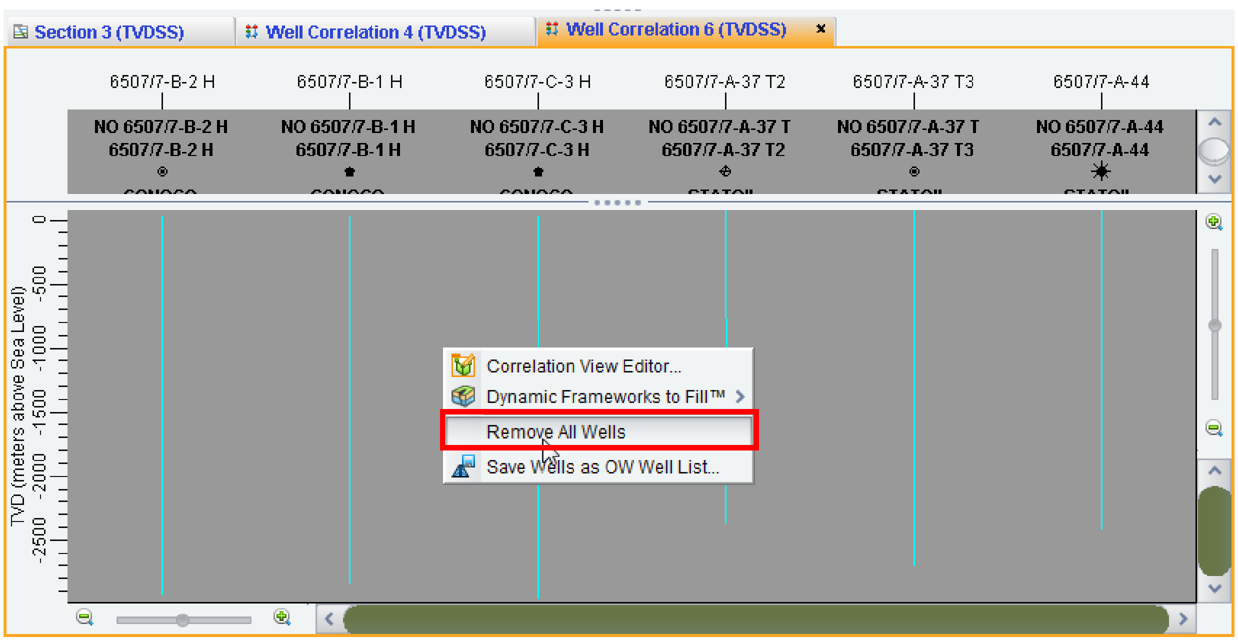


Exercise 2.3: Creating a Well Correlation View from a Map View

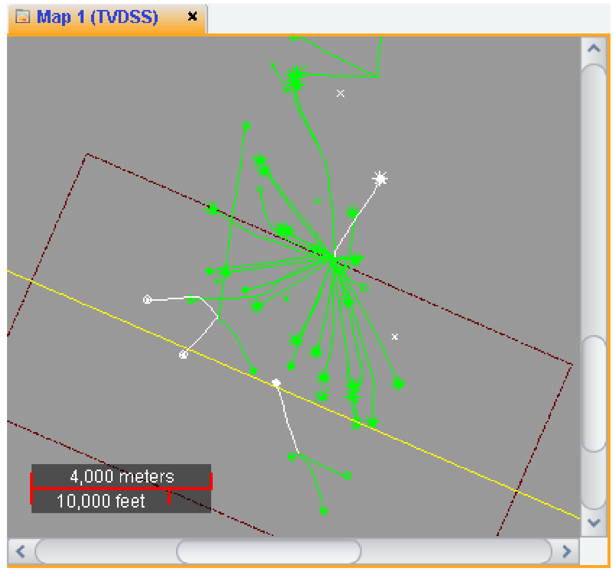
You have learned how to create *Correlation* views from Well Lists and from *Section* view. You can also create a *Correlation* view from *Map* view, by graphically selecting them. This method is especially useful for creating cross sections that do not necessarily line up with the crosslines and inlines of your seismic.

1. Activate the *Correlation* view that you created in the last exercise.

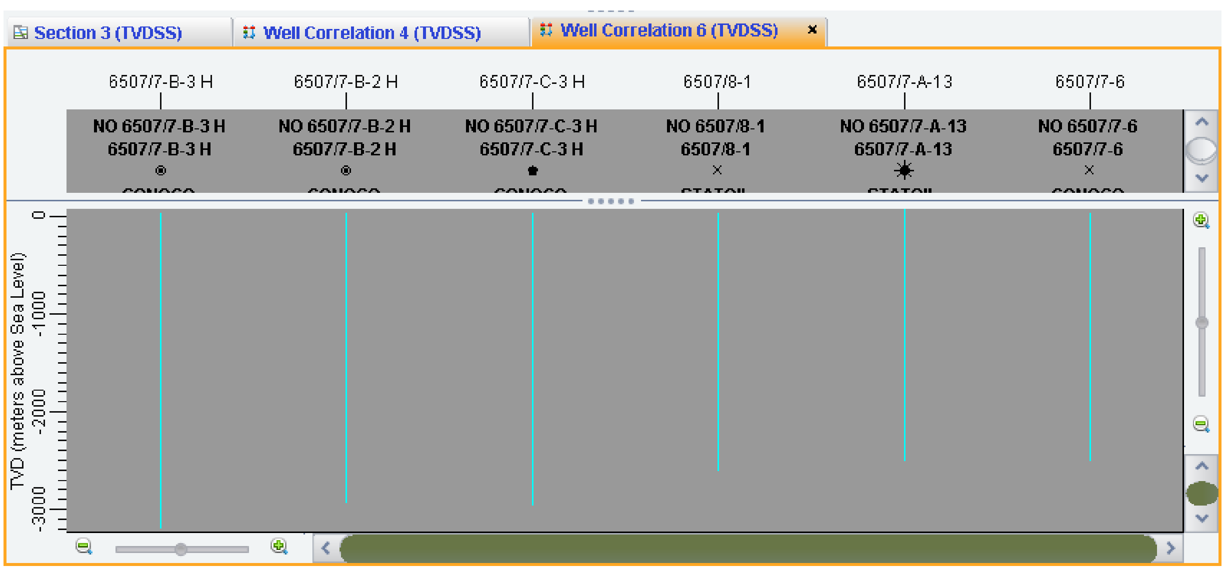
2. If wells are displayed in *Correlation* view, put your cursor in the view and **MB3 > Remove All Wells**.



3. Activate the *Map* view and ensure that well list **demo wells** is toggled on while all other data is toggled off. On the vertical menu bar click the **Select Well From Map** icon (). In the *Map* view, select a few **wells**. Note that the well path displays in white when selected. After you have chosen your wells, **MB2** to broadcast the wells to *Correlation* view.



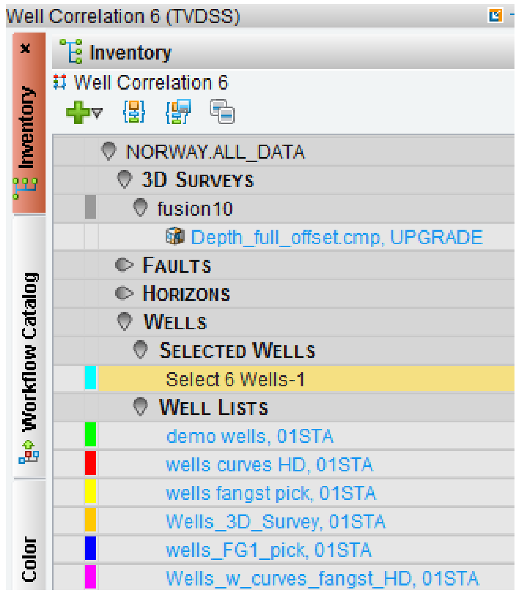
The selected wells are displayed in *Well Correlation* view in the order in which they were selected from *Map* view.



In the *Inventory* task pane, you will see that you now have a new item under Wells, called Selected Wells.

Note:

This is a temporary well list composed of the wells that you selected in your *Map* view. Selected Wells exist only in your session and do not write out to the database. Since these do behave as a well list, you have the ability to open *Well Details* and *Display Properties* for your Selected Wells lists.



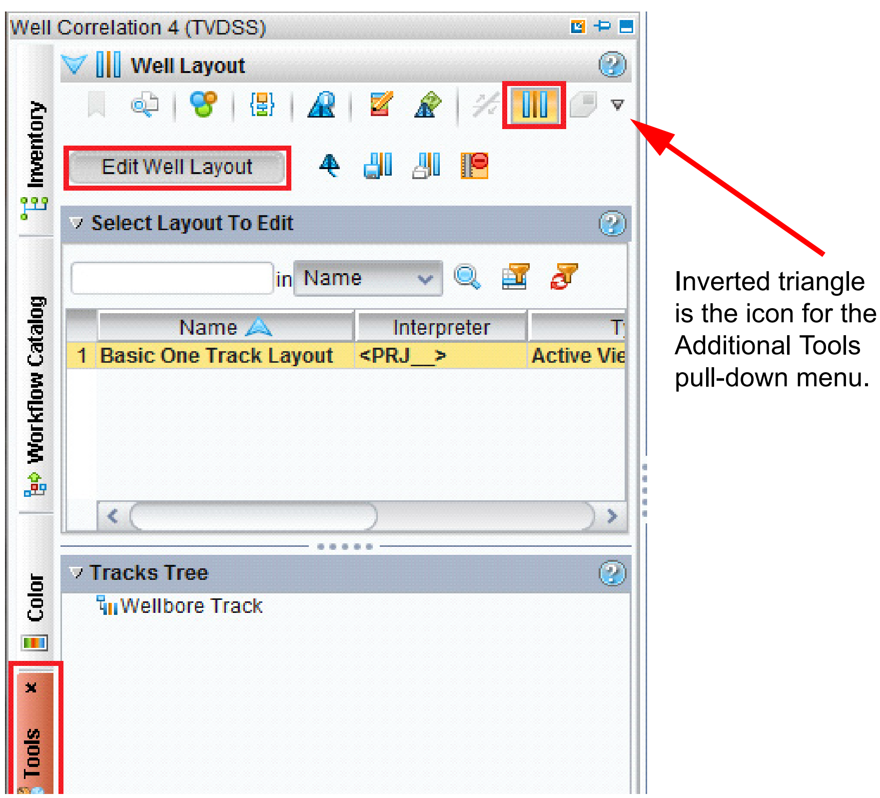
4. Close your newly created *Correlation* view.

Exercise 2.4: Creating Well Layouts in a Correlation View

The DecisionSpace Geosciences Well Layout tool makes it easy to display wellbore data. You can customize and save well layouts. This allows you to have multiple layouts displaying various data, depending on your requirements. By default, the Basic One Track Layout is selected for all wells in all views. This layout displays the wellbore along with any well data toggled on in the *Inventory.*You can create new well layouts by editing a saved layout and then saving that edited file with a new name, by creating a new layout, or by converting a StratWorks-generated Well Template into a DecisionSpace Geosciences Well Layout. Most users feel that the easiest method is to edit an existing layout. This will be covered in the next exercise.

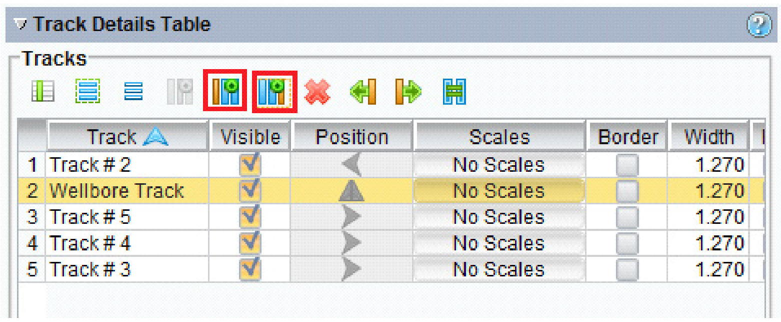
Creating Custom Well Layouts

1. From the demo wells list, activate the *Correlation* view that you made in Exercise 2.1. In the *Tools* task pane, click the **Well Layout** ( ) icon and then click the **Edit Well Layout** button**.**

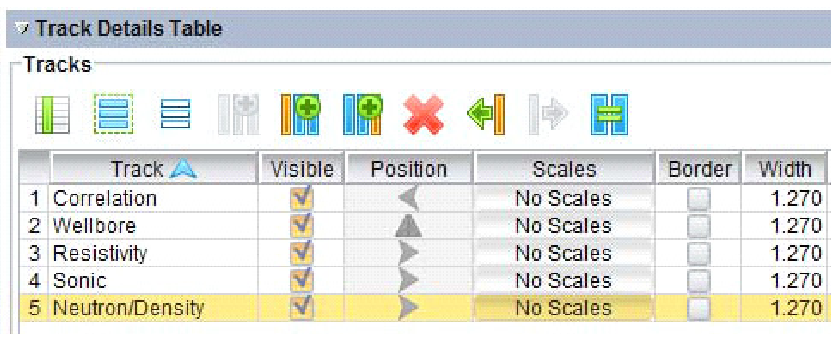


> **Note:**
>
> If the icon is not visible in the task pane, click the Additional Tools pull-down menu (see the image above).

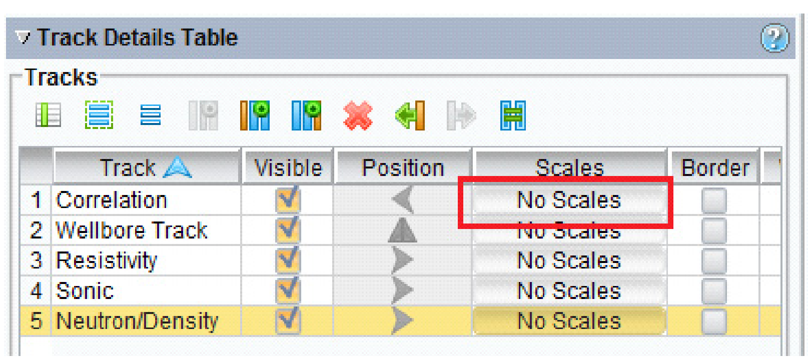
2. In the *Track Details Table,* click the **Add track left of highlighted track** icon ( ) one time, and then click the **Add track right of highlighted track** icon ( ) three times.



3. Click a **Track** name (for example, Track 2 in the image above) and enter the name "**Correlation**". Repeat this for all Track numbers, using the *Track Details Table* below as your guide.

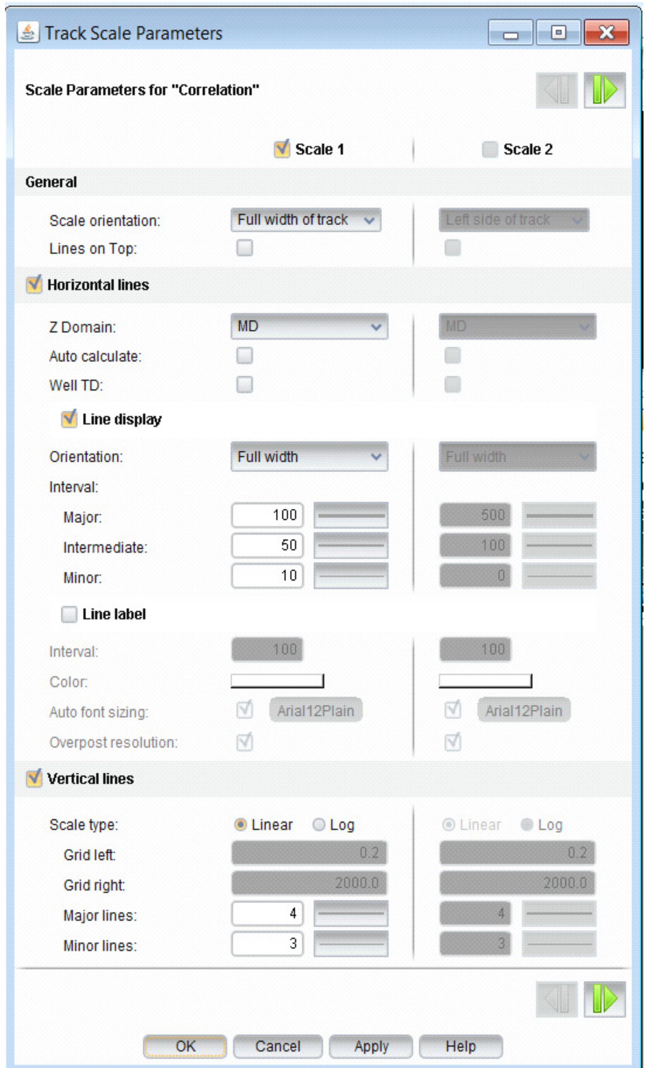


4. In the *Track Details Table,* click the **No Scales** box that is related to the Correlation track.



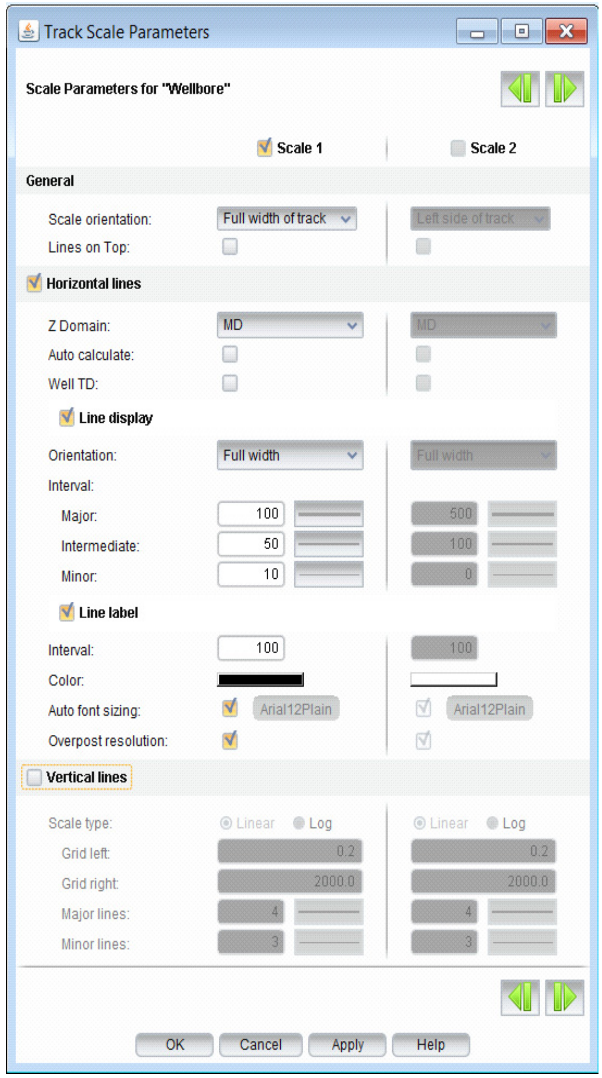
5. The *Track Scale Parameters* dialog is displayed. Set up the Track Scale Parameters for Correlation, Wellbore Track, Resistivity, Sonic, and Neutron/Density, as shown in the following images:

For Correlation



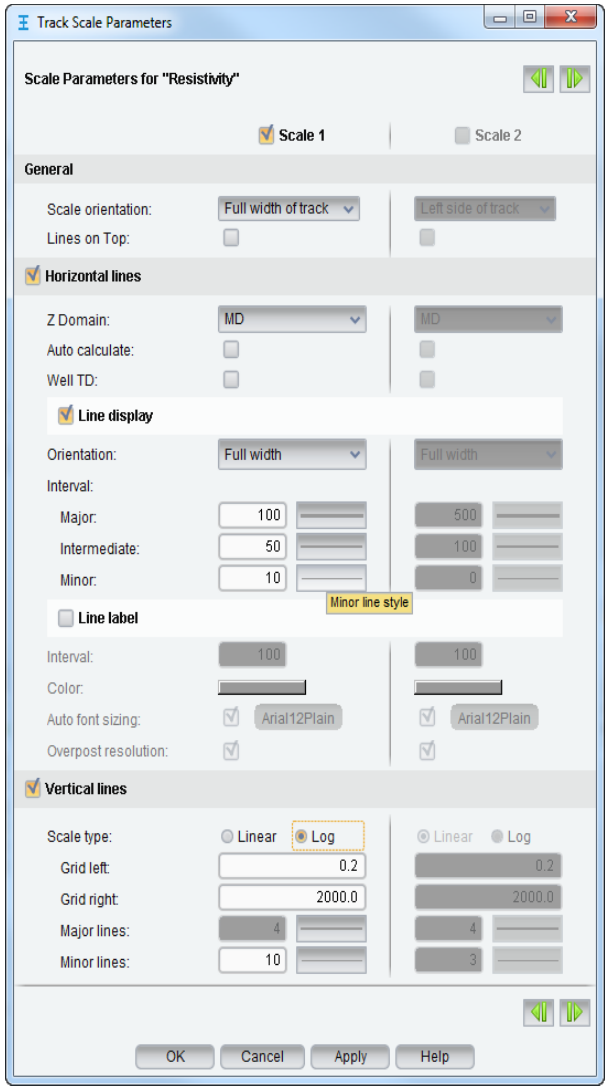
6. Click **Apply**. Then click the **Next Track** icon () to display the Track Scale Parameters for the next track. As in the previous step, change the parameters as shown in the images.

For Wellbore



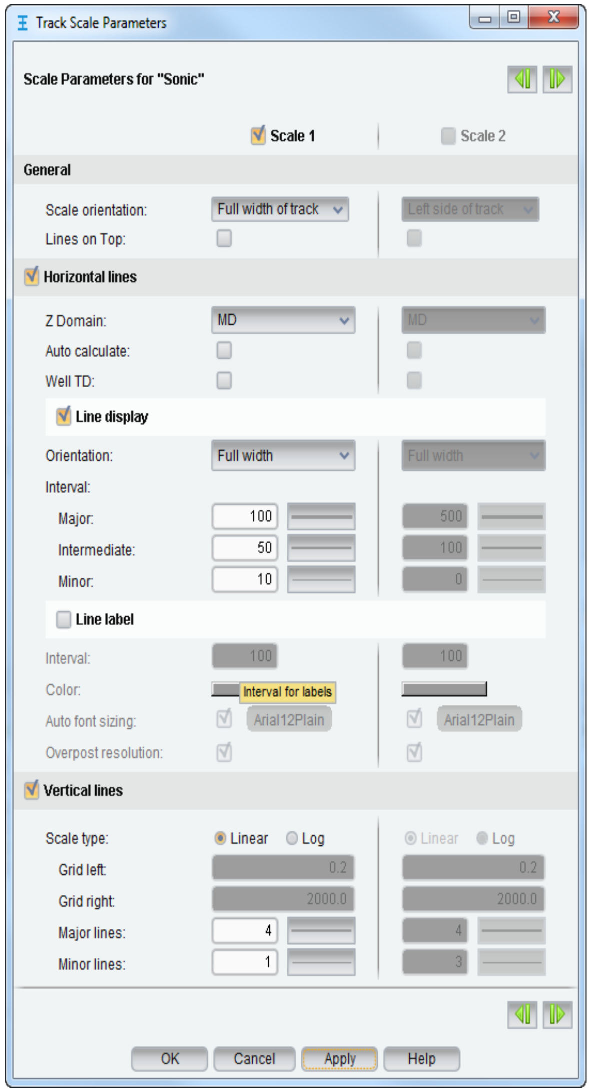
7. Click **Apply**. Then click the **Next Track** icon ( ).

For Resistivity



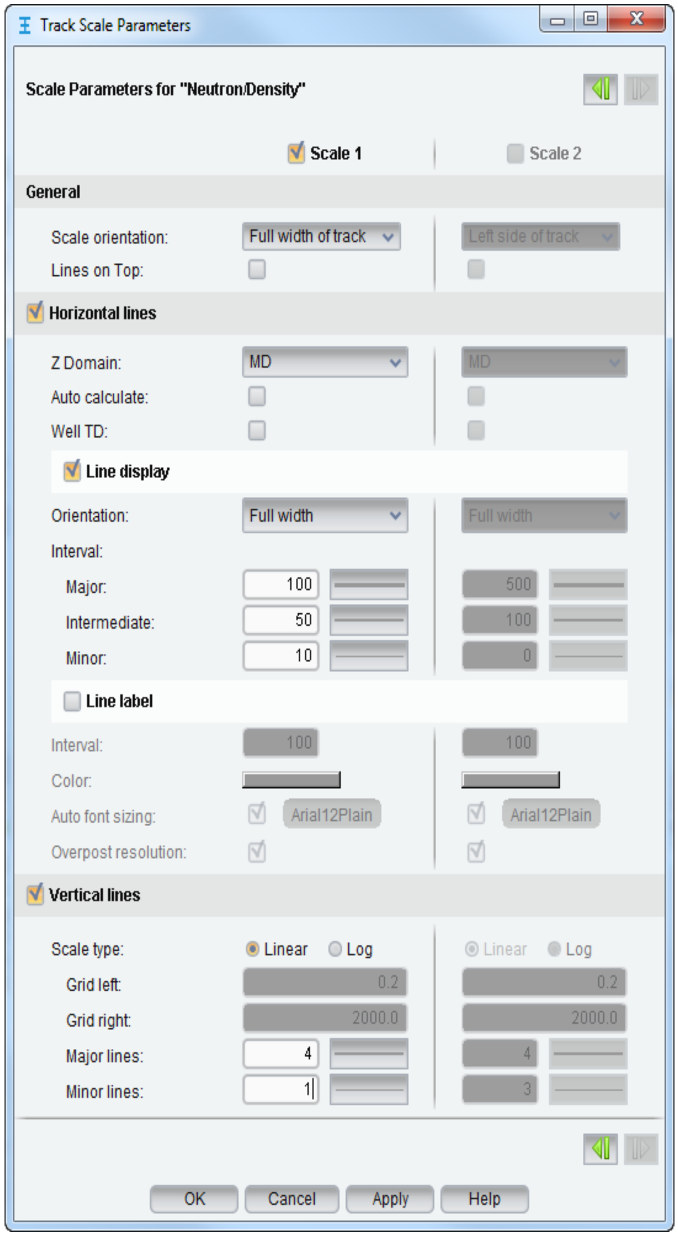
8. Click **Apply**. Then click the **Next Track** icon ( ).

For Sonic


Track Scale Parameters
Scale Parameters for "Sonic"
Scale 1
Scale 2
General
Scale orientation:
Full width of track
Left side of track
Lines on Top:
Horizontal lines
Z Domain:
MD
Auto calculate:
Well TD:
Line display
Orientation:
Full width
Interval:
Major:
100
500
Intermediate:
50
100
Minor:
10
0
Line label
Interval:
100
Color:
Interval for labels
Auto font sizing:
Arial12Plain
Overpost resolution:
Vertical lines
Scale type:
Linear
Log
Grid left:
0.2
Grid right:
2000.0
Major lines:
4
Minor lines:
1
3
OK
Cancel
Apply
Help

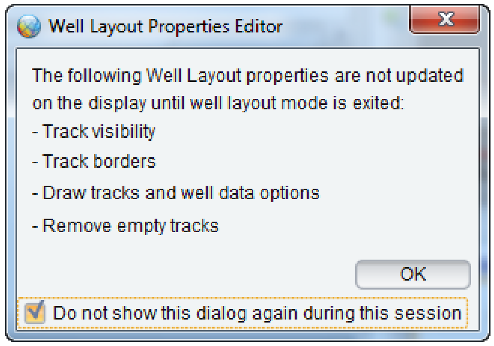
9. Make the changes and click **Apply**. Then click the **Next Track** icon ().

For Neutron / Density

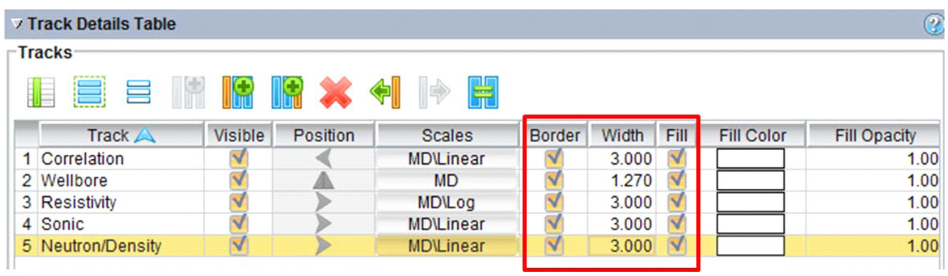


10. Click **OK**.

11. On the *Track Details Table,* scroll to the right and toggle on **Borders** and **Fill** for all tracks. You will receive the following pop-up as soon as you toggle your first item. Read through this warning, toggle on **Do not show this dialog again during the session**, and click **OK**.

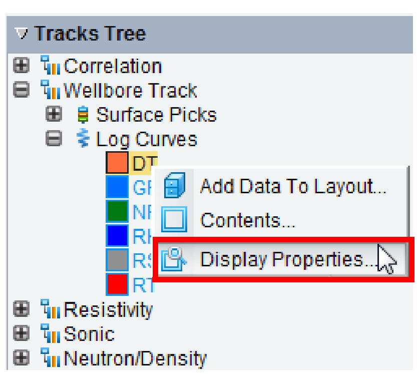


12. Adjust the **Width** of each column as specified below by double-clicking each Width cell and making the changes.

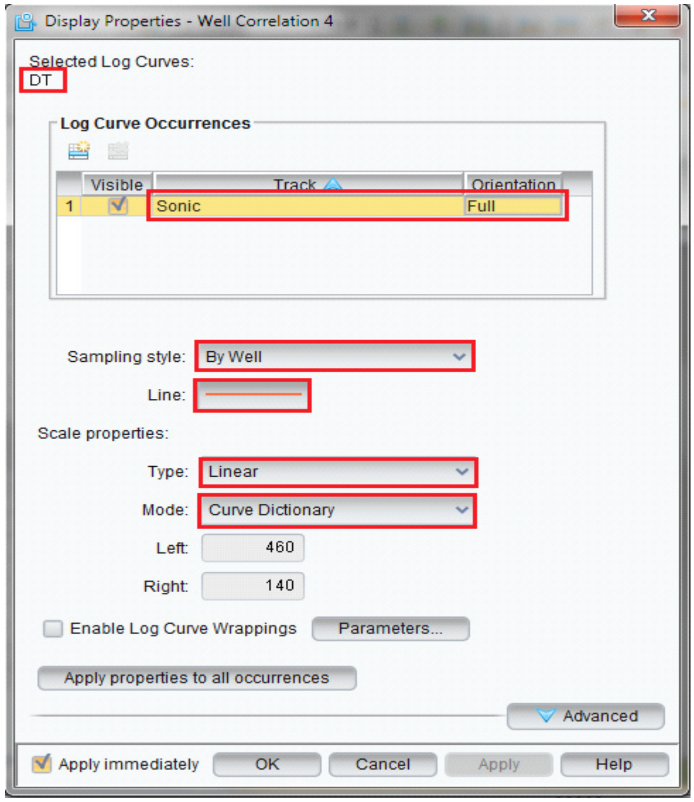


13. Click the **Select Session Data** ( ) icon and add the following curves to the session: **DT**, **NPHI**, **RHOB**, and **RS** (located under Wells > Log Curves). Click **OK**.

14. These curves will display in the Wellbore track by default. You can change where the curves will display. In the *Well Layout* task pane, under **Tracks Tree** in the **Wellbore** track tree, you will see all of the Log Curves you added in the previous step. Put your cursor on the **DT** log curve and **MB3 > Display Properties**.

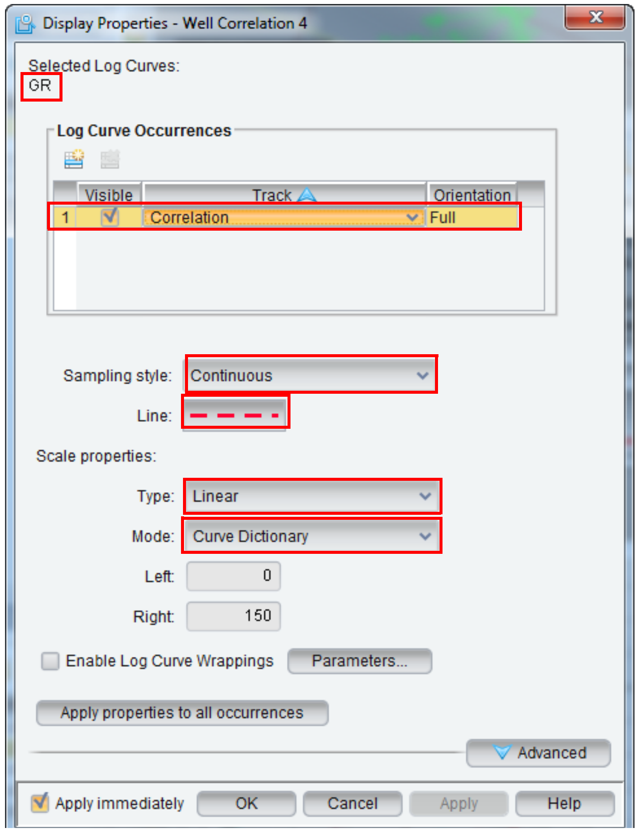


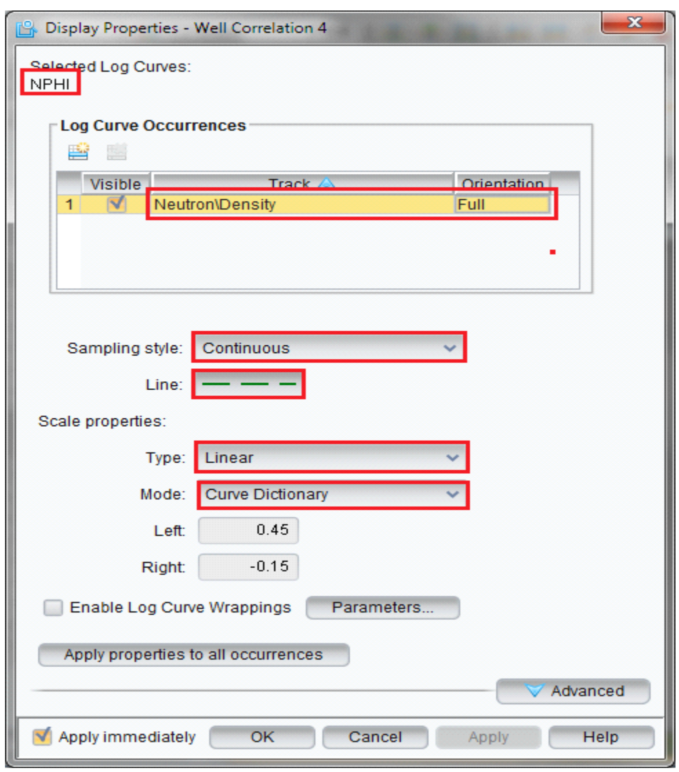
15. Change the display properties for the log curve, as shown in following *Display Properties* dialog. Follow the same procedures for the other five log curves, using the following images as your guide. Click **OK** to close the dialog.

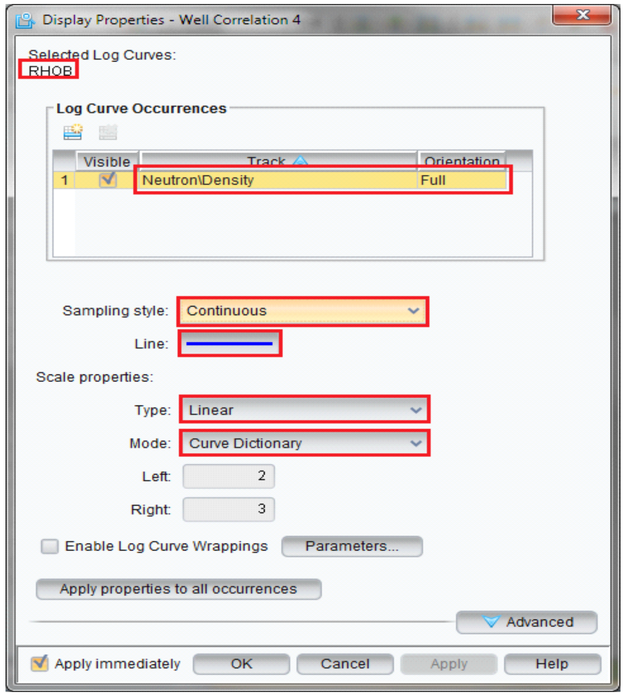


Note:

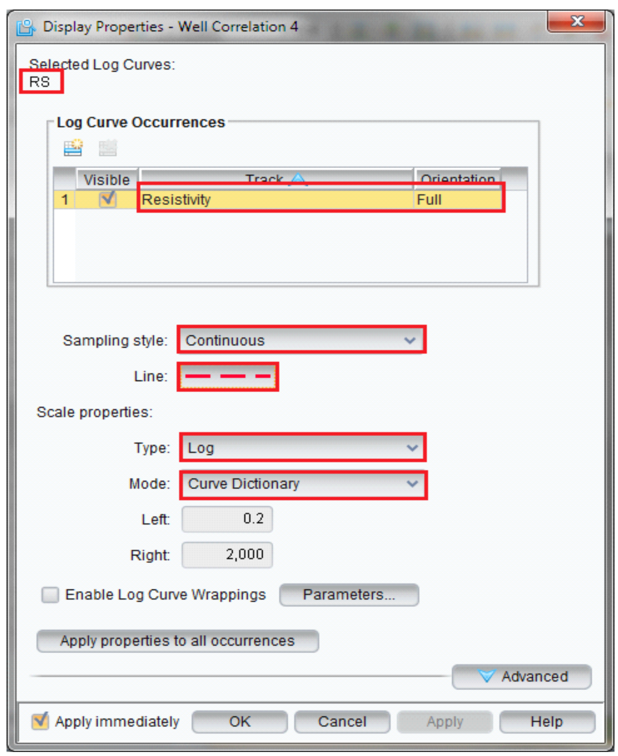
To switch between log curves in the *Display Properties* dialog without closing the box, click in the *Track Tree* panel on the log curve that you want to change the display properties of.


Display Properties - Well Correlation 4
Selected Log Curves:
GR
Log Curve Occurrences
Visible
Track
Orientation
1
Correlation
Full
Sampling style:
Continuous
Line:
Scale properties:
Type:
Linear
Mode:
Curve Dictionary
Left:
0
Right:
150
Enable Log Curve Wrappings
Parameters...
Apply properties to all occurrences
Advanced
Apply immediately
OK
Cancel
Apply
Help

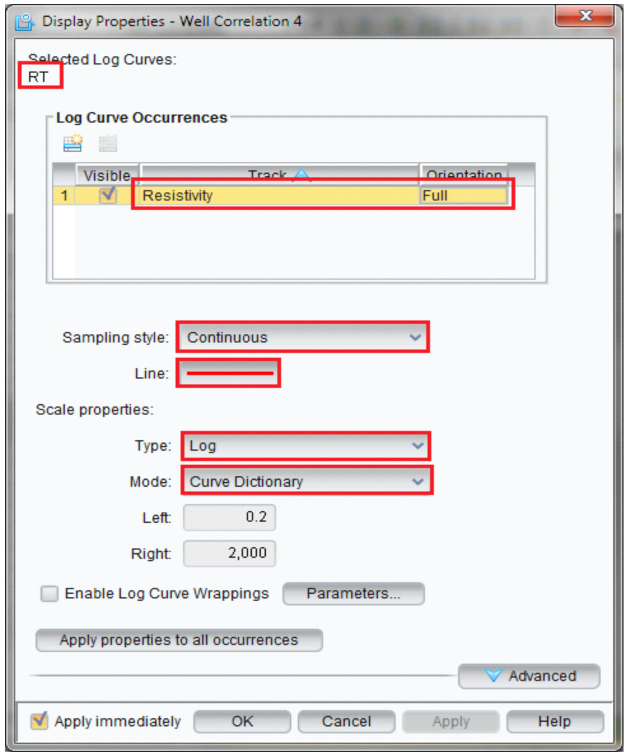

Display Properties - Well Correlation 4
Selected Log Curves:
NPHI
Log Curve Occurrences
Visible
Track
Orientation
1
Neutron\Density
Full
Sampling style:
Continuous
Line:
Scale properties:
Type:
Linear
Mode:
Curve Dictionary
Left:
0.45
Right:
-0.15
Enable Log Curve Wrappings
Parameters...
Apply properties to all occurrences
Advanced
Apply immediately
OK
Cancel
Apply
Help



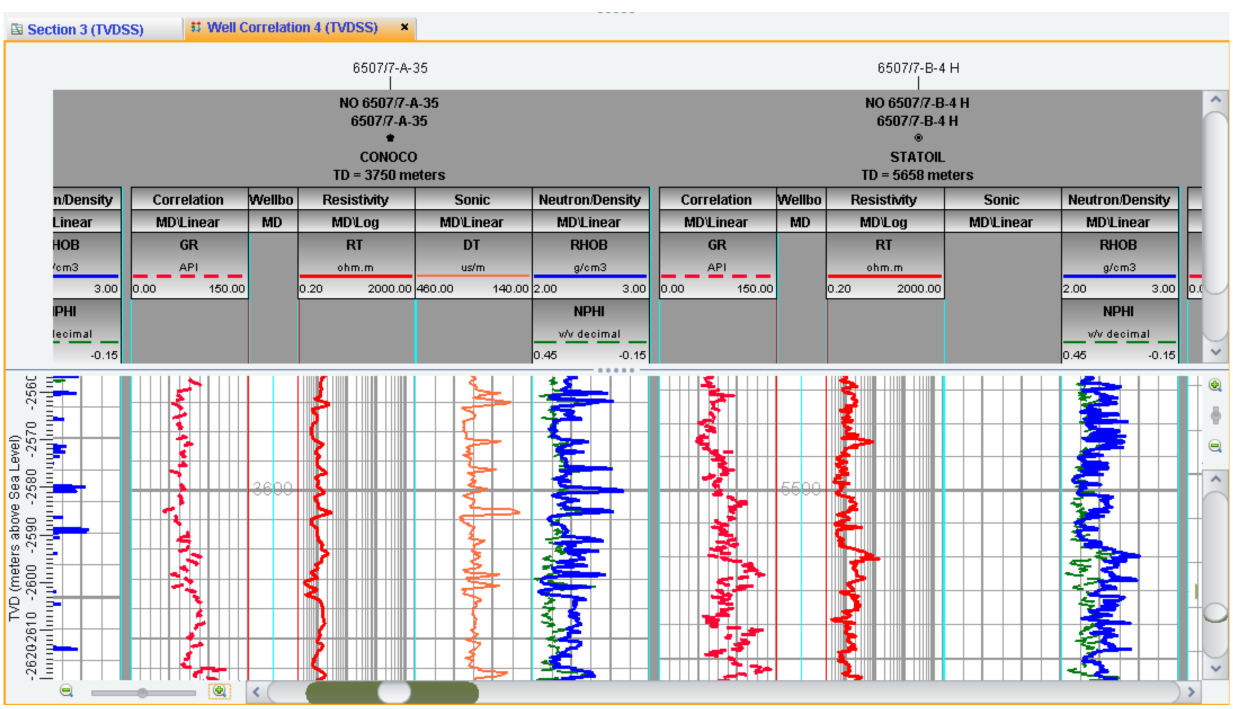
Display Properties - Well Correlation 4
Selected Log Curves:
RHOB
Log Curve Occurrences
Visible
Track
Orientation
1
Neutron\Density
Full
Sampling style:
Continuous
Line:
Scale properties:
Type:
Linear
Mode:
Curve Dictionary
Left:
2
Right:
3
Enable Log Curve Wrappings
Parameters...
Apply properties to all occurrences
Advanced
Apply immediately
OK
Cancel
Apply
Help



Display Properties - Well Correlation 4
Selected Log Curves:
RS
Log Curve Occurrences
Visible
Track
Orientation
1
Resistivity
Full
Sampling style:
Continuous
Line:
Scale properties:
Type:
Log
Mode:
Curve Dictionary
Left:
0.2
Right:
2,000
Enable Log Curve Wrappings
Parameters...
Apply properties to all occurrences
Advanced
Apply immediately
OK
Cancel
Apply
Help



After making the foregoing changes in the *Display Properties* dialogs, your *Correlation* view will look like the following image.



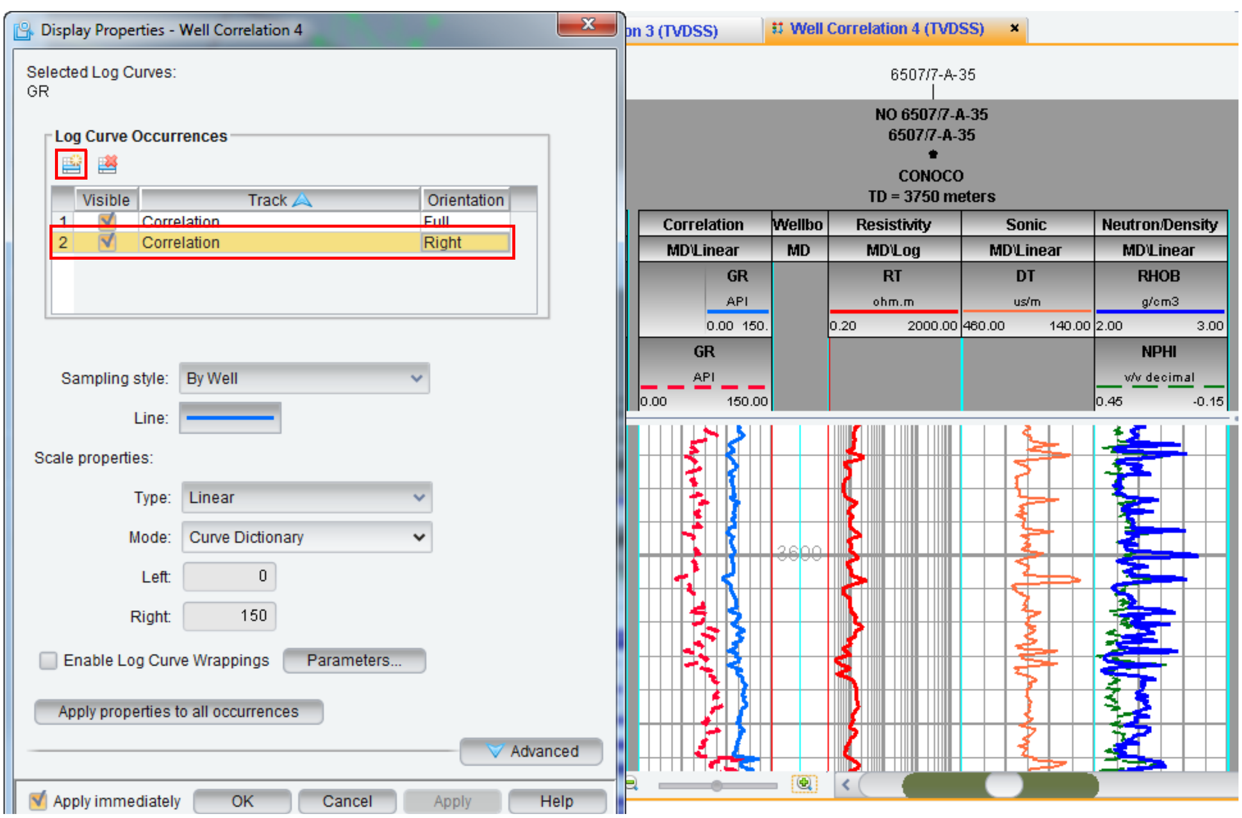
> **Note:**
>
> If any of your log curves do not show up in the layout, make sure that they are toggled on in the *Inventory* task pane.

Log Curve Occurrence

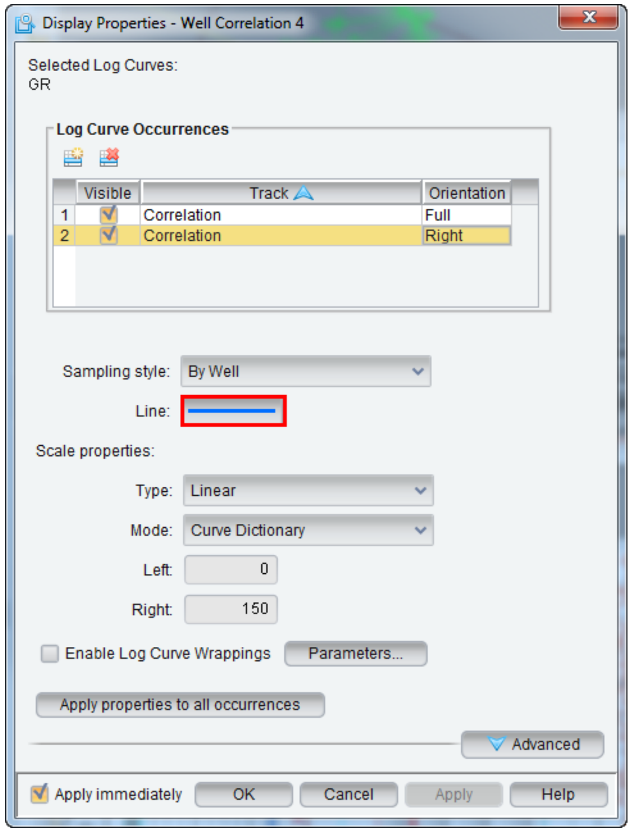
Multiple log curve occurrences is a new functionality. With this new feature you can display multiple occurrences of the same curve, in the same track, or in the same layout with different display properties.

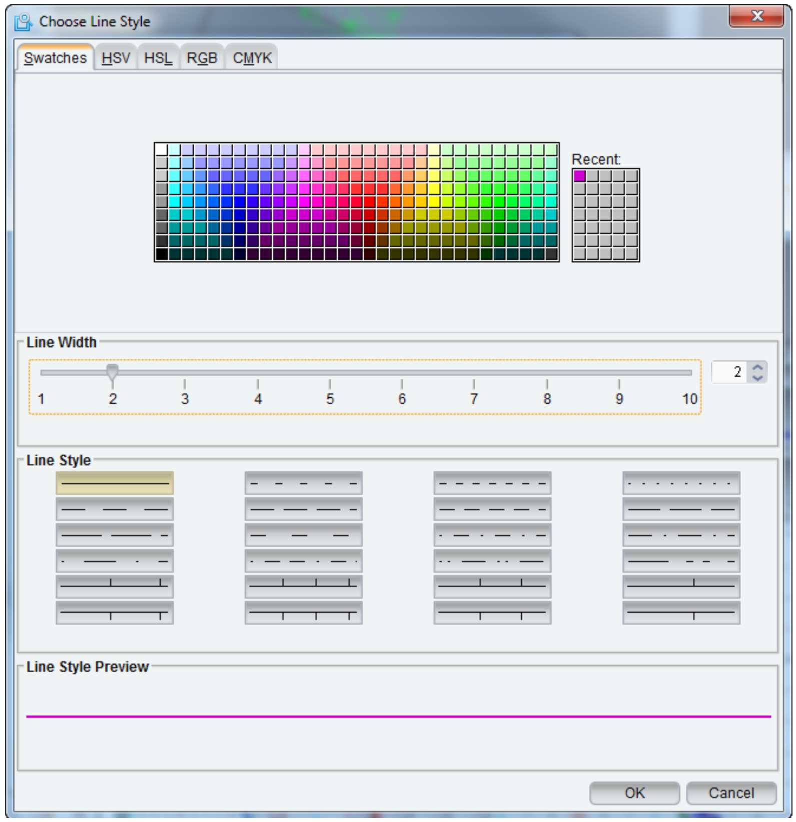
16. In the *Tracks Tree* panel of the *Tools* task pane, under Correlation > Log Curves, put your cursor on **GR** and **MB3 > Display Properties.** The *Display Properties* dialog opens.

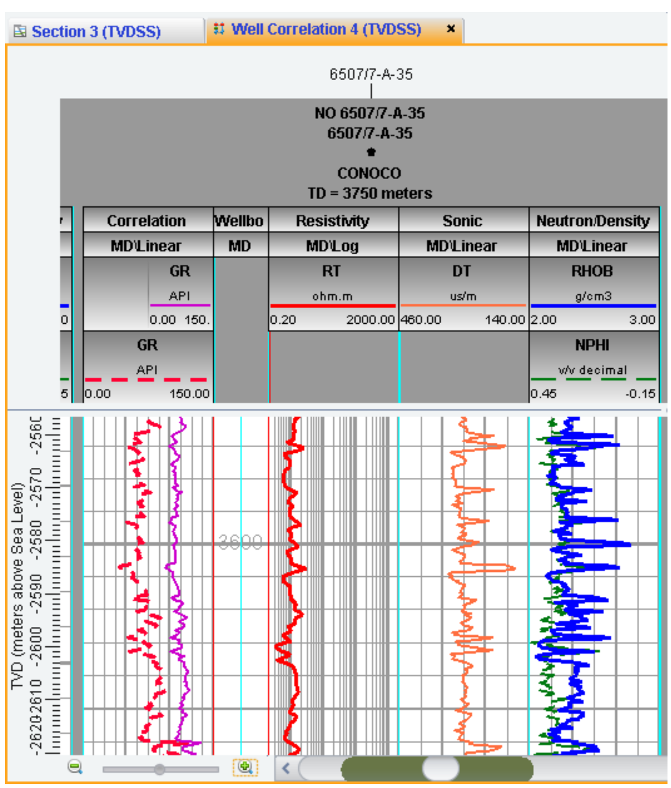
17. In the *Log Curve Occurrences* panel of the *Display Properties* dialog, click the **Add an Occurrence of the log curve** () icon. Another row will be added to the **Log Curve Occurrence** panel. Change its orientation to **Right.** The log curve appears on the *Correlation* view.



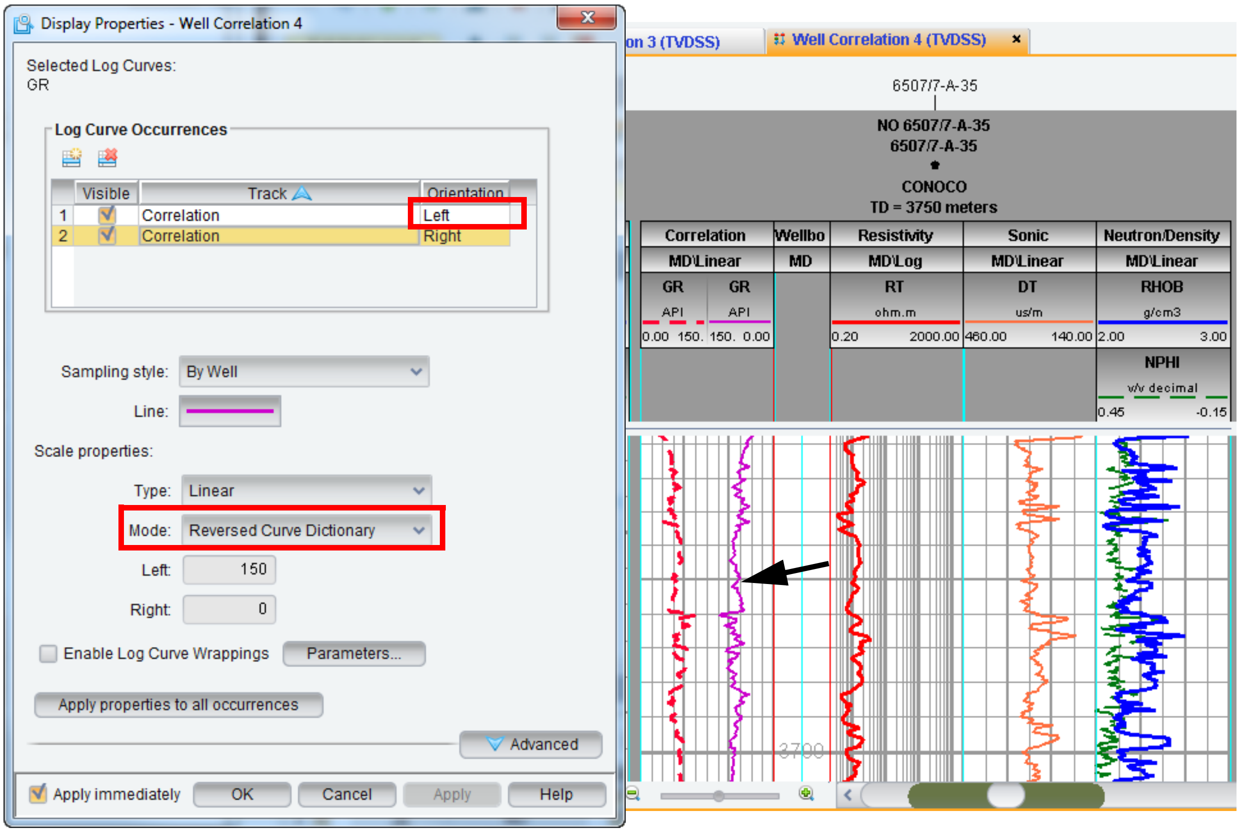
18. To change the Line Color, Line Width, and Line Style, select the GR occurrence you want to edit, then click the **Specify line color, width, and style properties** button to the right of Line:. The *Choose Line Style* dialog is displayed. Select the line color, width, and style that you want and click **OK.**



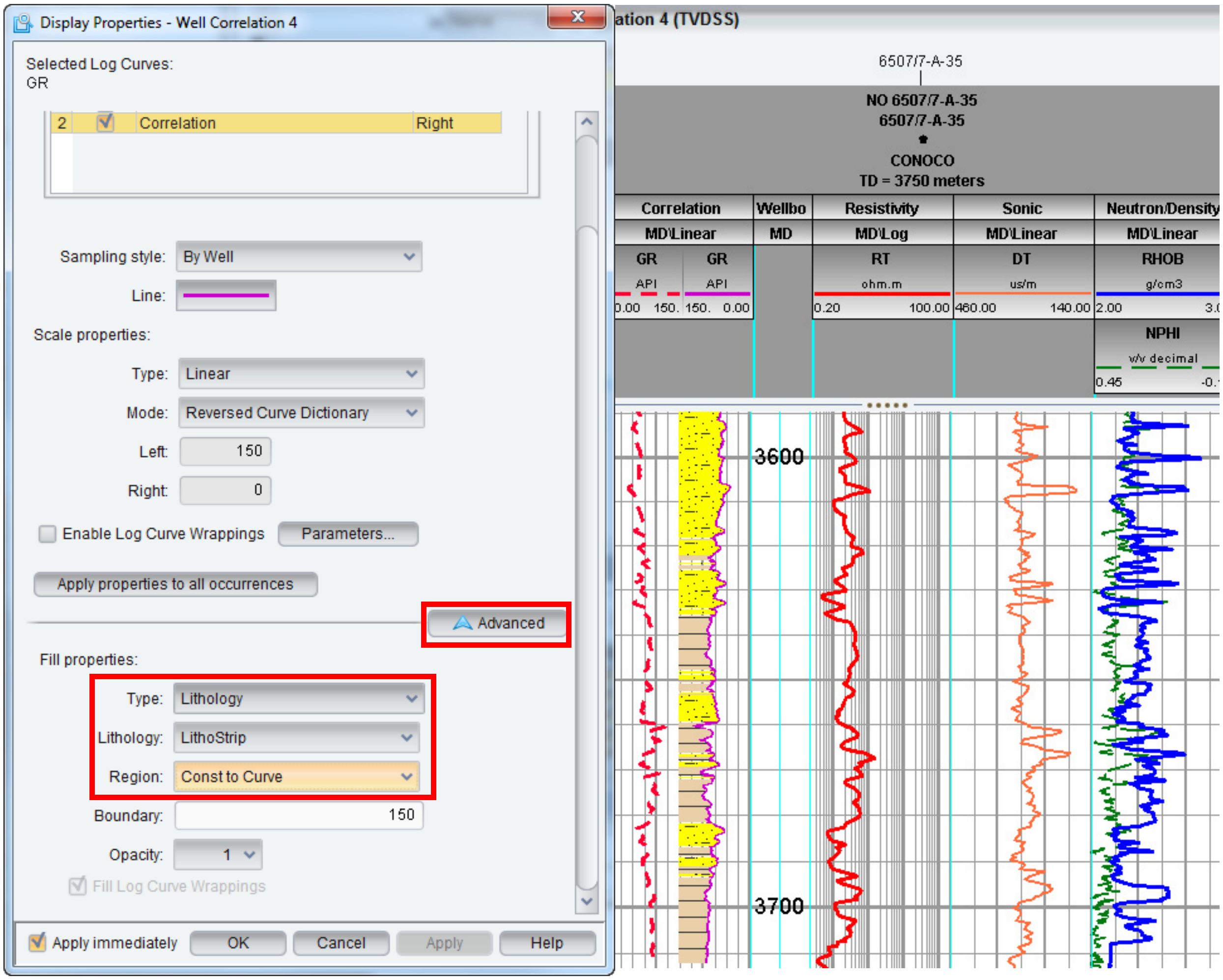

Choose Line Style
Swatches
HSV
HSL
RGB
CMYK
Recent:
Line Width
1 2 3 4 5 6 7 8 9 10
2
Line Style
Line Style Preview
OK
Cancel


Section 3 (TVDSS)
Well Correlation 4 (TVDSS)
6507/7-A-35
NO 6507/7-A-35
6507/7-A-35
CONOCO
TD = 3750 meters
Correlation
Wellbo
Resistivity
Sonic
Neutron/Density
MD\Linear
MD
MD\Log
MD\Linear
MD\Linear
GR
API
RT
ohm.m
DT
us/m
RHOB
g/cm3
0.00 150.
0.20 2000.00
460.00 140.00
2.00 3.00
GR
API
0.00 150.00
NPHI
v/v decimal
0.45 -0.15
TVD (meters above Sea Level)
-2560 -2570 -2580 -2590 -2600 -2610 -2620
3600

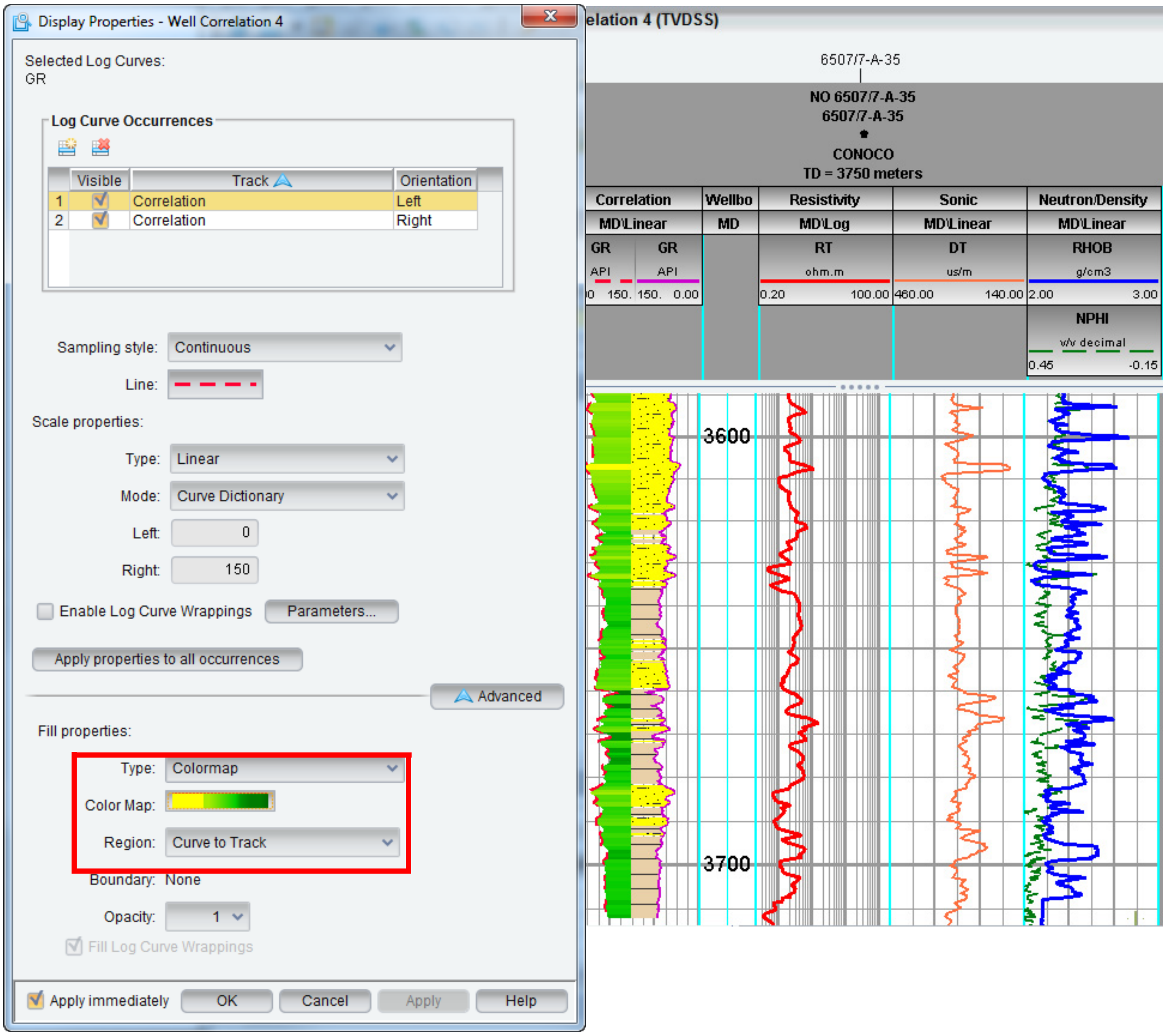
19. To create a butterfly/mirror log curve display, reverse the scale of the **second occurrence** of the GR log curve. In the Scale properties section of the *Display Properties* dialog, choose **Mode: Reversed Curve Dictionary** on the Mode pull-down menu. In addition, change the first occurrence of GR to have a **Left** orientation.



20. Now you will apply the lithology fill to the second occurrence of a log curve. Click the **Advanced** button in the *Display Properties* dialog. Select **Lithology** on the Type: pull-down menu, then select **LithoStrip** on the Lithology: pull-down menu. Select **Const To Curve** on the Region: pull-down menu.


Display Properties - Well Correlation 4
Selected Log Curves:
GR
2 Correlation Right
Sampling style: By Well
Line:
Scale properties:
Type: Linear
Mode: Reversed Curve Dictionary
Left: 150
Right: 0
Enable Log Curve Wrappings
Parameters...
Apply properties to all occurrences
Advanced
Fill properties:
Type: Lithology
Lithology: LithoStrip
Region: Const to Curve
Boundary: 150
Opacity: 1
Fill Log Curve Wrappings
Apply immediately
OK
Cancel
Apply
Help
ation 4 (TVDSS)
6507/7-A-35
NO 6507/7-A-35
6507/7-A-35
CONOCO
TD = 3750 meters
Correlation
Wellbo
Resistivity
Sonic
Neutron/Density
MD\Linear
MD
MD\Log
MD\Linear
MD\Linear
GR
GR
RT
DT
RHOB
API
API
ohm.m
us/m
g/cm3
150.
150.
0.00
0.20
100.00
460.00
140.00
2.00
NPHI
v/v decimal
0.45
3600
3700

21. You will now fill the Left-oriented GR curve. On the Type: pull-down menu, select **colormap**; on the Colormap: pull-down menu, select **Geology > GammaRay;** and on the Region: pull-down menu select **Curve to Track**. Click **OK**.



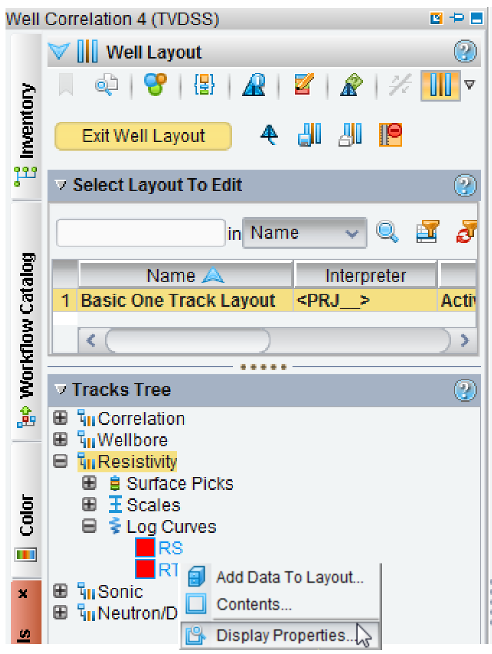
Note:

In the Geology GammaRay colorbar, shale is indicated by green to dark green, while the yellow indicates sandstone. Comparing the GammaRay colormap fill to the LithoStrip lithology fill will give you a good idea of the main sandstone.

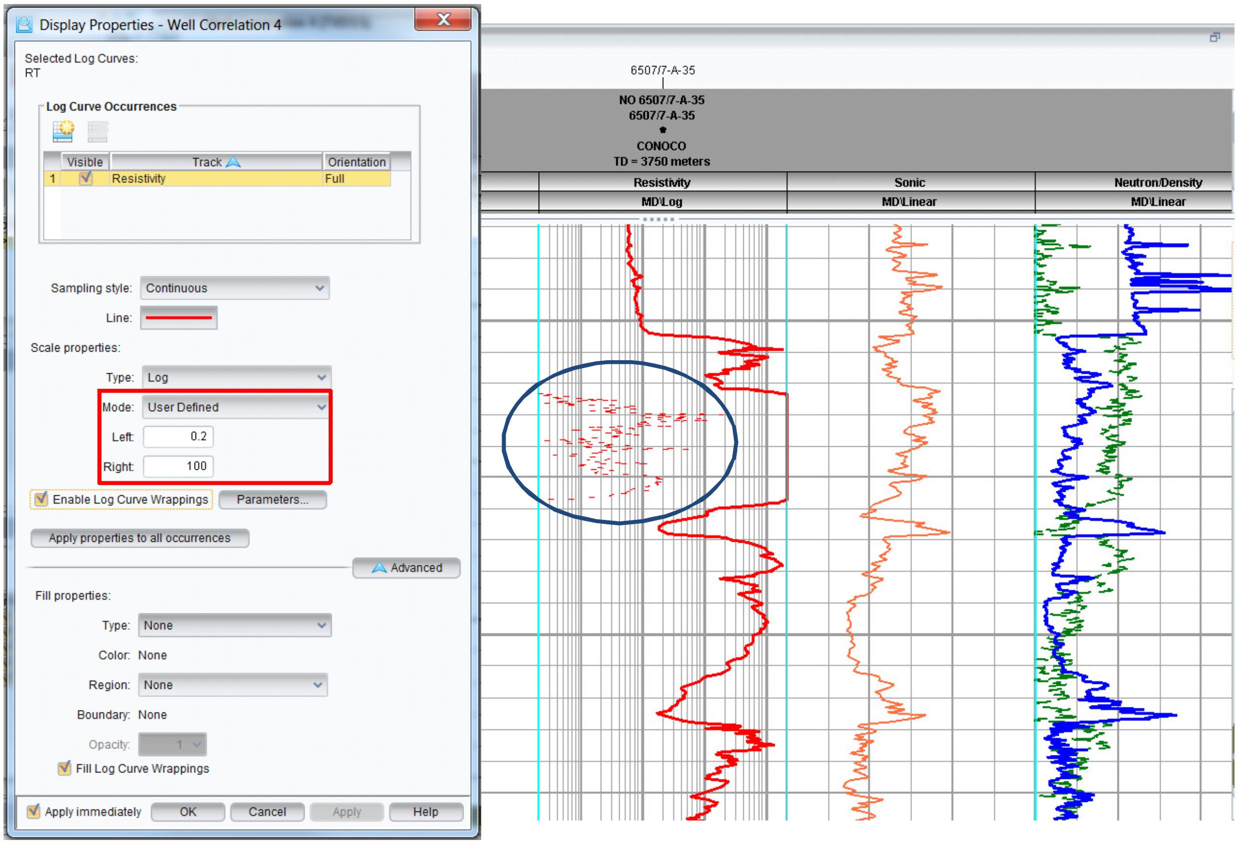
Curve Wrapping

Sometimes log curves contain spikes that are outside the normal range of the log. These log curve wraps need to be properly scaled to make your log curve display understandable. The log curve wrapping option lets you specify a scale factor for a curve so any spikes in the data wrap around the track allowing for the normal scale to remain for the bulk of the data, while making you aware of any abnormally large readings, without skewing the scale for the build of the data.

22. In the *Tracks Tree* panel of the **Well Layout** task pane, expand the **Resistivity** track, then expand the **Log Curves** section. Put your cursor on the **RT** curve and **MB3 > Display Properties**.

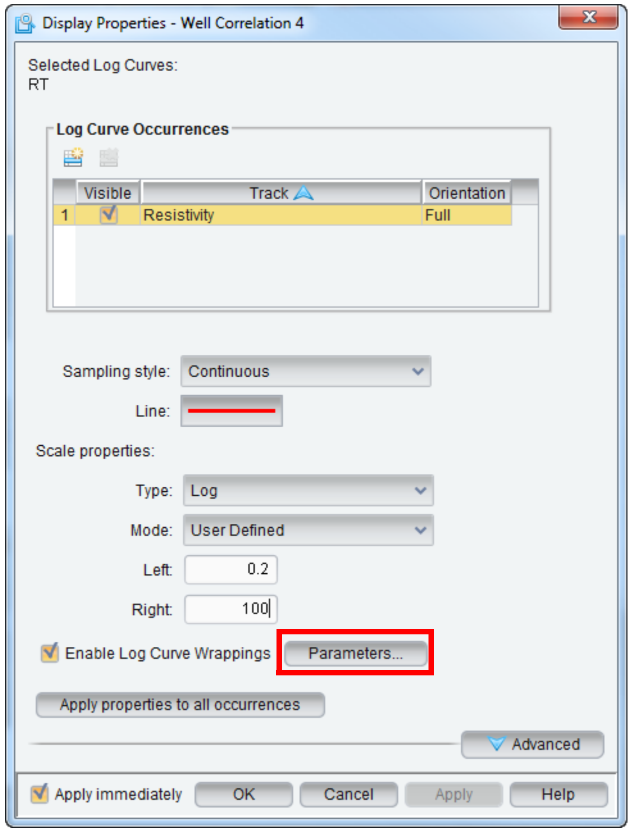


23. The *Display Properties* dialog for log curve RT is displayed. In the *Display Properties* dialog, toggle on **Enable Log Curve Wrappings**. On the Mode: pull-down menu, select **User Defined**. In the Left: field, enter **"0.2"**, and in the Right: field, enter **"100"**.

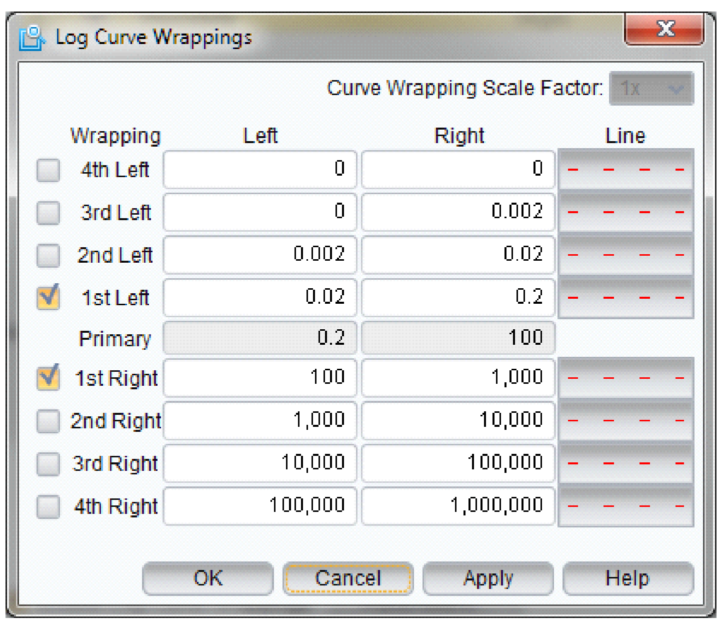


The blue ellipse in the above image indicates the wrapped RT log curve, which has values greater than 100. You can create up to four wraps on either side of the primary log.

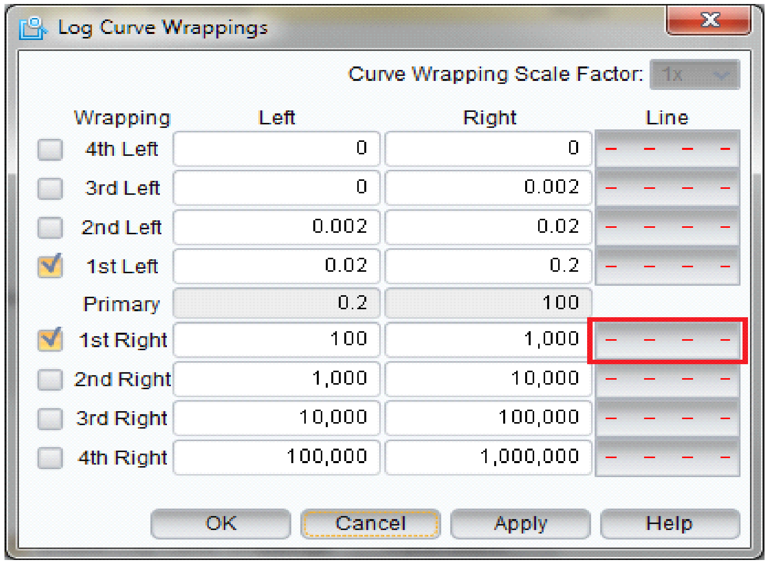
24. To change the properties of the wrapped log curve, click the **Parameter**s button in *Display Properties* dialog.



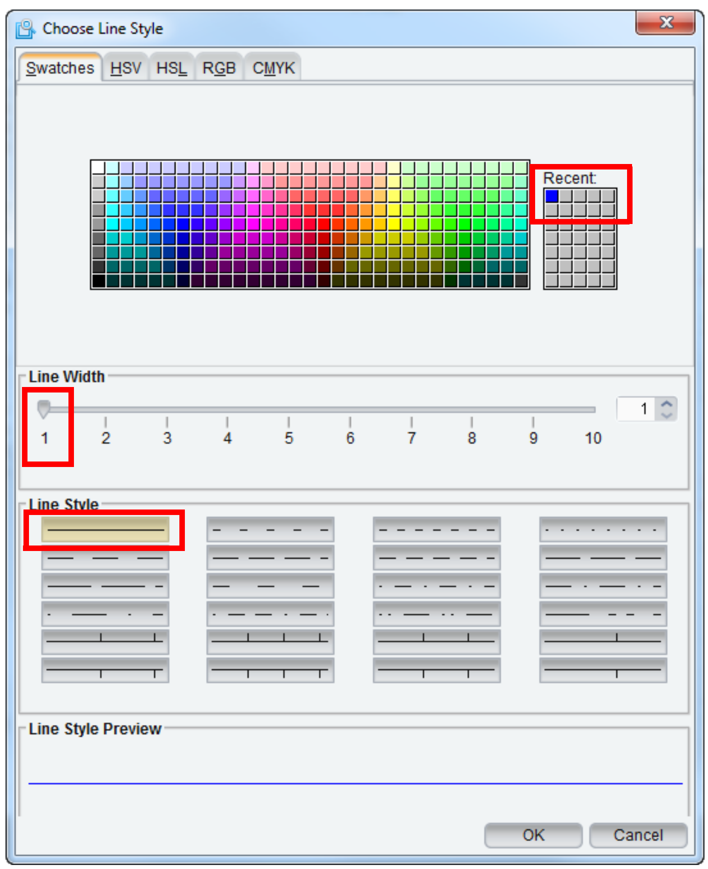
The *Log Curve Wrappings* dialog is displayed.



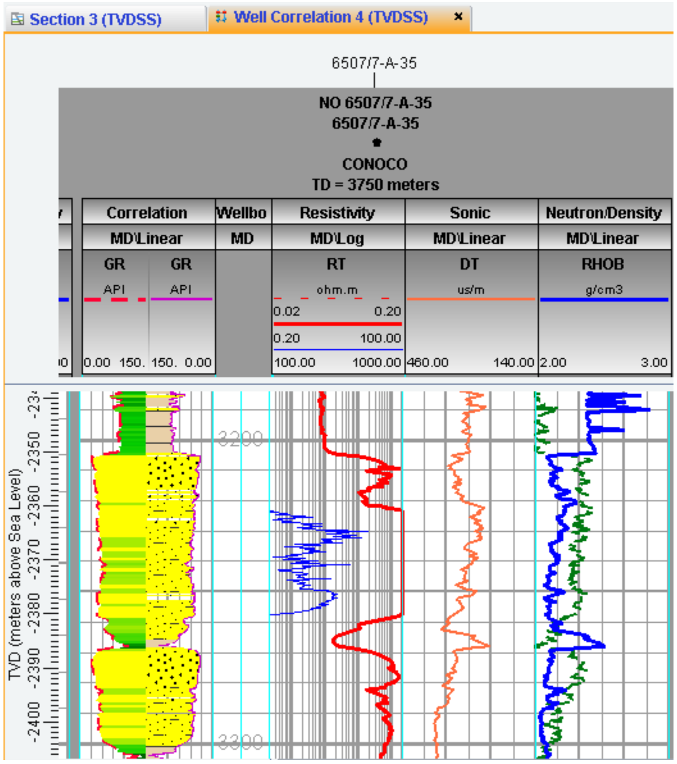
25. In the *Log Curve Wrappings* dialog, click the **Line style button for the 1st right wrapping**.



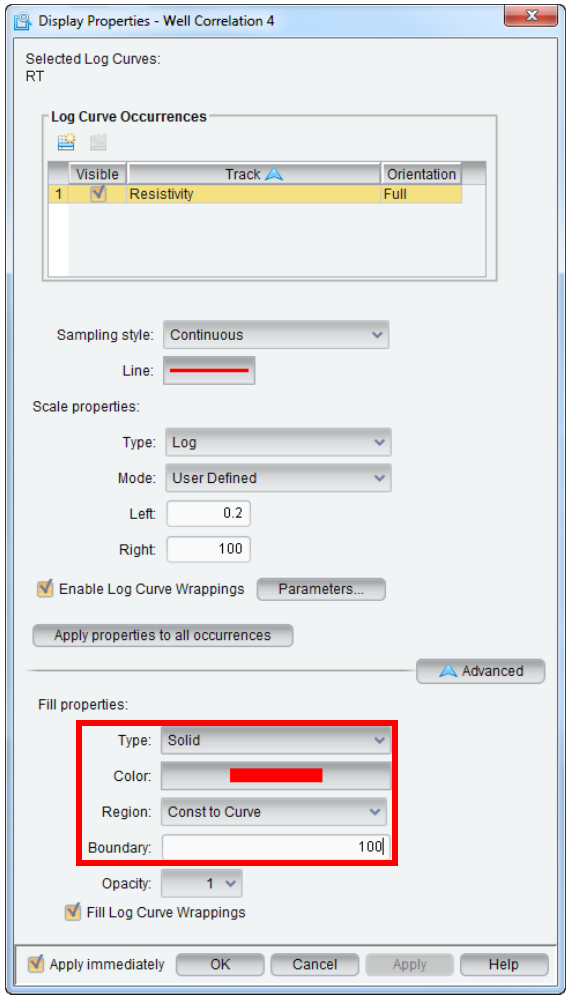
26. The *Choose Line Style* dialog is displayed. Select **blue** as a Line color, set Line Width to **1,** and set Line Style to **solid**. Click **OK**.



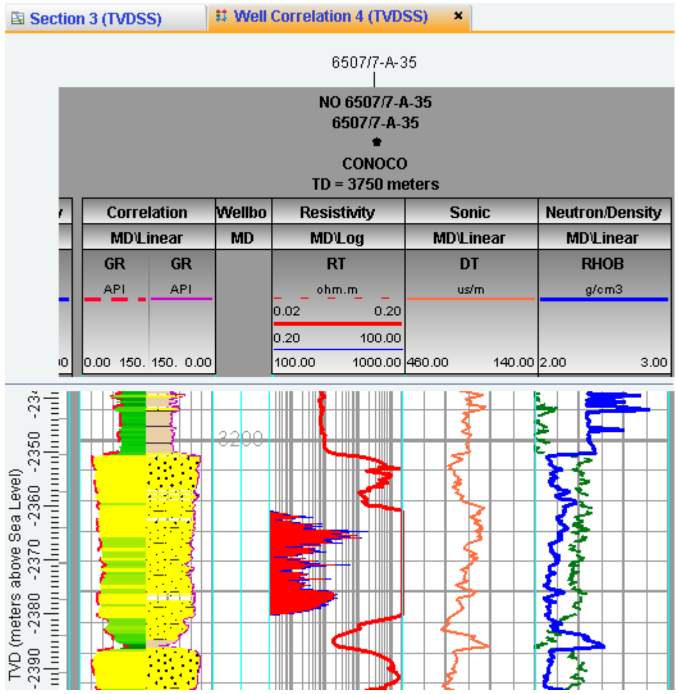
27. Click **OK** in the *Log Curve Wrappings* dialog.



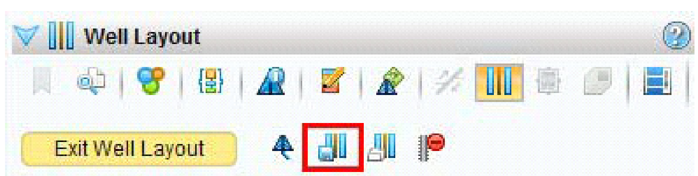
28. In the *Advanced* panel of the *Display Properties* dialog, perform the following steps. On the Type: pull-down menu, select **Solid.** Click the Color: icon and select **red**. In the Boundary: field enter **"100".** Click **OK.**



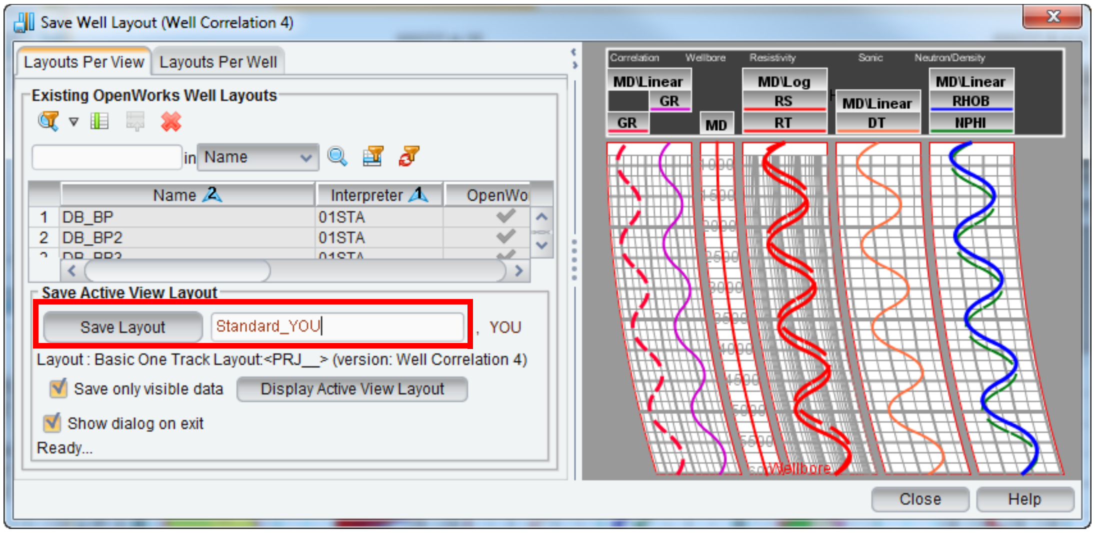
This will fill the space between the curve and a specified value. This will also highlight the areas that are significantly above 100.



29. On the *Well Layout* task pane click the **Save Well Layout...** ( ) icon.



30. In the Save Layout field, enter **“Standard_YOU”** and then click the **Save Layout** button. Close the **Save Well Layout** dialog.

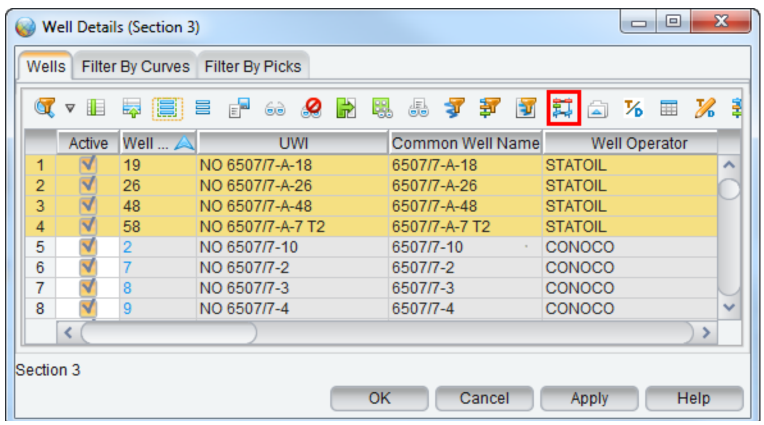


Exercise 2.5: Adding a Layout to Wells in Correlation View

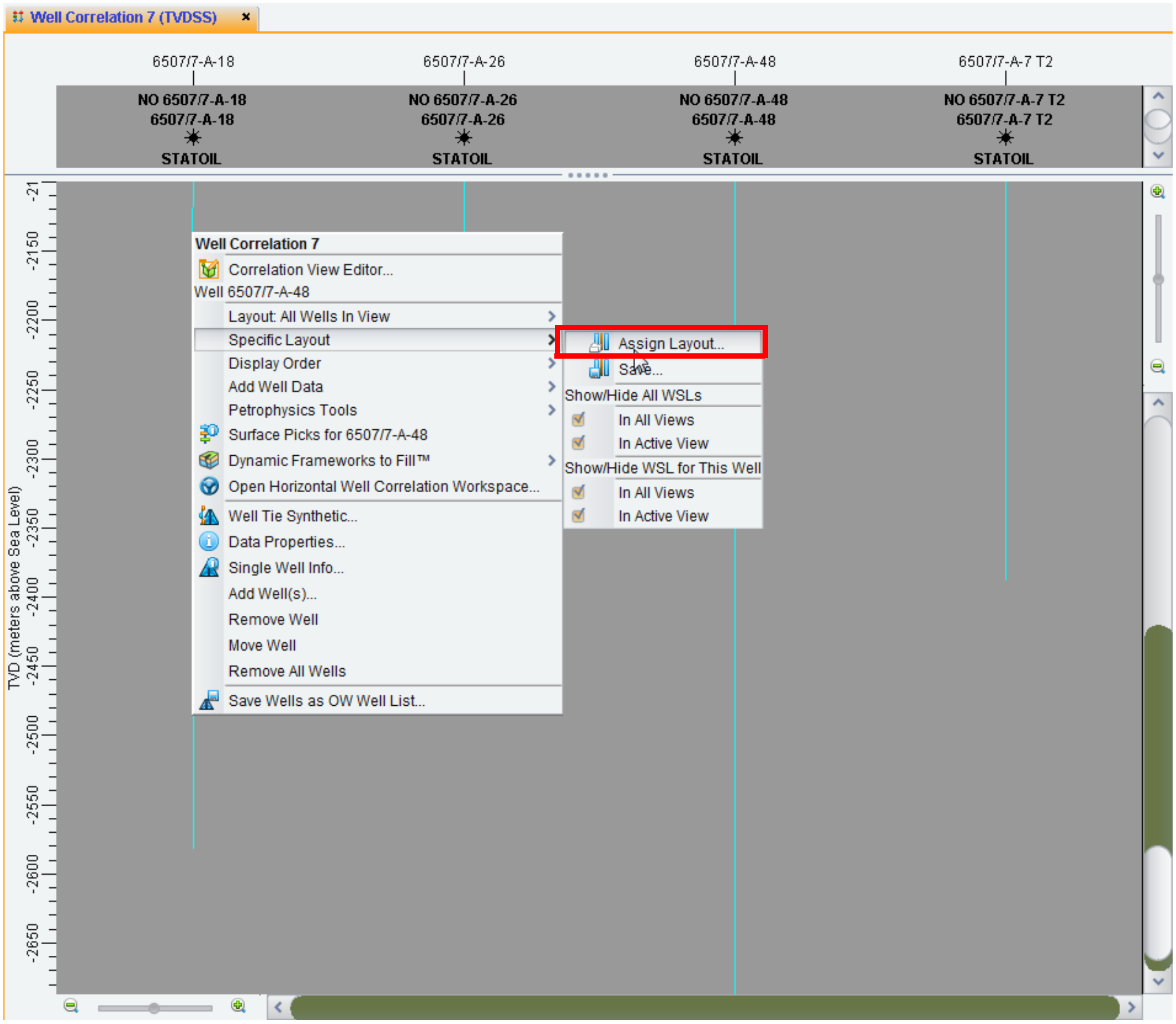
From time to time wells may be missing one or more well logs, so the layout that you created for all of the wells may not work for a particular well. You can use a different layout for every well in *Correlation* view, one layout for all wells in *Correlation* view, or any combination of specific Well Layouts assigned to specific wells.

Display a Specific Layout

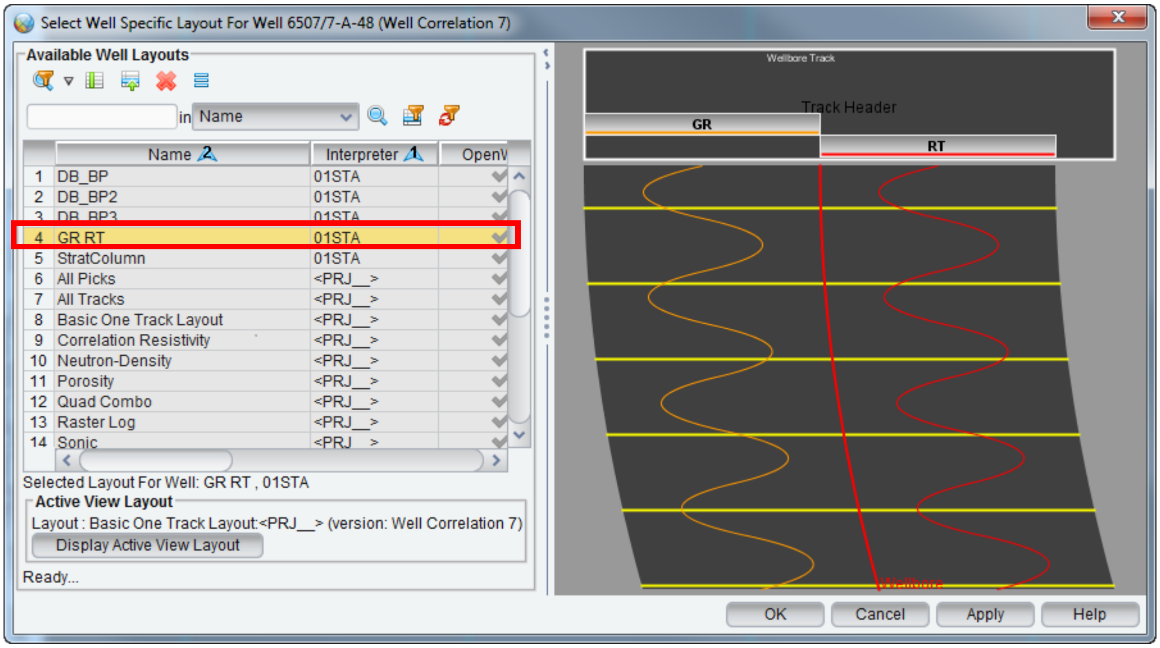
1. Make sure the *Well Correlation* view that was open during the previous exercise is closed. In the *Inventory* task pane, put your cursor on well list **demo wells** and **MB3 > Well Details.** In the *Well Details* dialog, select the following wells and click **Display Selected Wells in New Correlation View** icon**.**



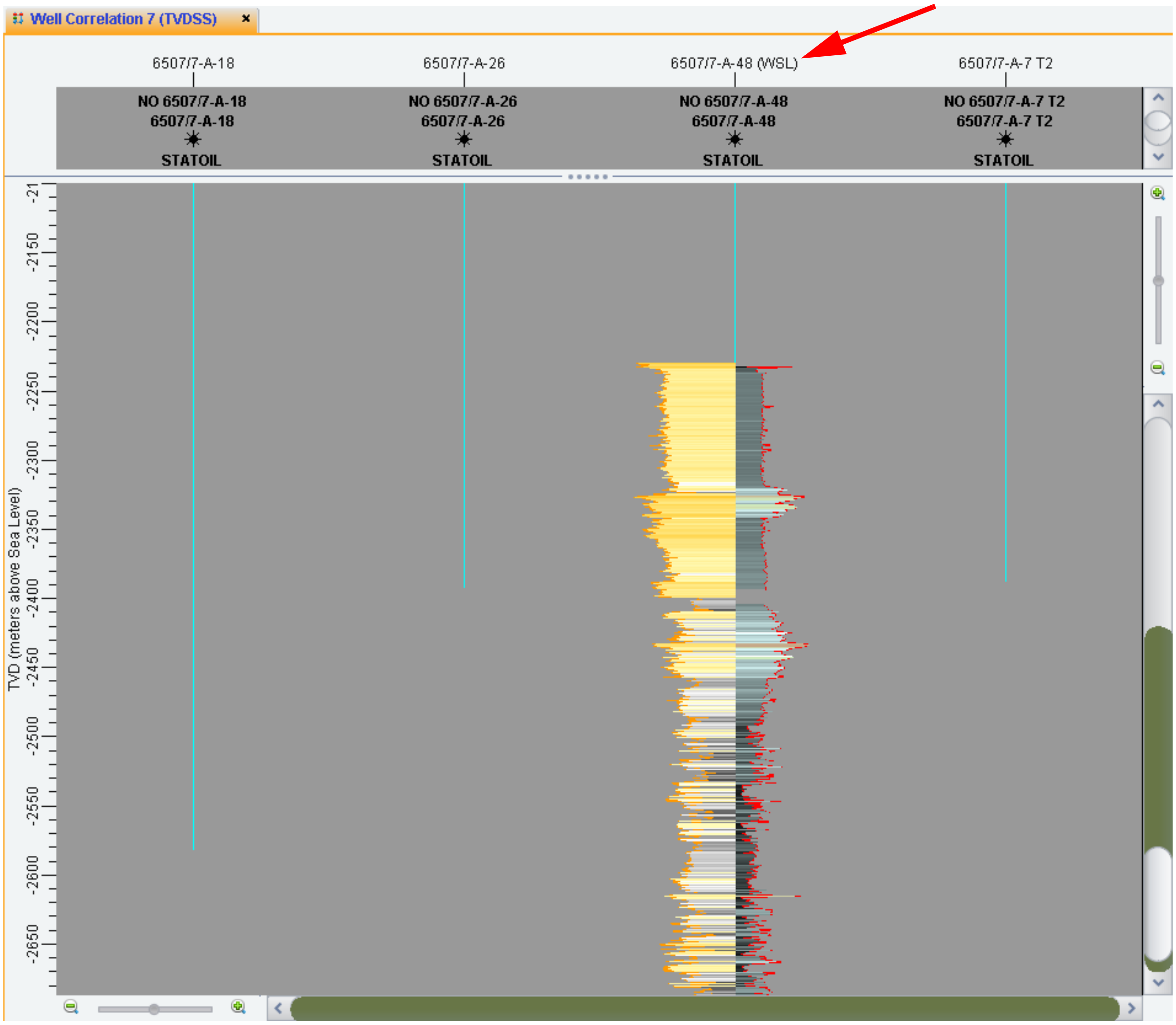
2. In *Well Correlation* view, put your cursor on **well 6507/7-A-48** and **MB3 > Specific Layout > Assign Layout..,**



3. On the *Select Well Specific Layout For Well* dialog, select the **GR RT** well layout and click **OK.**



The well layout is applied only to well 6507/7-A-48.

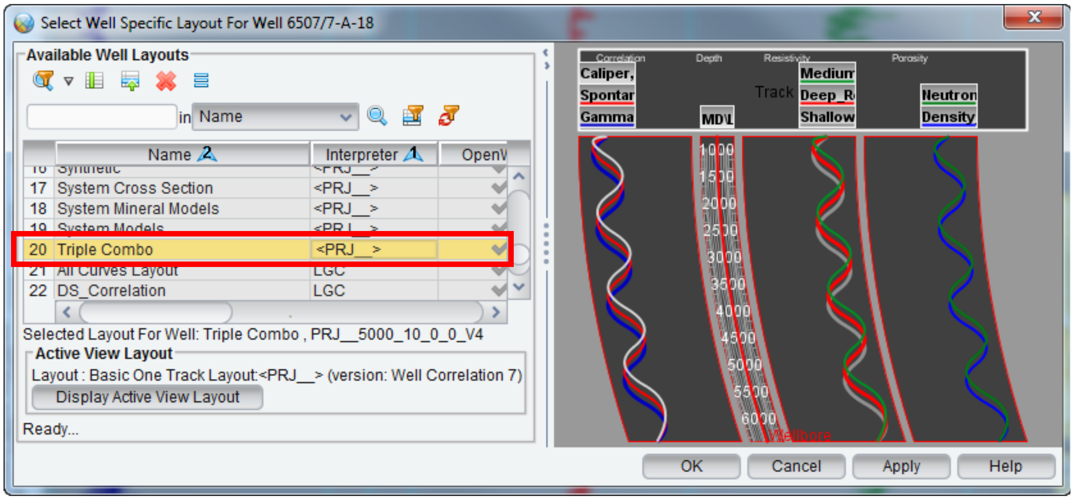


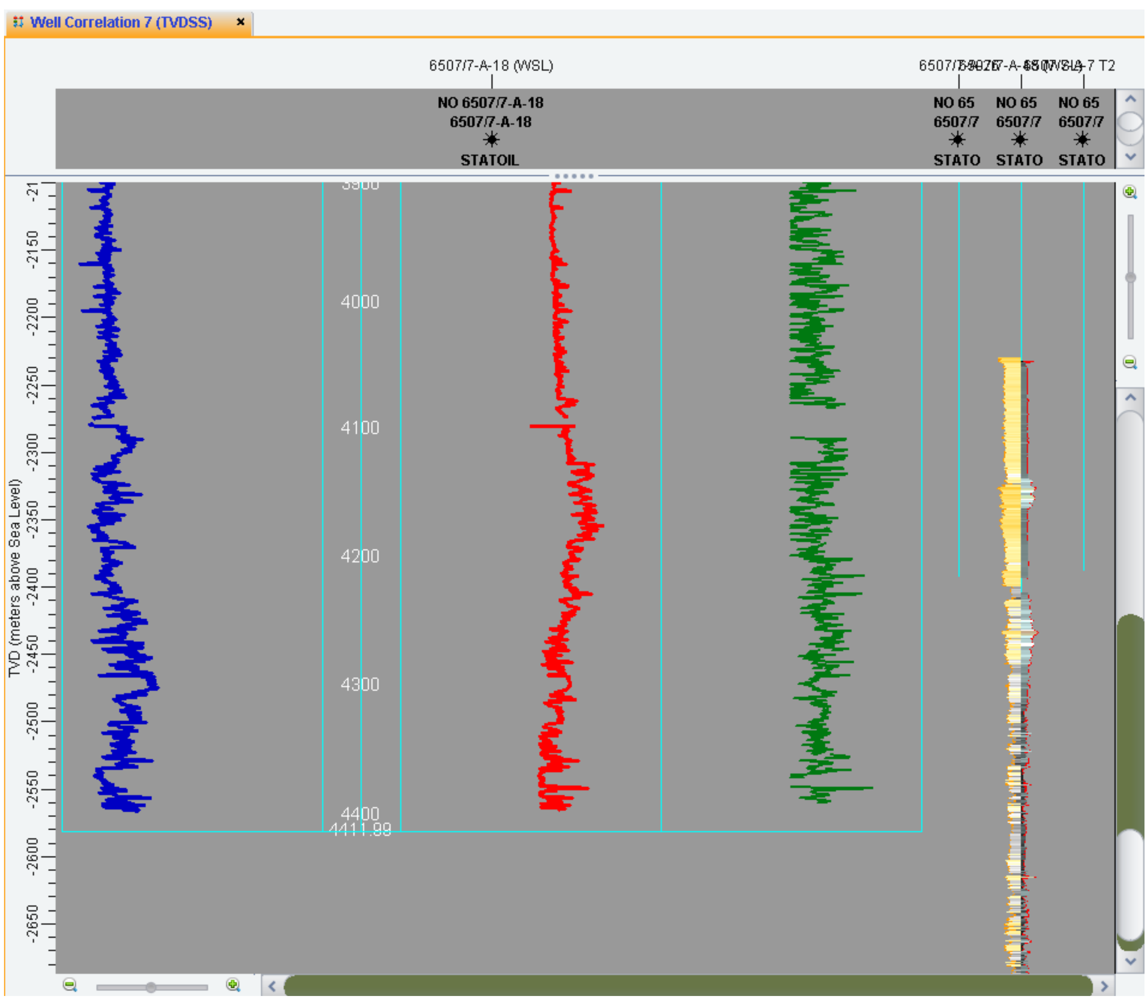
> **Note:**
>
> Wells using a Well Specific Layout are noted with a (WSL) to make viewers aware that the well is different from the rest of the displayed wells, as shown in the above image.

Now you will apply another Well Layout to a different well in *Correlation* view.

4. In *Well Correlation* view put your cursor on well 6507/7-A-18 and **MB3 > Specific Layout > Assign Layout**.

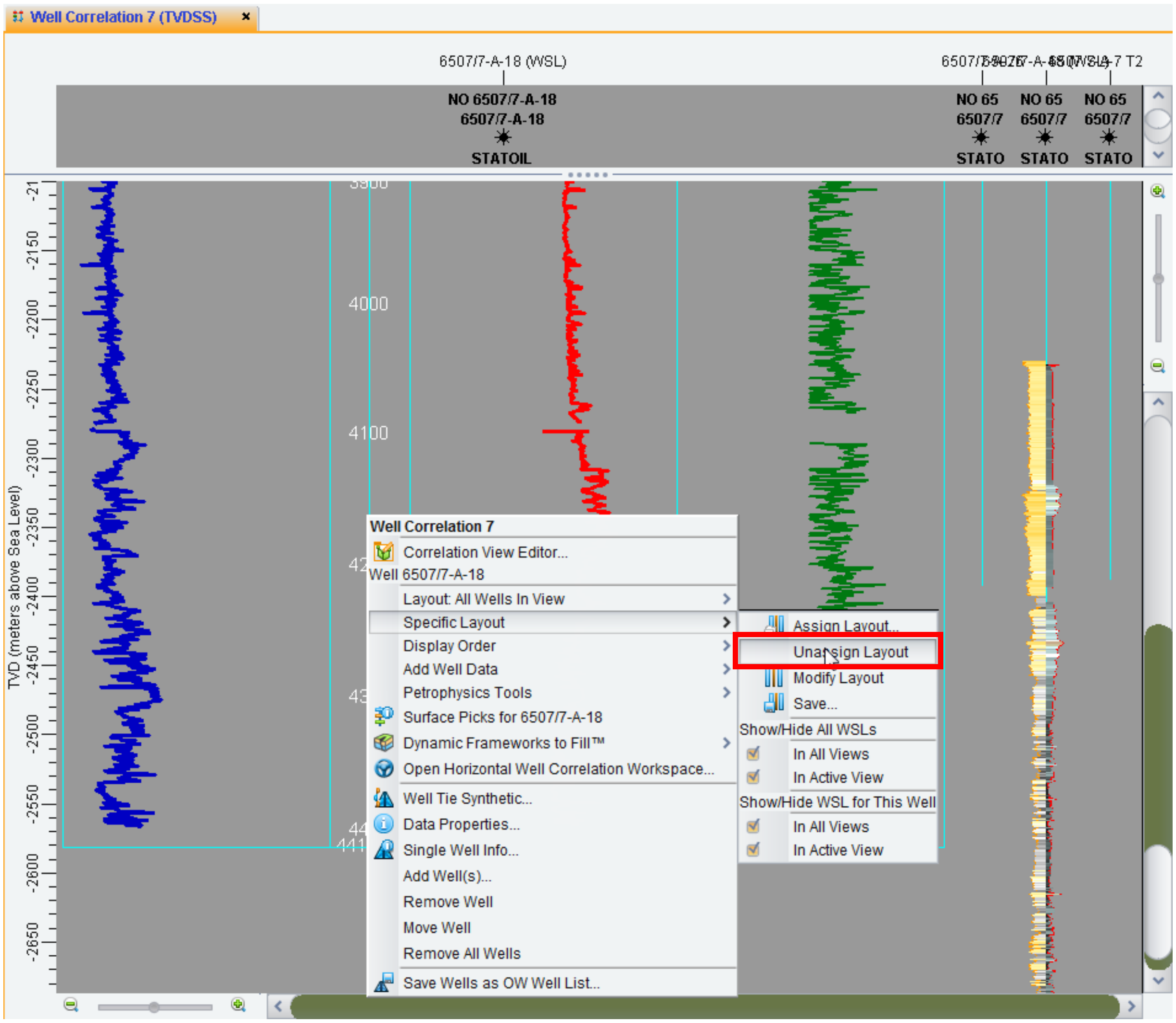
5. In the *Select Well Specific Layout for Well* dialog, select layout **Triple Combo** on the *Available Well Layouts* panel and click **OK**.





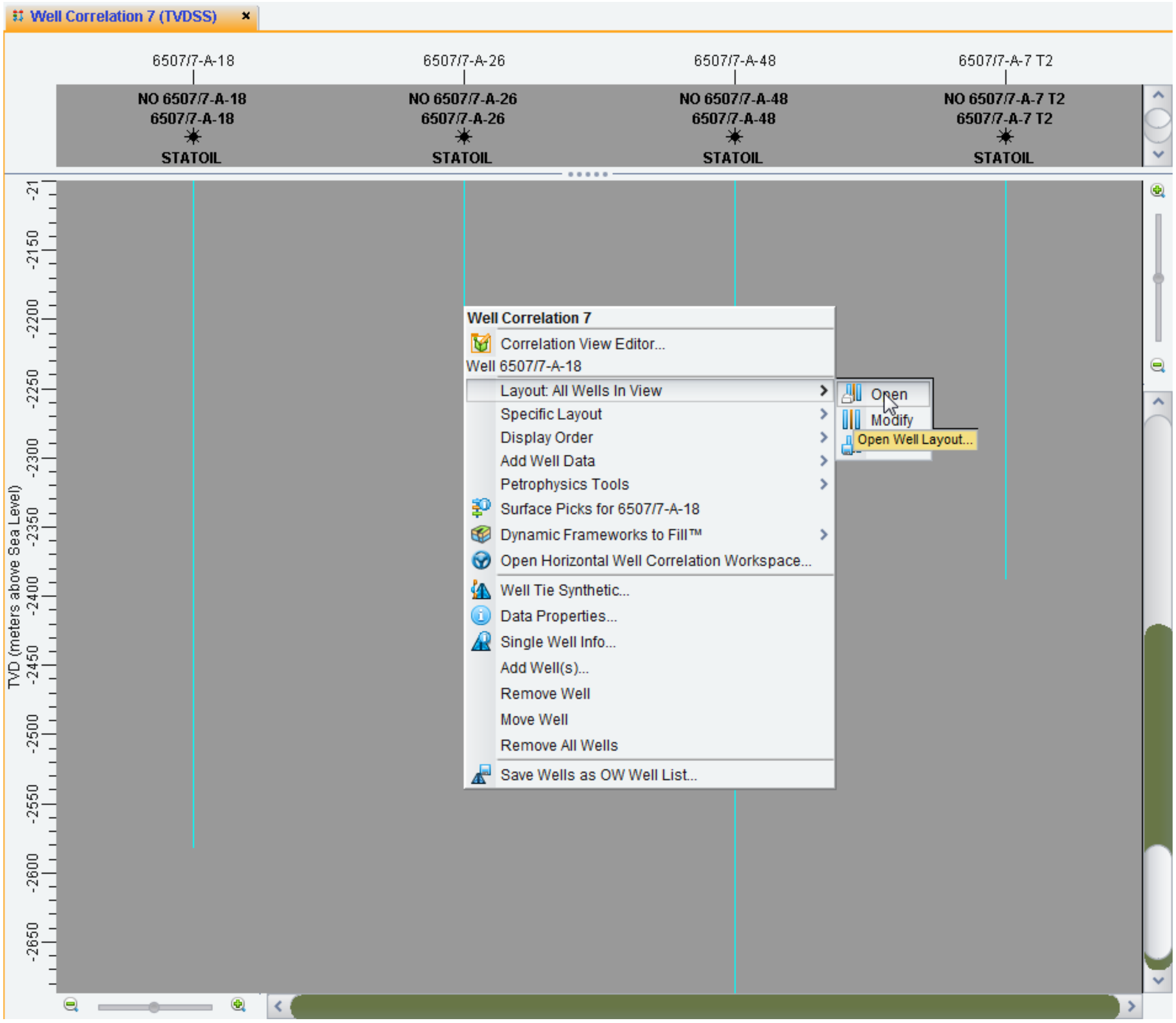
Displaying a Layout in All Wells in Correlation View

6. Now you will use one layout for all wells in *Correlation* view. Before doing this you need to unassign the specific layouts from wells 6507/7-A-18. Put your cursor on a well that is assigned a specific layout and **MB3 > Specific Layout > Unassign Layout.**

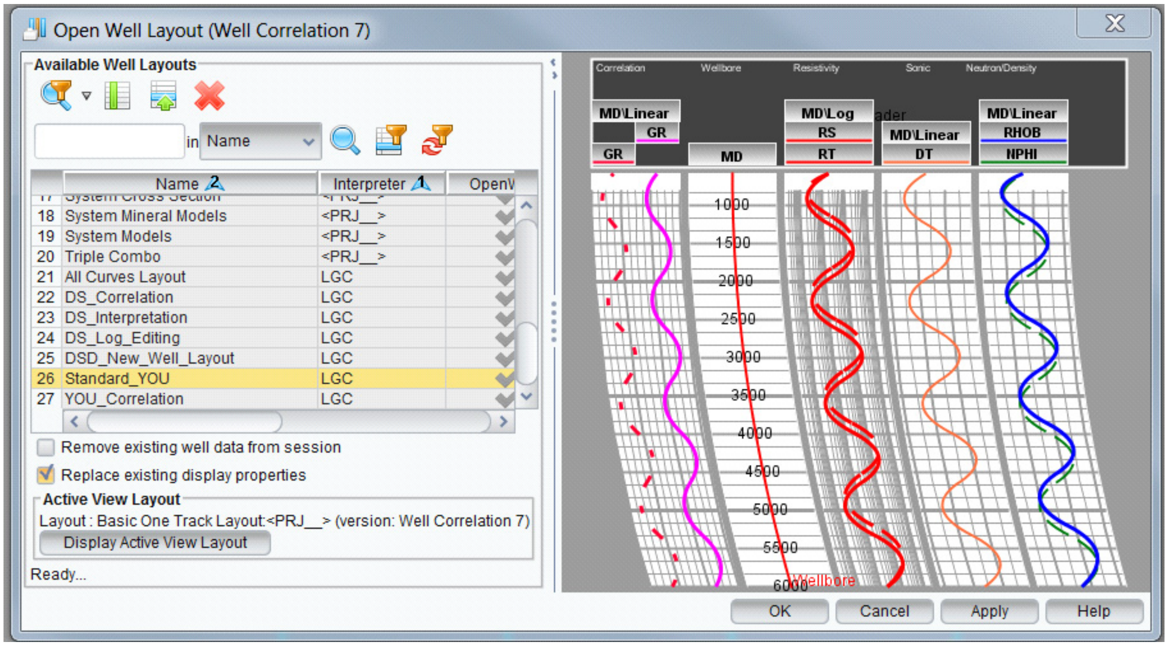


7. This will remove the well layout from that well, leaving it open to display the Well Layout selected for all wells in view (in this case, Basic One Track Layout). Remove the **specific layout** from well 6507/7-A-48.

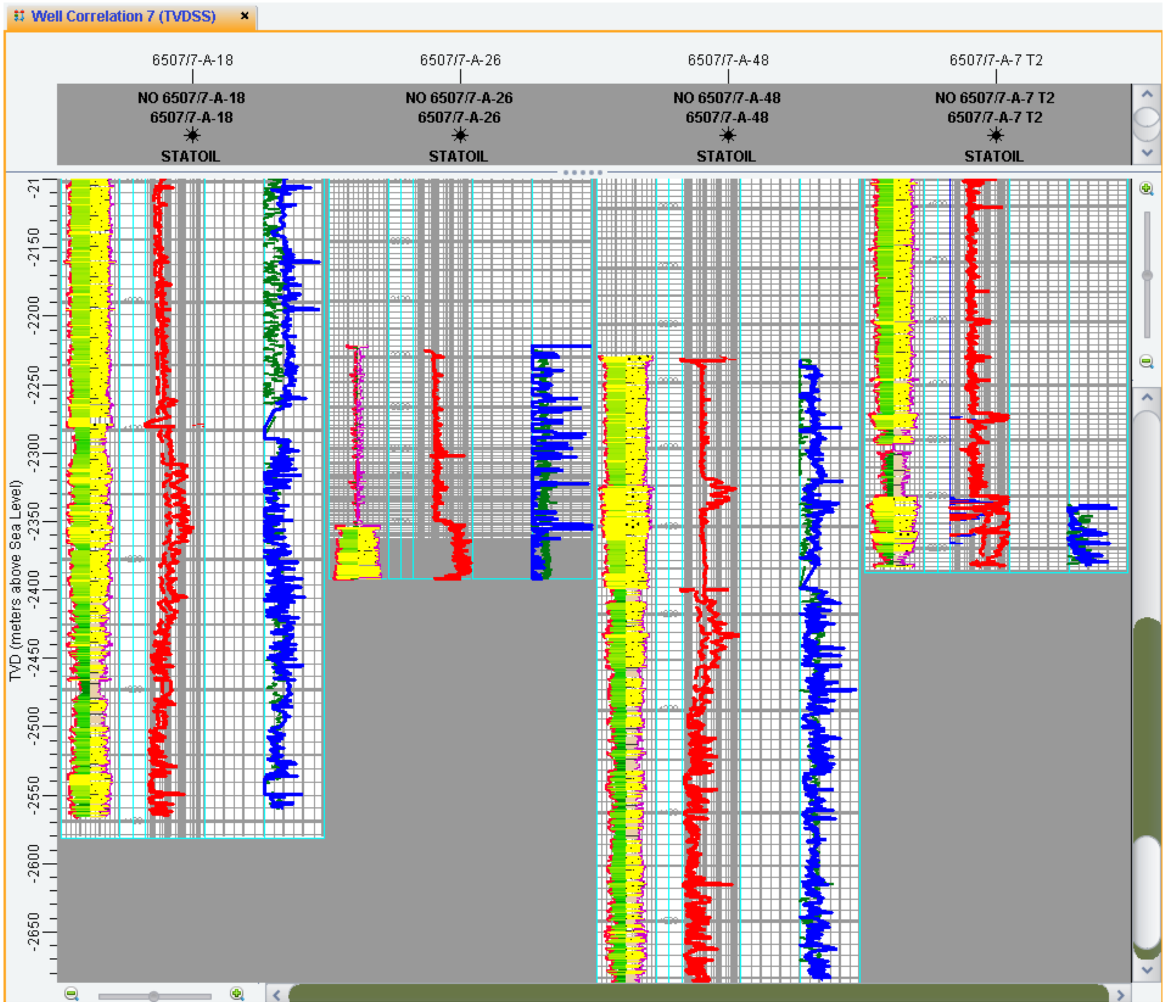
8. In *Correlation* view put your cursor on any well and **MB3 > Layout: All Wells In View > Open.**



9. The *Open Well Layout* dialog is displayed. Select **Standard_YOU,LGC** and click **OK.**



The same well layout is applied on all of the wells in *Correlation* view.



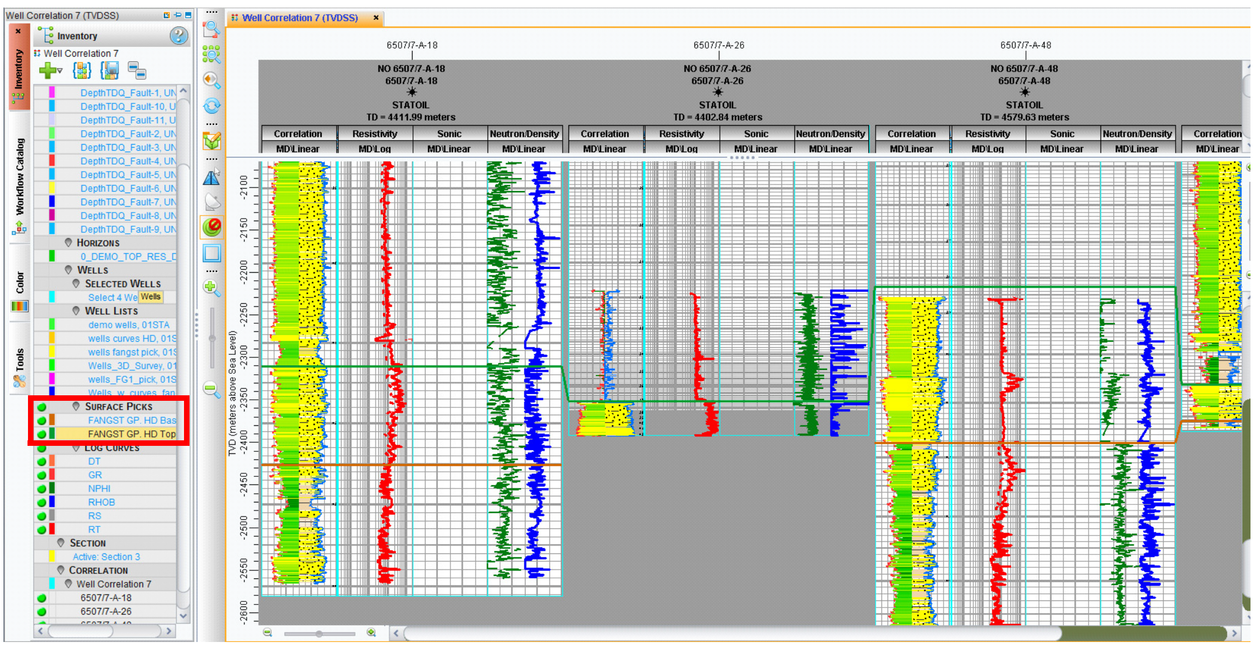
Note:

If you do not first select *Unassign Layout,* when you apply the Layout to all of your wells, the specific layout will override. When you unassign the specific layout to those wells, the layout you have just applied to all wells will appear automatically.

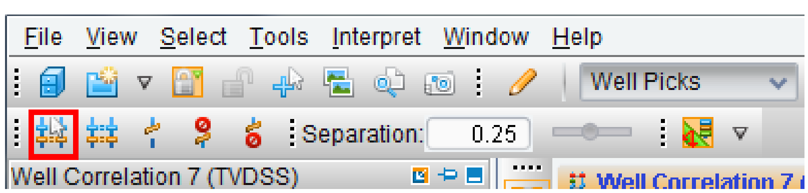
Exercise 2.6: Flattening a Correlation View and Changing Views from TVT to TST

One of the advantages of flattening on a particular surface pick is to be able to see the stratigraphy in your area as you are making your interpretations. In this exercise, you will learn how to use the flattening tool. You will also learn the difference between TST and TVT and how to switch between TST and TVT in your views.

1. With *Correlation* view still active from the previous exercise, go to the *Inventory* task pane and toggle on the Surface Picks **FANGST GP.HD Top** and **FANGST GP.HD Base**.



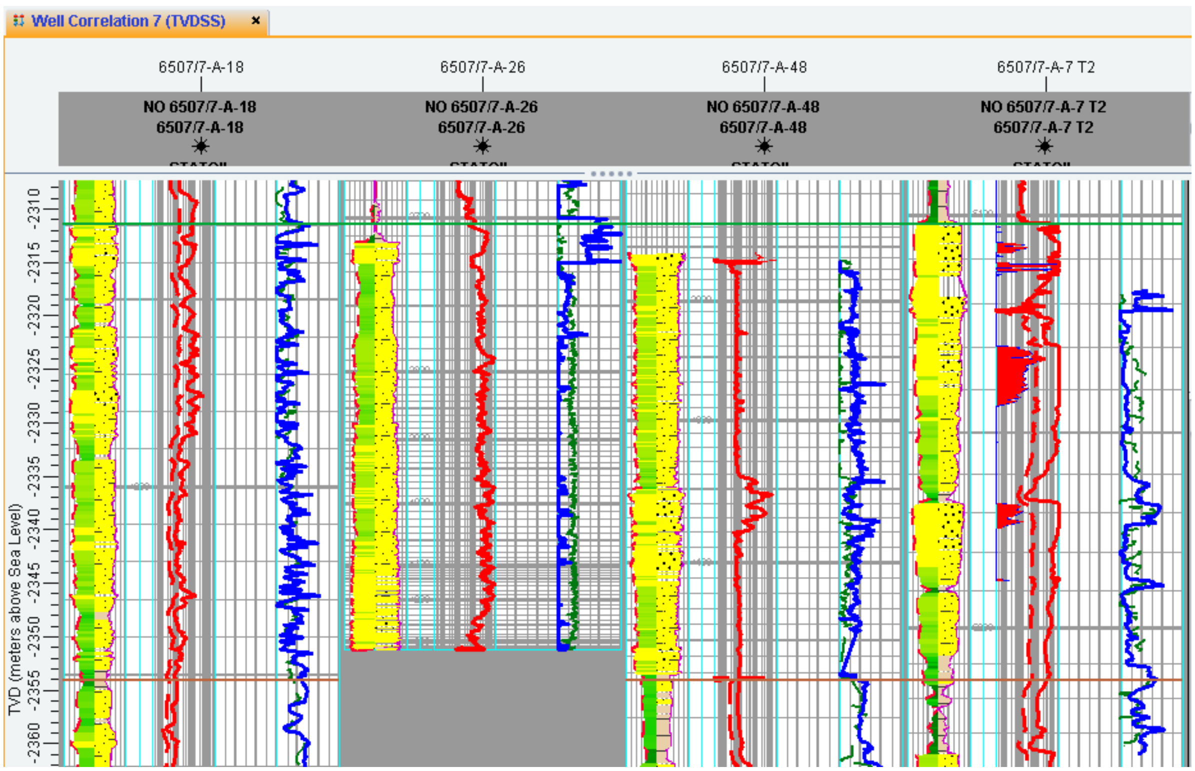
2. To flatten on a pick, click the **Select Pick for Flattening** () icon on the main toolbar.



3. Click the **FANGST GP. HD Top** surface pick on any of the wells in the *Correlation* view. The **FANGST GP. HD Top** surface pick will become flat. Zoom in further, if necessary.

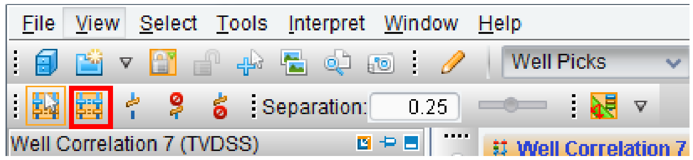
> **Note:**
>
> If you hover over the pick the name will appear. This is to reassure you that you are selecting the right pick.

4. To flatten multiple picks, **<Ctrl> + MB1** on the additional pick. For this exercise **<Ctrl> + MB1** on **FANGST GP. HD Base** surface pick.



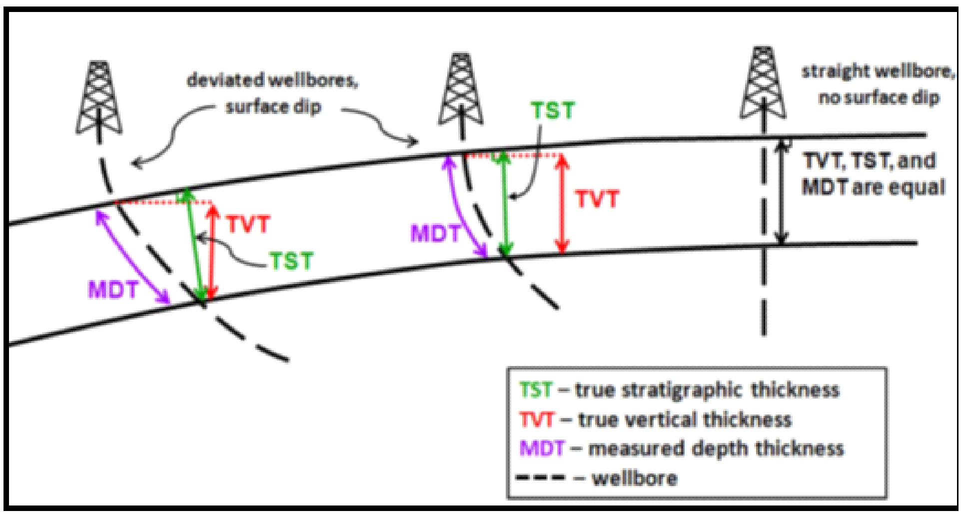
> **Note:**
>
> This has an effect on the real shape of log curves as it squeezes or stretches the well display with its curves, to accommodate for the flattening. Be aware that the pick will flatten according to the value of the particular well pick that you selected. The vertical scale (in this case, TVD) is not longer applicable to your wells in this state.

5. To reset picks to their original positions, click the **Reset Pick Flattening** ( ) icon.

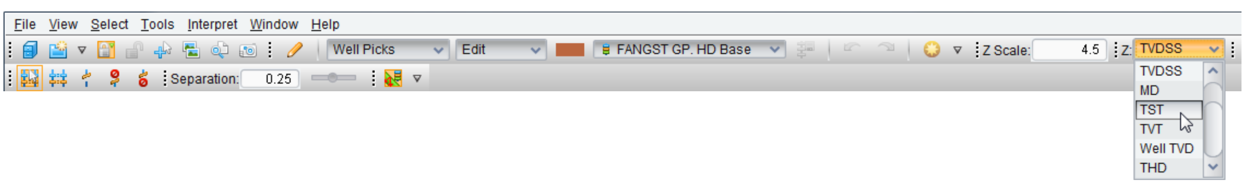


Changing View from TVT to TST

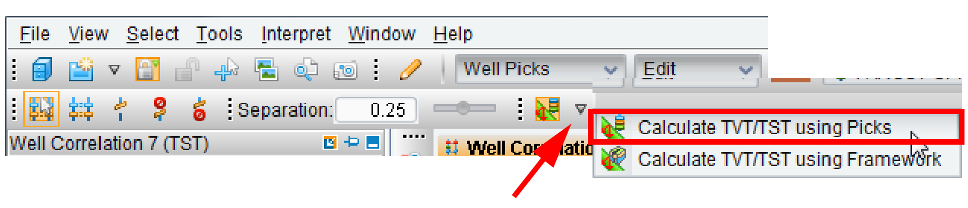
DecisionSpace Geosciences allows you to display a *Correlation* view in either True Vertical Thickness (TVT) or True Stratigraphic Thickness (TST) using dip and azimuth values from either well picks or from a Framework surface.



6. On the main toolbar, on the Z: pull-down menu, select **TST**.



7. Click the **Calculating TVT/TST using Picks** icon, and on the pull-down menu select **Calculate TST/TVT using Picks**. The display shows the proper vertical spacing for the selected domain**.**



Note:

TVT and TST assume all bedding surfaces are parallel. The calculations are based on dip angle and dip azimuth values assigned to individual surface or fault picks in each well (as assigned in the *Pick Details* panel of the *Well Pick Interpretation* task pane). For each well, the software will analyze each pick from the kelly bushing (KB) to total depth (TD). When a pick is found with dip values and azimuth values, those values are applied to all units below that pick to TD unless another pick is found with dip values, at which point the new values are used.

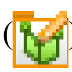
Exercise 2.7: Setting View Properties for Well Correlation View

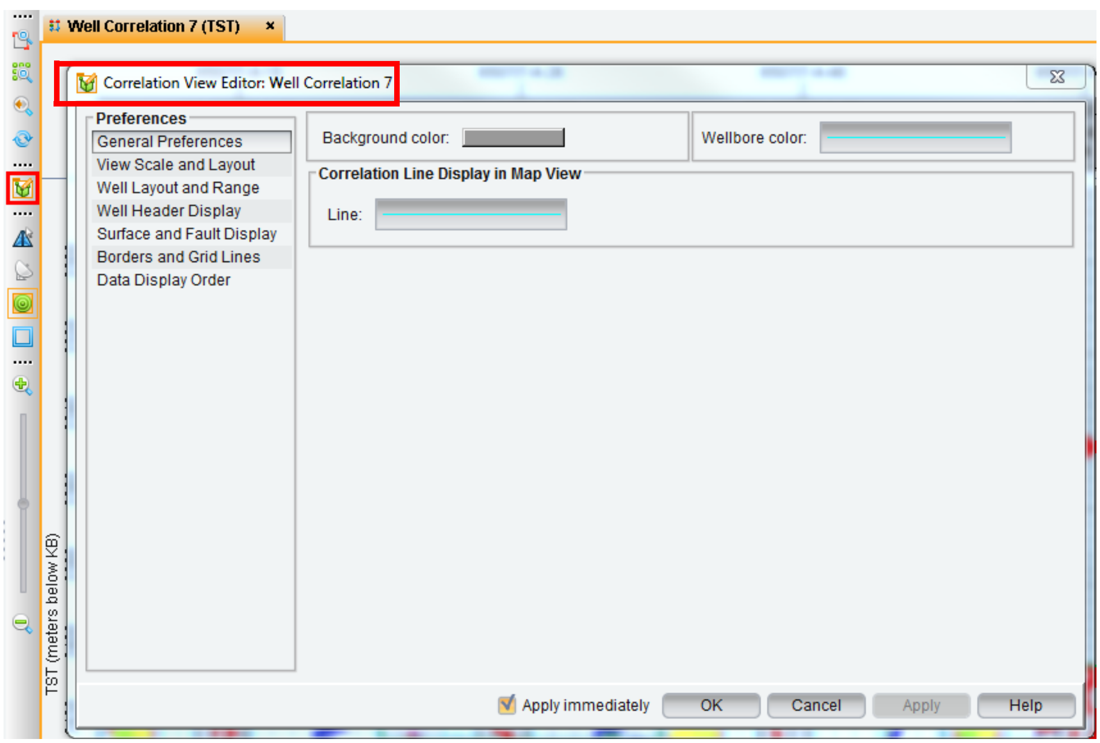
Typically, when you are looking at your well logs you are interested in a specific portion of the logs, and do not see the well in its entirety. You can adjust the settings so you are seeing only the area in which you are interested within the *View Editor*.

In addition to changing the range in which you are viewing your log curves, you can change the spacing of your wells, the scale at which you are viewing them, and more. In this exercise you will learn how to change some of the settings for viewing your well logs in the *Correlation View Editor*.

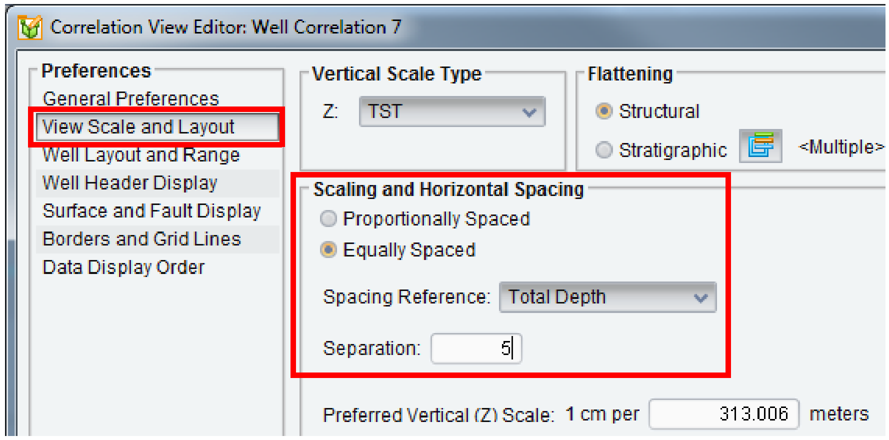
Proportionally Spacing or Equally Spacing Wells

Wells in *Correlation* view may be displayed proportionally spaced or equally spaced.

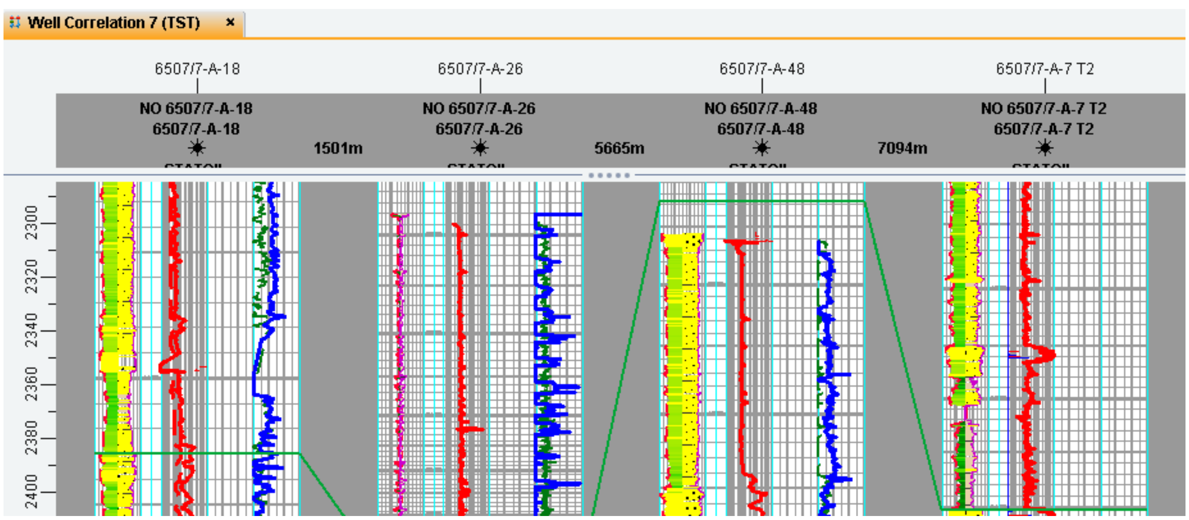
1. In the *Correlation* view, click the **View Editor** () icon. The *Correlation View Editor* will display.



2. In the *Preferences* panel of the *Correlation View Editor*, select **View Scale and Layout.** In the *Scaling and Horizontal Spacing* panel, select **Total Depth** on the Spacing Reference pull-down menu. In the Separation: field, enter **"5".**

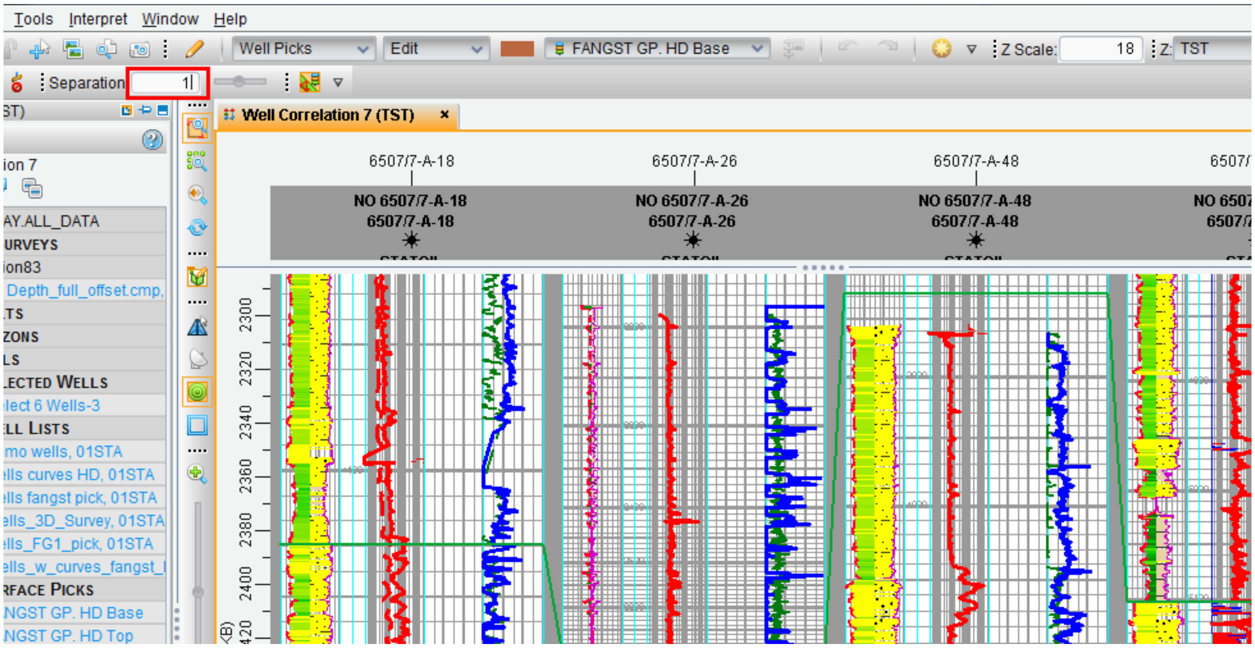


The wells are now more widely spaced. Note that when the wells are proportionally spaced, a distance line is displayed between each well, with the value of the distance between each well.

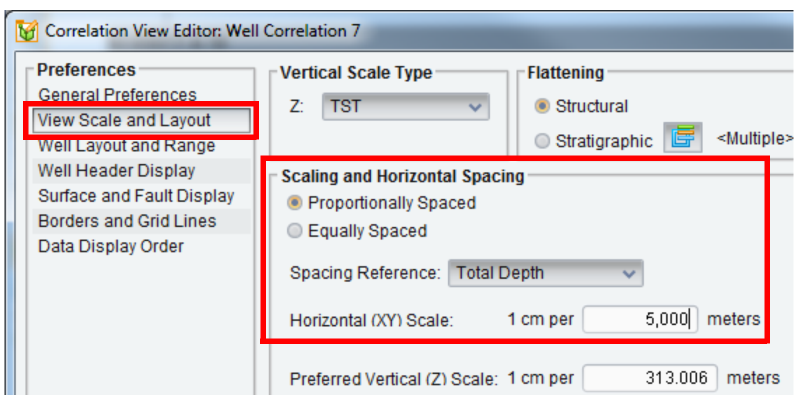


3. You can apply well separation by entering a value in the Separation: field in the main window. Change the Separation: to **"1"**.

The figure below shows wells with Separation: = 1.



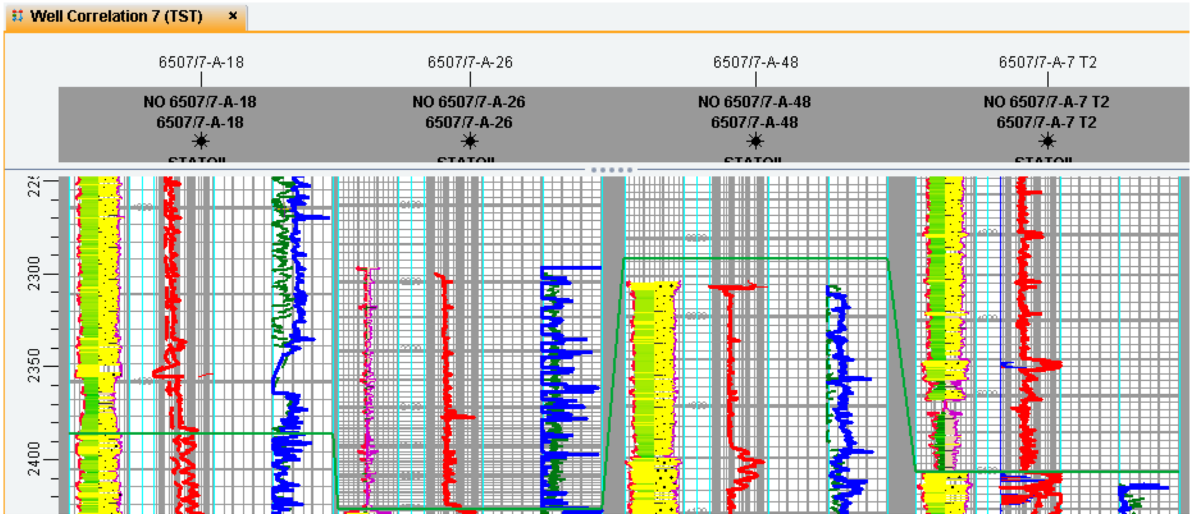
4. In the Preference panel of the *Correlation View Editor* select **View Scale and Layout.** In the *Scaling and Horizontal Spacing* panel, toggle on **Proportionally Spaced,** and on the Spacing Reference: pull-down menu, accept the default **Total Depth.** In the Horizontal (XY) Scale: field, enter **"5,000"**.



Note:

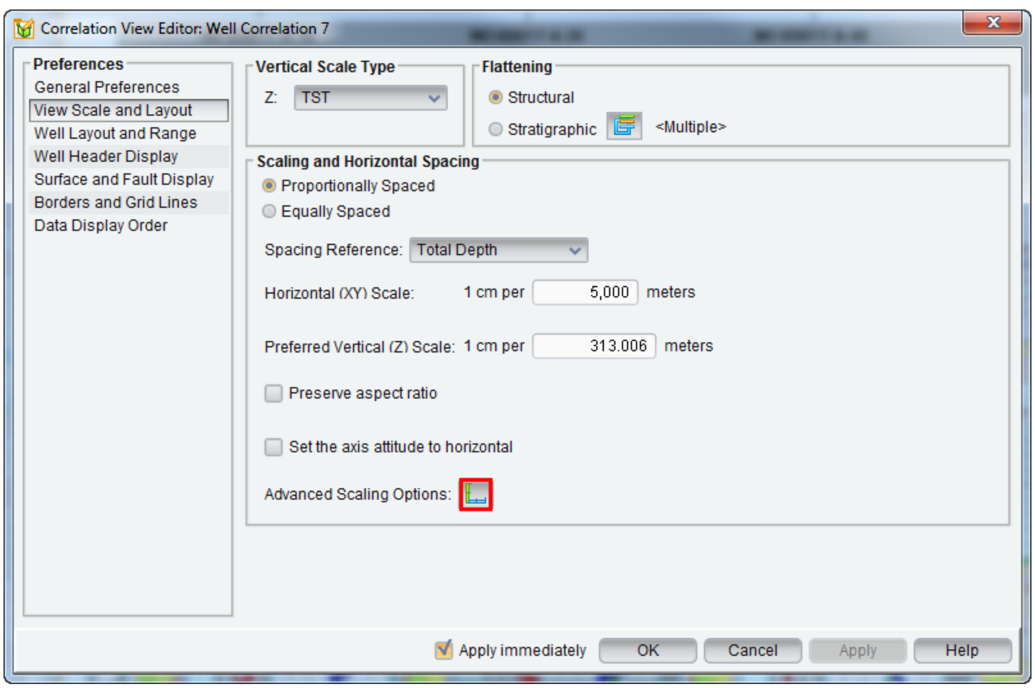
Proportionally spaced well display is based on the geographic distance between the wellbores.

This image shows that the space between wells varies.

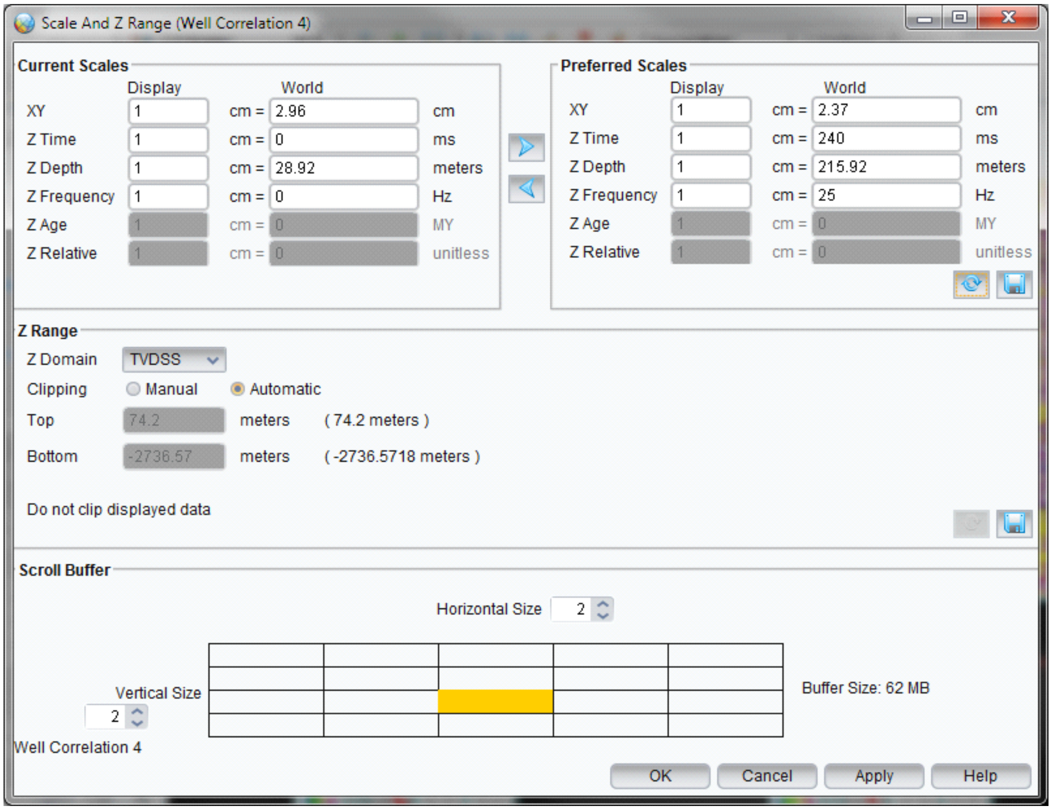


Modify Scale

5. In *Well Correlation* view, set a suitable zoom level. Then, in the *Correlation View Editor,* click the **Advance Scaling Option** icon ( ) to open the *Scale And Z Range* window.



The *Scale and Z Range* dialog will open.

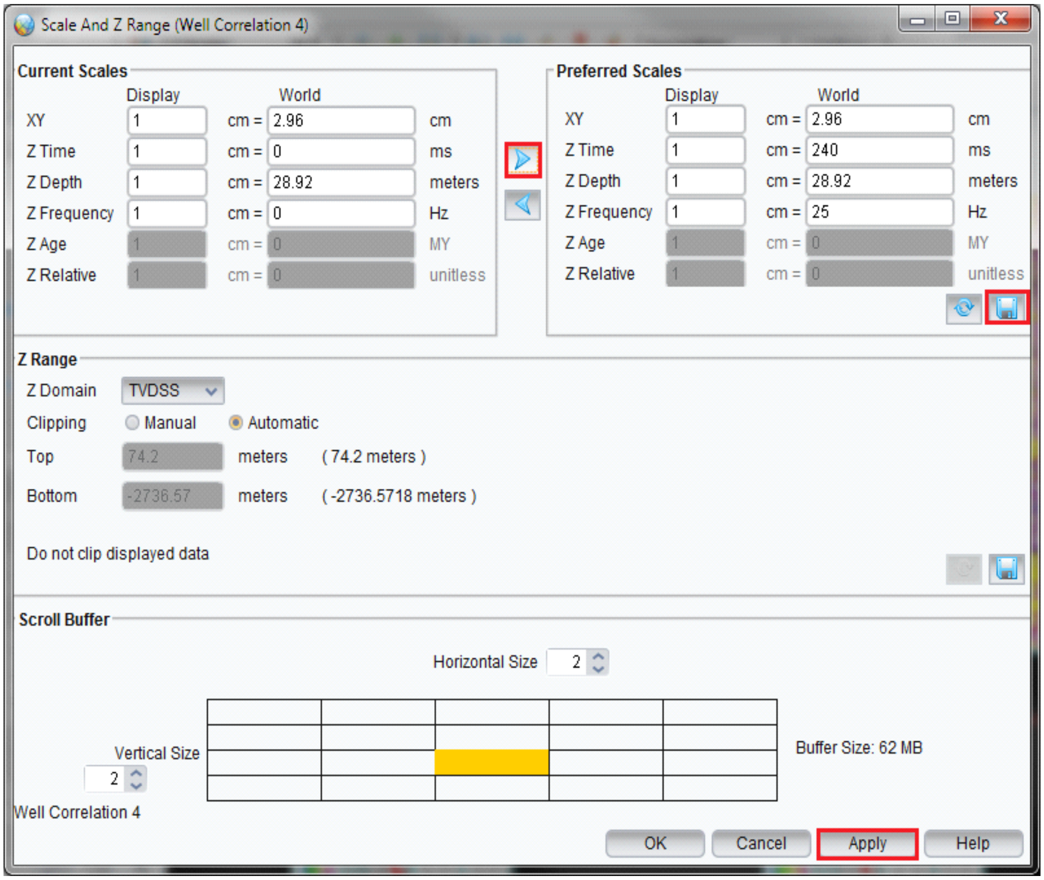


Note:

Preferred Scales displays default preferred settings that can be edited and will become your preferred values for a view. In *Section*, *Correlation*, and *Map* views, click the Preferred Scale icon () to display the objects in the view at the preferred scale.

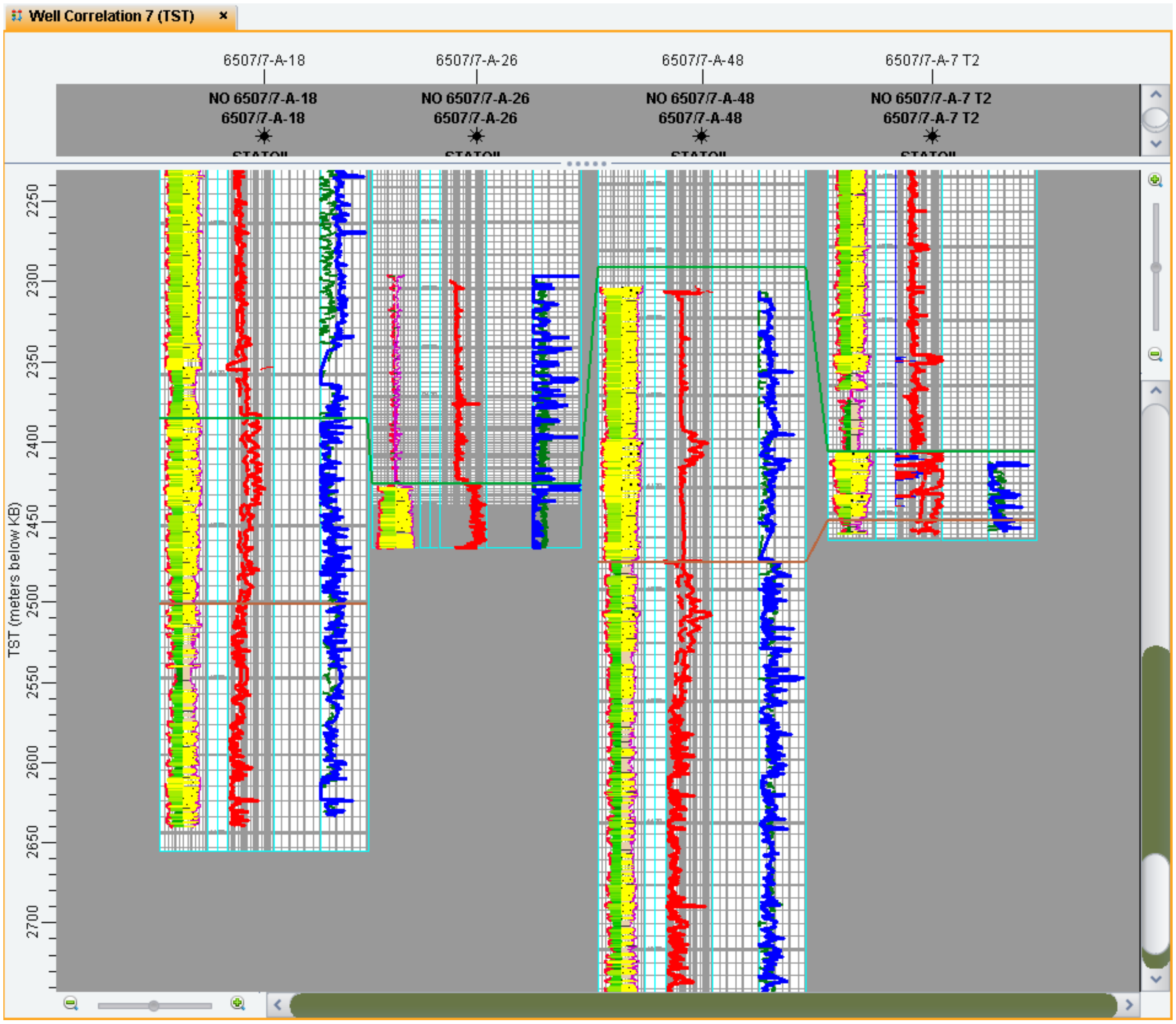
6. In the *Scale And Z Range* dialog you will observe that the **Current Scale** and **Preferred Scale** are different. Click () to apply a

Current Scale value to **Preferred Scale.** Click the **Save** icon. Click **Apply**.



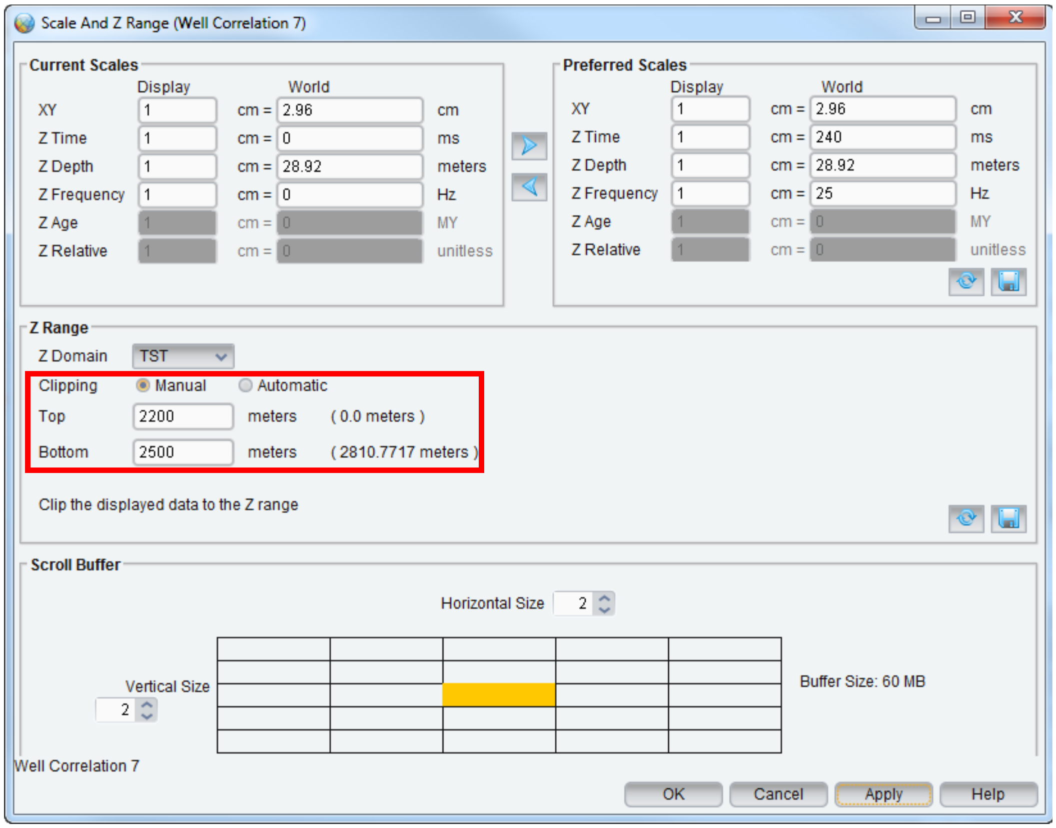
7. In the *Well Correlation* view, zoom in or zoom out, then click the *Preferred Scale icon* () to display the data at your new preferred scale.

The data will be restored to your preferred scale.

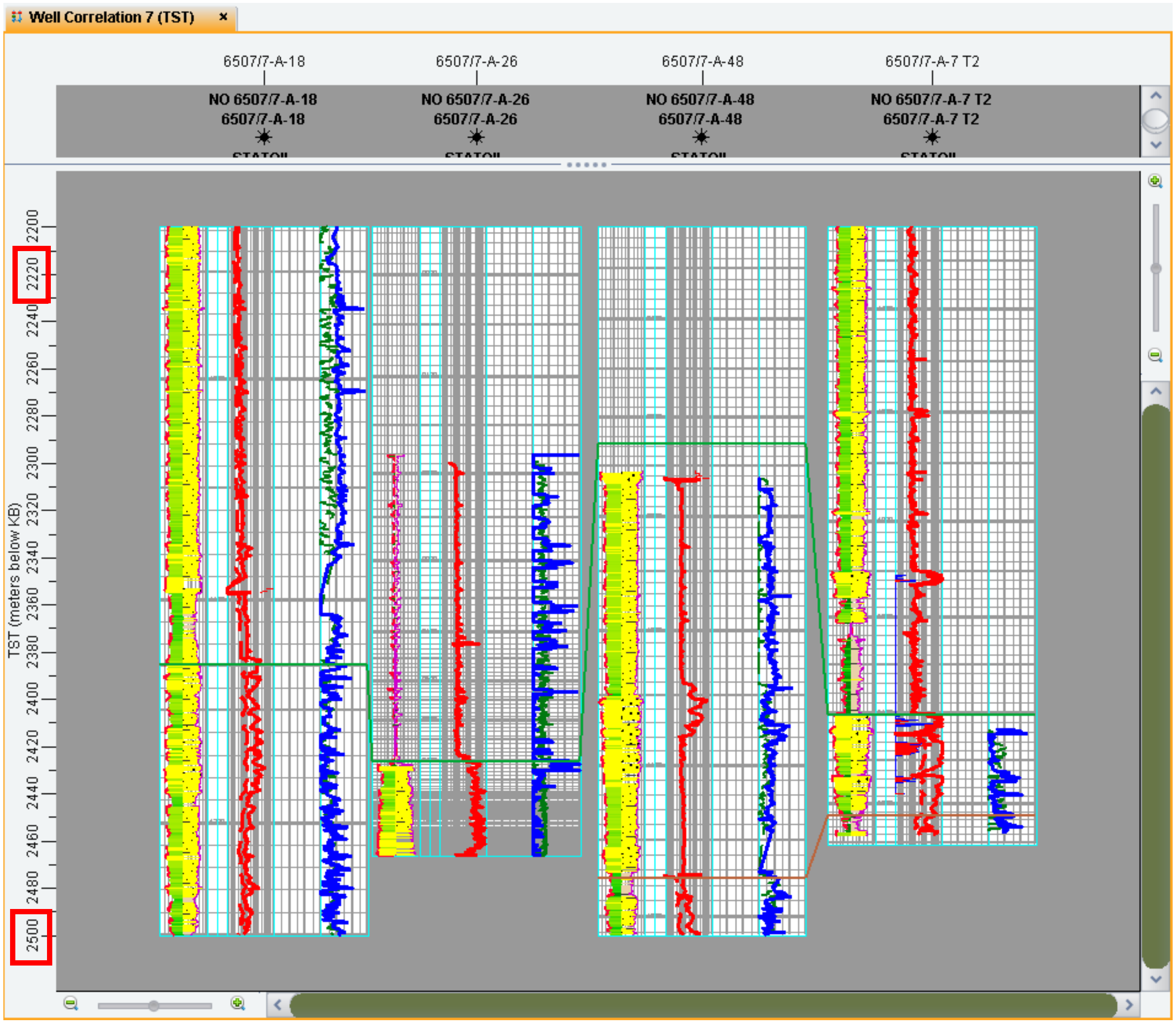


Using Z Range to Clip the Well Correlation View

8. In the *Z Range Panel* of the *Scale And Z Range* dialog, select the **Manual** radio button. In the Top: field, enter **“2200”** and in the Bottom: field, enter **“2500”.** Click the **Save** icon and click **OK**.

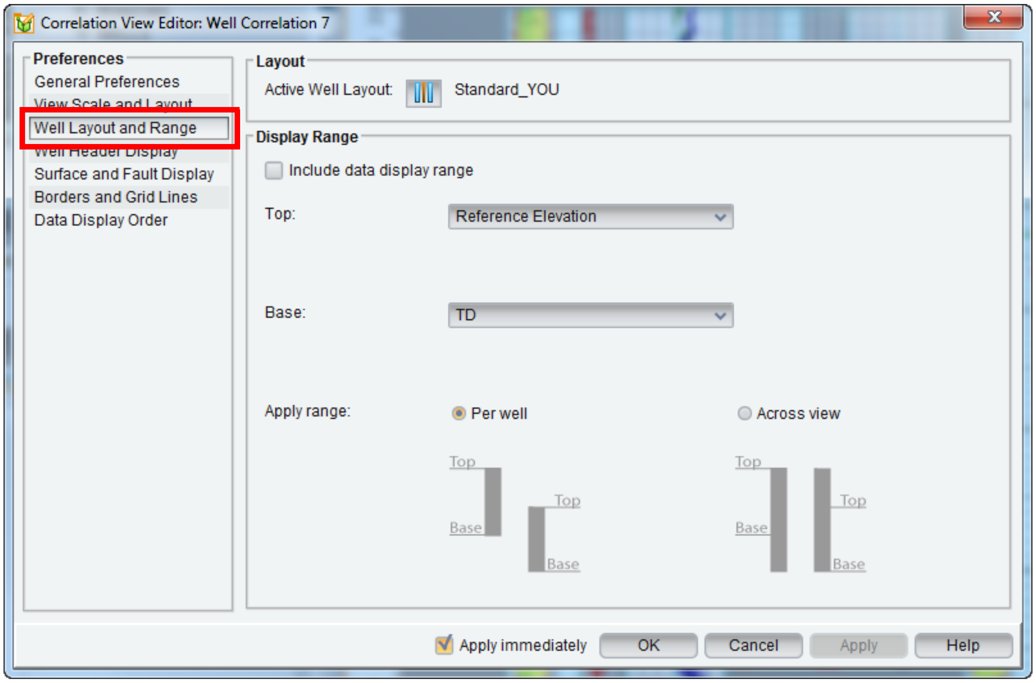


Your *Correlation* view will show only the data between 2200 to 2500 meters.



Using Display Range to Clip Well Correlation View

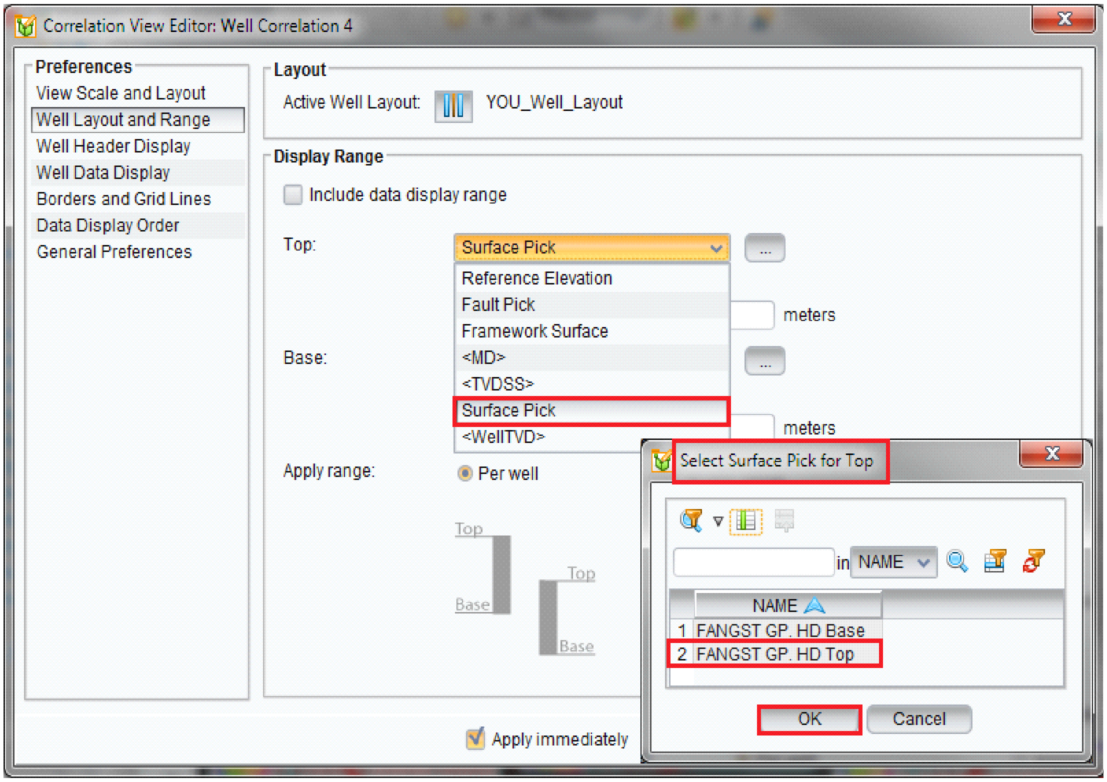
9. In the *Preferences* panel of the *Correlation View Editor,* select **Well Layout and Range.**



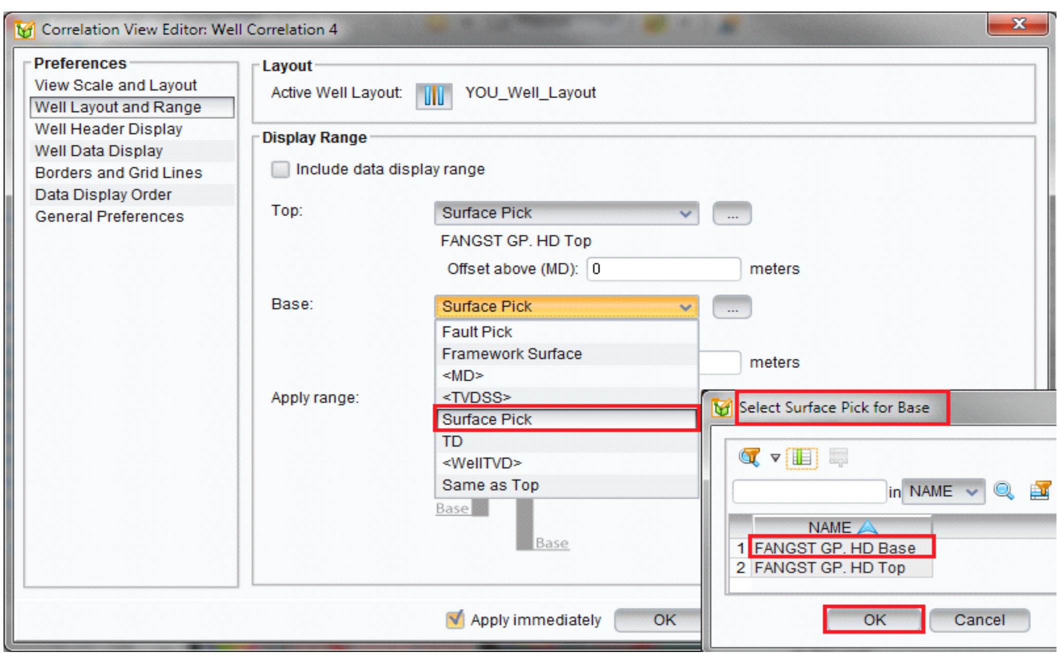
Note:

You may use different data types, such as Framework Surface, Fault Pick, or Surface Pick to set the top and base constraints. To clip the *Well Correlation* view you can also use Depth in TVDSS or MD. For this exercise you will use a Surface Pick for clipping.

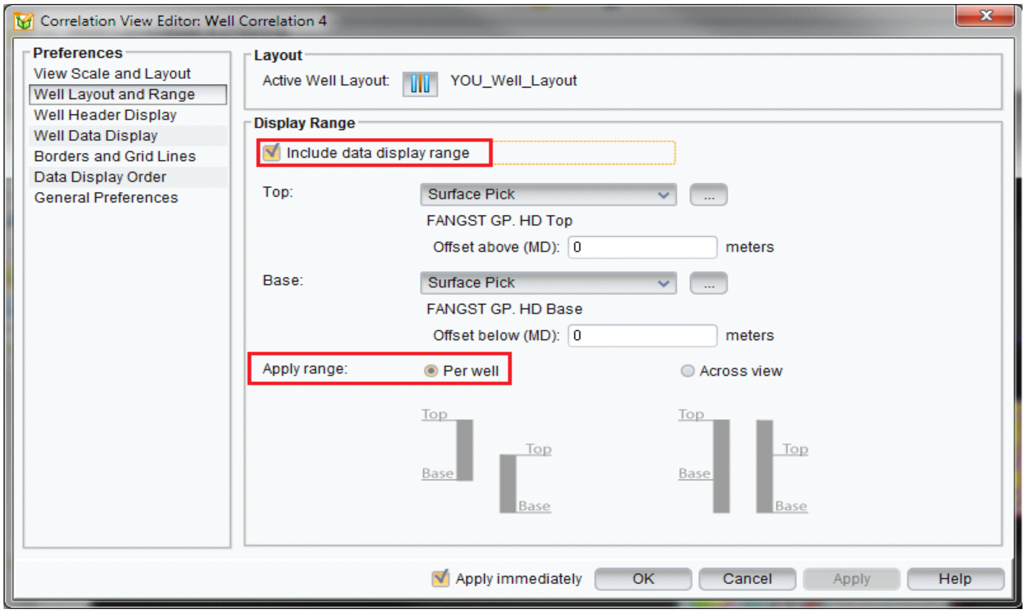
10. On the Top: pull-down menu of the *Display Range* panel, select **Surface Pick.** The *Select Surface Pick for Top* window appears. Select **FANGST GP.HD Top** and click **OK**.



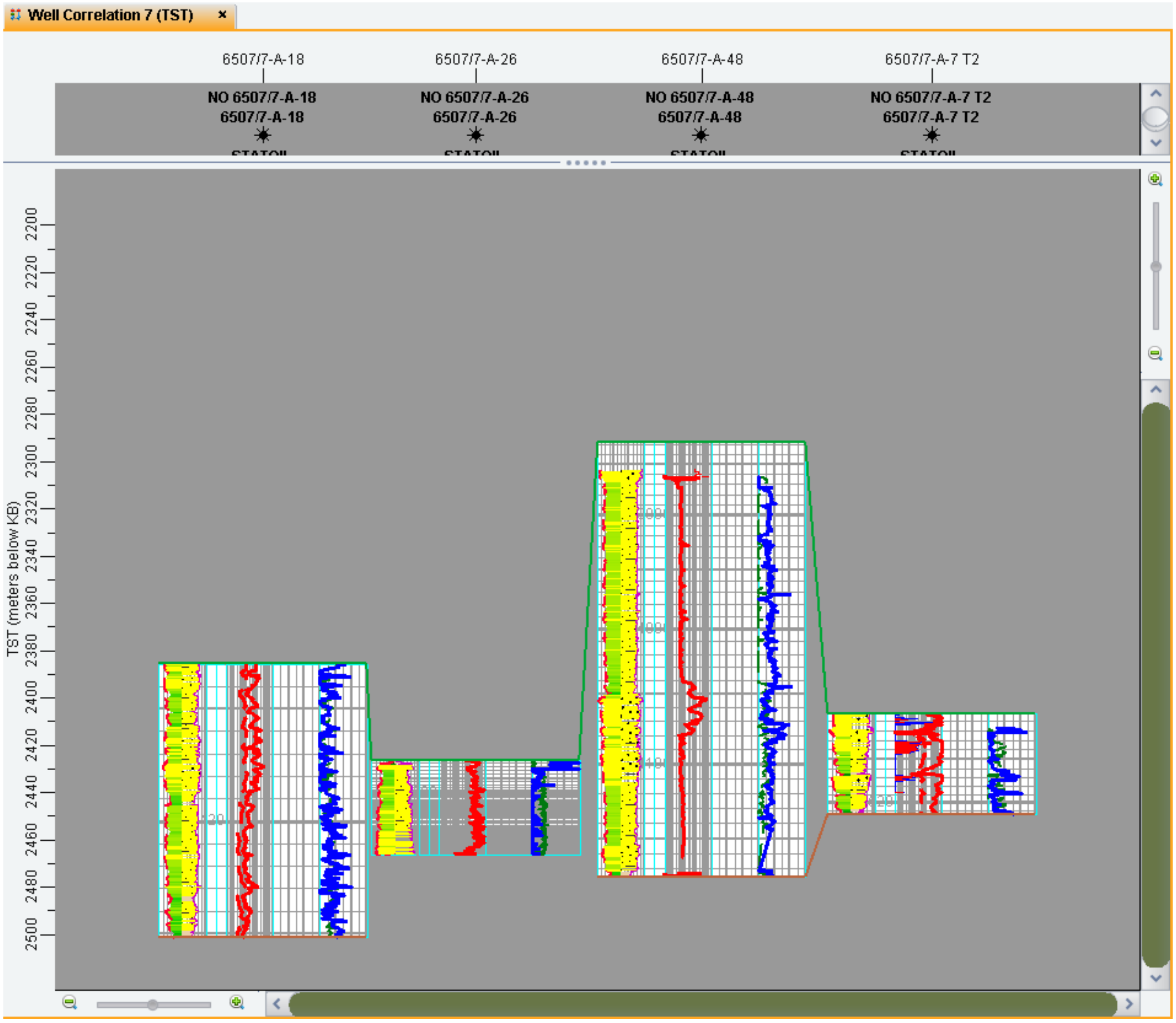
11. On the Base: pull-down menu, select **Surface Pick**. In the *Select Surface Pick for Base* dialog, select **FANG_GP.HD_Base.** Click **OK**.



12. On the *Display Range* panel of the *Correlation View Editor,* toggle on **Include data display range**. Toggle on Apply Range: **Per Well**. You can set the Offset below (MD): and Offset above (MD): values, but for this exercise you will use **"0"** for both. Click **OK**.



The *Well Correlation* view will be similar to the following image.



Note:

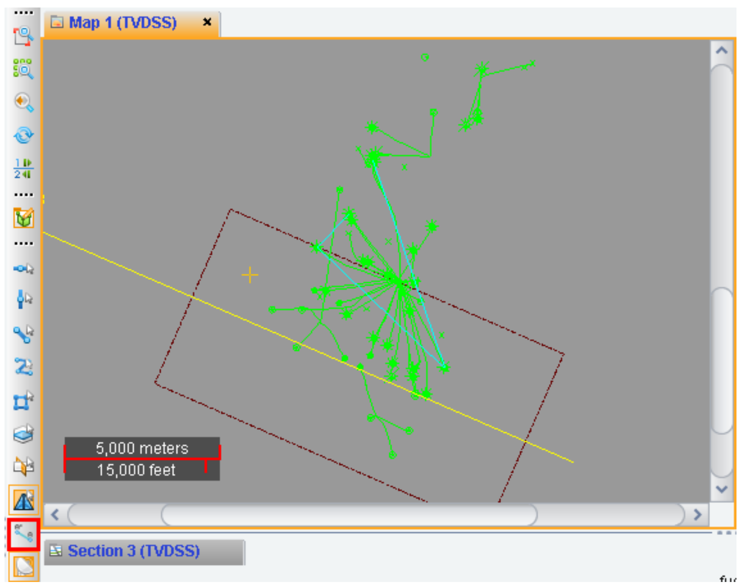
In the *Display Range* panel, by toggling on Apply Range: Across view you match the display range for all wells according to the extreme high and extreme low of any of the wells in view. This allows for all wells to be clipped at the same point across the entire view. Per Well applies the Top and Base constraints to each well to determine the range of the display per well.

Exercise 2.8: Line of Section (LOS)

The Line of Section tool is a new tool in this version of DecisionSpace. The LOS tool allows you to create sections by graphically selecting the wells along which you want to view the seismic. You can specify the portion of the well from which you wish to see the seismic, such as TD, along the Well path, or at a specific surface pick.

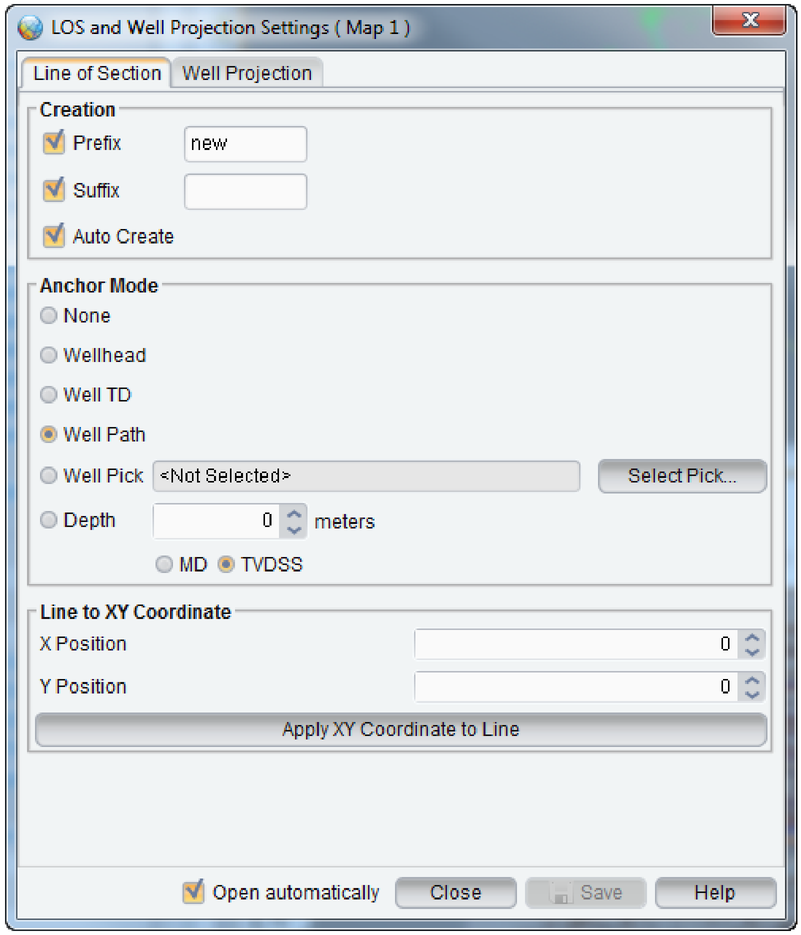
1. Activate the *Map* view in the other window and display only the well list **demo wells 01STA.**

2. On the vertical menu bar click the **Create LOS** () icon. The *LOS and Well Projection Setting* dialog opens.

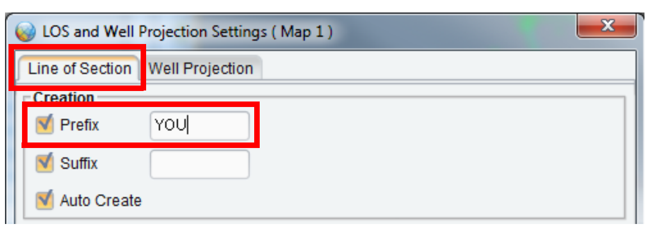


In the *Creation* panel you can specify how you will differentiate the LOS with Prefix and Suffix, which you want to add in your LOS name.

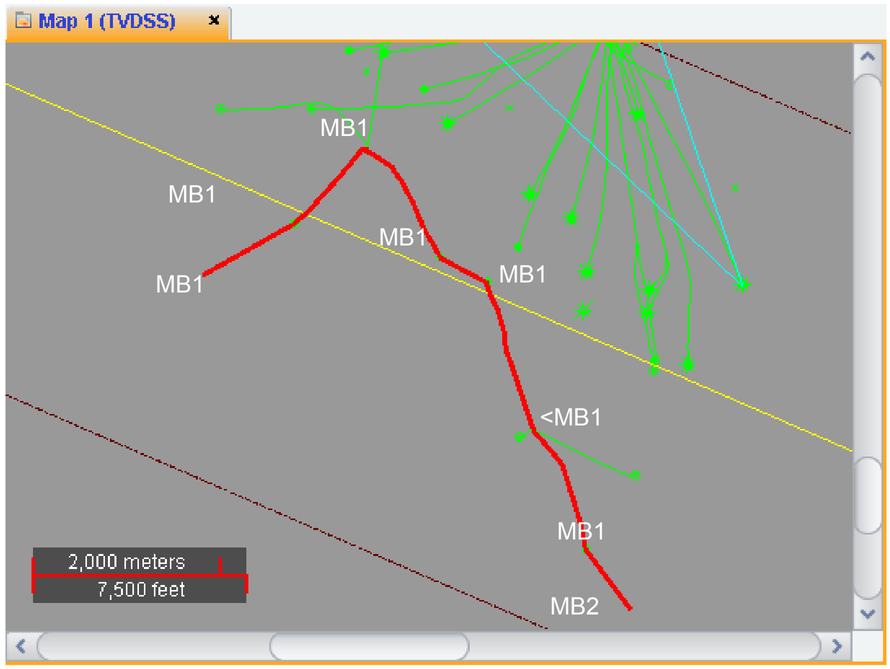
In the *Anchor Mode* panel you can specify where you want to snap the LOS.



3. In the *LOS and Well Projection Setting* dialog, select the ***Line of Section*** tab, and in the Prefix text field enter **"YOU"**.



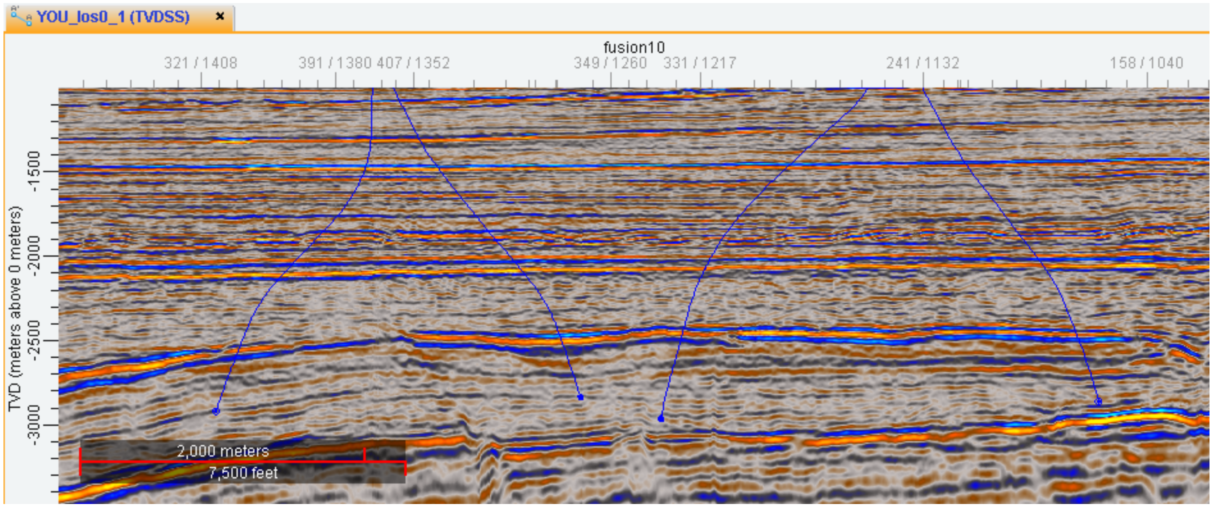
4. MB1 at the point where you want to start your LOS (a place off of a well), then, click all other **wells** that you want to include in your LOS. The well path will be selected by default. When you have selected all of the wells you want to include, MB1 again, and MB2 to end.



Note:

When using making your selections along a wellbore, the location of the wellbore on which you click does matter. Clicking on the top half of the wellbore causes the LOS to go from wellhead down to TD. Clicking on the lower half of the wellbore causes the LOS to go from TD to the wellhead

The *Section* view is displayed, showing all of your wells. The new LOS appears in *Inventory*.



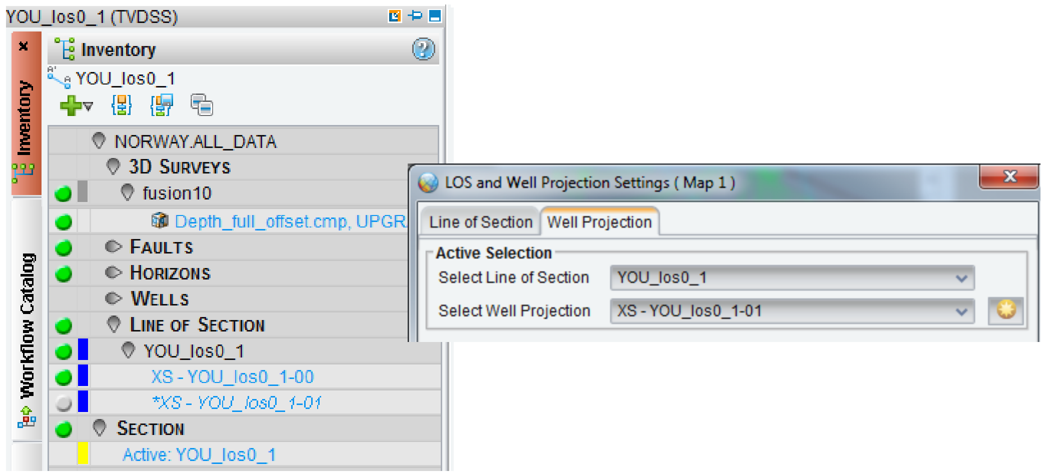
Note:

Using LOS automatically renames your *Section* view for you to help keep your session organized.

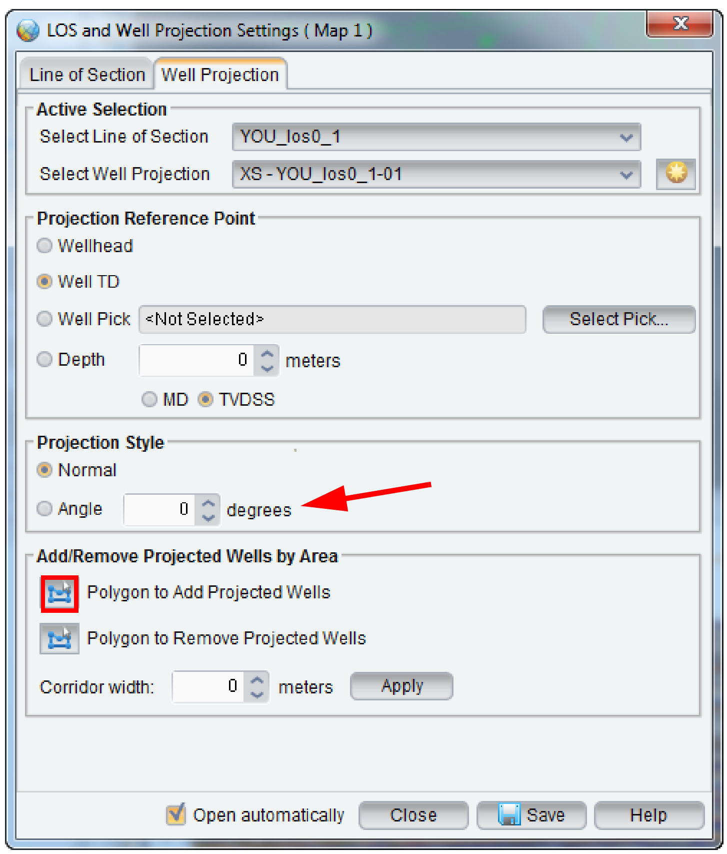
Note:

You can add multiple well projections to a single Line of Section.

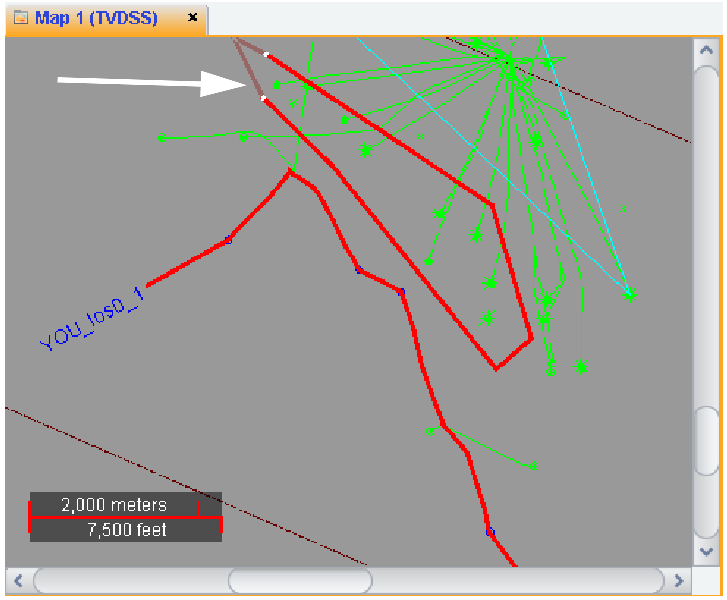
5. To add another projection to the LOS, select the *Well Projection* tab on the *LOS and Well Projection Settings* dialog. In the *Active Selection* panel click the **Create new well projection list** ( ) icon. A new projection is listed in *Inventory.*



6. In the *Add/Remove Projected Wells by Area* panel, click the **Polygon to Add Projected Wells** ( ) icon.

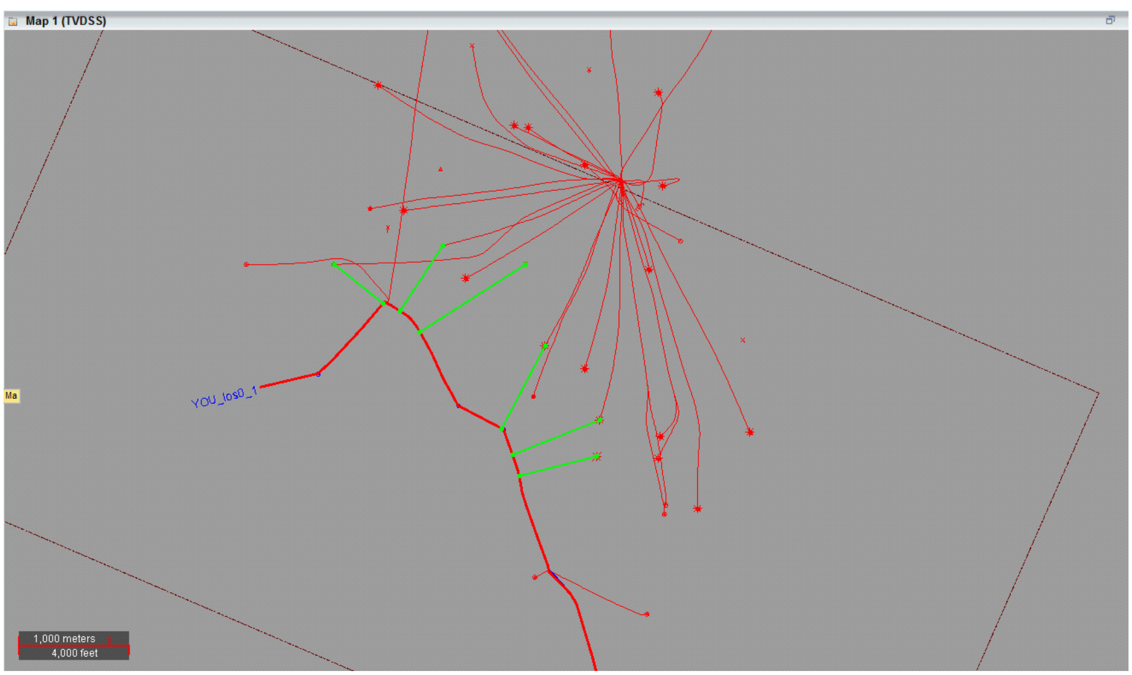


7. In *Map* view, **MB1** along a path to create a **polygon** around several wells. **MB2** to end the **polygon**.



The wells that were included in your polygon will be added to the well projection, and highlighted in green.

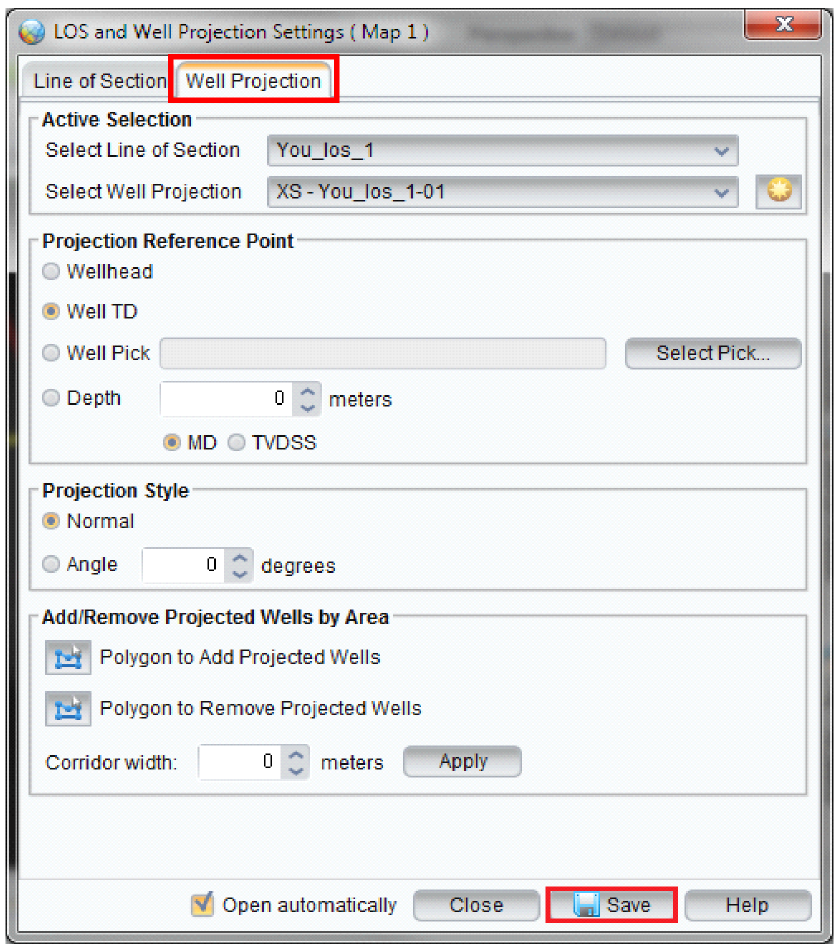
The image below has been changed to best display the newly selected wells. Your view may not exactly match the following image, but it should be similar.



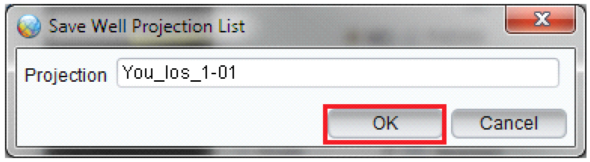
> **Note:**
>
> When using the polygon method, wells will project to the LOS only if they are perpendicular to the LOS.

> **Note:**
>
> Depending on the shape of your polygon, you may see a pop-up window stating that it is unable to project one or more wells. If you get this pop-up, click OK and be aware of which wells were unable to project onto your LOS. You can manually project them onto your LOS later.

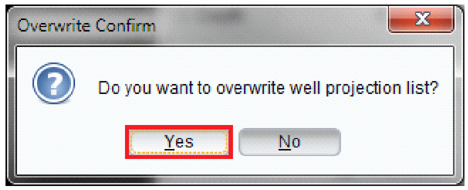
8. On the *Well Projection* tab, click the **Save** button.



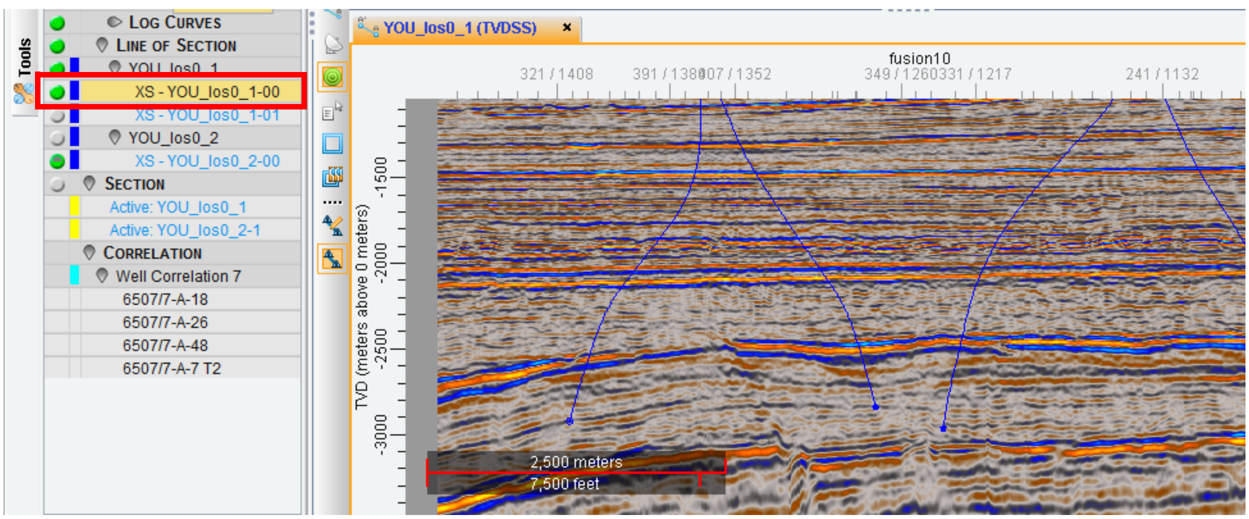
9. The *Save Well Projection List* dialog appears; click **OK.**

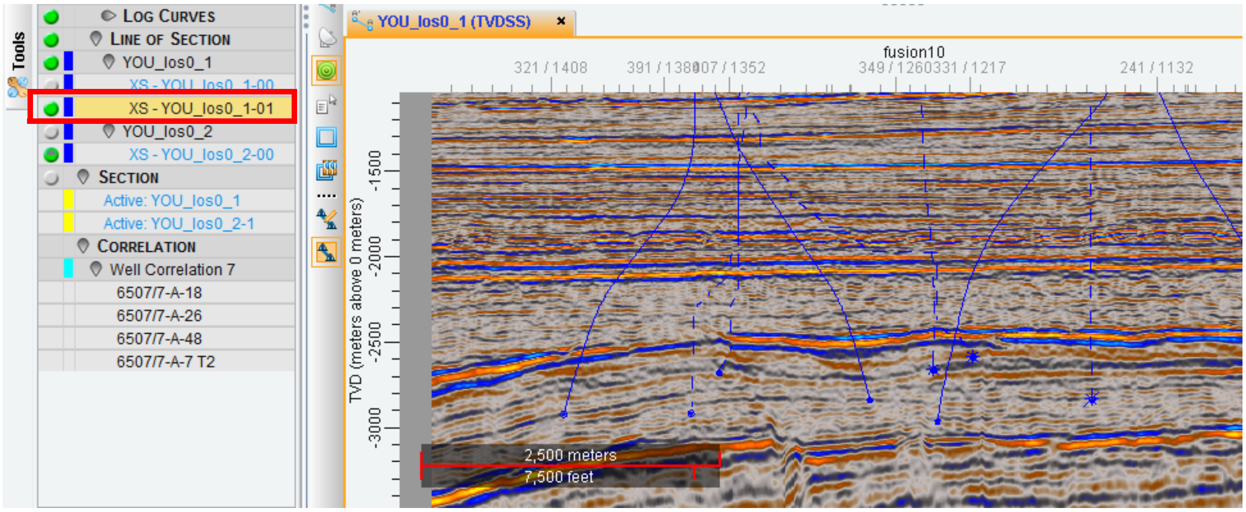


10. The *Overwrite Confirm* message appears. Click **Yes**.



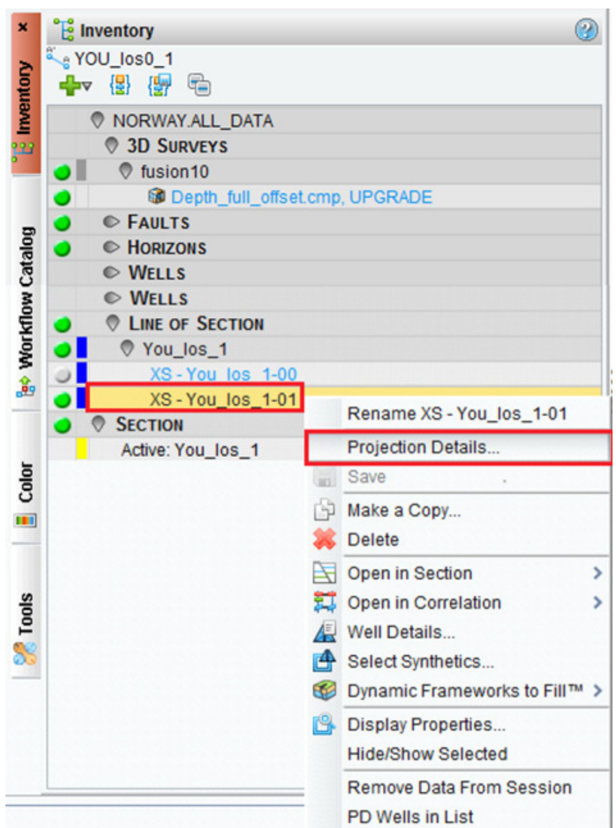
11. Activate the *Section* view. Toggle on each **LOS** and observe them in *Section* view.



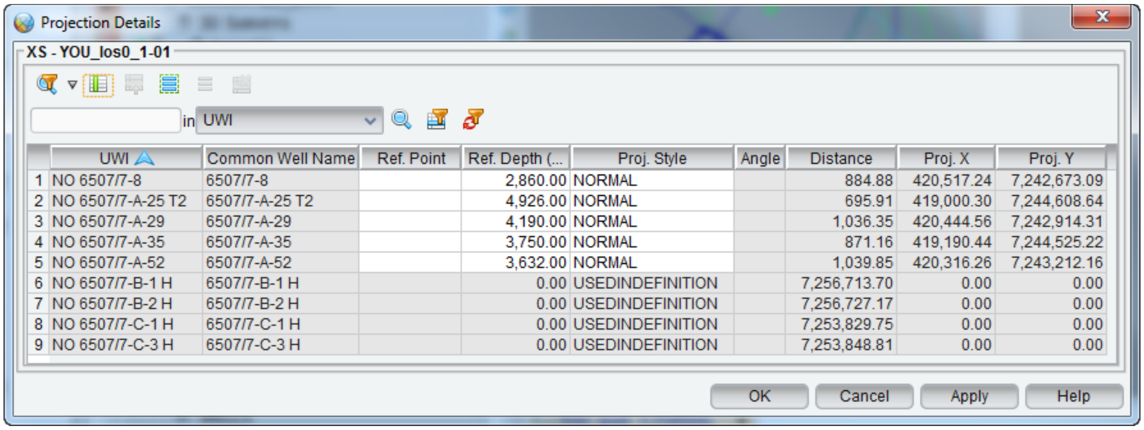


Well Projection Detail

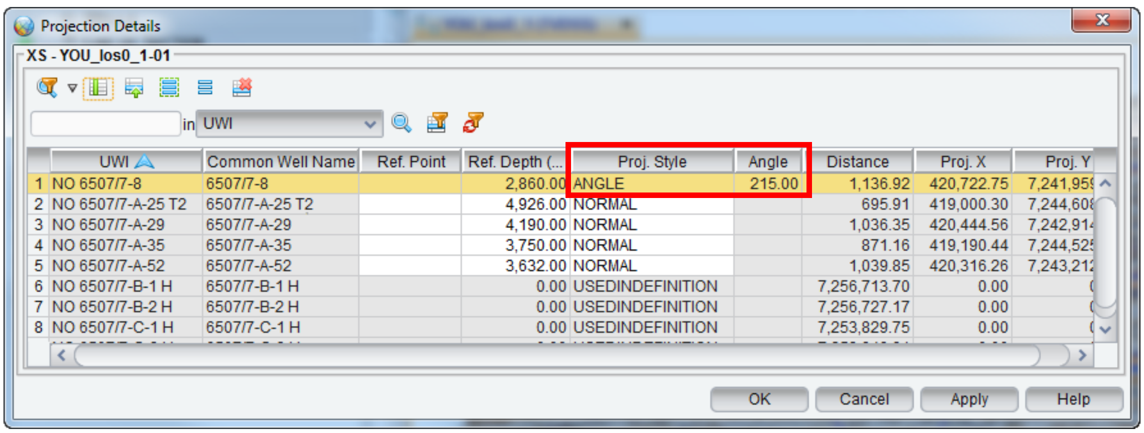
12. You can check projection detail. In the *Inventory* task pane, put your cursor on **XS-You_los_1-01** and **MB3 > Projection Details.**

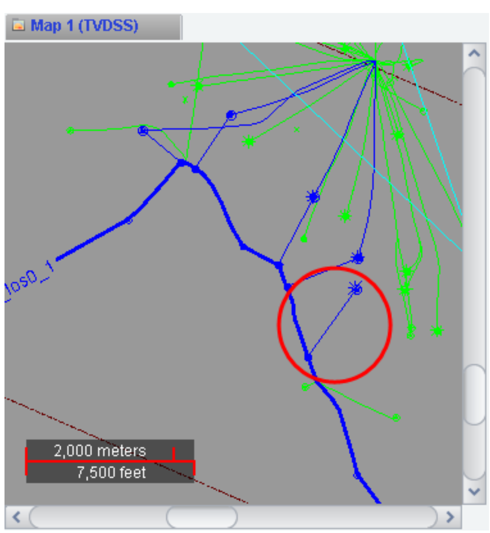


The *Projection Details* dialog opens.



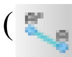
13. Select a well with a Proj. Style that is NORMAL**.** Click the **NORMAL** pull-down menu and select **ANGLE**. In the Angle column enter **“215”**. Click **OK**.



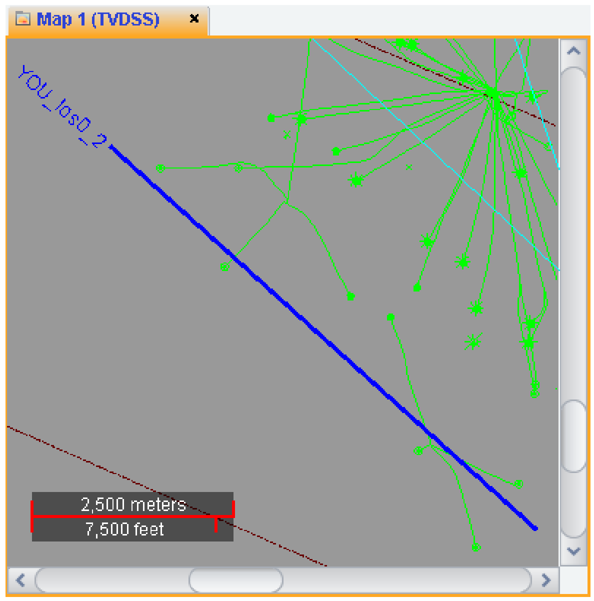


The well will now project toward the LOS at the specified angle.

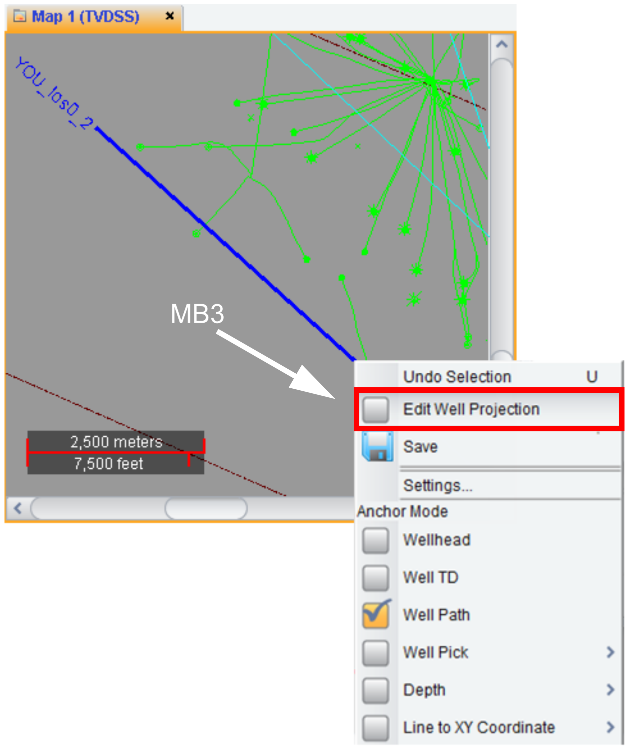
Now you will create a straight LOS and you will manually project the wells onto it.

14. Make sure your *Map* view is active. In the *Inventory,* toggle off the previous LOS. Select the **Create LOS** () icon.

15. **MB1** to digitize a straight **LOS** in *Map* view.

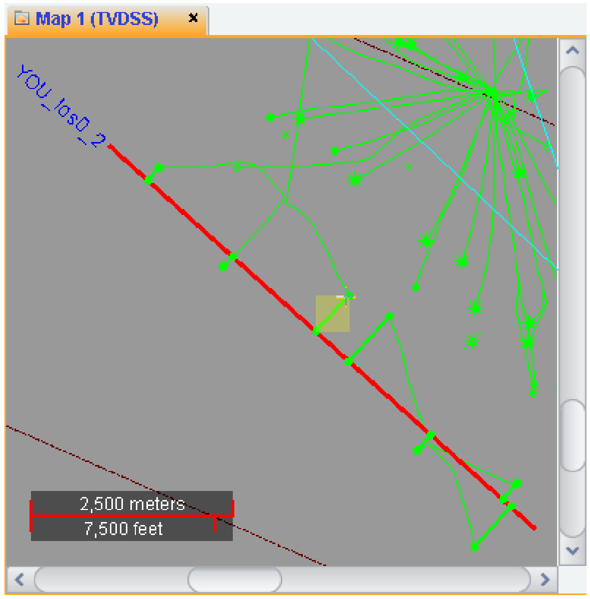


16. With your cursor on the LOS, **MB3** > **Edit Well Projection**. This will open to the *Well Projection* tab. It will not send the LOS to the *Section* view, as when you click **MB2**.

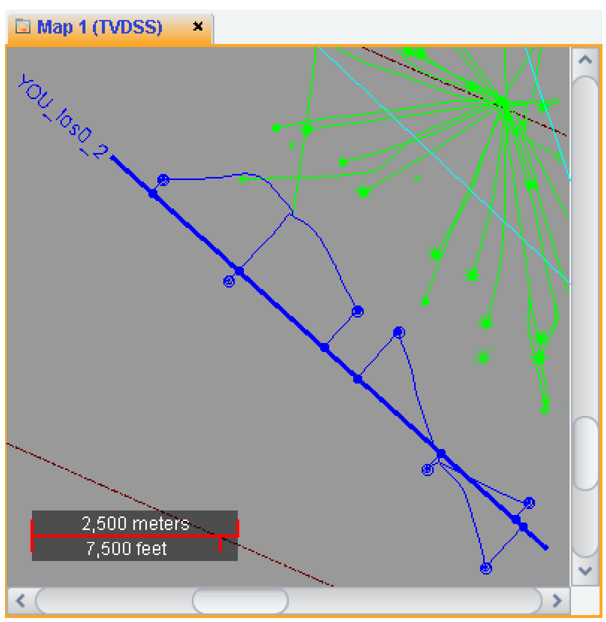


> **Note:**
>
> You may also click directly on the *Well Projection* tab in the *LOS and Well Projection Settings* dialog.

17. Click each **well** that you want to project on your LOS.



18. When you are finished, click the **Save** button in the LOS and *Well Projection Settings* dialog. The new LOS is now listed in *Inventory*.

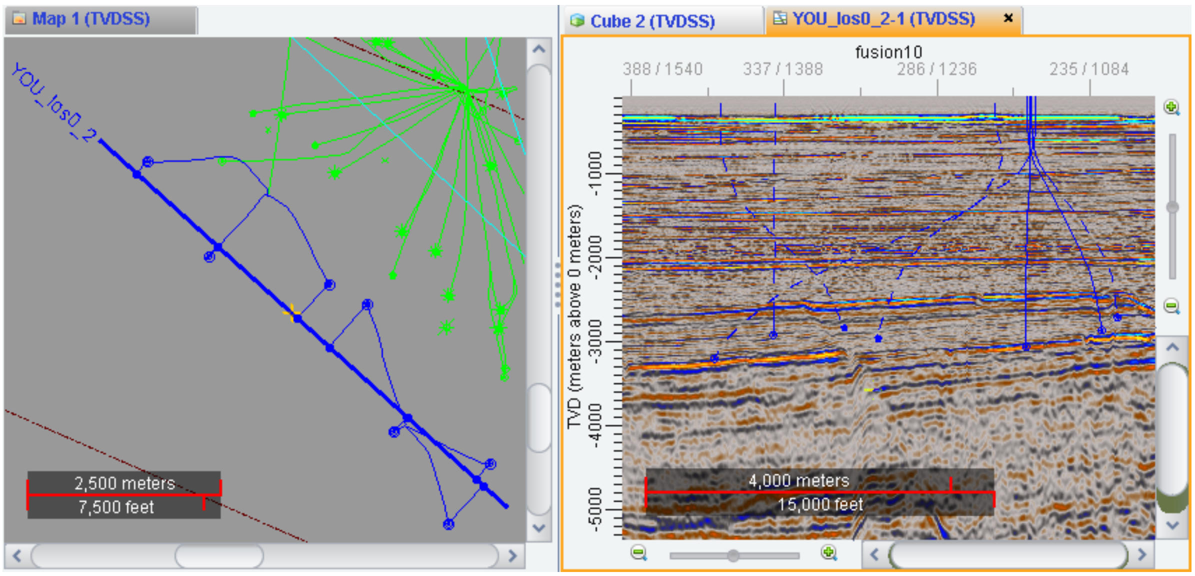


Note:

You can display the Line of Section in *Section* view and also in *Correlation* view.

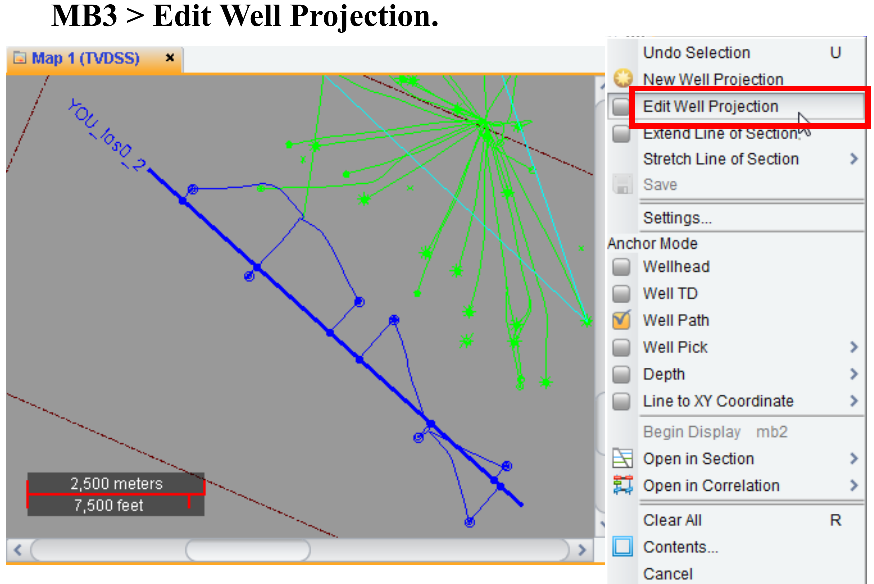
19. In the *Inventory* task pane, put your cursor on **YOU_los0_2-00** and **MB3 > Open in Section > New Tab**. The Line of Section is shown in a new *Section* view tab.

20. Arrange your layout as shown below, so you can see the *Map* and *Section* views together.

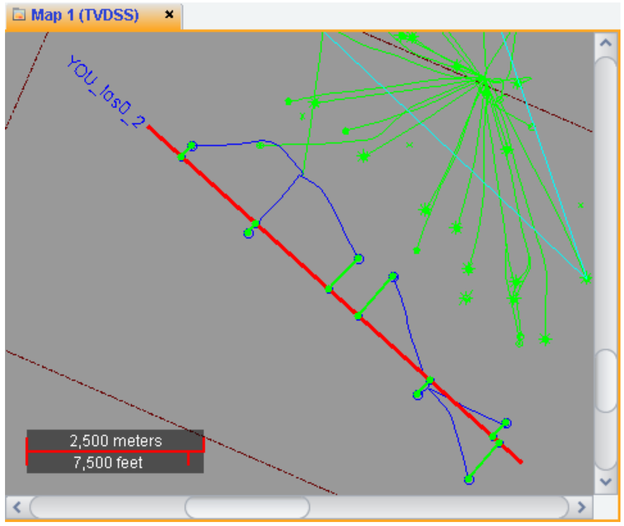


Graphically Modifying a Projection

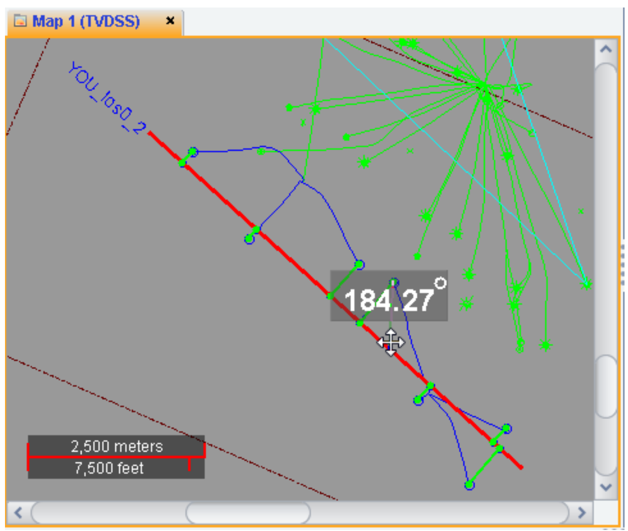
21. Activate the *Map* view and put your cursor on the **Line of Section**. **MB3 > Edit Well Projection.**



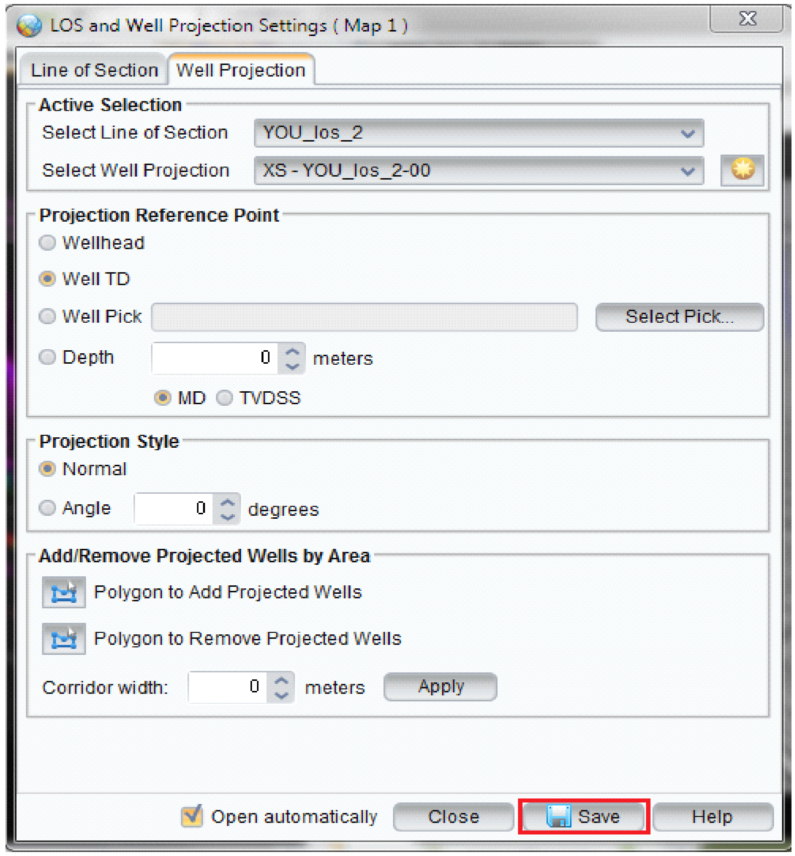
Note that all of your projection paths turn green.



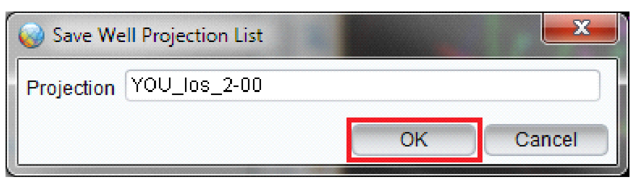
22. Select one well and drag it to a new location on the LOS. As you drag, a pop-up will inform you of the current projection angle.



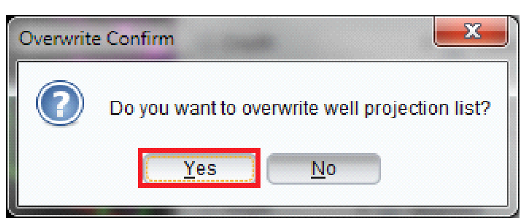
23. After graphically modifying the well projection onto the LOS, click **Save** in the *LOS and Well Projection Settings* dialog.



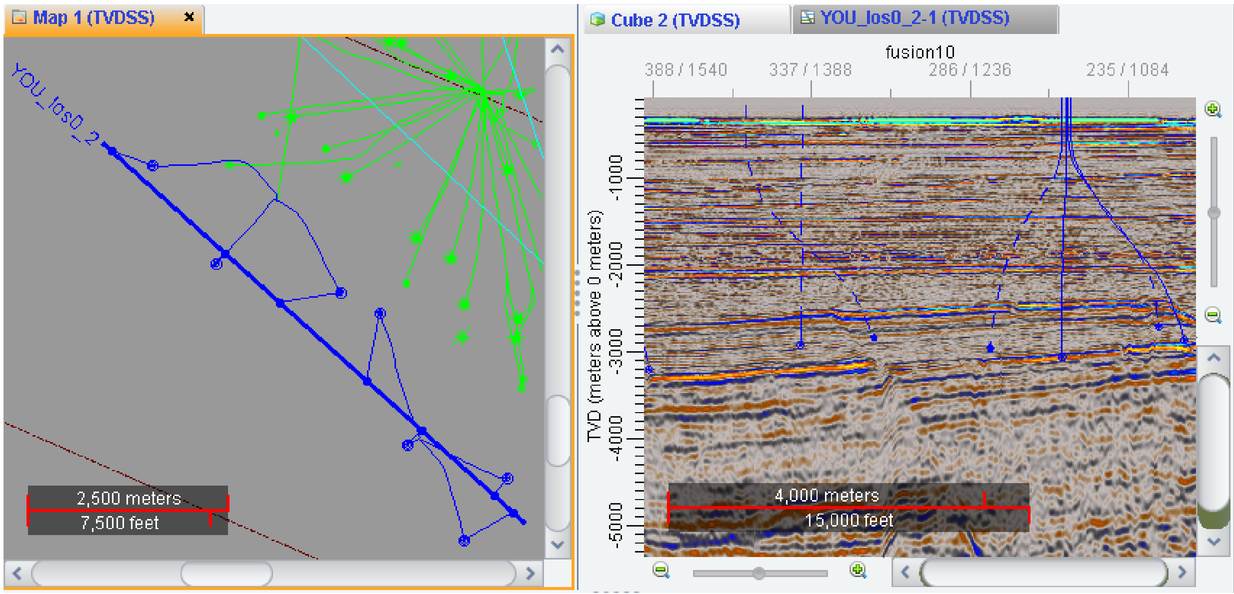
24. When the *Save Well Projection List* window displays, click **OK.**



25. When the *Overwrite Confirm* dialog displays, click **Yes.**

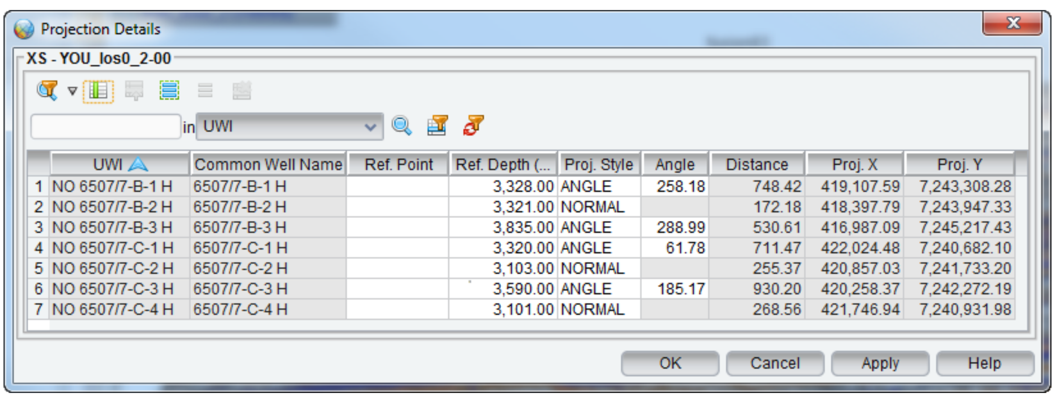


Observe in *Section* view that the well shows a different projection.



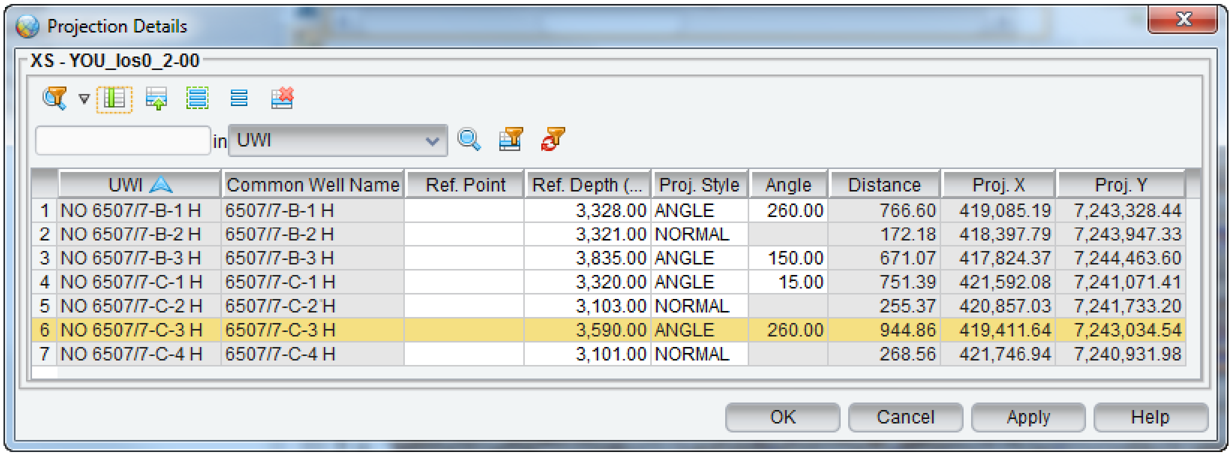
Manually Modifying the Projection

26. In the *Inventory* task pane, put your cursor over **XS-YOU_los_2-00** and **MB3 > Projection Details.**



	UWI	Common Well Name	Ref. Point	Ref. Depth (...	Proj. Style	Angle	Distance	Proj. X	Proj. Y
1	NO 6507/7-B-1 H	6507/7-B-1 H		3,328.00	ANGLE	258.18	748.42	419,107.59	7,243,308.28
2	NO 6507/7-B-2 H	6507/7-B-2 H		3,321.00	NORMAL		172.18	418,397.79	7,243,947.33
3	NO 6507/7-B-3 H	6507/7-B-3 H		3,835.00	ANGLE	288.99	530.61	416,987.09	7,245,217.43
4	NO 6507/7-C-1 H	6507/7-C-1 H		3,320.00	ANGLE	61.78	711.47	422,024.48	7,240,682.10
5	NO 6507/7-C-2 H	6507/7-C-2 H		3,103.00	NORMAL		255.37	420,857.03	7,241,733.20
6	NO 6507/7-C-3 H	6507/7-C-3 H		3,590.00	ANGLE	185.17	930.20	420,258.37	7,242,272.19
7	NO 6507/7-C-4 H	6507/7-C-4 H		3,101.00	NORMAL		268.56	421,746.94	7,240,931.98

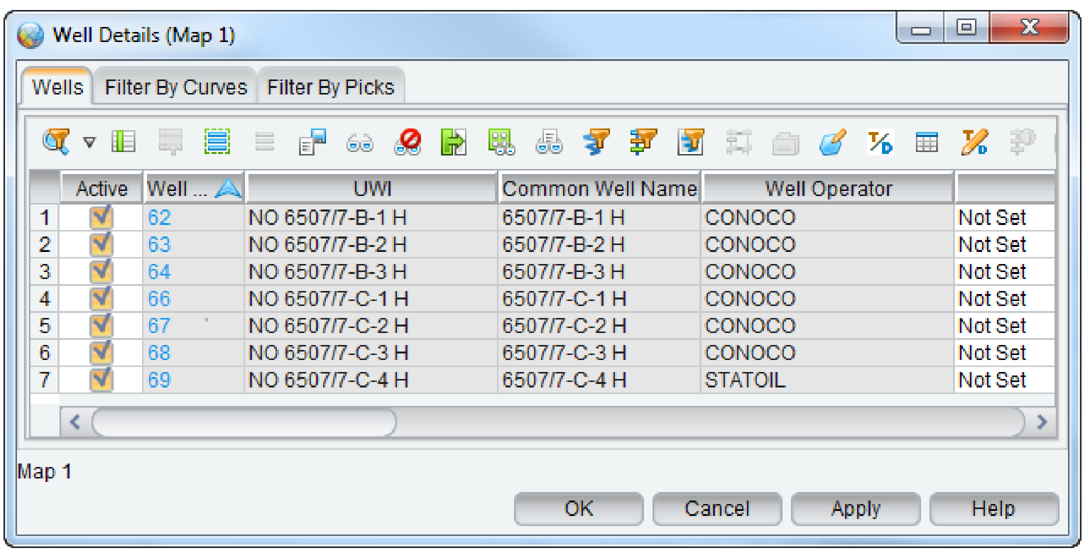
27. In the **Proj.Style** column of the *Projection Details* dialog, you will see an Angle for the wells you manually moved, as well as the angle at which you moved them. Click **OK**..



	UWI	Common Well Name	Ref. Point	Ref. Depth (...	Proj. Style	Angle	Distance	Proj. X	Proj. Y
1	NO 6507/7-B-1 H	6507/7-B-1 H		3,328.00	ANGLE	260.00	766.60	419,085.19	7,243,328.44
2	NO 6507/7-B-2 H	6507/7-B-2 H		3,321.00	NORMAL		172.18	418,397.79	7,243,947.33
3	NO 6507/7-B-3 H	6507/7-B-3 H		3,835.00	ANGLE	150.00	671.07	417,824.37	7,244,463.60
4	NO 6507/7-C-1 H	6507/7-C-1 H		3,320.00	ANGLE	15.00	751.39	421,592.08	7,241,071.41
5	NO 6507/7-C-2 H	6507/7-C-2 H		3,103.00	NORMAL		255.37	420,857.03	7,241,733.20
6	NO 6507/7-C-3 H	6507/7-C-3 H		3,590.00	ANGLE	260.00	944.86	419,411.64	7,243,034.54
7	NO 6507/7-C-4 H	6507/7-C-4 H		3,101.00	NORMAL		268.56	421,746.94	7,240,931.98

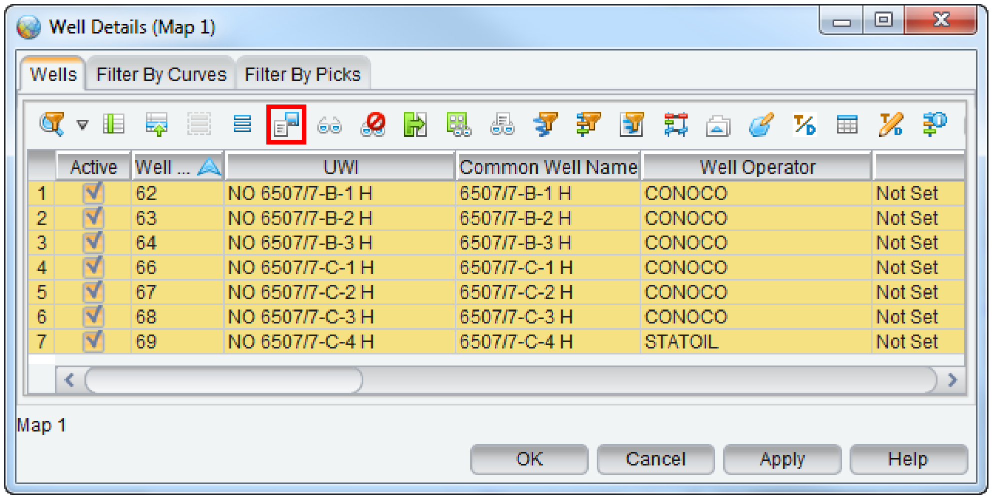
Saving Well Lists from LOS

28. In the *Inventory,* put your cursor on **XS_YOU_los_2-00** and **MB3 > Well Details.** The *Well Details* dialog opens.

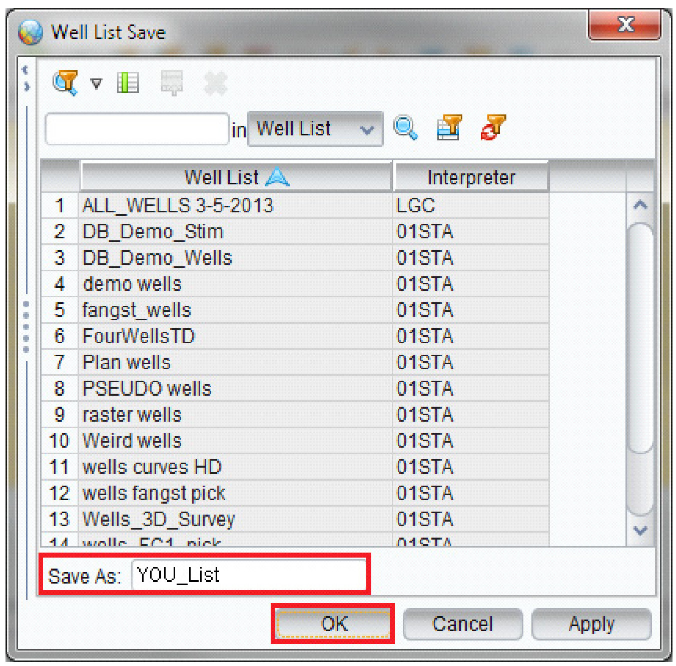


	Active	Well ...	UWI	Common Well Name	Well Operator	
1	✓	62	NO 6507/7-B-1 H	6507/7-B-1 H	CONOCO	Not Set
2	✓	63	NO 6507/7-B-2 H	6507/7-B-2 H	CONOCO	Not Set
3	✓	64	NO 6507/7-B-3 H	6507/7-B-3 H	CONOCO	Not Set
4	✓	66	NO 6507/7-C-1 H	6507/7-C-1 H	CONOCO	Not Set
5	✓	67	NO 6507/7-C-2 H	6507/7-C-2 H	CONOCO	Not Set
6	✓	68	NO 6507/7-C-3 H	6507/7-C-3 H	CONOCO	Not Set
7	✓	69	NO 6507/7-C-4 H	6507/7-C-4 H	STATOIL	Not Set

29. In the *Well Details* dialog, select all **wells** and click the **Save as List** () icon.



30. The *Well List Save* dialog opens. In the Save As: text field, enter **"YOU_List"** and click **OK**.



31. A new Well list will be created and listed in the *Inventory* task pane. Select **File > Exit. Save** your session if you wish to return to it later.

Chapter 3
Surface Interpretation and Mapping with Dynamic Frameworks to Fill

The DecisionSpace Geosciences software provides fast and powerful tools for surface interpretation. With Dynamic Frameworks to Fill you have all the tools you need for new-generation mapping, for creating grids and contouring maps, and for performing residual-fit operations that honor well pick data, with the option of automatic updates of maps that are linked to your interpretation.

Topics Covered in this Chapter

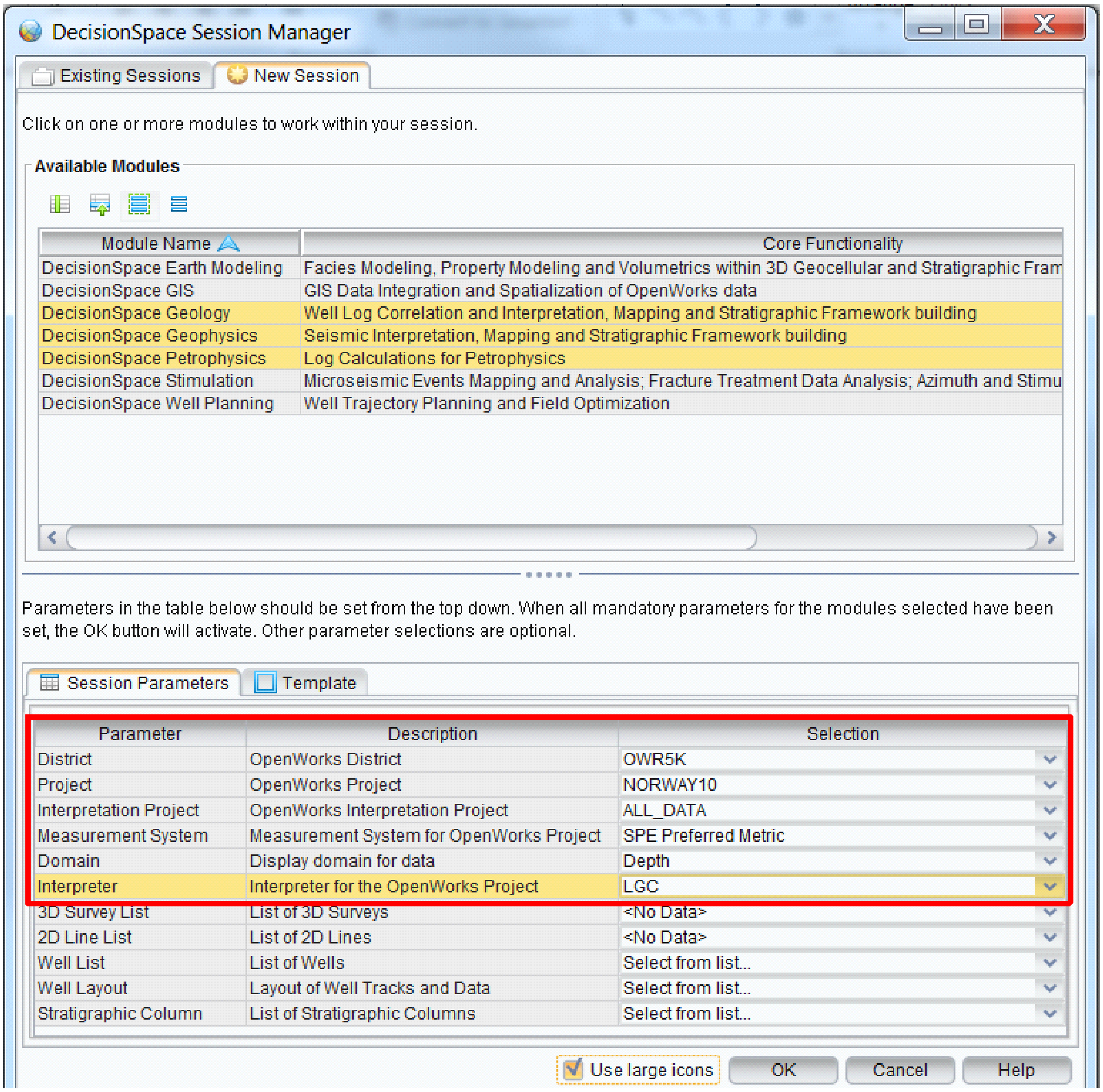
In this chapter you will learn how to:

- Create and edit a surface pick.
- Create a surface using surface picks.
- Map while interpreting with Dynamic Frameworks to Fill.
- Use Single-Pick Mode.
- Use predicted tops from Dynamic Frameworks to Fill surface maps.
- Create and edit fault picks.

With DecisionSpace Geosciences and Dynamic Frameworks to Fill, interpretation of surface picks and mapping go hand in hand. As a result, interpreted surfaces are available in *Map* view, *Cube* view, *Section* view, and *Well Correlation* view.

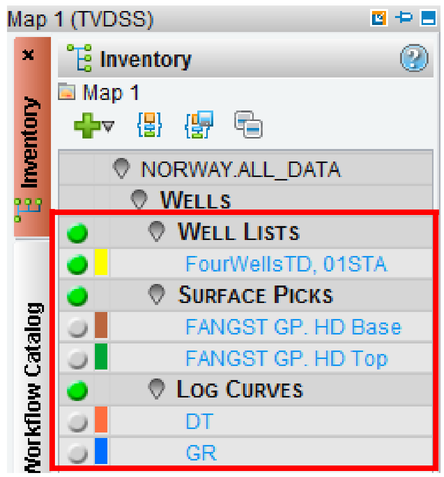
Exercise 3.1: Selecting and Setting Up Data

Begin by closing your current session and opening a new session with the following modules selections and session parameters.



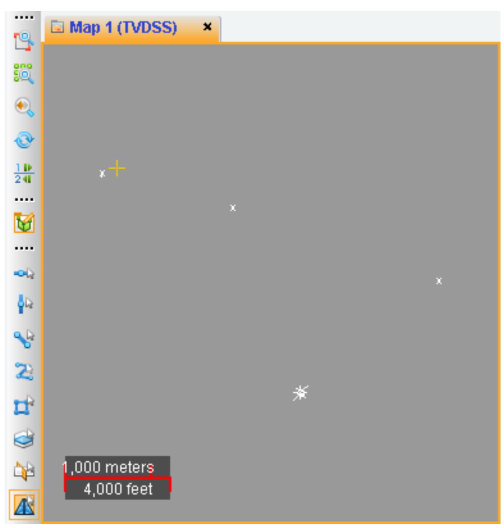
1. Activate *Map* view and then click the **Select Session Data** icon () and add the following objects to the session.

   - Logs Curves — **GR** and **DT**
   - Well Lists — **FourWellsTD,01STA**
   - Surface Picks — **FANGST GP.HD Base** and **FANGST GP.HD Top**



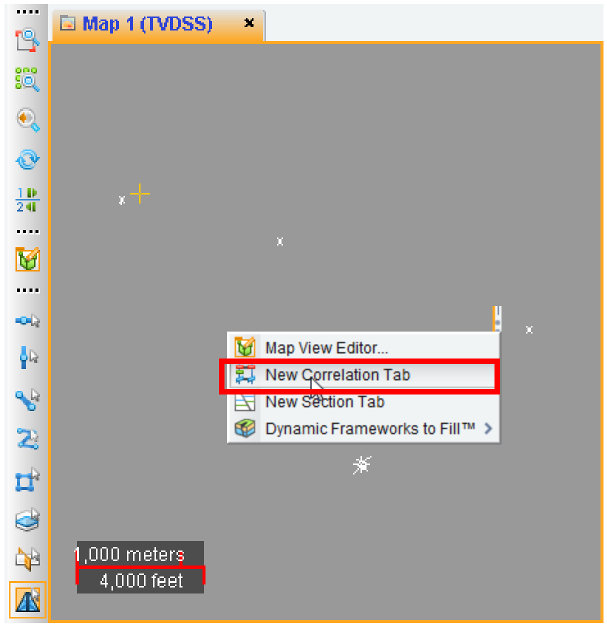
2. In the vertical tool bar of the *Map* view, click the **Select Wells from Map** icon ().

3. Click all of the **wells** of the FourWellsTD well list in *Map* view.



> **Note:**
>
> You can select and unselect by clicking the well in *Map* view. Depending on your background color, the color of the selection will be black or white.

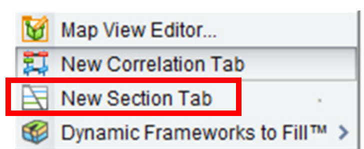
4. With your cursor in *Map* view, **MB3 > New Correlation Tab**



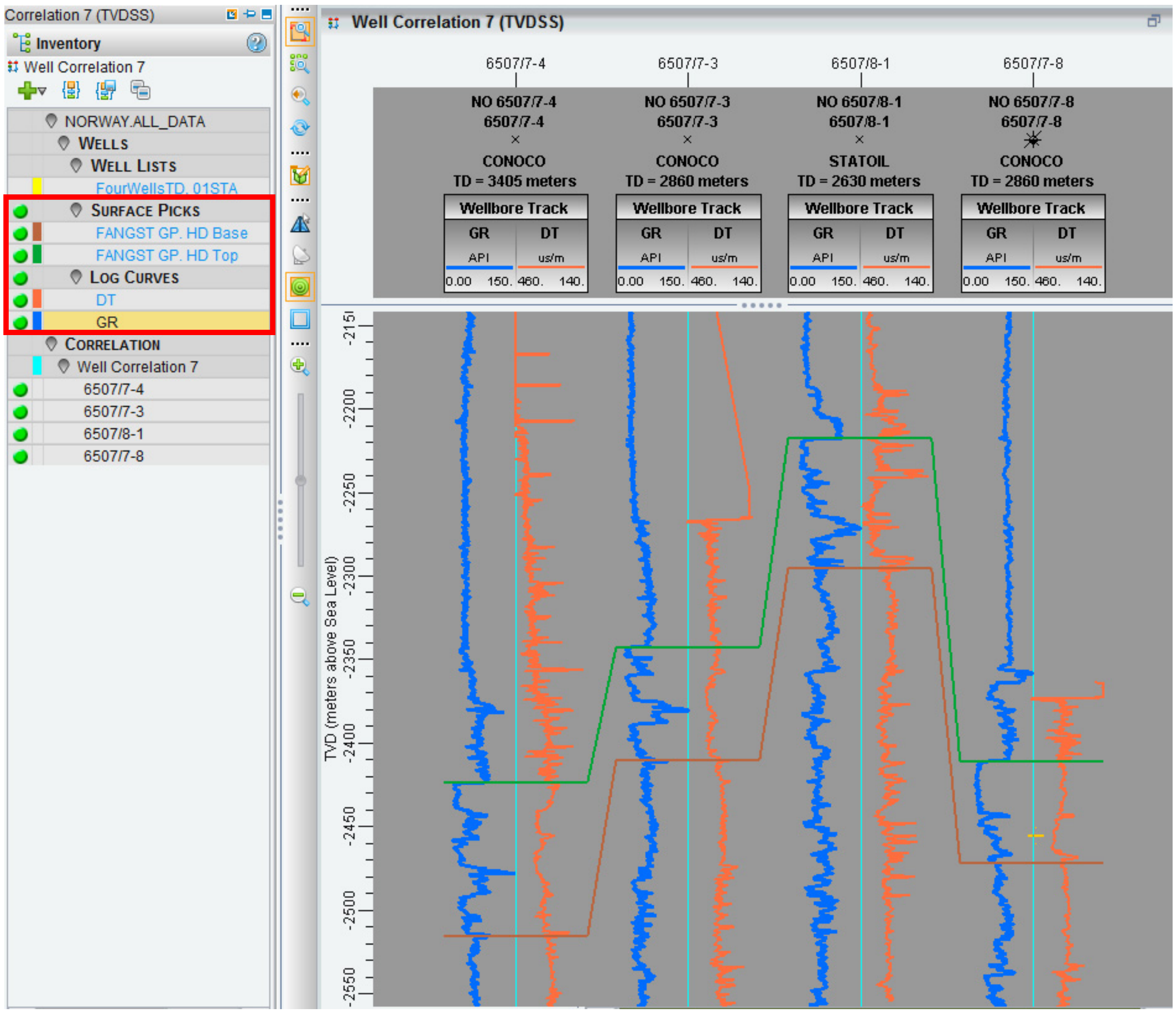
This will open a new *Correlation* view.

Note:

You can also create a new *Section* view, following the same command: **MB3 > New Section Tab**.



5. Maximize the newly created *Correlation* view and in the *Inventory* task pane, toggle on all **surface picks** and **log curves**, and zoom to depth **-2150 to -2550** to get a better look at the displayed surface picks, as in the following illustration.

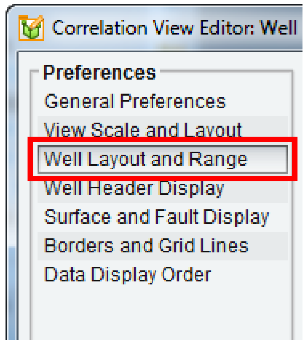


Note:

To change the log-curve display, put your cursor on the log curve of interest and **MB3 > Display Properties**. In the *Display Properties* dialog you can choose the colors, line thickness, track specification, scale fill, and more.

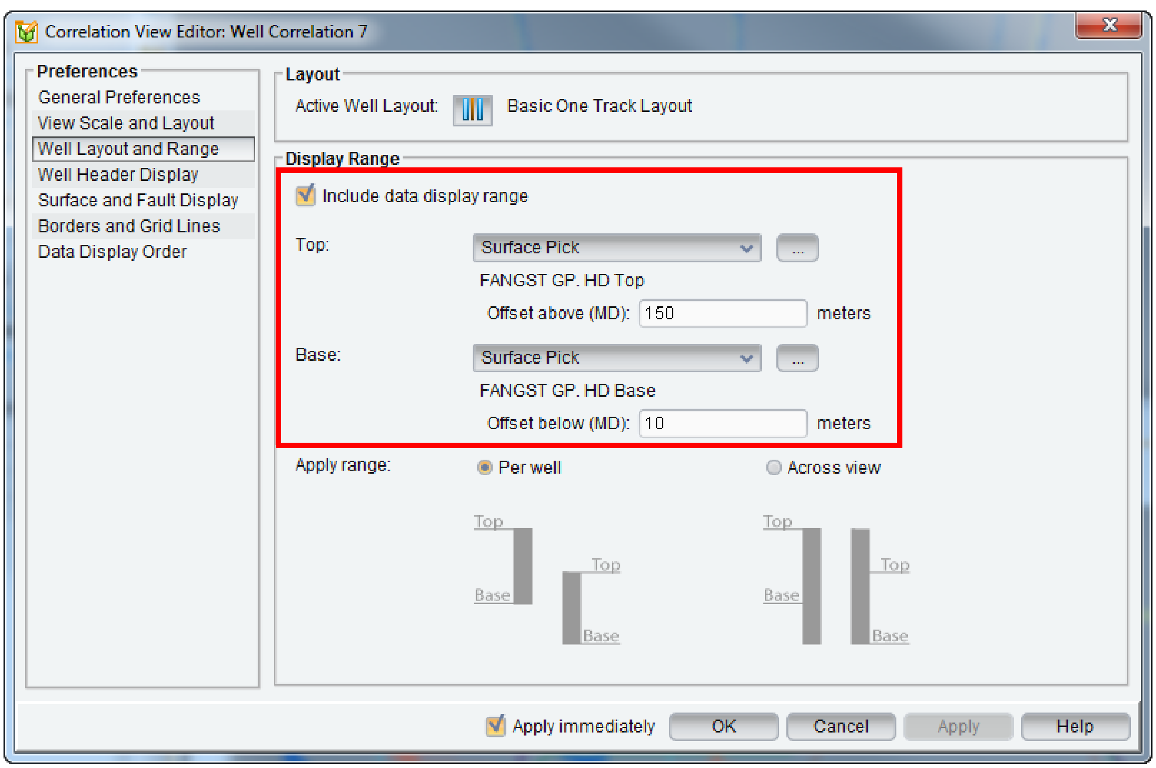
6. In *Correlation* view, click the **View Editor** icon () to limit the display of the log curve to your area of interest.

7. In the *Preferences* panel of the *Correlation View Editor*, click **Well Layout and Range**.



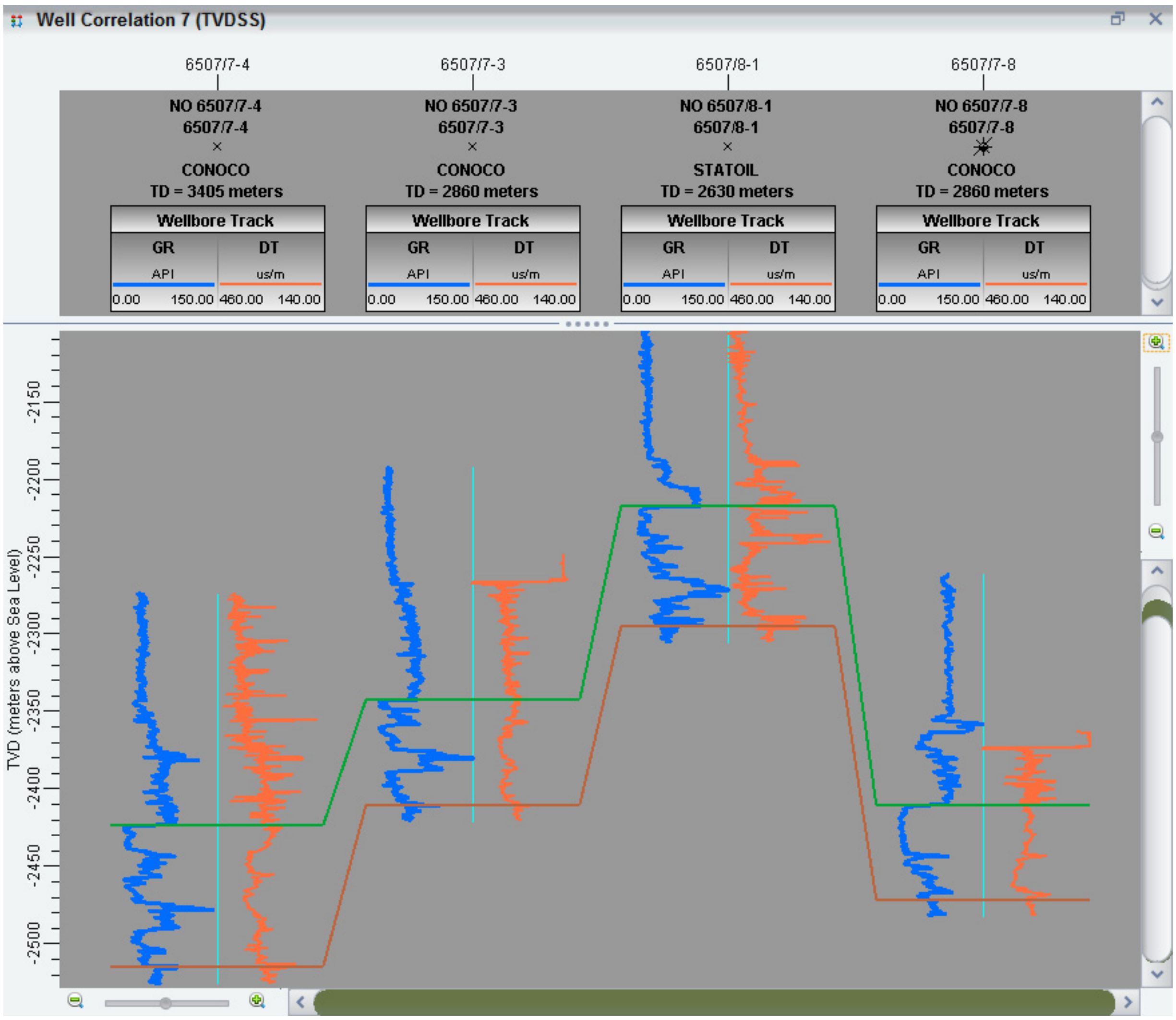
8. In the *Display Range* panel, perform the following steps.

- Toggle on **Include data display range**.
- In the Top: pull-down menu, select **Surface Pick** > **FANGST GP. HD Top**.
- In the Base: pull-down menu, select **Surface Pick** > **FANGST GP. HD BASE**.
- In the Offset above (MD): field for the Top: Surface Pick, enter **"150"**.
- In the Offset below (MD): field for the Base: Surface Pick, enter **"10"**. Click **OK**.



Note:

The first time you select Surface Pick from the Base: pull-down menu, the *Select Surface Pick for Top/Base* dialog will appear. To return to this dialog, click the more button, next to the pull-down menu.

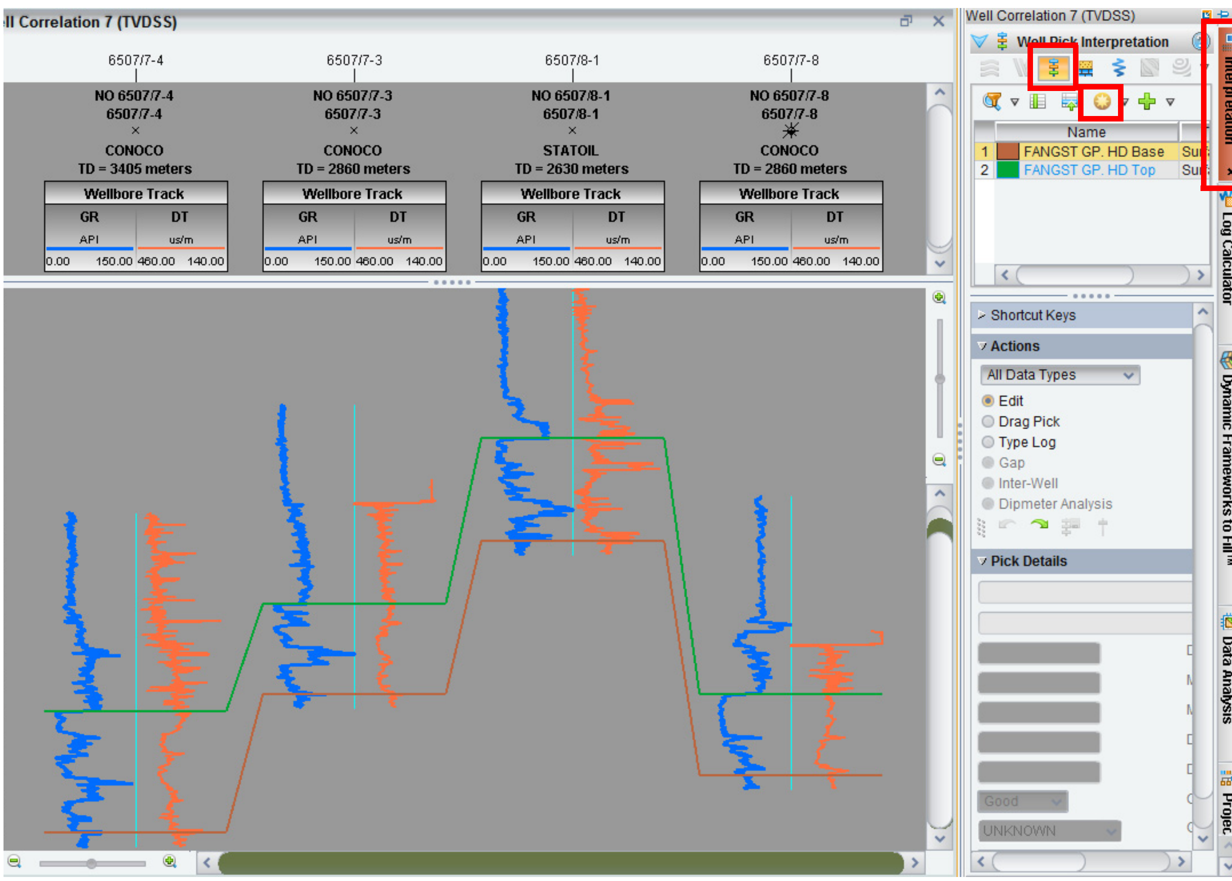


Exercise 3.2: Creating a Surface Pick

Typically, geologists will do most of their interpretation in *Correlation* view, where they can easily see the log curves for their wells. In this exercise you will learn how to interpret surface picks on your well logs in *Correlation* view.

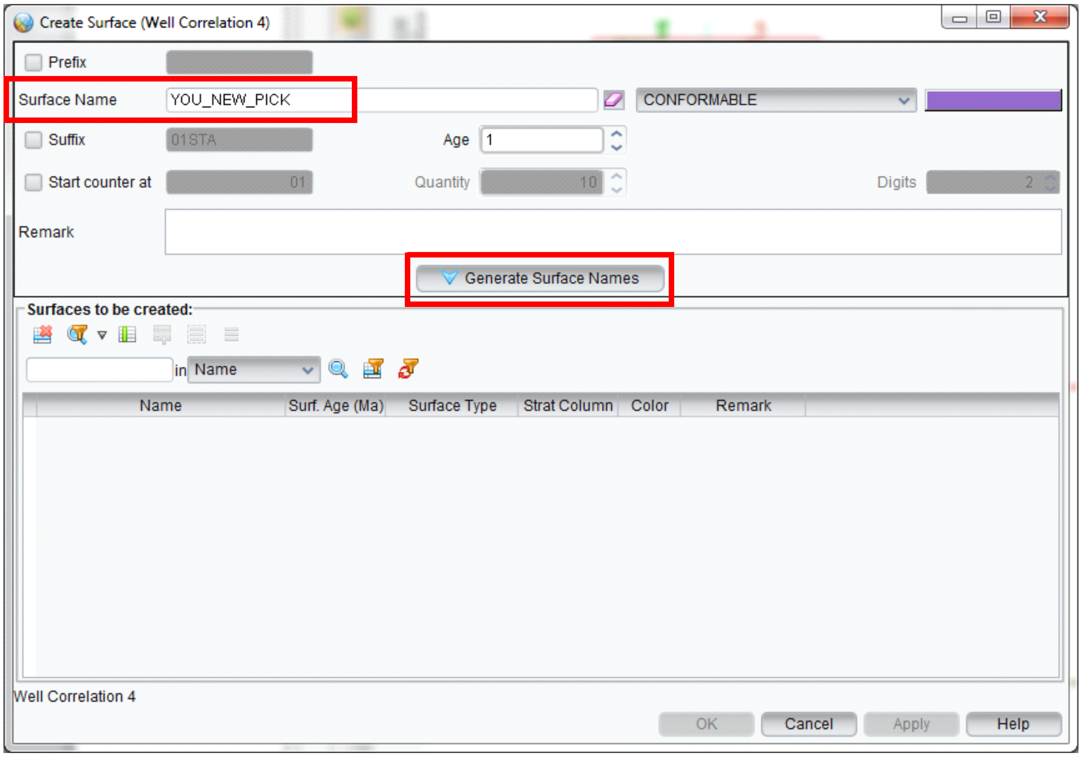
To start your surface pick interpretation, you will create a new surface pick.

1. Select the *Interpretation* task pane and click the **Well Pick Interpretation** icon ( ), then click the **Launch Create Surfaces dialog** icon ( ).



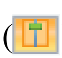
> **Note:**
>
> The *Correlation* view offers different options for the Z-value scale bar in the depth domain: TVD, TVDSS, MD, TST, TVT, well TVD, and THD.

2. In the Surface Name text field of the *Create Surface* dialog, enter **"YOU_NEW_PICK"**. Click the **Generate Surface Name** button, then click **OK**.

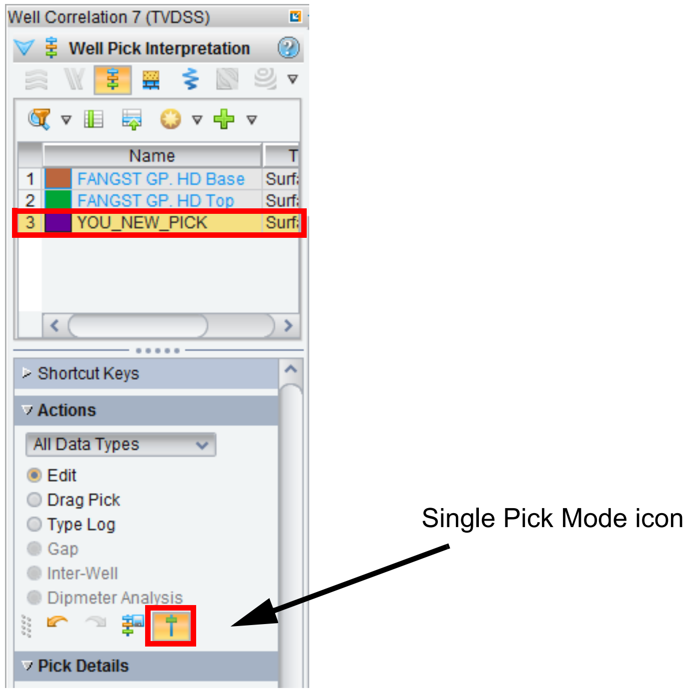


> **Note:**
>
> You can create multiple surfaces at one time in the *Create Surface* dialog before you click OK.

3. In the *Interpretation* task pane of the *Correlation* view, select **YOU_NEW_PICK**. This toggles on Interpretation Mode.

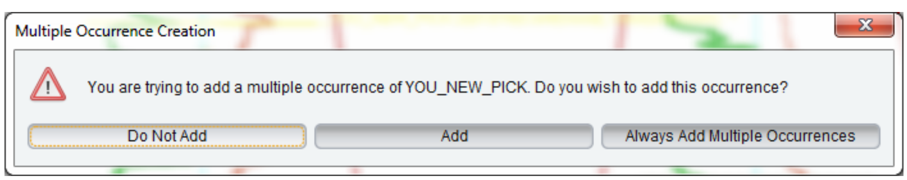
By default, this is set as Single Pick Mode ().

The Single Interpretation Pick Mode works like the Surface Pick Interpretation feature in the Landmark classic application, StratWorks®. Single Pick Interpretation Mode allows you to create only one instance of a pick per well. Any additional clicks along the wellbore will move the original well pick rather than causing the *Multiple Occurrences Creation* dialog to display. It is not necessary to drag the pick from its old depth to its new depth in this mode.

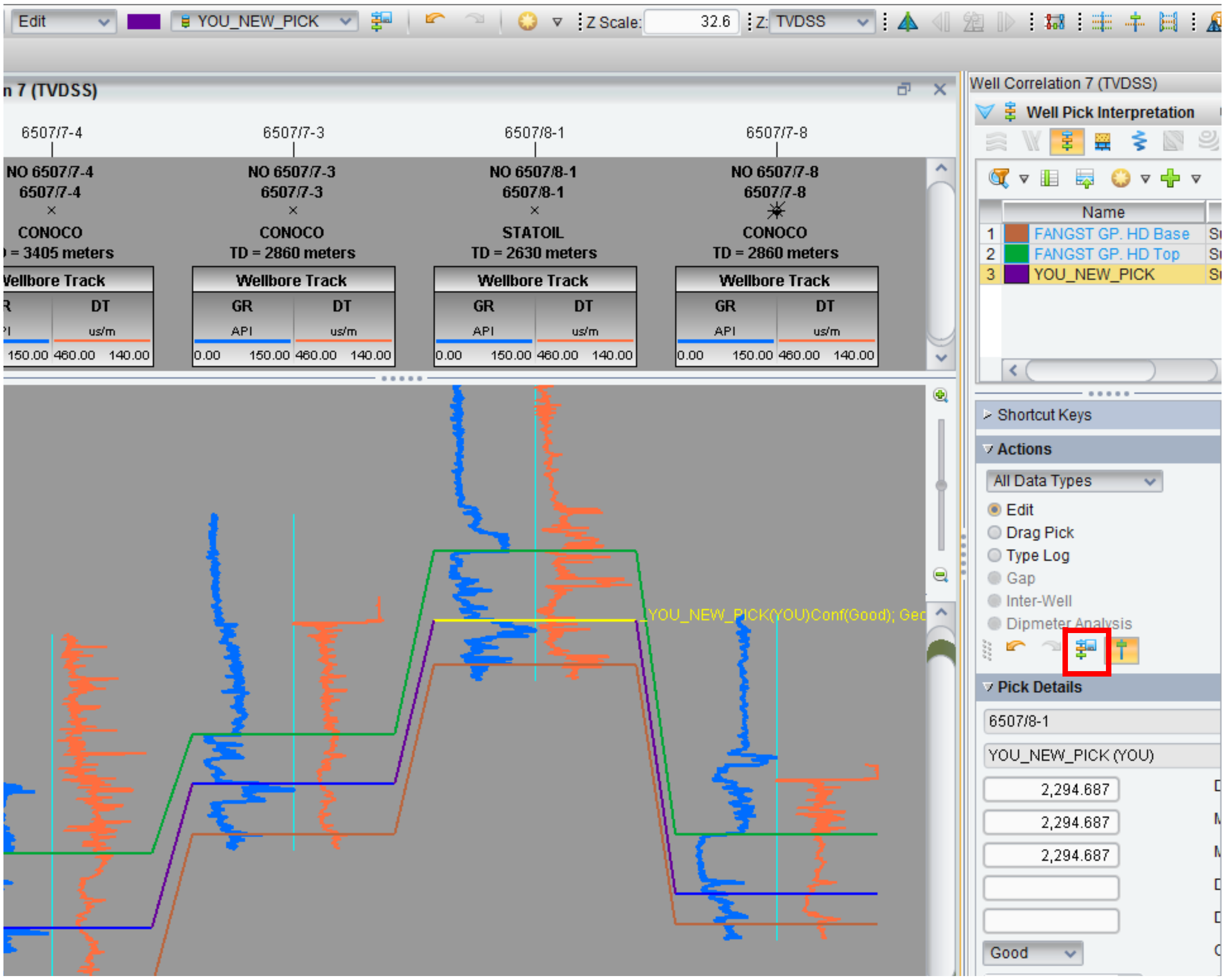


Note:

If you want to add multiple occurrences of a surface pick, you need to toggle off Single Interpretation Mode, then interpret the multiple occurrences. The software will ask you how you want your additional selection to be handled. For future editions of the multiple occurrences, you can use the Single Pick Interpretation Mode.

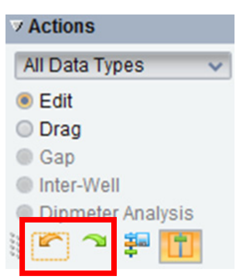


4. Using the image below as a guide, interpret **YOU_NEW_PICK.** When you are finished, click the **Save well pick changes to the database** ( ) icon.



Note:

The Undo and Redo options will be available until you save your interpretation. You can also use the shortcut keys <Ctrl> + Z for Undo and <Ctrl> + Y for Redo, if you are using a Windows computer.

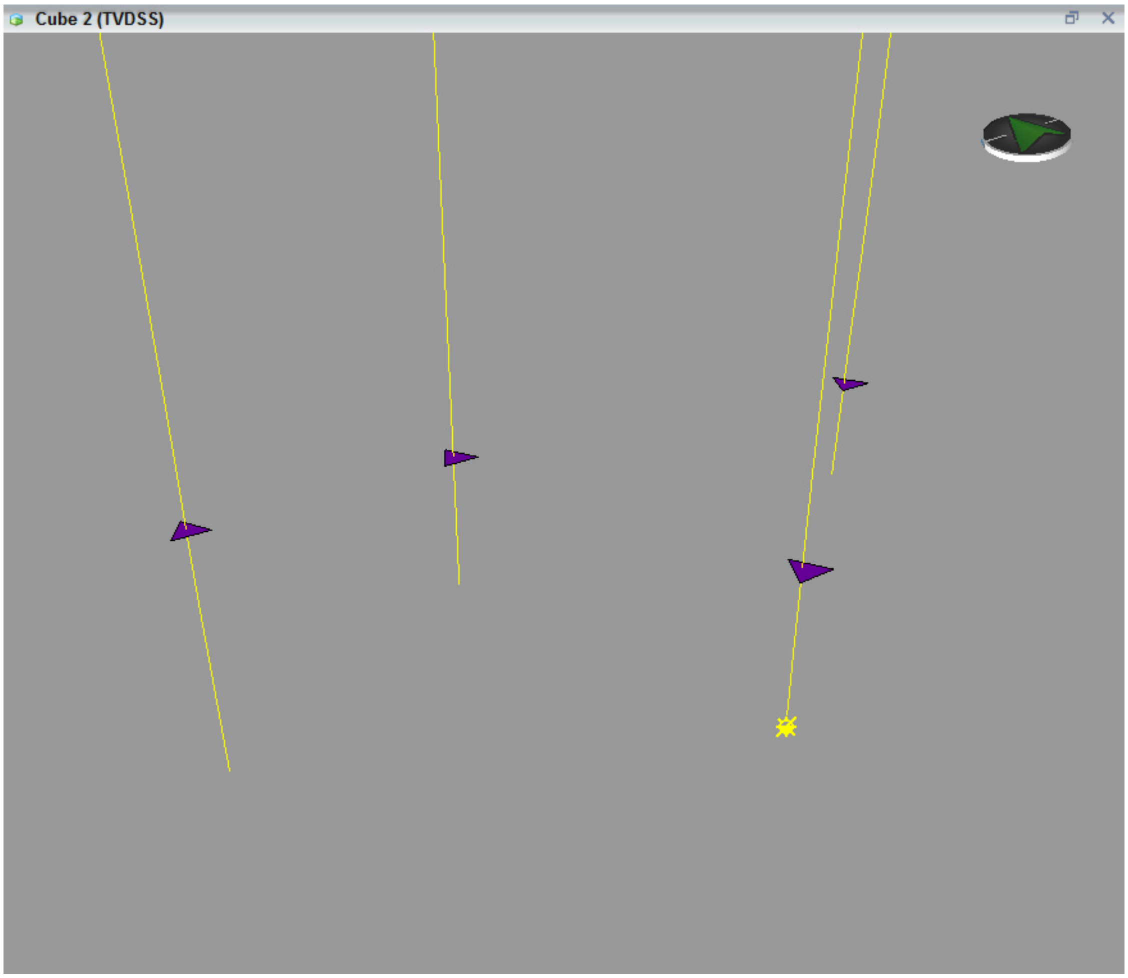


Exercise 3.3: Mapping Using Dynamic Frameworks to Fill

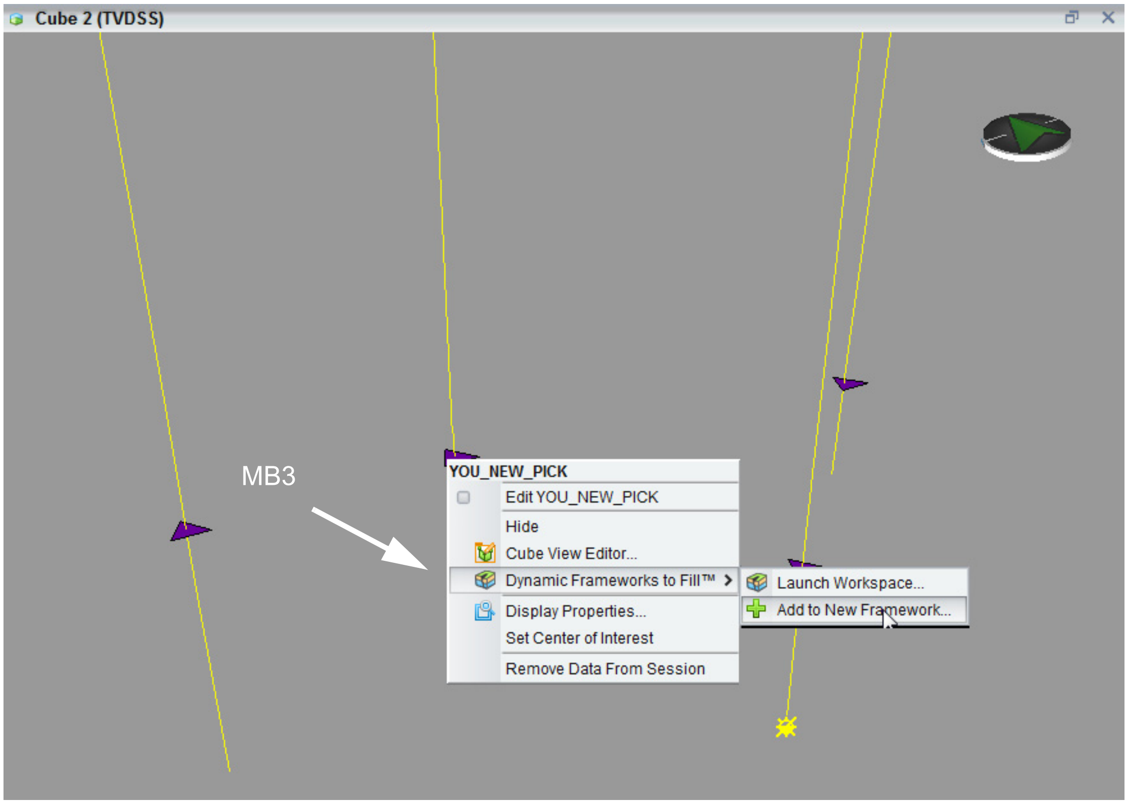
Dynamic Frameworks to Fill provides a new and advanced mapping methodology, wherein the maps are directly linked with the input data, to automatically update all of the maps. This section will serve as an overview of fast mapping using surface picks. (More detailed mapping workflows will be presented in the next chapter.)

1. In the *DecisionSpace* dialog, double-click ***Cube 2 (TVDSS)*** to maximize the *Cube* view to window size.

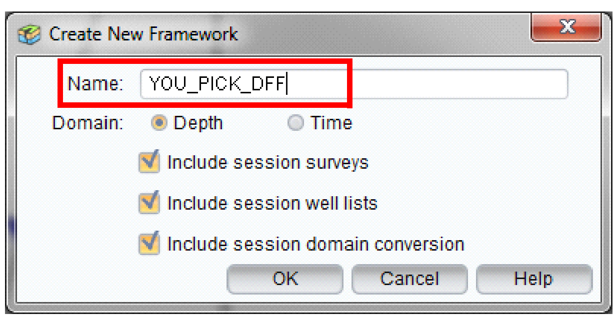
2. In the *Inventory* task pane, toggle on the **FourWellsTD** well list and **YOU_NEW_PICK**.



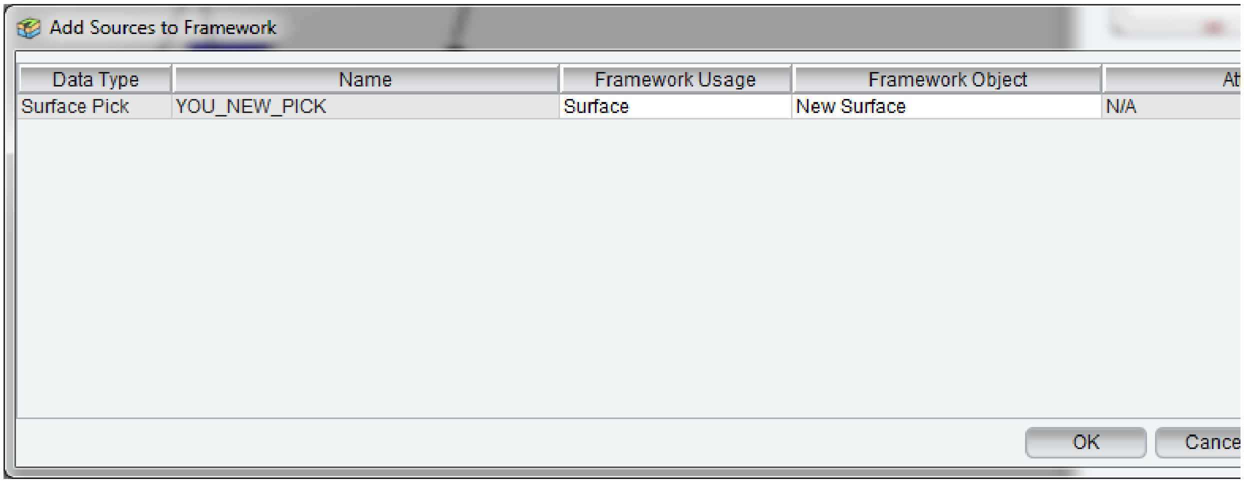
3. Put your cursor on a **YOU_NEW_PICK** and **MB3 > Dynamic Frameworks to Fill > Add to New Framework**.



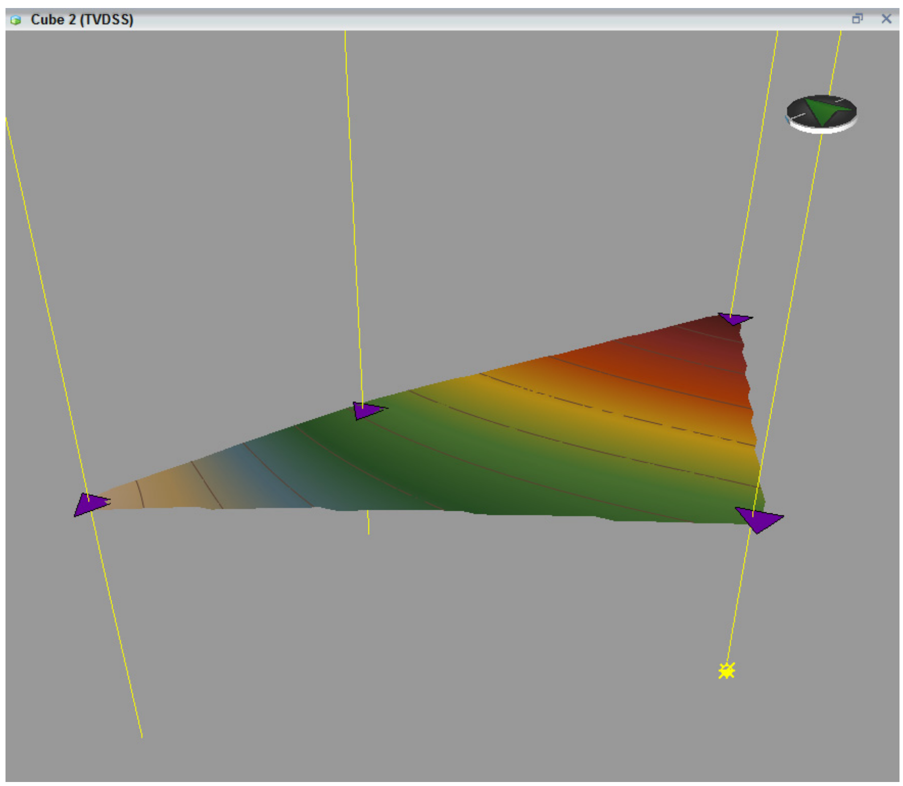
4. In the Name: text field of the *Create New Framework* dialog, enter **"YOU_PICK_DFF"**. Click **OK**.



5. The *Add Sources to Framework* dialog opens, showing you that YOU_NEW_PICK is the source for surface pick mapping. Click **OK**.



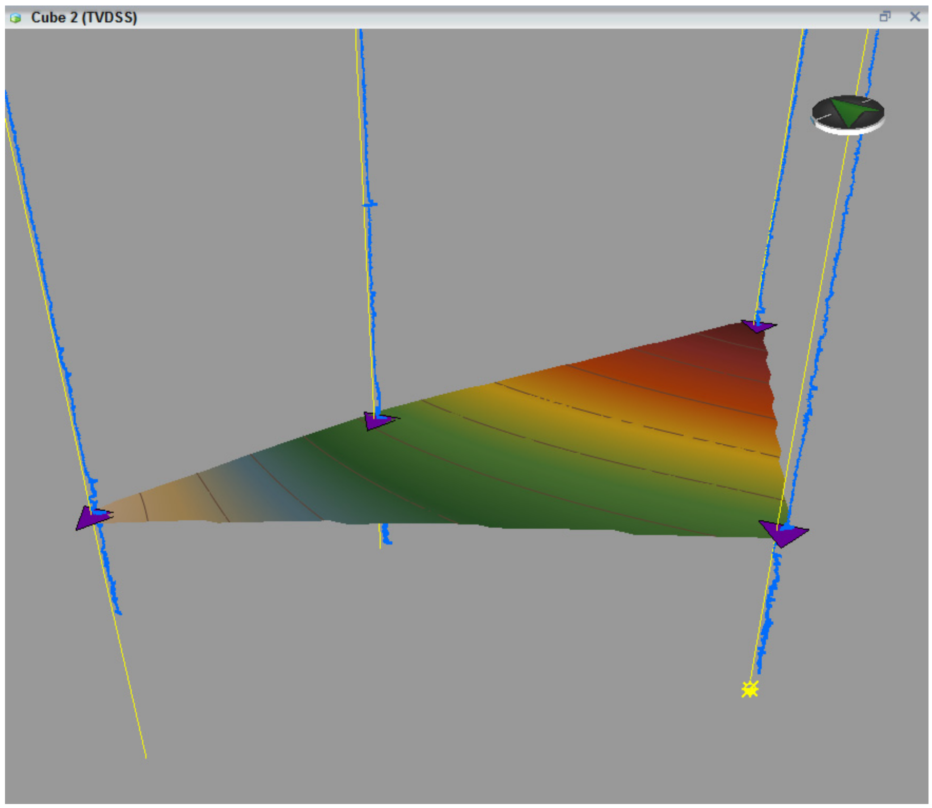
You now have a mapped Surface based on your Surface Pick values.



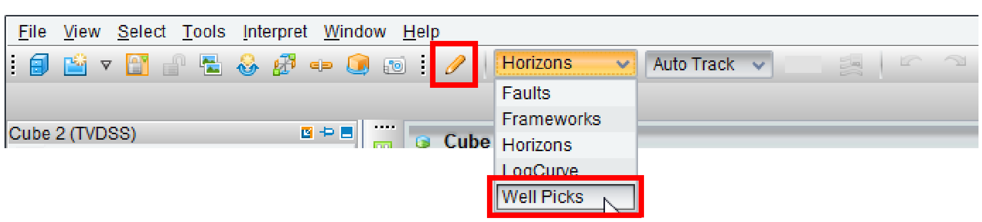
Exercise 3.4: Updating Dynamic Surface Picks

With Dynamic Frameworks to Fill you can update your maps with the last modification, on the fly, and you can try different scenarios to create a more accurate geological model.

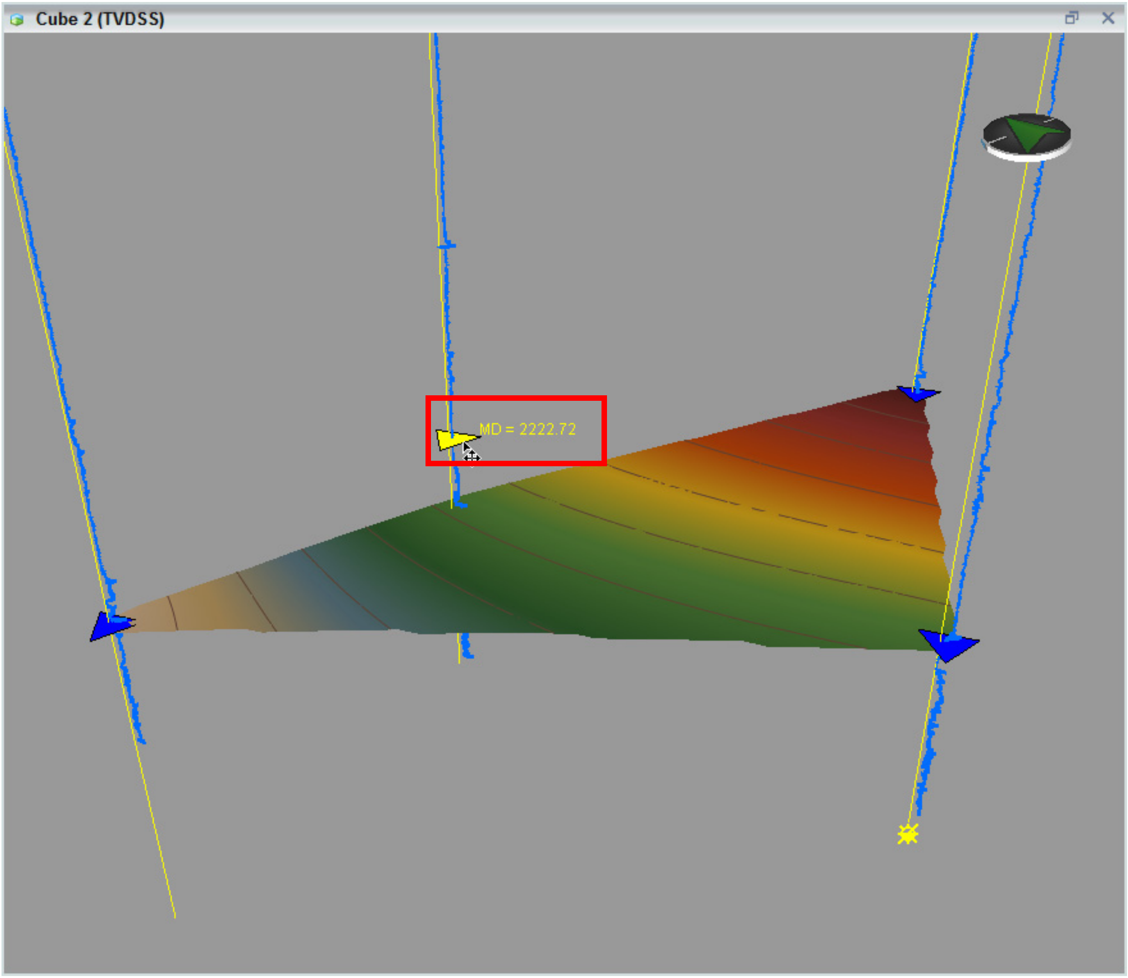
1. In the *Inventory,* toggle on log curve **GR**.



2. In the Interpretation tool bar at the top of the dialog, select **Well Picks** and toggle on **Interpretation Mode** ().



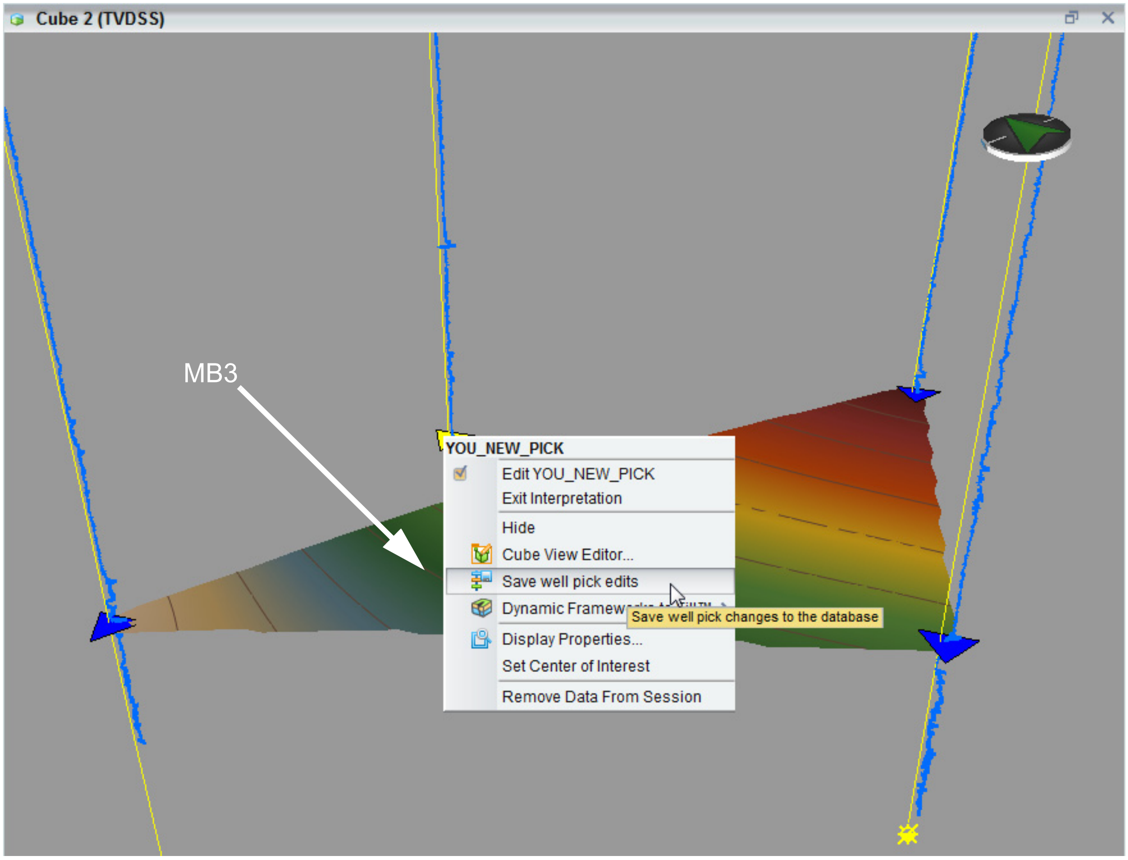
3. With the interpretation mode on, you can edit the surface picks in *Cube* view. Select one of the surface picks and drag it to a different depth along the wellbore.



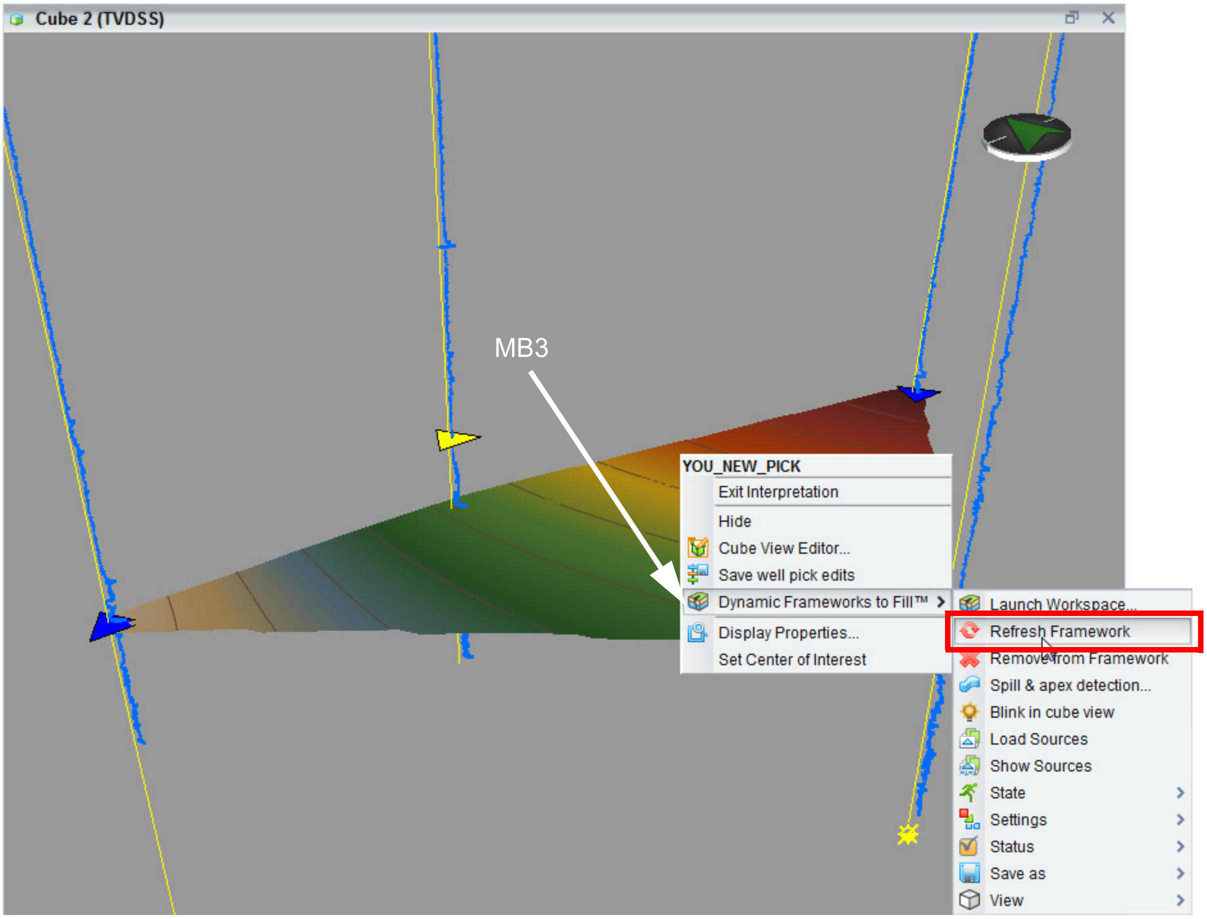
Note:

You may need to rotate the cube to better access the surface pick. <Alt> + MB1 will temporarily remove selection mode and allow you to rotate your view.

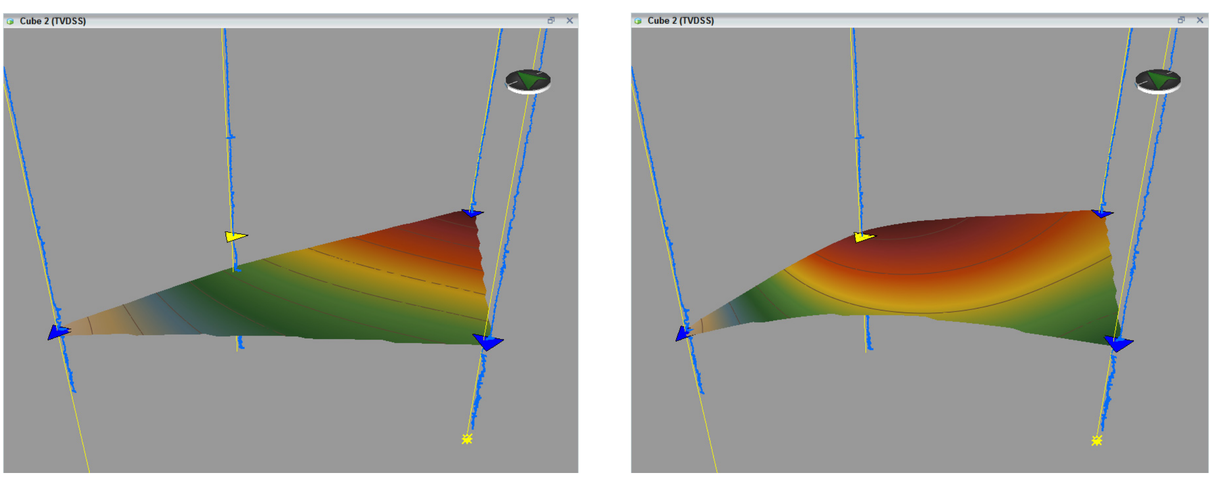
4. With your cursor in the surface pick, **MB3 > Save well picks edits** to apply the change to the database.



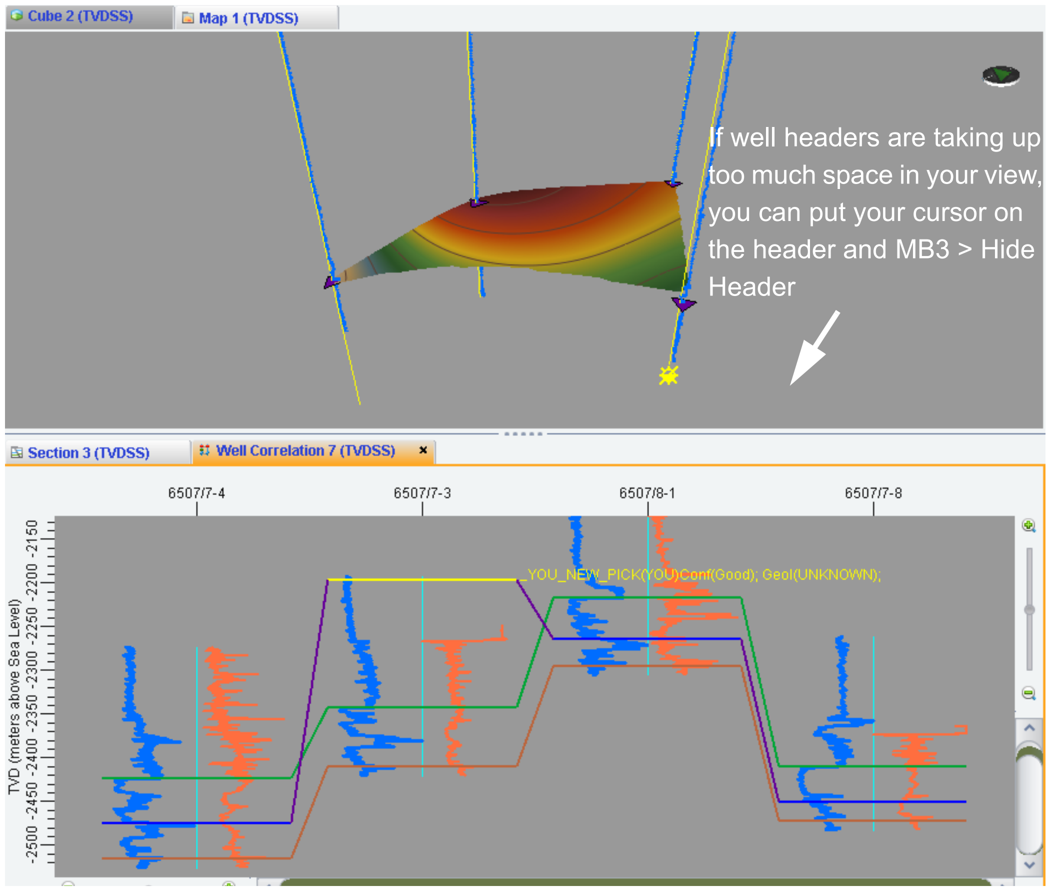
5. By default, Dynamic Frameworks to Fill requires a manual refresh. Later, you will use the automatic refresh feature. To refresh the Framework, put your cursor on the surface and **MB3 > Dynamic Frameworks to Fill > Refresh Framework**.



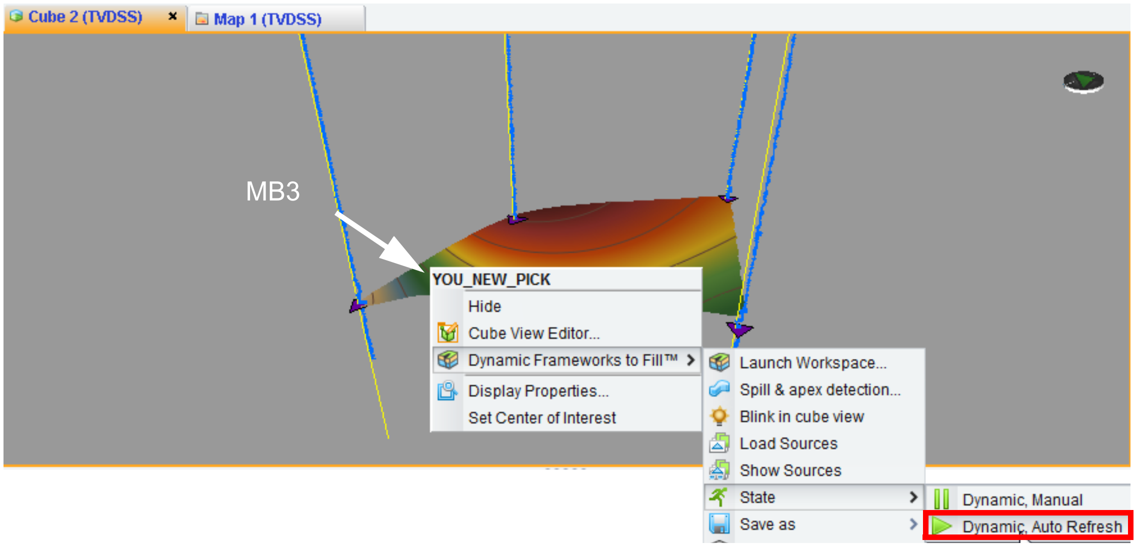
Dynamic Frameworks to Fill refreshes from the surface pick values in the database and regrids the surface. The image on the left shows *Cube* view before updating, and the image on the right shows it after updating.



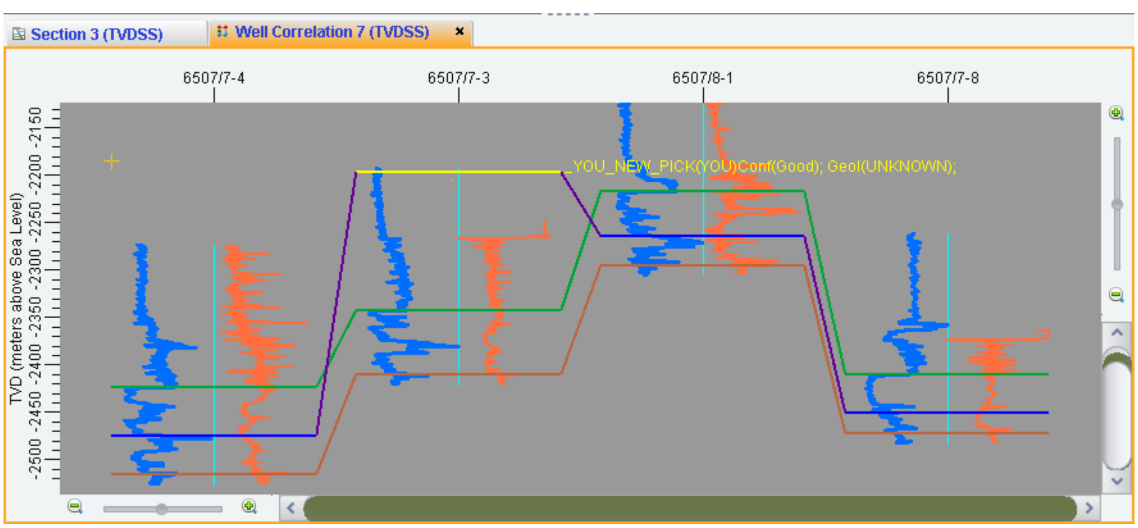
You will create a view similar to the following image. The top tile shows the Framework surface in *Cube* view and the lower tile shows the surface picks in *Correlation* view. You do this by clicking on the name tab of the view and dragging it to the position you want it to occupy. A red box appears where the view will appear when you release MB1.



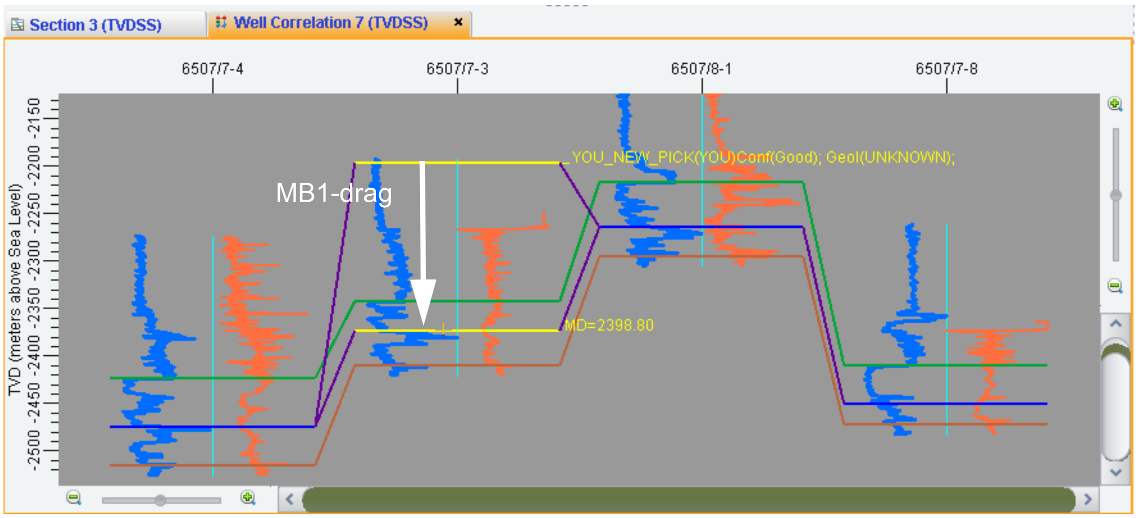
6. To set the Framework to automatic refresh, put your cursor on the **YOU_NEW_PICK** framework in the *Inventory* task pane of the *Cube* view and **MB3 > Dynamic Frameworks to Fill > State > Dynamic Auto Refresh**.



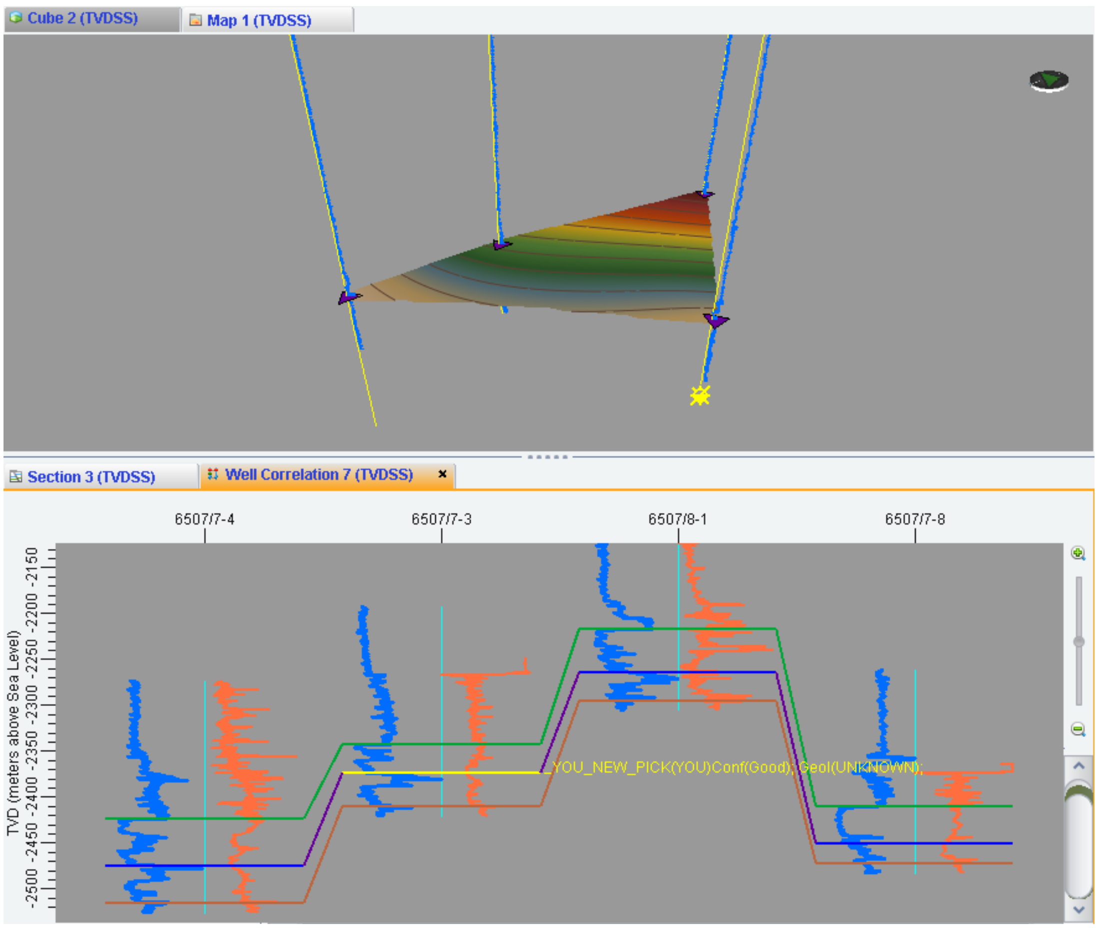
7. Now you will update your surface picks in *Correlation* view. You have an incorrect pick that you will re-interpret for the well you previously changed in *Cube* view. Activate *Correlation* view and put your cursor on the surface pick of interest until a pencil icon appears. Double-click the **surface pick** to enter surface pick interpretation mode.



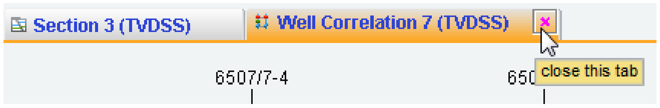
8. By **click-and-drag,** re-interpret the bad pick at a more suitable location, between the FANGST GP.TD Top and FANGST GP.HD Base picks.



9. Click the **Save well pick changes to the database** icon ( ). When you save the pick, the Framework will update to show the revised surface.



10. Close your active *Correlation* view.



You can see that Dynamic Frameworks to Fill honors the data saved to the OpenWorks database, and always has the latest version of the geological model when set to Dynamic, Auto Refresh state.

Note:

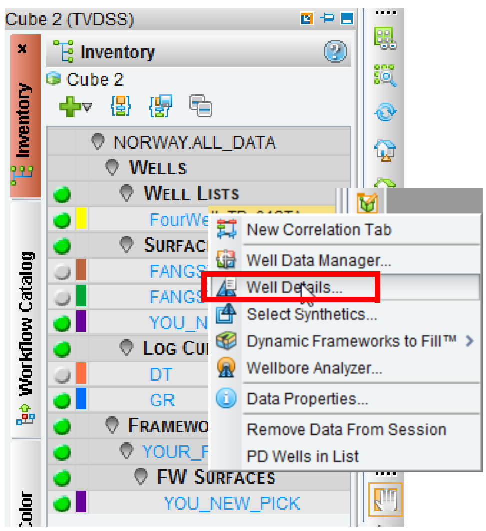
When you open a Framework, always reference the most recent version of the data that you used, to avoid problems. For example, if you use the surface picks of another interpreter and that interpreter changes a pick, you will see the changes when you open the Framework. Or, when you are working with the Framework and the other interpreter changes some of the data, the changes will appear in your Framework after the next refresh (in real time, if you are using auto refresh mode).

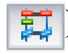
Exercise 3.5: Interpreting Surface Picks: Correlation Options

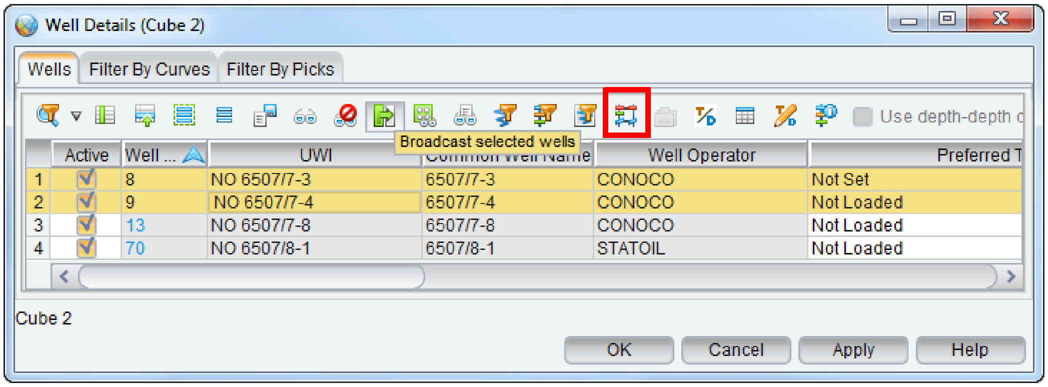
Often your log curves will not look exactly the same from well to well, and sometimes they can be drastically different from well to well; whether they look the same or different depends on the geology between them.

When you are interpreting a surface pick you can use different correlation options to improve your interpretation. In this exercise you will use the curve ghosting option to compare the interpretation from one well to the other wells, to assist the correlation.

1. In the *Inventory* task pane, put your cursor on **FourWellsTD** and **MB3 > Well Details**.



2. In the *Well Details* dialog, select wells 6507/7-4 and 6507/7-3, then click **Display Selected Wells in New Correlation View** icon ().

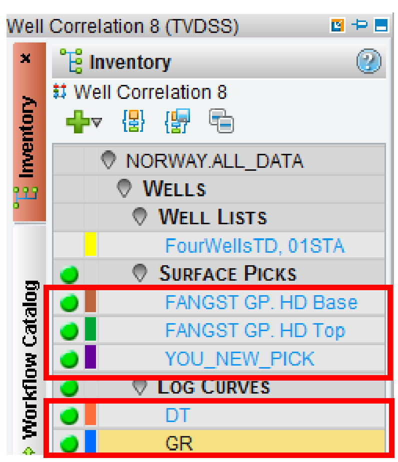


3. Click **Cancel** to close the dialog.

You have two curve ghosting options to improve surface pick interpretation: Drag Pick and Type Log.

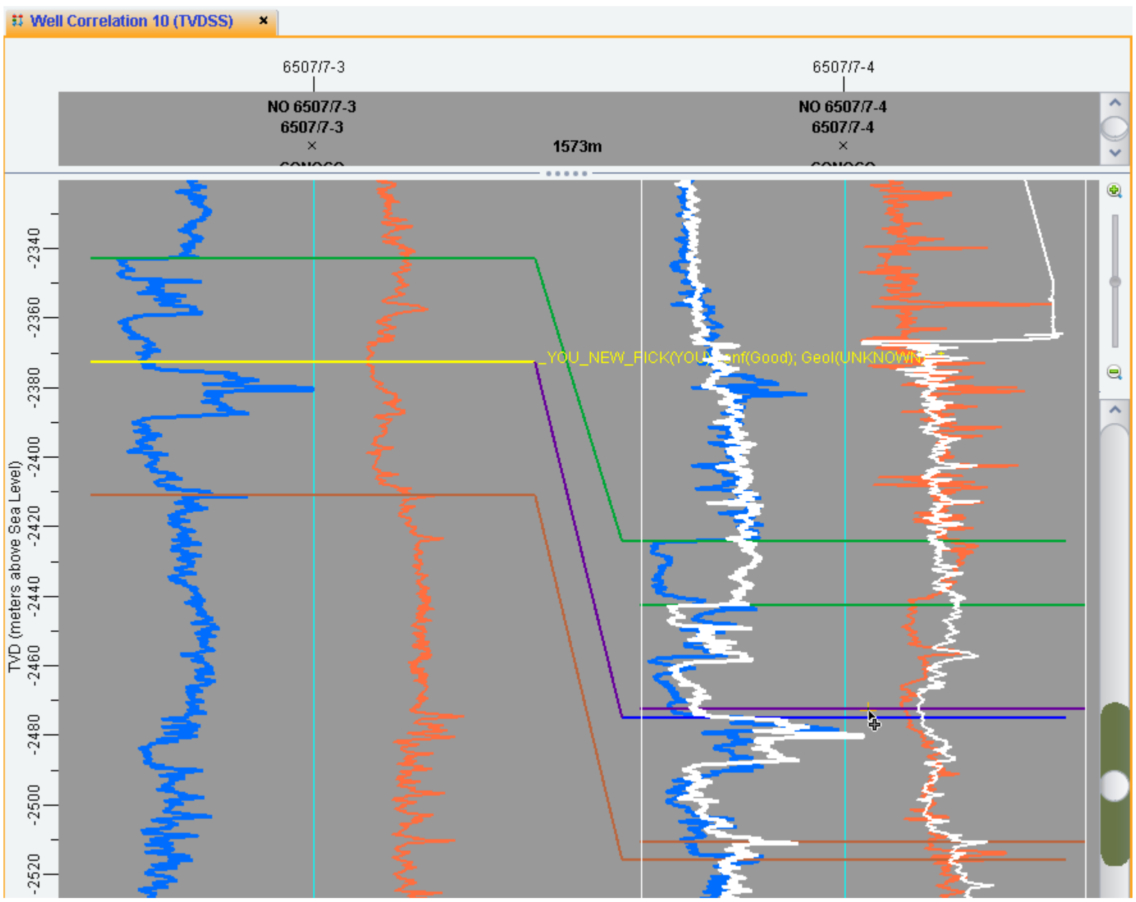
- **Drag Pick** — creates a correlation ghost with the option of a fast interpretation of a surface pick of choice; however, you can't change the visual form of the log (no stretching or squeezing).
- **Type Log** — creates a correlation ghost with the stretch/squeeze option and requires switching to Edit mode to interpret picks.

4. Creating a new *Correlation* view this way will open it in a new window. Toggle on surface picks **FANGST GP.HD Base**, **FANGST GP.HD Top**, **YOU_NEW_PICK** and log curves **DT** and **GR**.

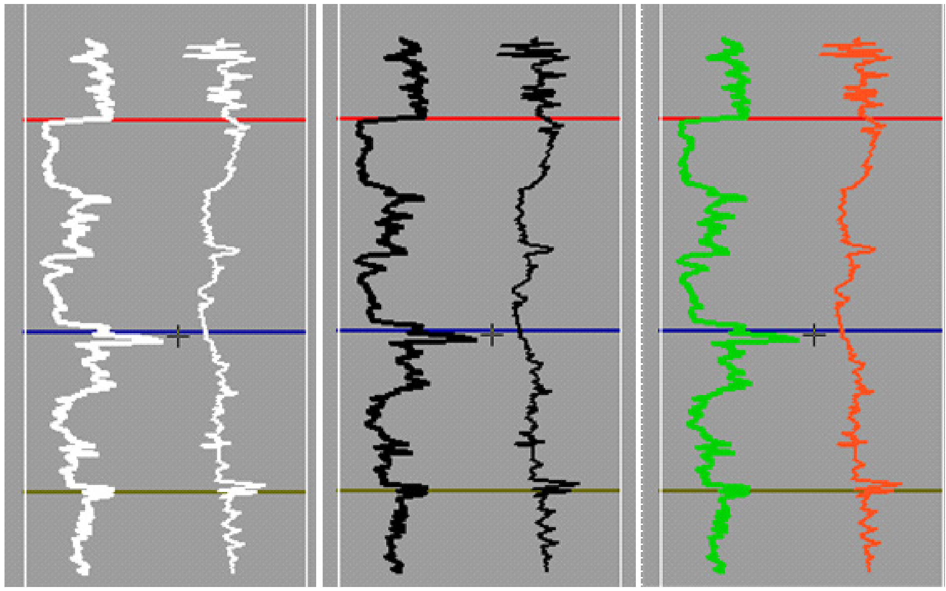


5. Click the **Well Pick Interpretation Mode** icon and select **Drag Pick** from the pull-down menu.

6. Click the **YOU_NEW_PICK** for well 6507/7-4 to activate a correlation ghost, then go to the next well and use the correlation ghost to decide the new position of the surface pick. Click (MB1) to interpret.

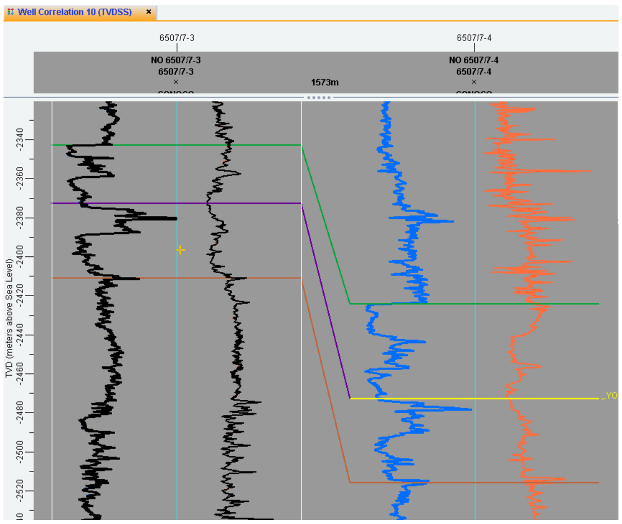


7. You can change the color of the ghost curve. With your cursor in *Correlation* view, **MB3 > Curve Color**, and select **Black** from the **three options**: Black, White, or Same as View.

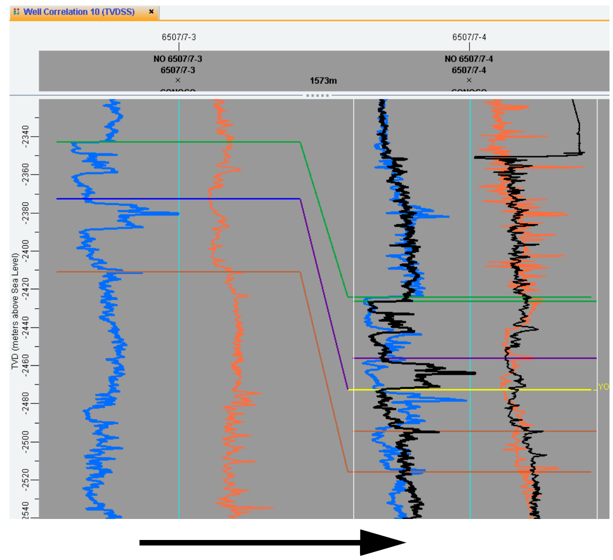


8. **MB2** to end **Drag Pick** action.

9. Now select the **TYPE LOG** action and click one of the wells, which will appear as a ghost curve in black. Select well **6507/7-3**, then click-and-drag to well **6507/7-4**.



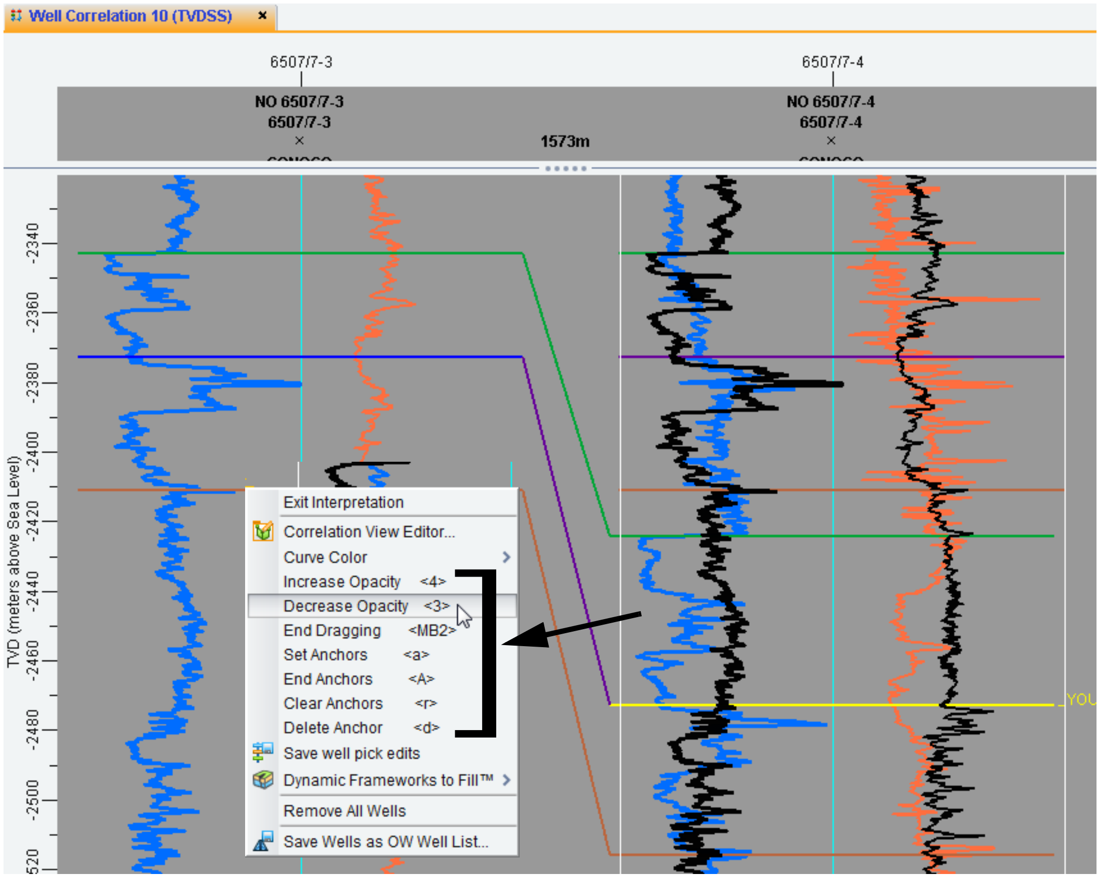
The area between the white bars shows the curve ghost.



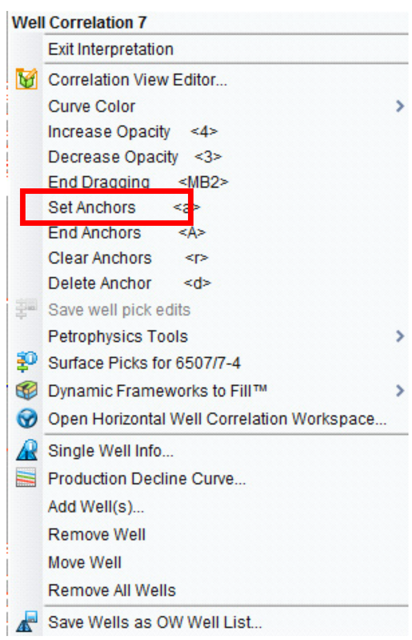
Drag to another well to correlate.

10. With your cursor in *Correlation* view, **MB3** to see the following editing options:

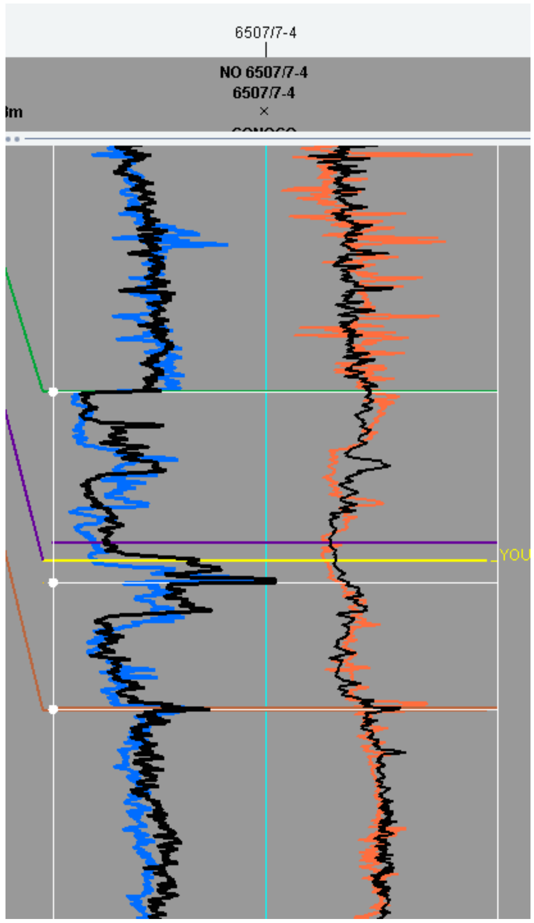
Editing Option	What it does	Shortcut Key
Increase opacity	Increases opacity of the ghost curve by 10%	4
Decrease opacity	Decreases opacity of ghost curve by 10%, down to a minimum of 30% opacity	3
End dragging	Ends current curve ghost	MB2
Set anchors	Allows you to place anchors to stretch/squeeze the ghost curve (disables dragging the ghost curve)	a
End anchors	Disables Set anchors and allows you to drag the ghost curve.	<Shift> + a
Clear anchors	Deletes all anchors	r
Delete anchor	Deletes the anchor at the cursor position	d



11. To set an anchor, **MB3 > Set Anchors**.

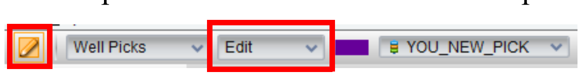


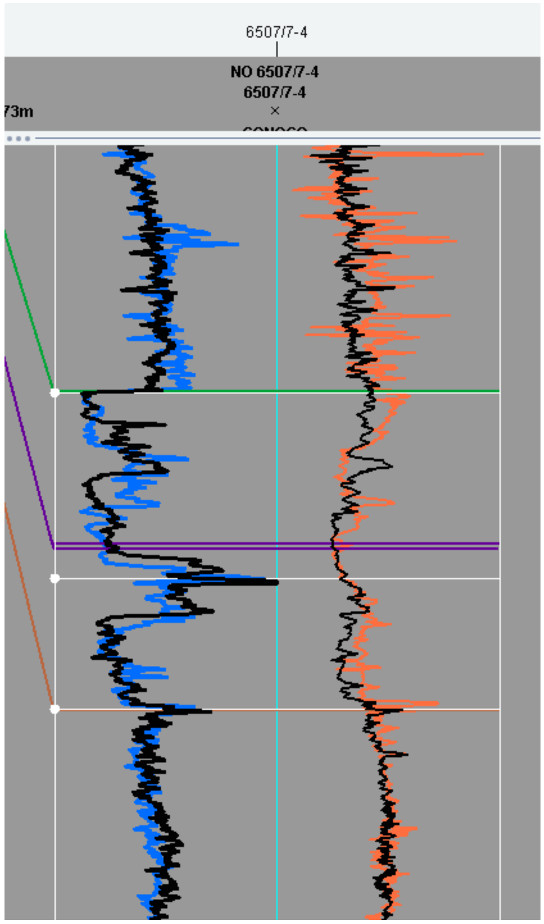
12. Click the **FANGST GP.HD Top** pick to create the first anchor, then click in the **interval** where you want to set an anchor. After at least two anchors have been placed, click-and-drag any **anchor** to stretch/squeeze an interval.



> **Note:**
>
> The anchors are set on the ghost curve. If you are using curve spikes or picks as indicators for your anchors, ensure that you are clicking the Z-value for these items on the ghost curve, not according to the well below. Using a different color or opacity for the ghost curve is very useful in this situation.

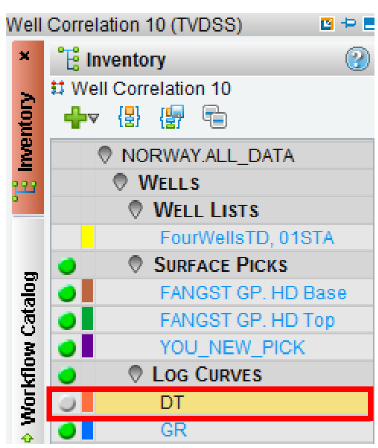
13. To interpret using the ghost curve you must change the interpretation action to **Edit** and interpret the surface pick.



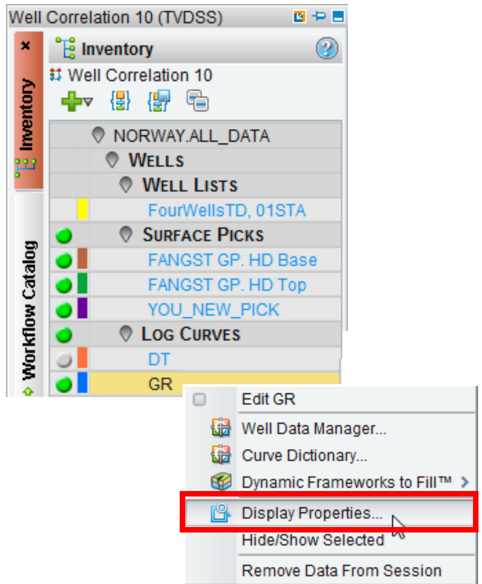


14. Click the **Save Pick** icon ( ) to save the interpretation and exit the Interpretation Mode ( ).

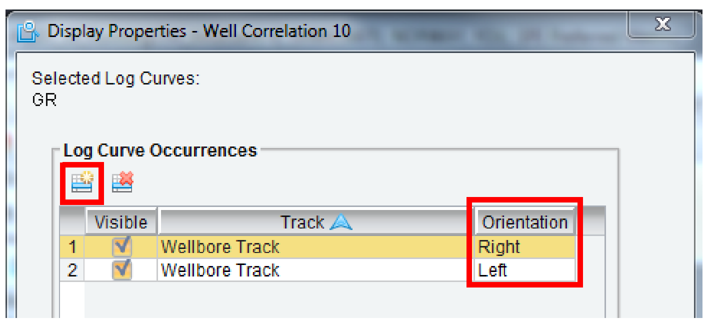
15. To continue with the interpretation, toggle off the **DT** log curve.



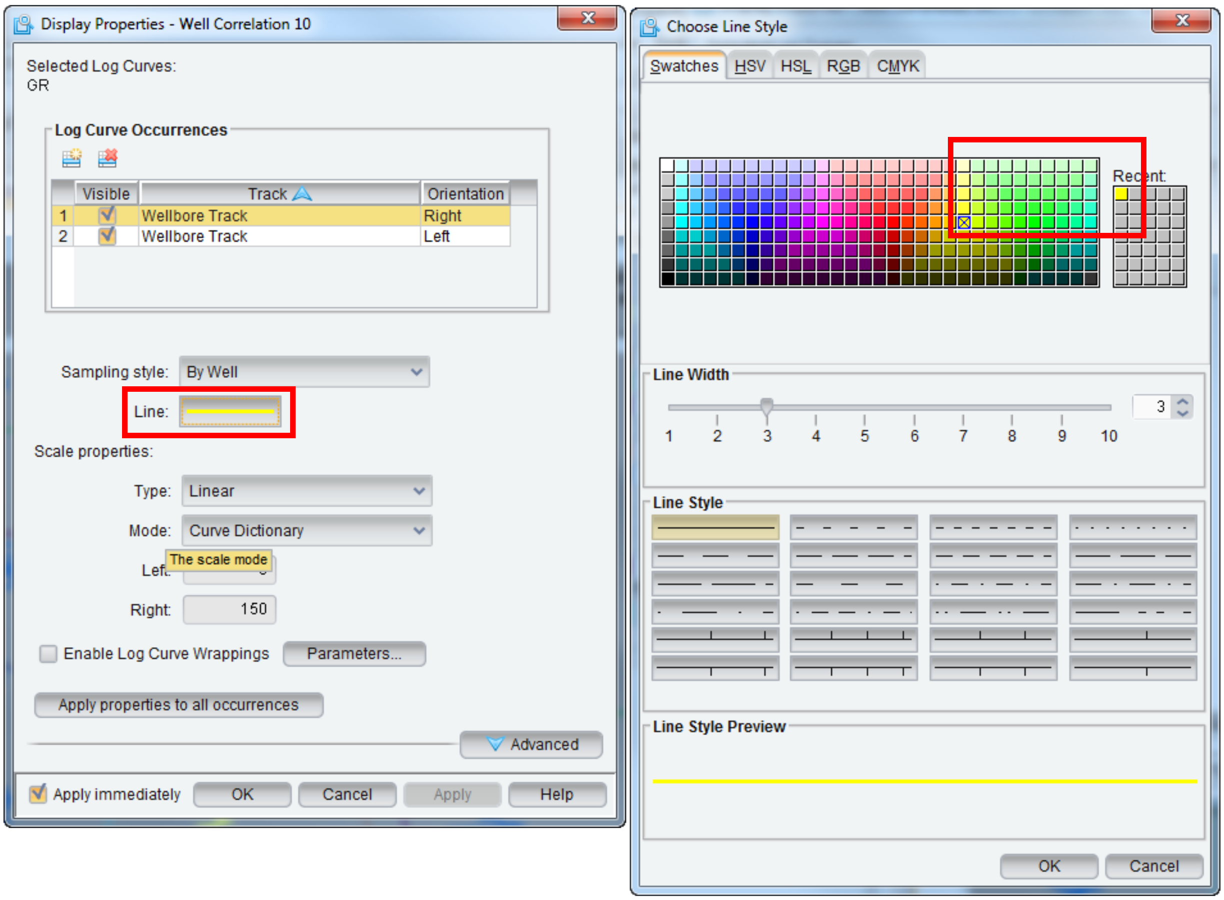
16. In the *Inventory* task pane, put your cursor over the log curve **GR** and **MB3 > Display Properties**.

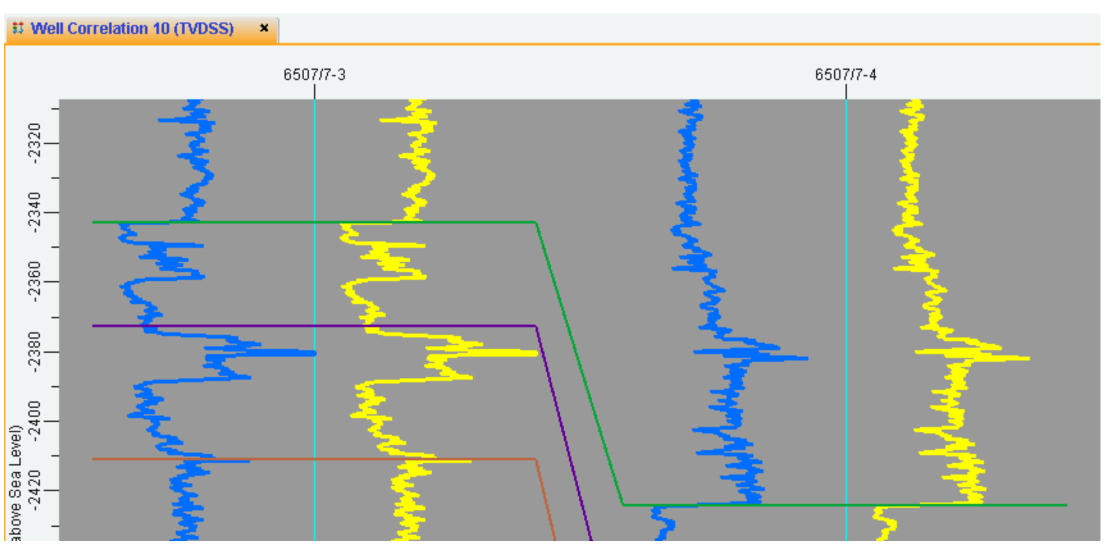


17. In the *Display Properties* dialog, click the **Add an occurrence of the log curve** icon (), then change the orientation so one occurrence is oriented to the **Left** while the other is oriented to the **Right**.

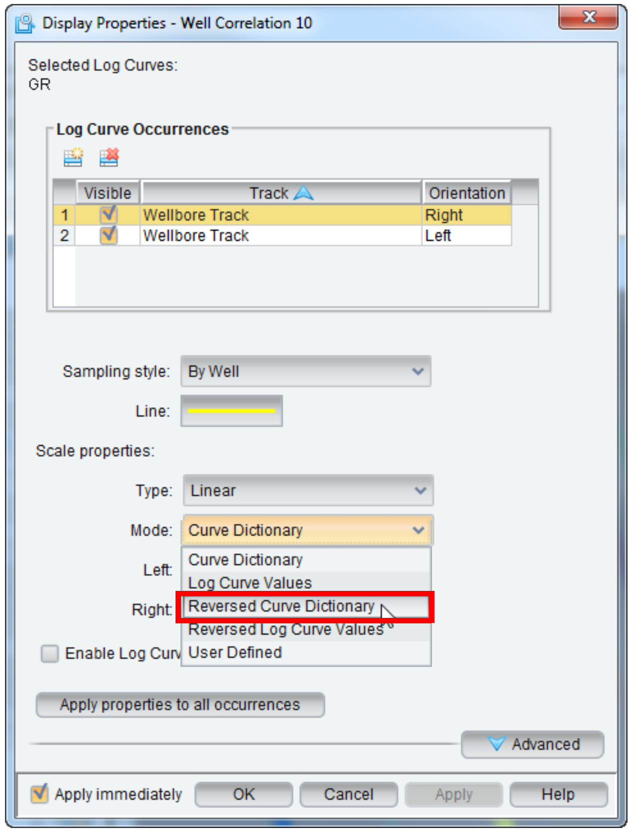


18. To change the color of the new GR curve, select the **Line:** button. Specify the **line color**, **width**, and **style** properties. On the *Choose Line Style* dialog, select **yellow**, then click **OK**.

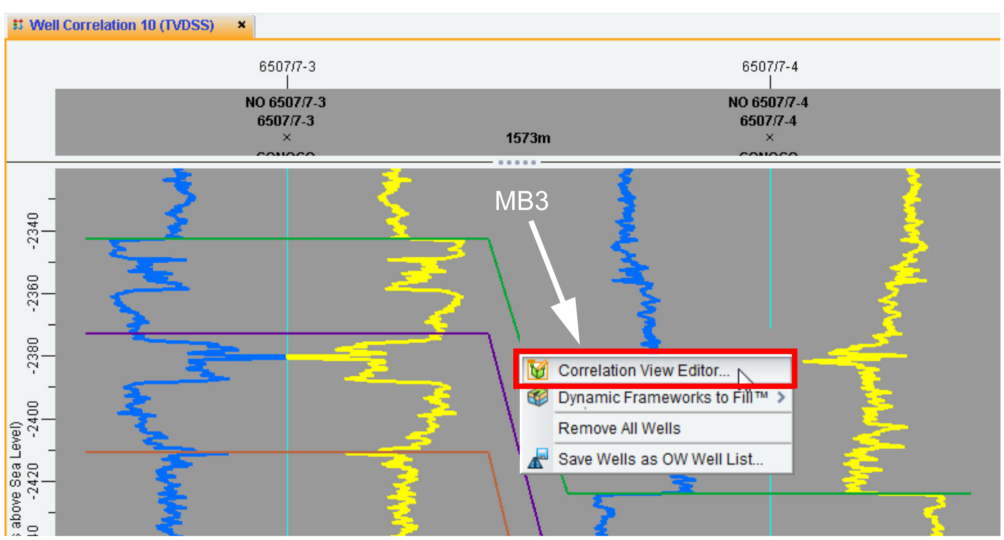




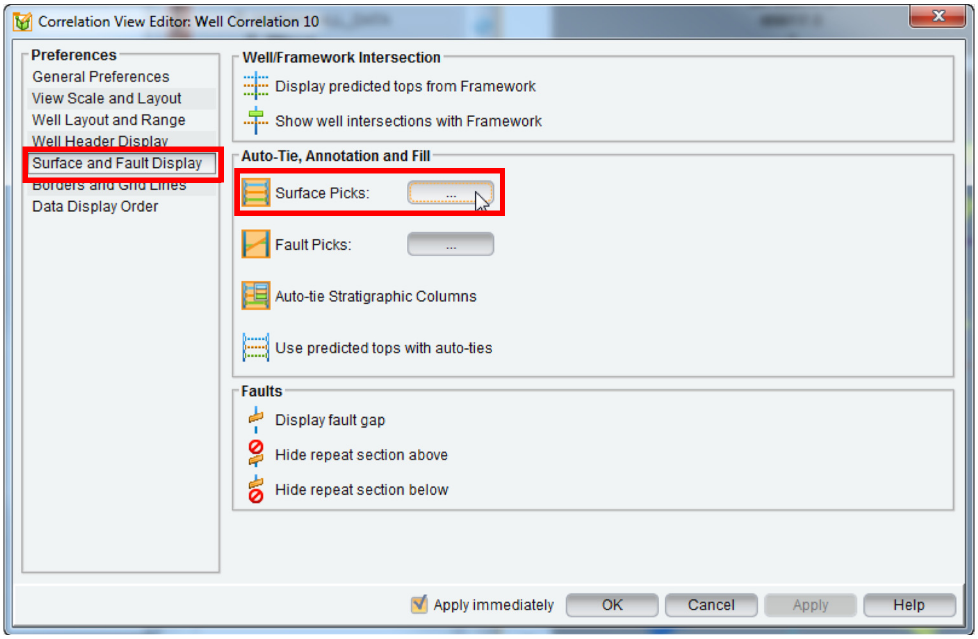
19. To flip the values of the right-oriented occurrence in the Scale Properties: Mode: pull-down menu, select **Reversed Curve Dictionary**. Click **OK**.



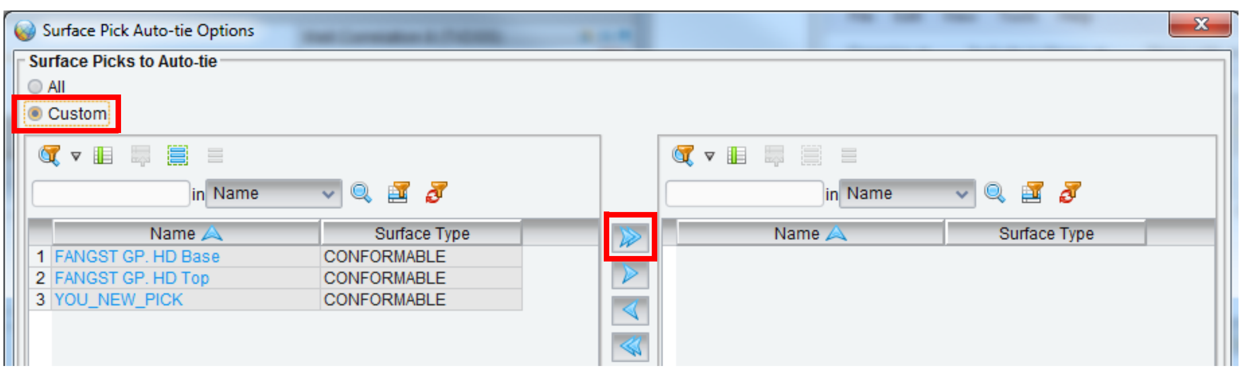
20. To interpolate log curve values between wells, put your cursor in *Correlation* view and **MB3 > Correlation View Editor**.



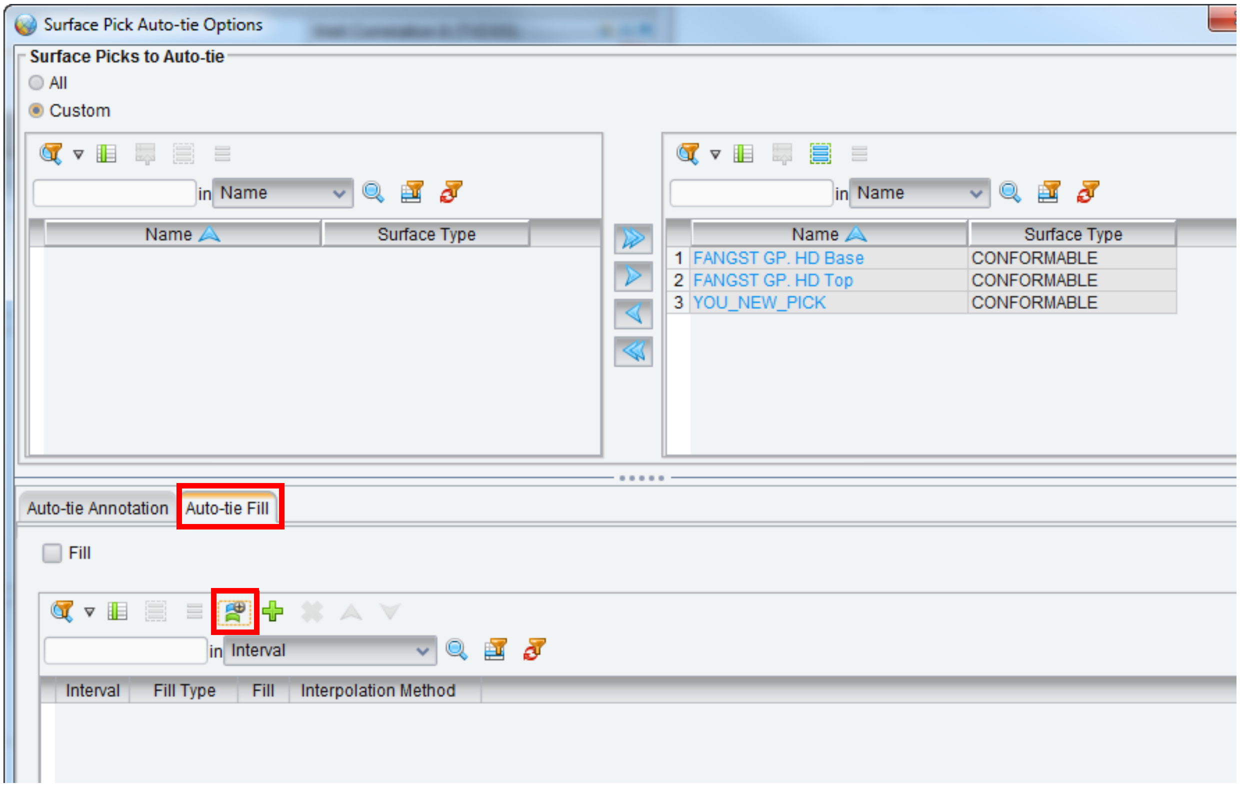
21. In the *Preferences* panel of the *Correlation View Editor*, click **Surface and Fault Display.** In the A*uto-Tie, Annotation and Fill* panel, select the **Surface Picks:** button.



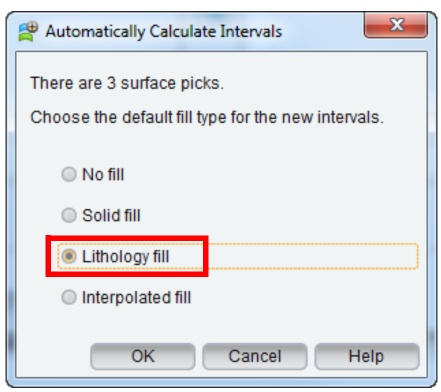
22. In the *Surface Pick Auto-tie Options* dialog, toggle on **Custom**. Click the **Add all entries to the selection table** icon.



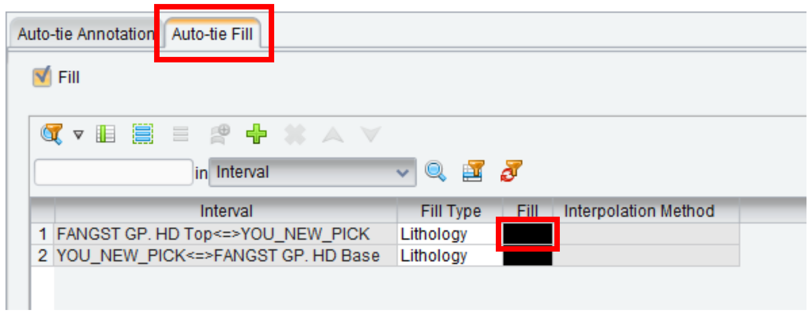
23. In the *Auto-tie Fill* tab of the *Surface Pick Auto-tie Options* dialog, click the **Automatically populate table with calculated intervals** () icon.



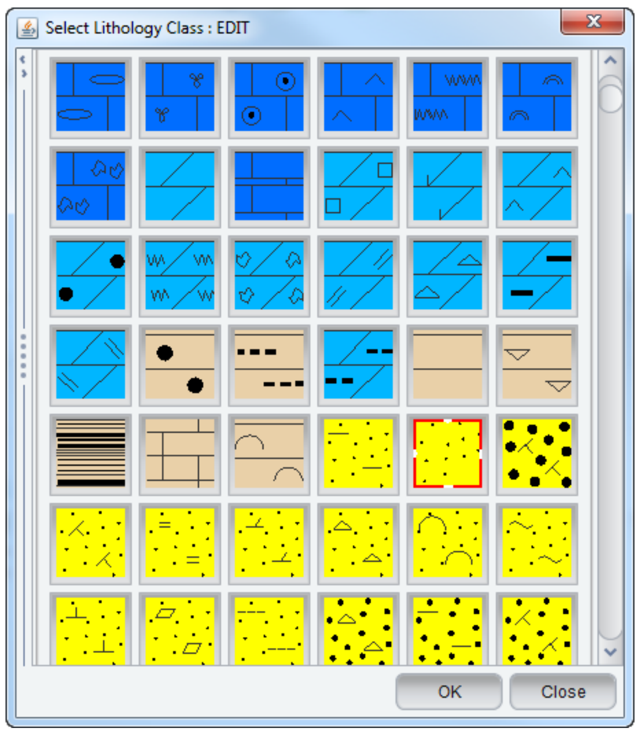
24. In the *Automatically Calculate Intervals* dialog, toggle on **Lithology fill** and click **OK**.



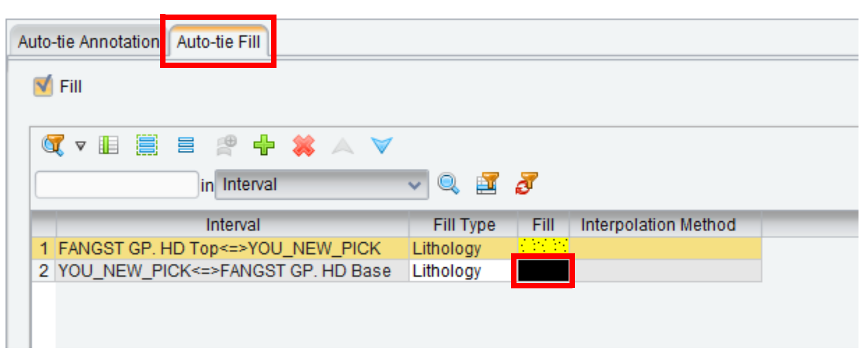
25. In the *Auto-tie Fill* tab, select the **Fill** color for interval FANGST GP. HD Top <=>YOU_NEW_PICK.



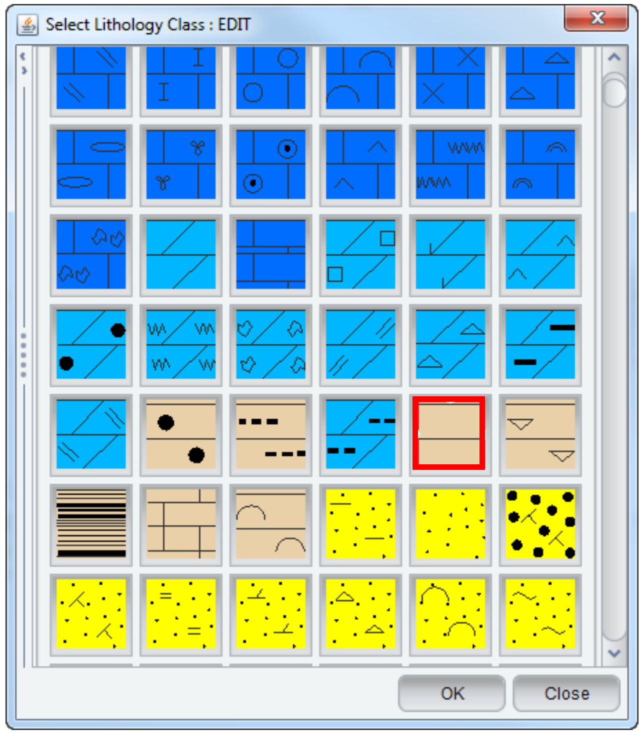
26. In the *Select Lithology Class* dialog, select **FINE SAND**. Click **OK**.



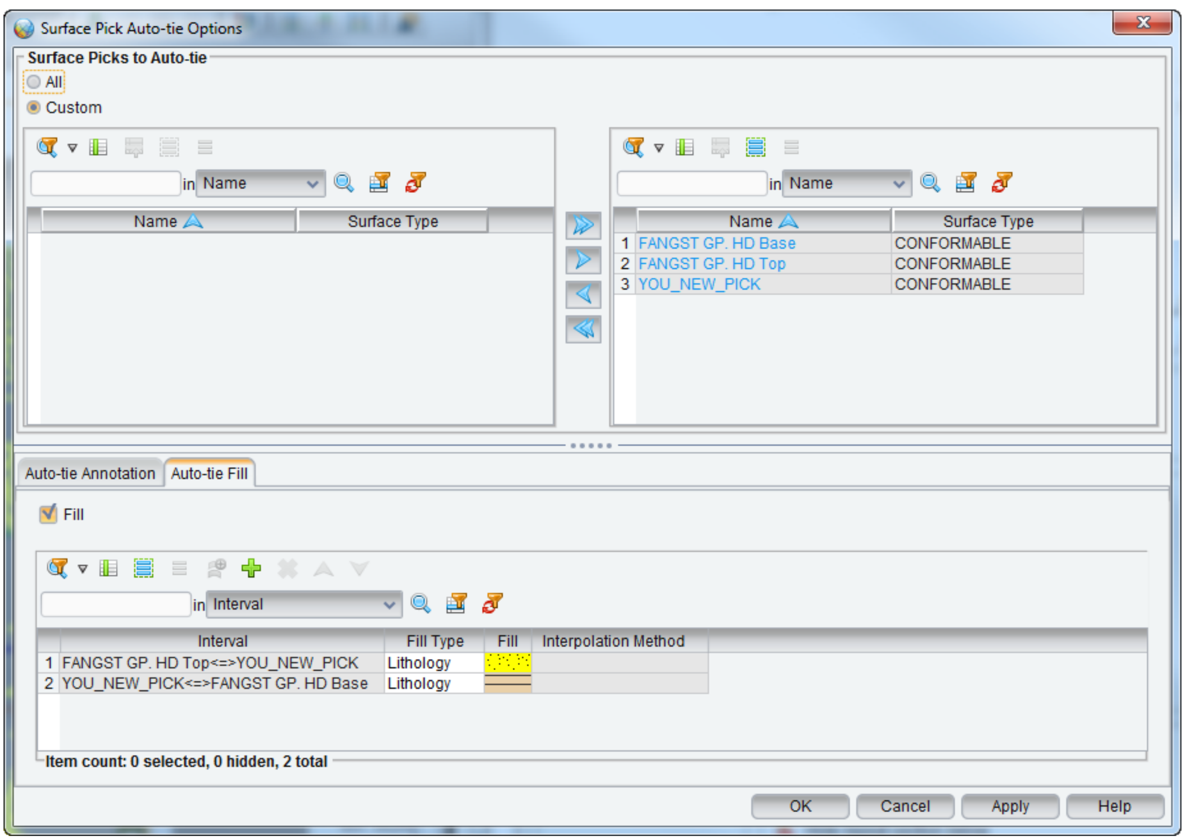
27. In the *Auto-tie Fill* tab, select the **Fill** color for interval YOU_NEW_PICK <=>FANGST GP. HD Base.



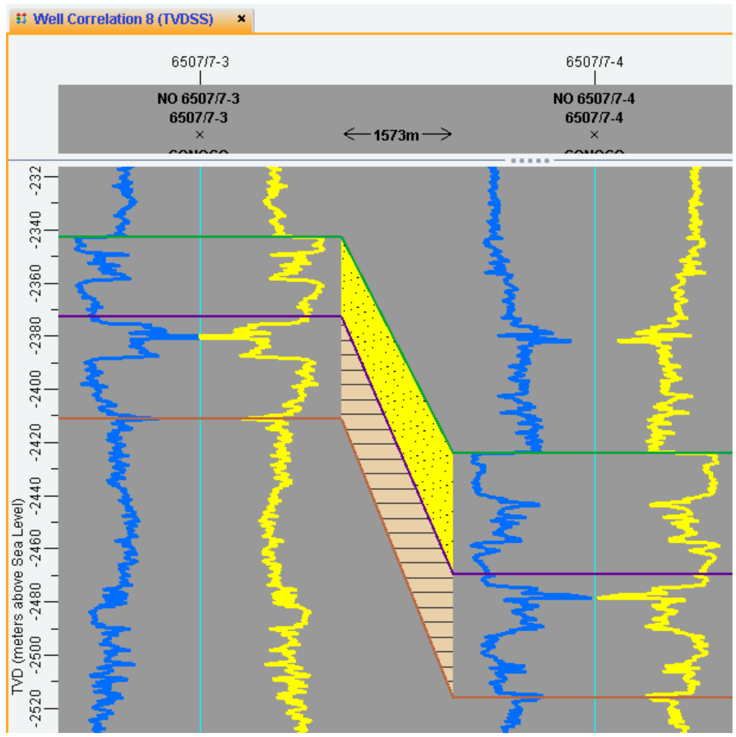
28. In the *Select Lithology Class* dialog, select **SHALE**. Click **OK**.



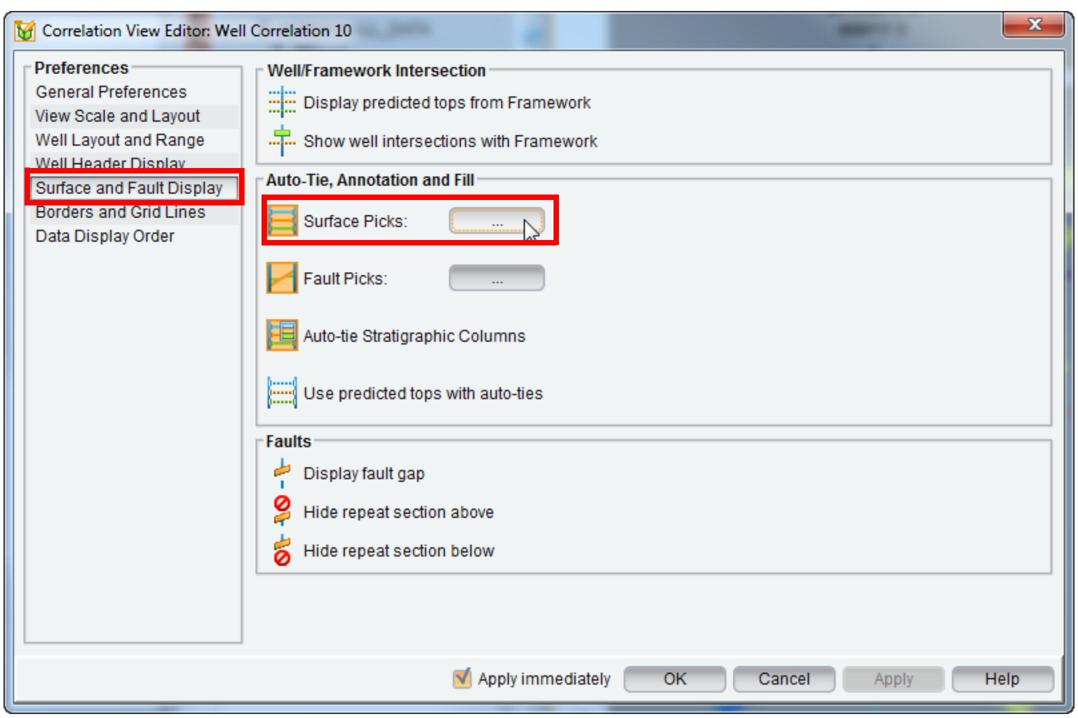
29. In the *Surface Pick Auto-tie Options* dialog, click **OK**.



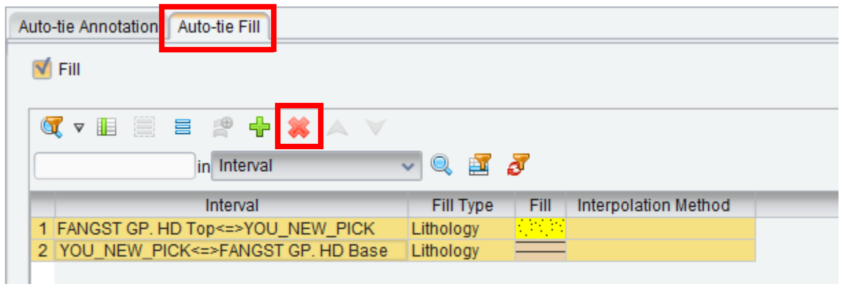
30. In *Correlation* view, the lithology fill extends between wells.



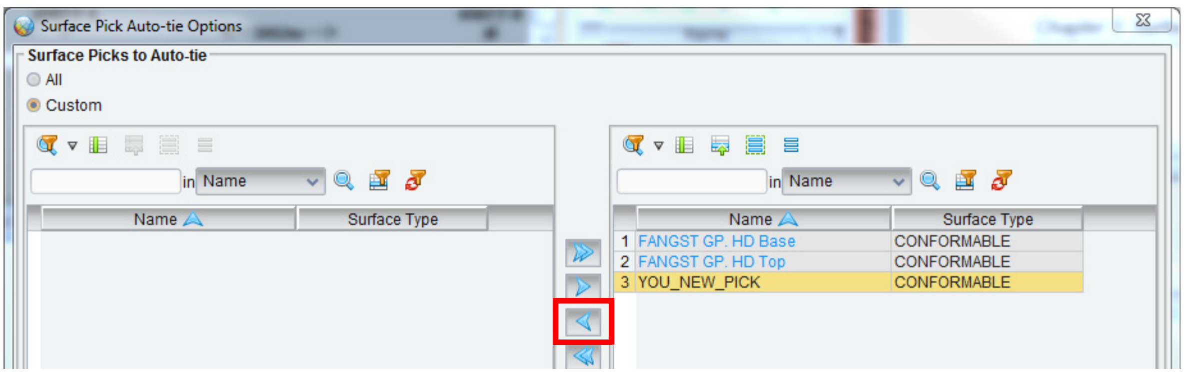
31. In the *Correlation View Editor*, select **Surface and Fault Display** in the *Preferences* panel. In the *Auto-Tie, Annotation, and Fill* panel, select the **Surface Picks:** button.



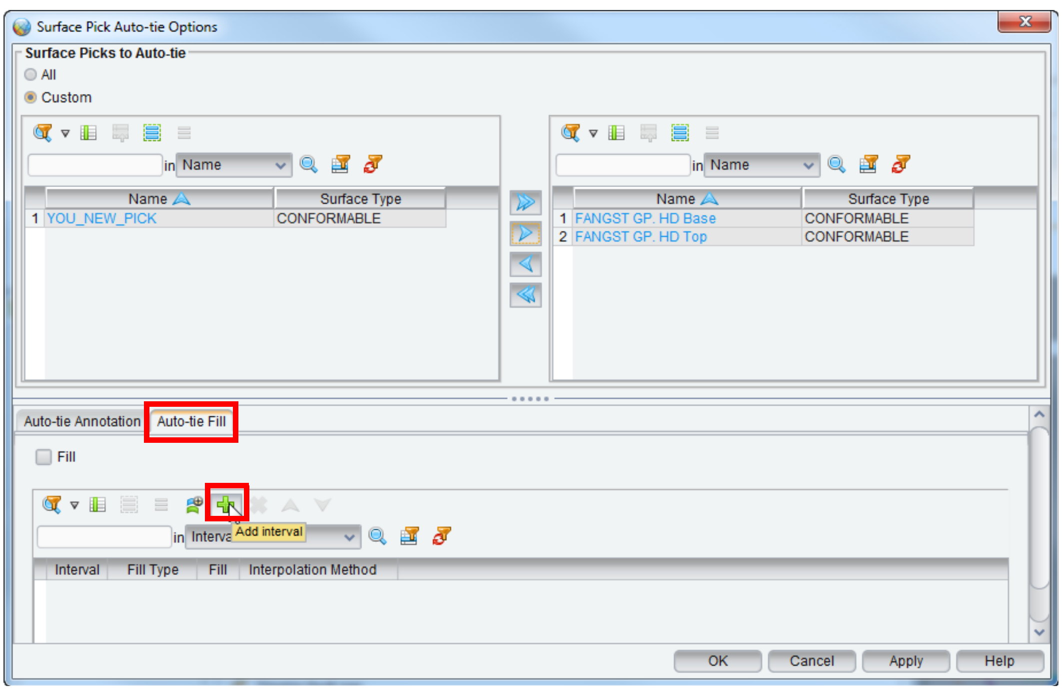
32. In the *Auto-tie Fill* tab of the *Surface Pick Auto-tie Options* dialog, select both intervals and click the **Delete Interval** ( ) icon.



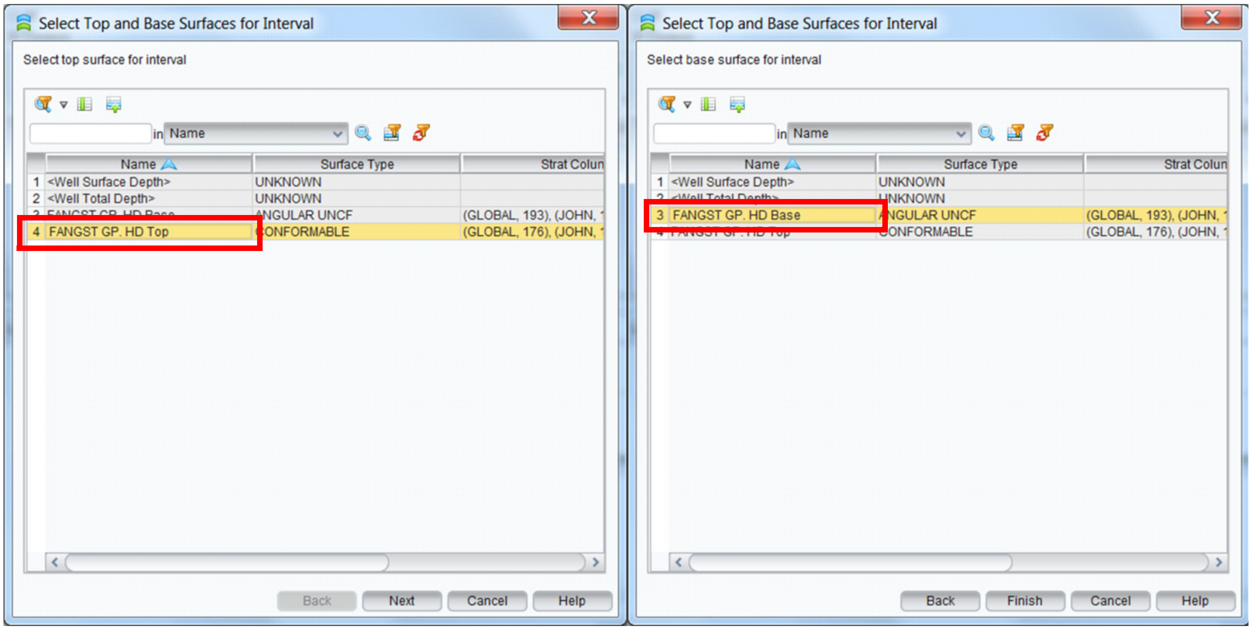
33. In the *Surface Pick Auto-tie Options* dialog, select surface pick **YOU_NEW_PICK** and click the **Remove entry from the selection table** ( ) icon.



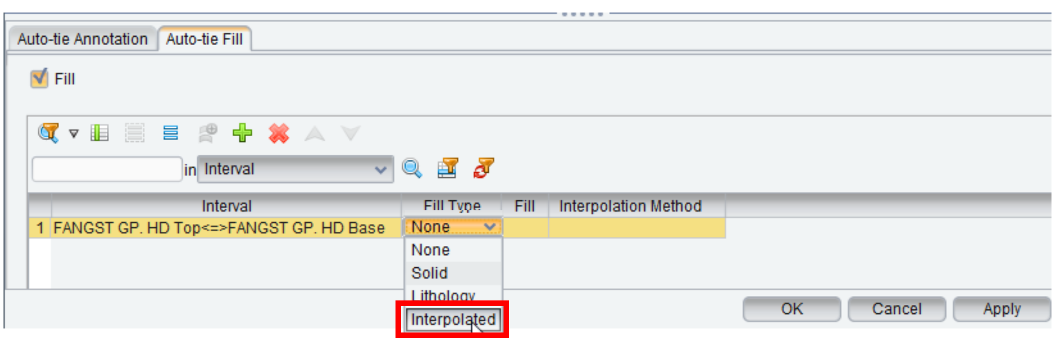
34. Select the ***Auto-tie Fill*** tab in the lower half of the *Surface Pick Auto-tie Options* dialog. Click the **Add Interval** icon ( ).



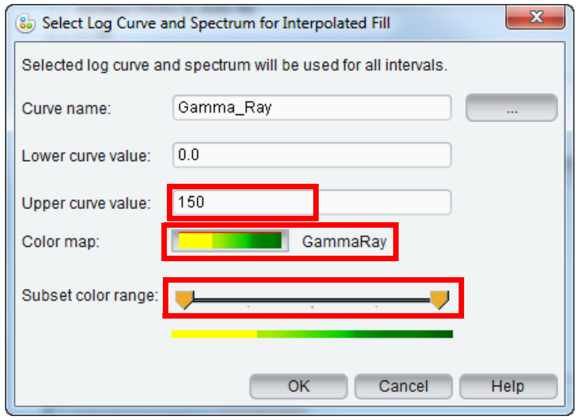
35. The *Select Top and Base Surfaces for Interval* dialog opens. Select **FANGST GP.HP Top** and click the **Next** button**.** Then select **FANGST GP.HP Base**. Click **Finish**.



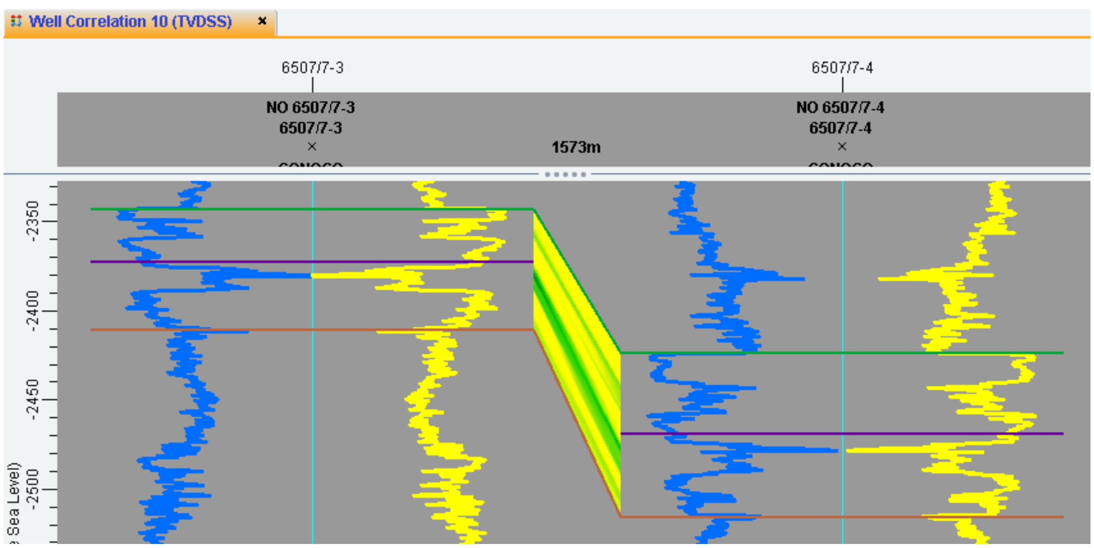
36. On the *Auto-Tie Fill* tab of the *Surface Pick Auto-Tie Options* dialog, select **Fill Type > Interpolated.** Then, click the **Fill** cell, which will enable you to change display properties.



37. On the *Select Log Curve and Spectrum for Interpolated Fill* dialog, change the Subset color range: to the **full extent** by clicking-and-dragging the right-most arrow all the way to the right. Change the Color map: to **Geology > GammaRay**, and enter **"150"** in the Upper Curve Value: text field. Click **OK**.

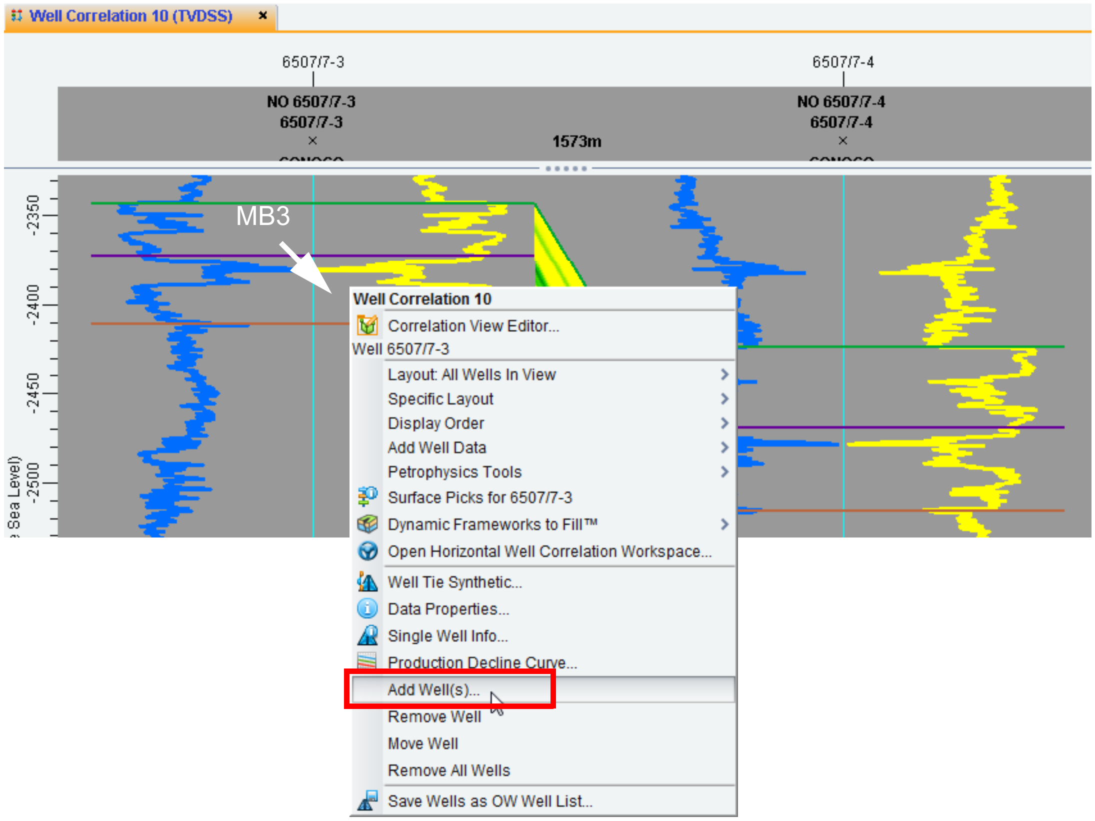


38. Click **OK** in the *Surface Pick Auto-tie Options* dialog. Click **OK** in the *Correlation View Editor* dialog.

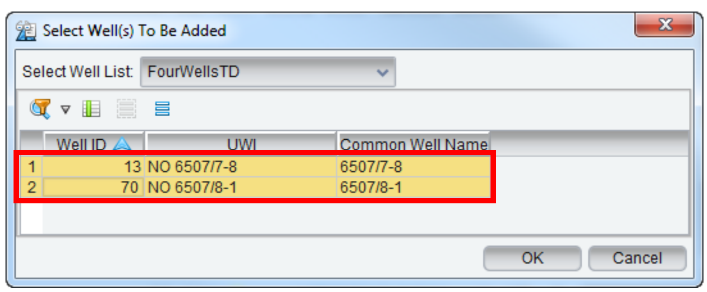


You can create and combine different fill intervals, as you desire.

39. To add more wells, put your cursor on any of the wells and **MB3 > Add Well(s)...**.

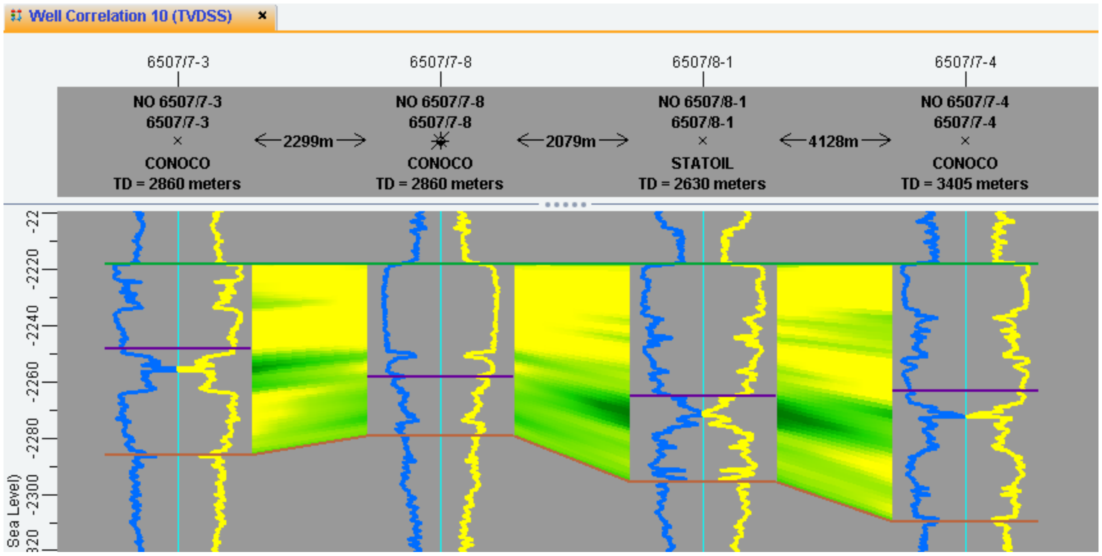


40. You can select wells from different well lists, but only from well lists that you have in your session. Select the two remaining wells from the list and click **OK**.



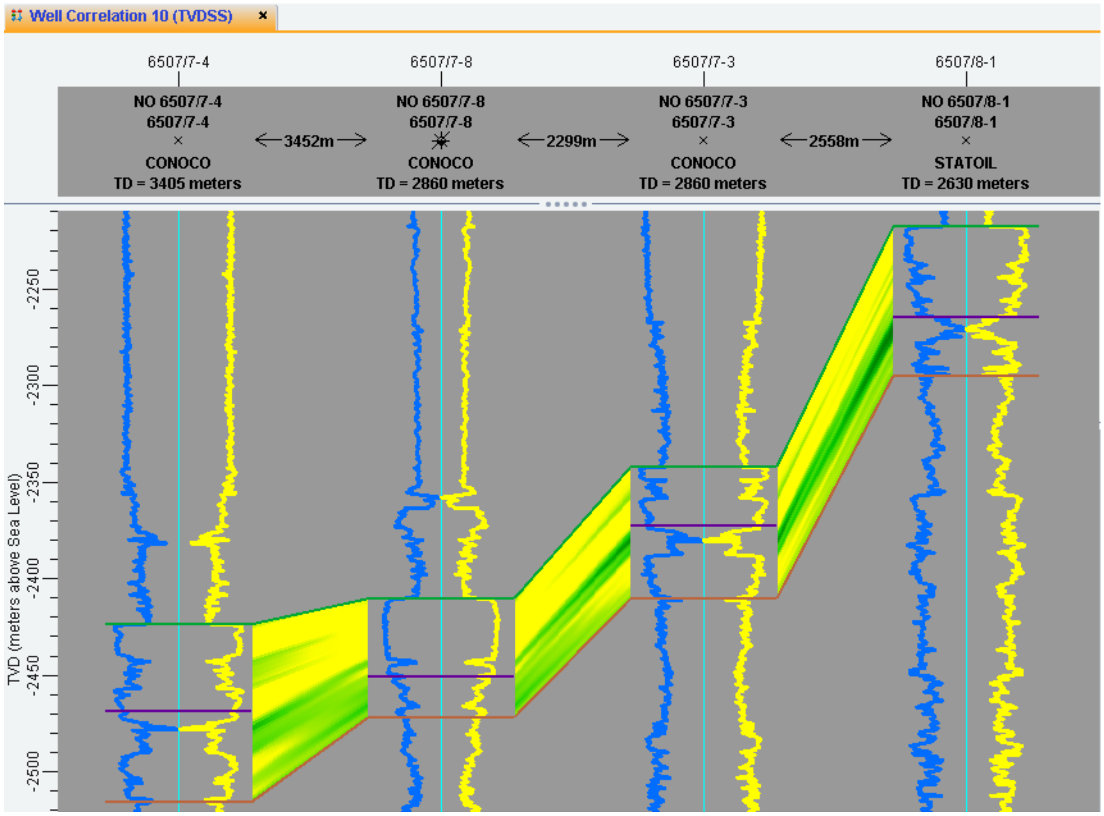
You can also drag-and-drop a well from the *Well Details* dialog into *Correlation* view.

The image below is a correlation of wells with more data.

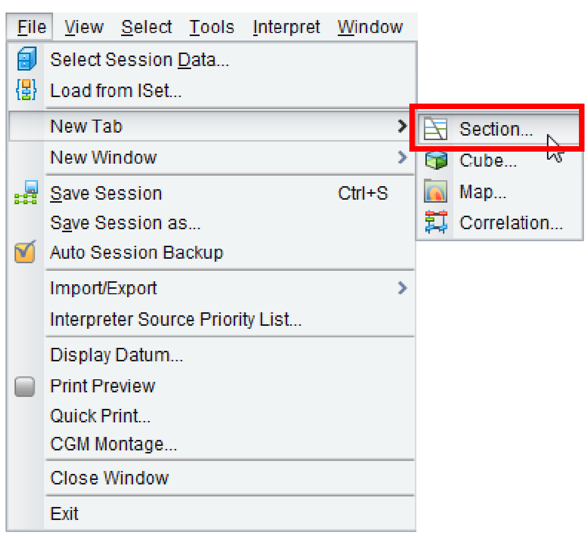


> **Note:**
>
> In the above image, well separation has been increased to 1 and FANGST GP.HD Top has been flattened to make fill more apparent.

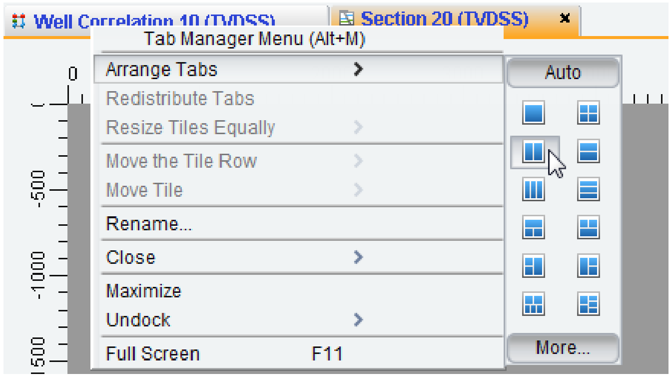
41. To change well positions, put your cursor on one of the wells and **MB3 > Move Well**. Then click the new area where you want the well.



42. To create a *Section* view, using selected wells and layout from the *Correlation* view, select **File > New Tab > Section**.



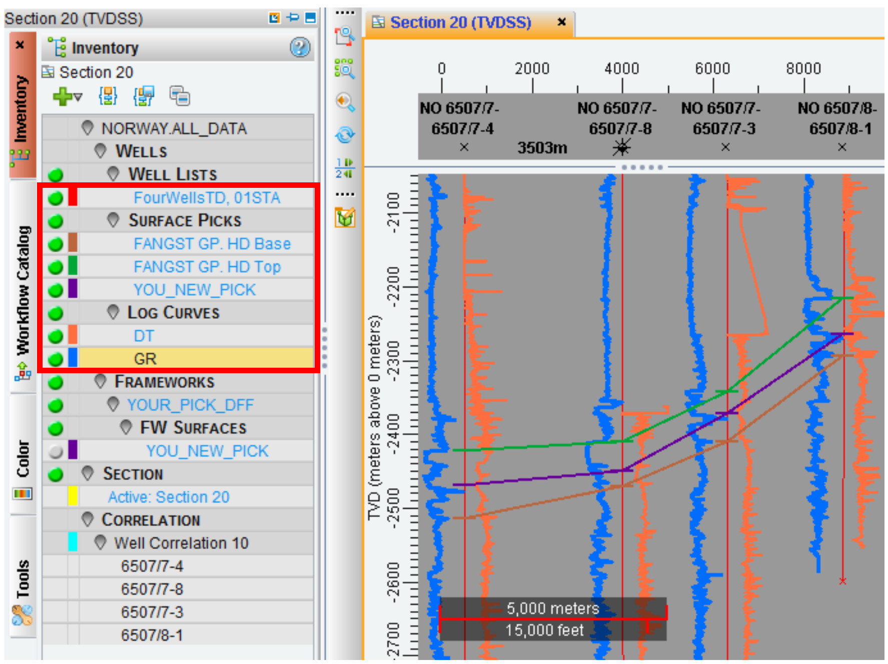
43. On the *Section* view tab, **MB3 > Arrange Tabs**. Select the **2 vertical tabs** ( ) icon.



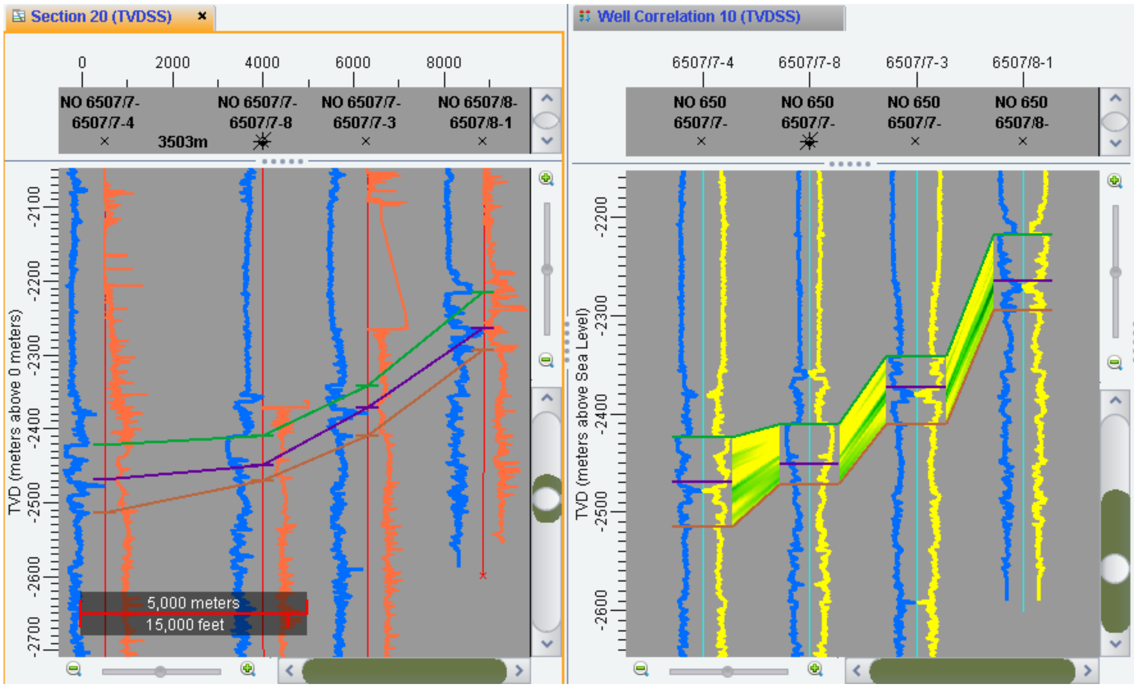
Note:

You can also access the *Tab Manager Menu* by Alt> + M.

44. In the *Inventory* task pane of the *Section* view, toggle on Well list **FourWellsTD,** all **Surface Picks,** and log curves **DT** and **GR.**



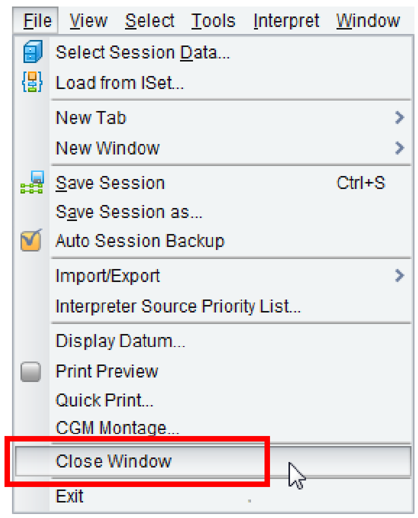
45. Creating a *Section* view from a *Correlation* view uses the same X,Y locations of the *Correlation* view, allowing you to view a structural *Section* and *Correlation*.

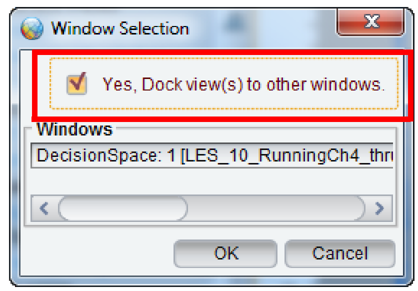


Exercise 3.6: Creating a Fault Pick

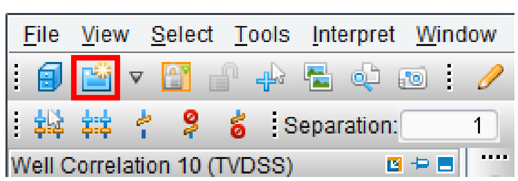
Faults in your area will cause missing sections or repeated sections in your well logs. In this exercise you will learn how to create faults picks, as well as how to create a gap in the log where you believe there is a missing section.

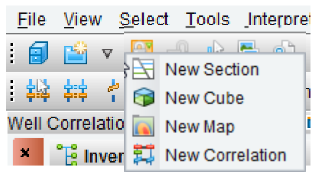
1. In the window containing only *Correlation* view, select **File < Close Window.** In the *Window Selection* dialog, toggle on **Yes, Dock view(s) to other windows,** then click **OK**.



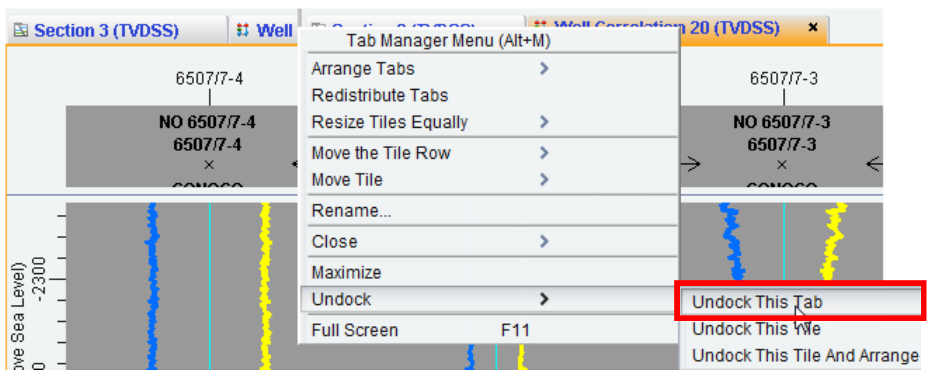


2. With *Correlation* view active, click the **New Tab** icon ( ).

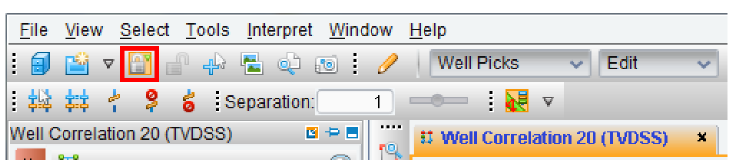


> **Note:**
>
> To quickly create a new *Cube* view, *Section* view, *Map* view, or *Correlation* view, click the pull-down menu button (triangle) beside the **New Tab** icon ( ) and select the appropriate command.
>
> 
>

3. To undock the new correlation view and place it in a new window, put your cursor on ***Well Correlation*** view and **MB3 > Undock > Undock This Tab.**

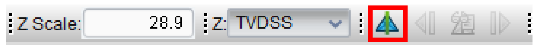


4. In the window containing only *Correlation* view, it is necessary to disconnect the views from each other, so when zooming or positioning changes are made to one it does not cause changes in the other. Click the **Unlock Modes, Scale and Position** icon ( ).



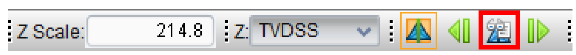
> **Note:**
>
> The Unlock Modes, Scale and Position toggle is used to associate views of the same type in terms of XYZ movement, zoom, and other items set in View > Lock Position and Mode. By default these two correlation views would move and zoom together. This will not be the case, since we have unlocked one of them.

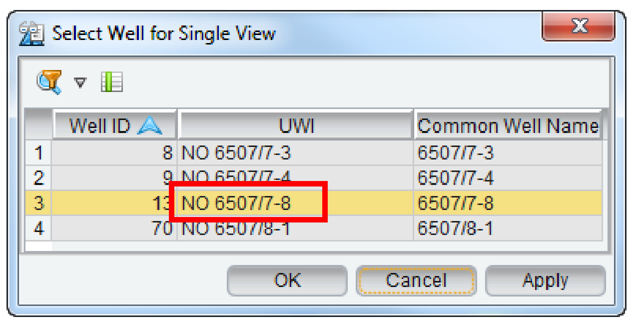
5. To make a Fault Pick interpretation, click the **Single Well View Mode** icon ( ).



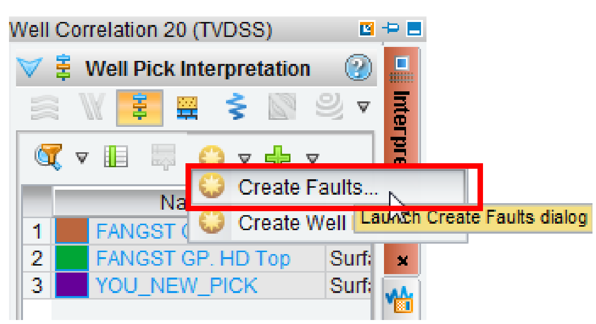
> **Note:**
>
> With the Single Well View Mode you can analyze a particular well in detail, while leaving out the distraction from the other wells in your view. You may also navigate easily through the wells in order, using the arrows, or by clicking the Select Well From List icon ( ).

6. Click the **Select Well from List** icon. In the *Select Well for Single View* dialog, select well **6507/7-8**. Click **OK**.

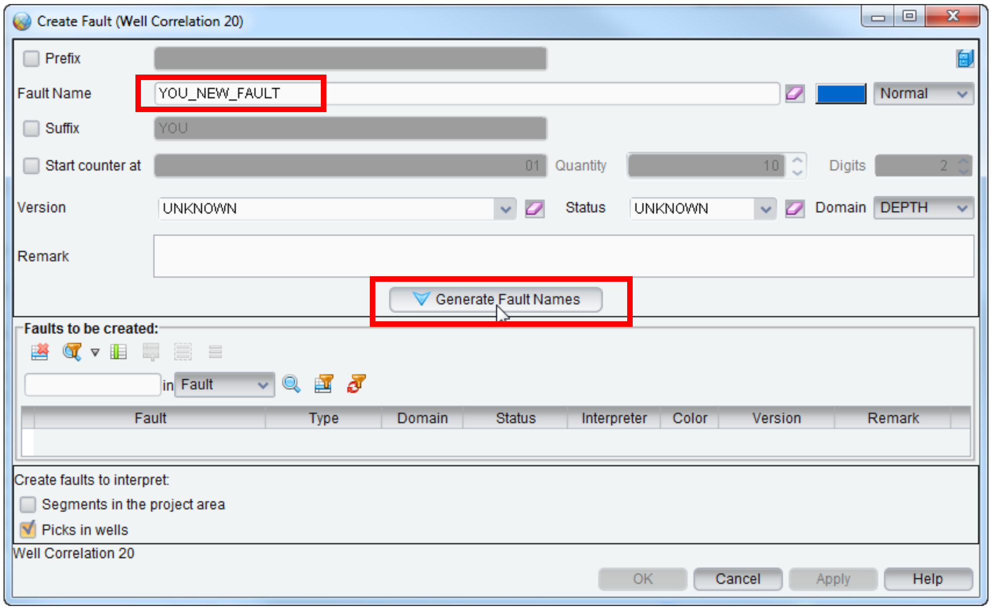




7. In the *Interpretation* task pane, click the pull-down **menu** next to the Launch Create Surfaces dialog icon, and then select **Create Faults...**

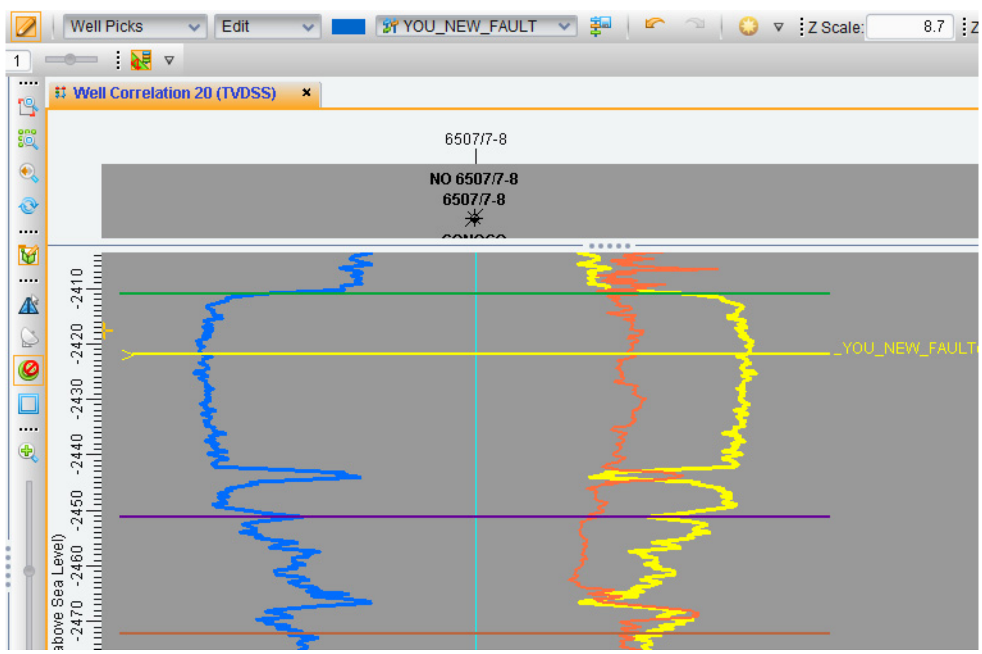


8. In the *Create Fault* dialog enter "**YOU_NEW_FAULT**" in the Fault Name field and click **Generate Fault Names**. Click **OK**.

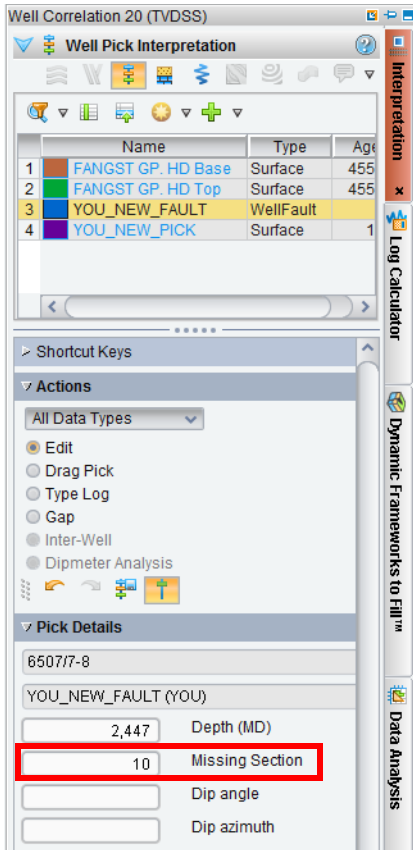


9. Toggle on log curve **DT.** Toggle on **Interpretation Mode** and ensure you have selected YOU_NEW_FAULT for interpretation.

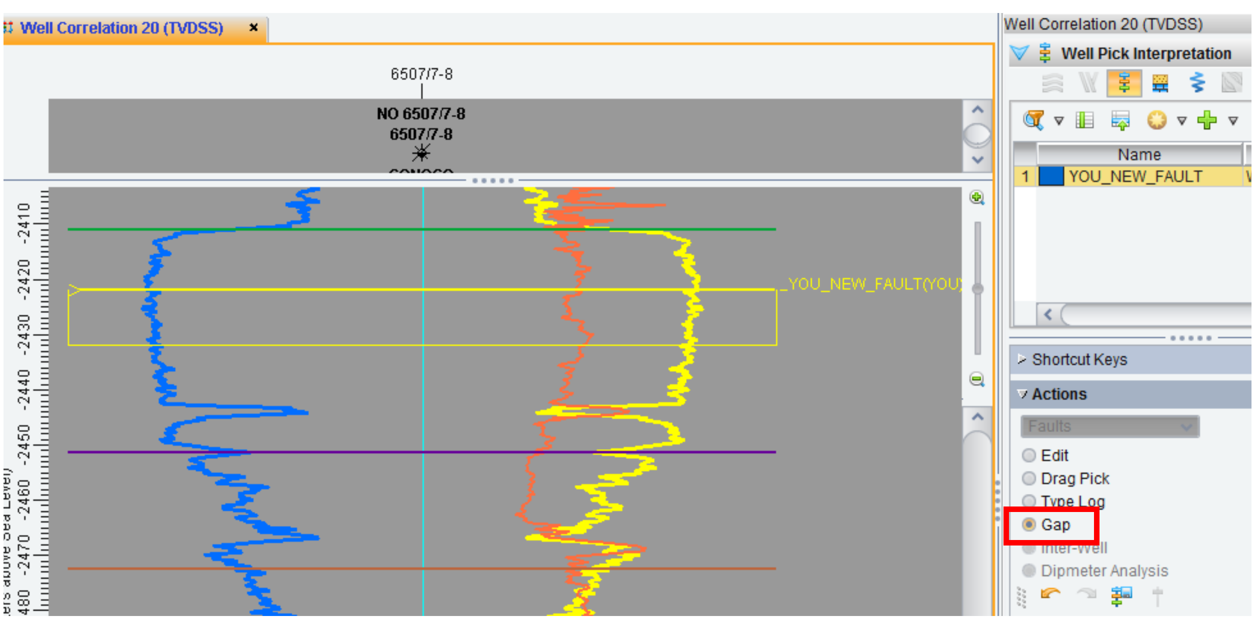
10. Interpret the fault pick that is below the surface pick **FANGST GP.HD Top,** at about MD 2,447.



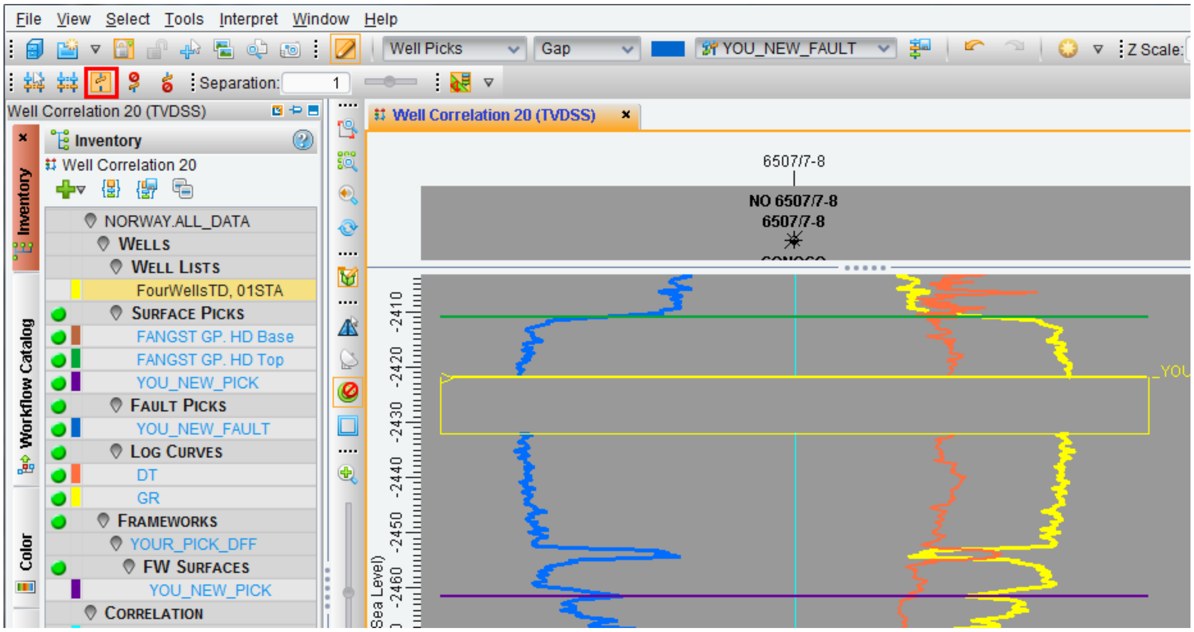
11. In the *Pick Details* panel of the *Well Pick Interpretation* task panel, enter **“10”** in the Missing Section text field of the fault pick.



12. In the *Actions* panel in the *Well Pick Interpretation* task pane, toggle on the **Gap** action to see the formation gap below the fault pick.



13. To see the missing part of the well logs, click the **Fault Gapping** icon ().

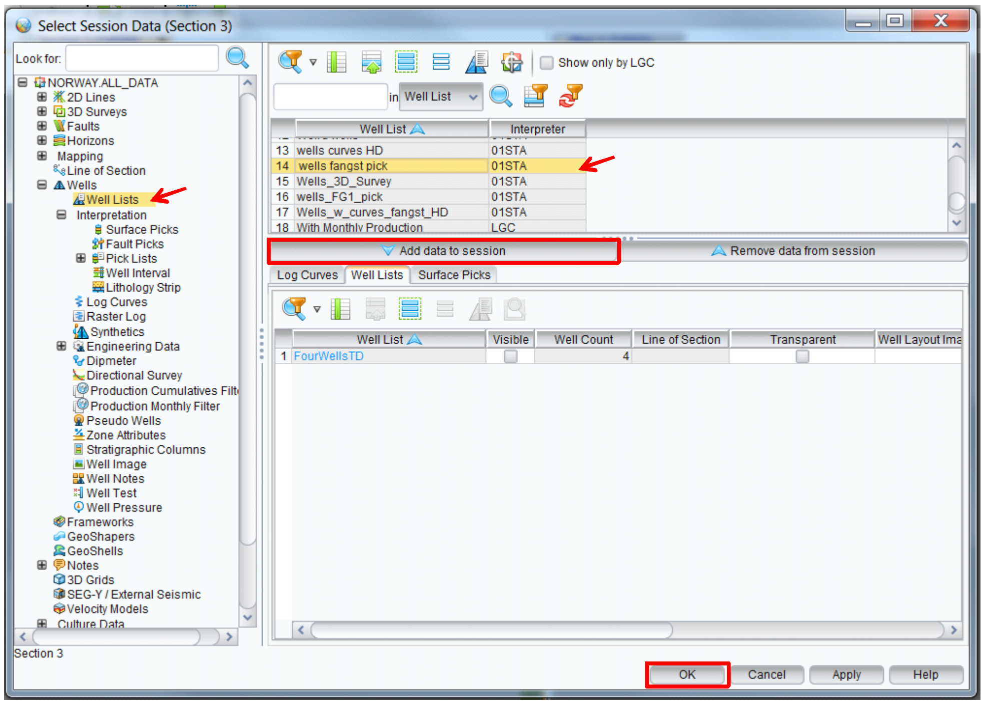


For the next exercise you will continue with your session, but you may close the *Correlation* view in which you were working.

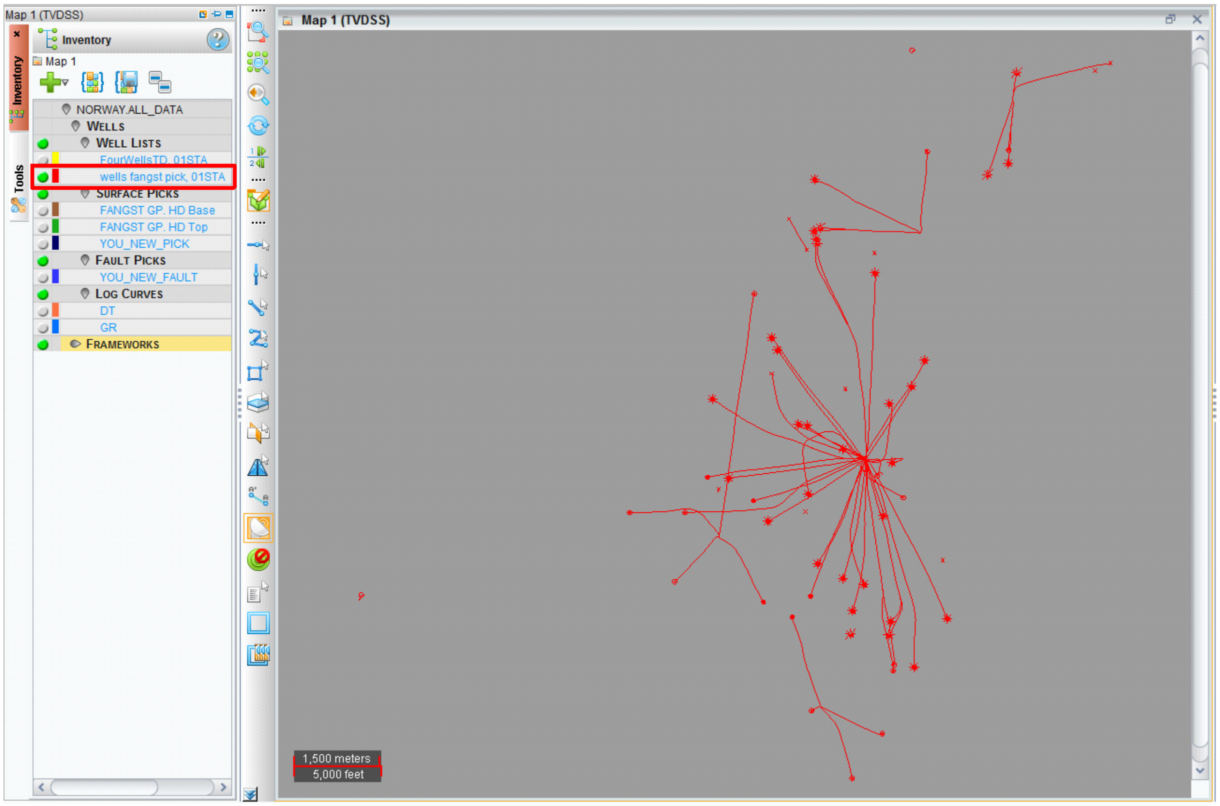
Exercise 3.7: Using QC Tools

DecisionSpace has a variety of tools to perform QC of surface pick interpretation. In this exercise you will learn to identify outliers with Surface Pick Analysis, as well as best practice to fix errors in your interpretation.

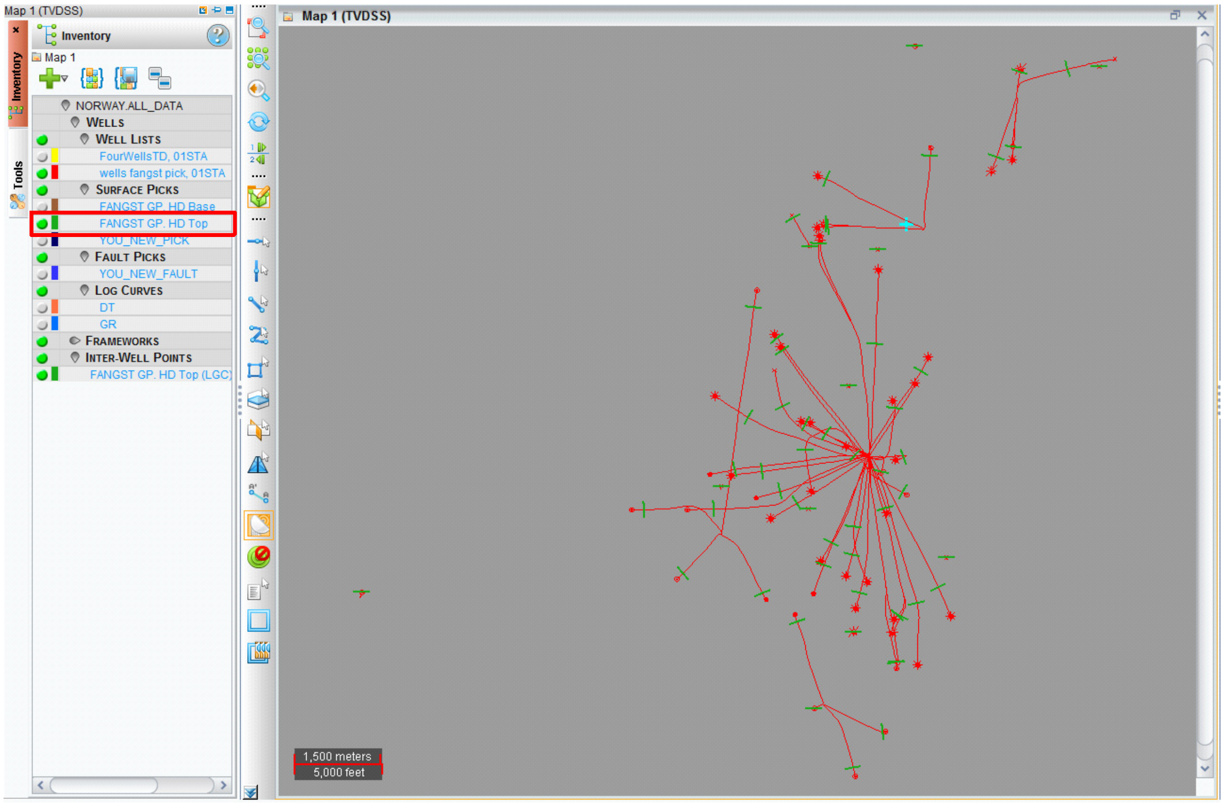
1. Choose the **Select Session Data (** **)** icon and in the *Select Session Data* dialog, select **Wells > Well Lists > wells fangst pick.** Click the **Add data to Session** button and click **OK** to close the dialog.



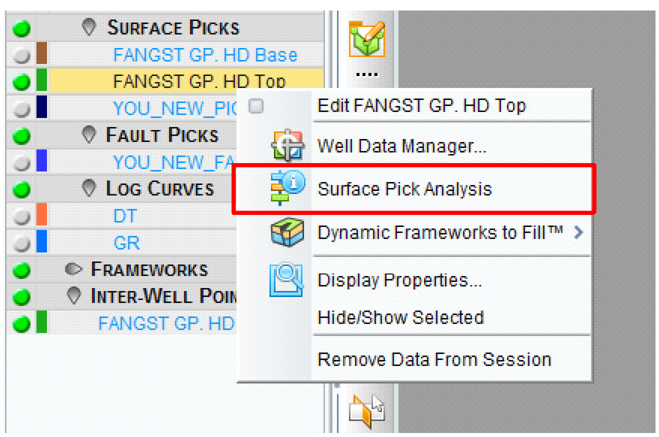
2. Activate and maximize *Map* view, and in the *Inventory* task pane, toggle on WELL LISTS **wells fangst pick, 01STA**.



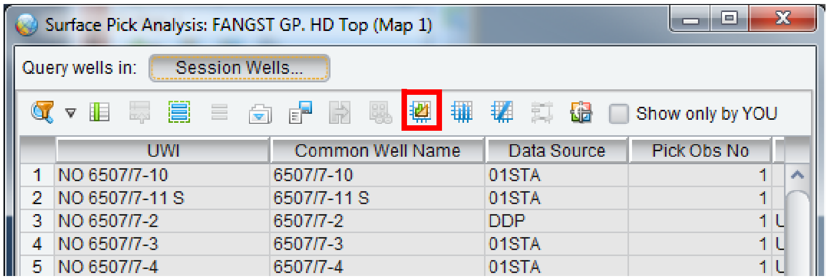
3. In the *Inventory* task pane of the *Map* view, toggle on surface pick **FANGST GP.HD Top**. You will see that the surface pick exists in all wells. You will perform a QC of the surface pick in all wells by cross-plotting the MD / TVDSS values to see the distribution of the depth.



4. In the *Inventory* task pane, put your cursor on surface pick **FANGST GP.HD Top** and **MB3 > Surface Pick Analysis**.



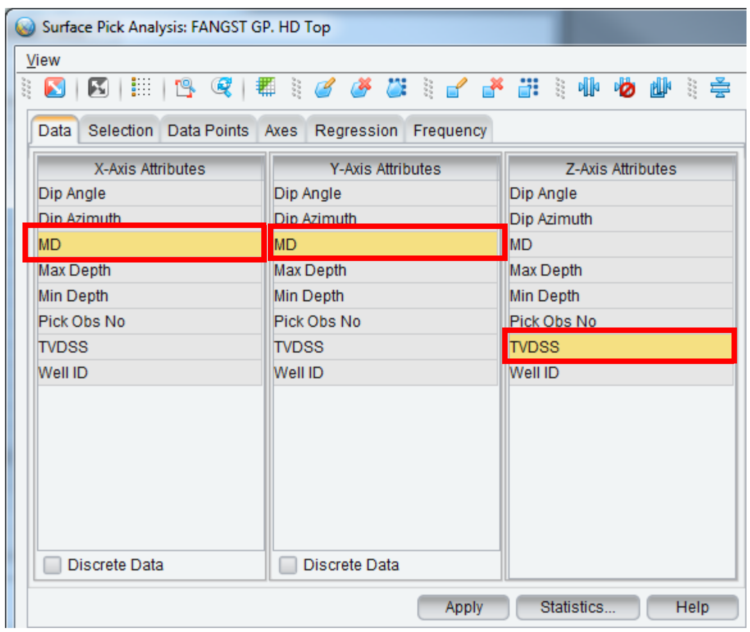
5. In the *Surface Pick Analysis* dialog, by default you will see the Session Wells query results. Click the **Cross Plot** icon.



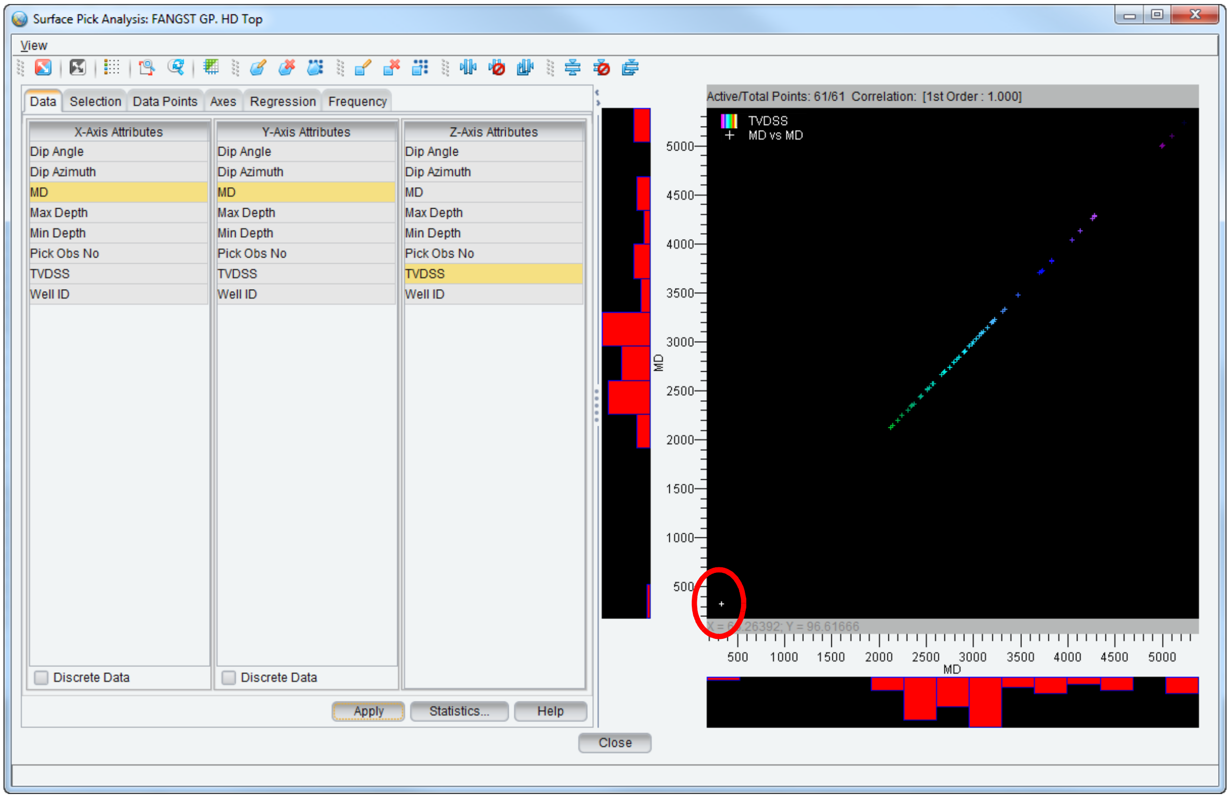
6. In the *Data* tab of the *Surface Pick Analysis* dialog, select the following attributes:

- X-Axis Attributes — **MD**
- Y-Axis Attributes — **MD**
- Z-Axis Attributes — **TVDSS**

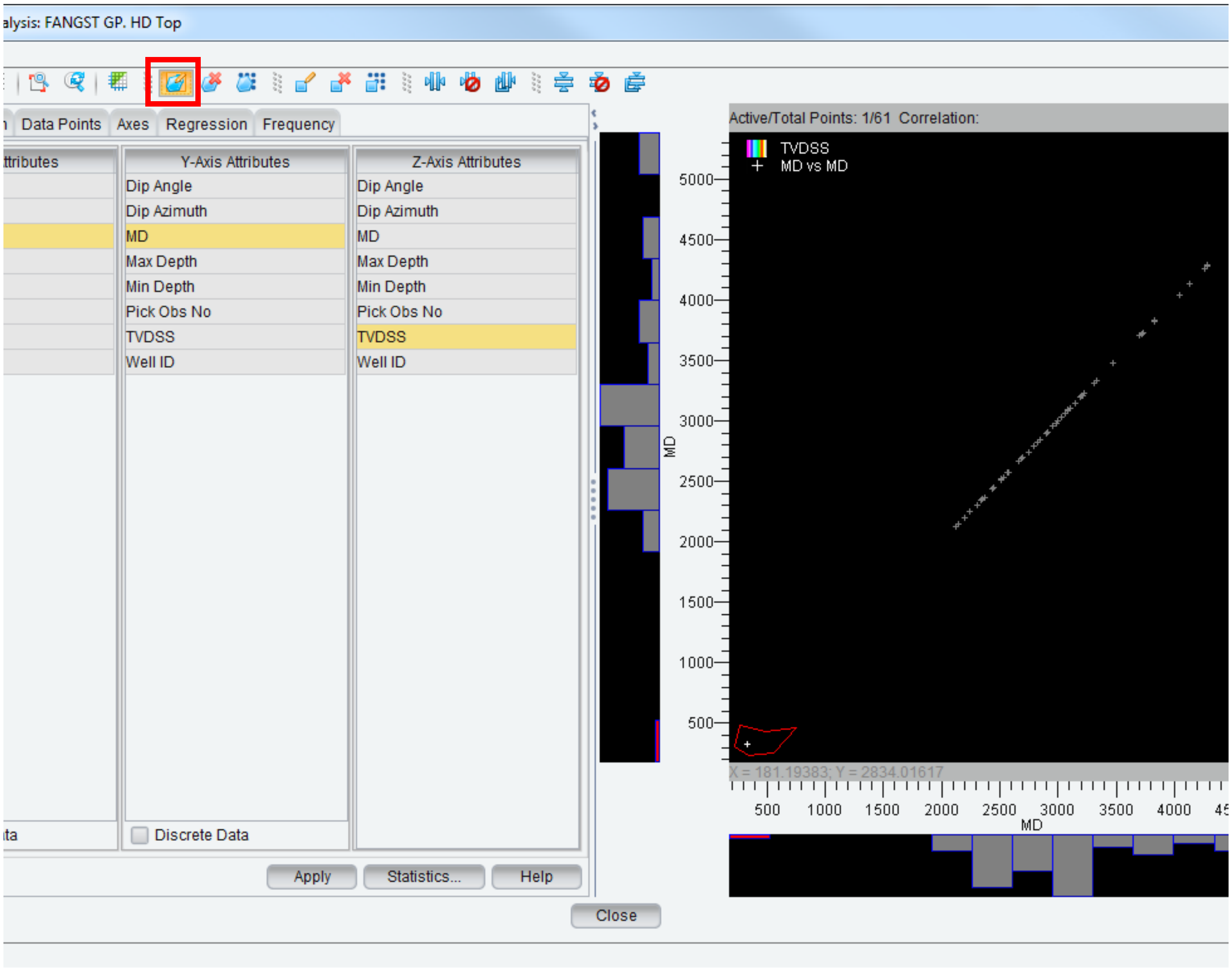
7. Click **Apply.**



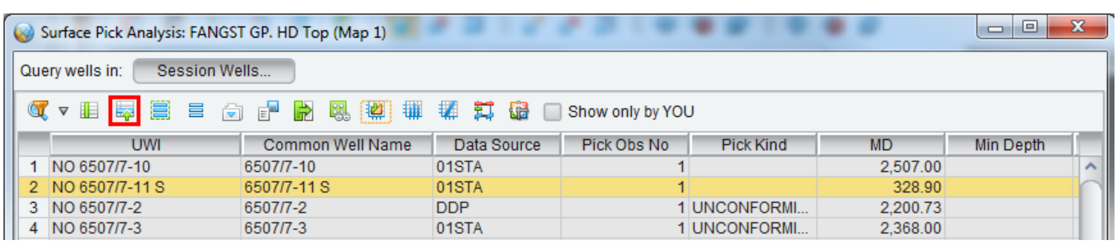
The cross plot shows that the distribution of most of the picks starts at 2000 m. However, one point is out of the range (the outlier is in the red circle on the following image).

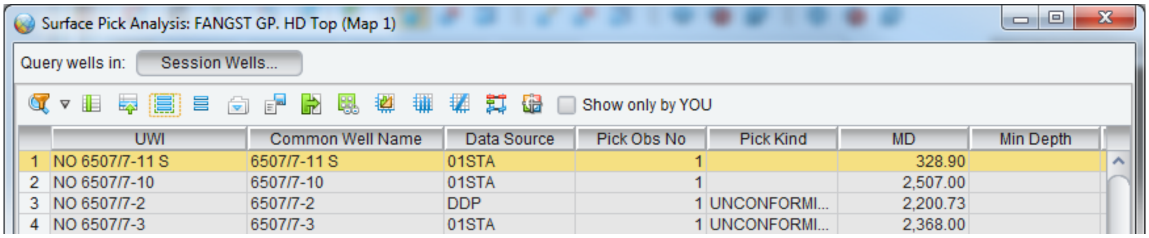


8. To find the wells represented by the irregular points, click the **Draw Polygon** icon. By means of **MB1**, digitize a **polygon** around the outlier. **MB2** to close the polygon.

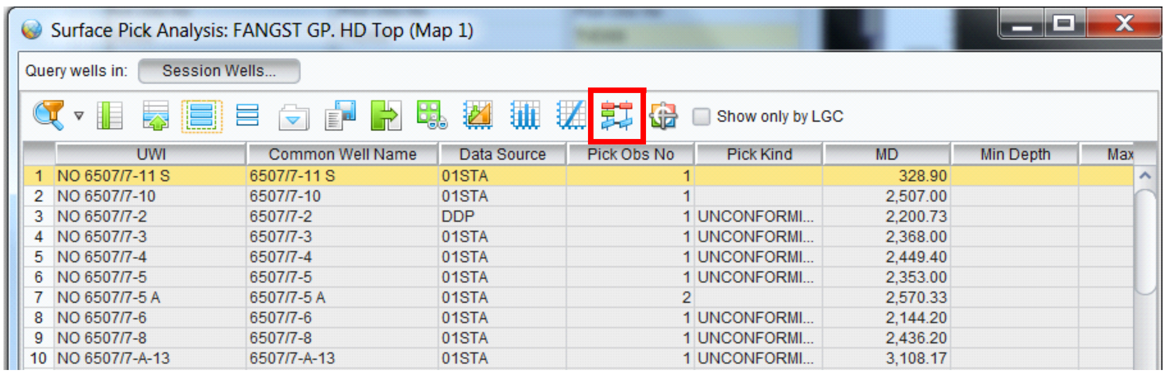


9. The wells that have the irregular values are now highlighted in the *Surface Pick Analysis* dialog. To move all selected wells for easier viewing, click the **Move Selected Rows to Top** icon ( ).

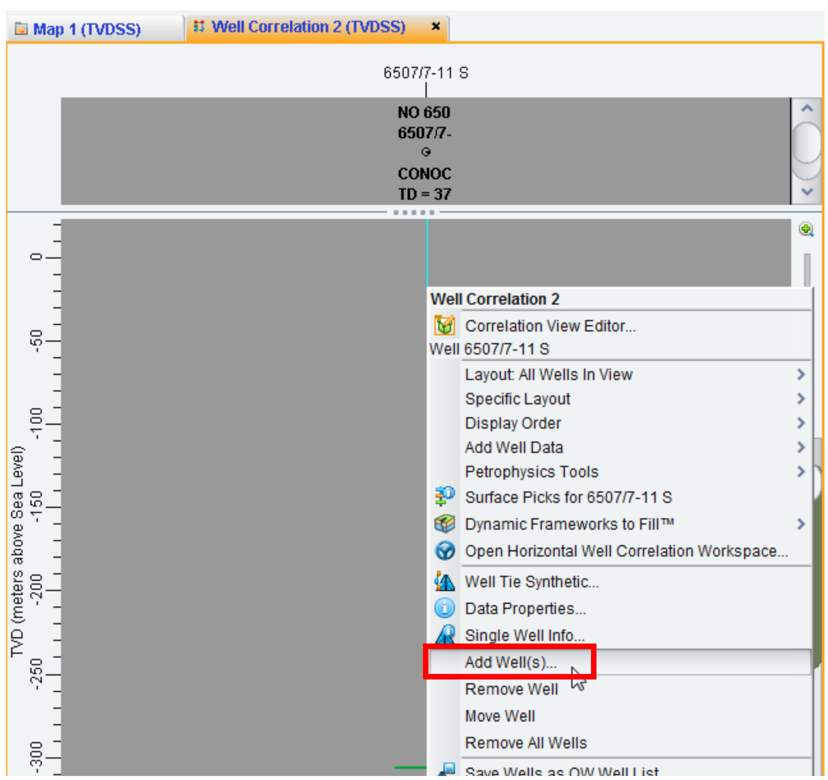




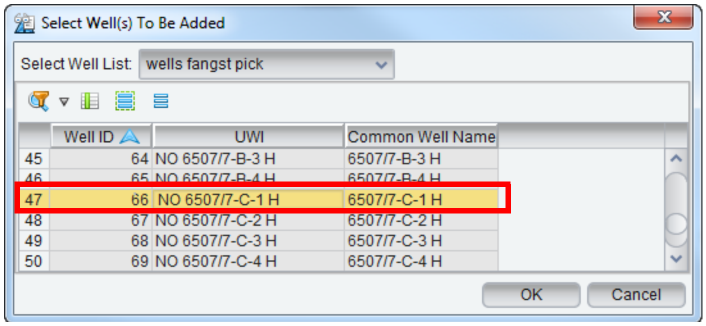
10. To review these wells you need to create a *Correlation* view from your current selection. Click the **Display Selected Wells in New Correlation View** icon ( ).



11. To review the interpretation, add a new well to the *Correlation*. Put your cursor over the wellbore and **MB3 > Add Well(s).**

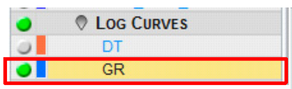


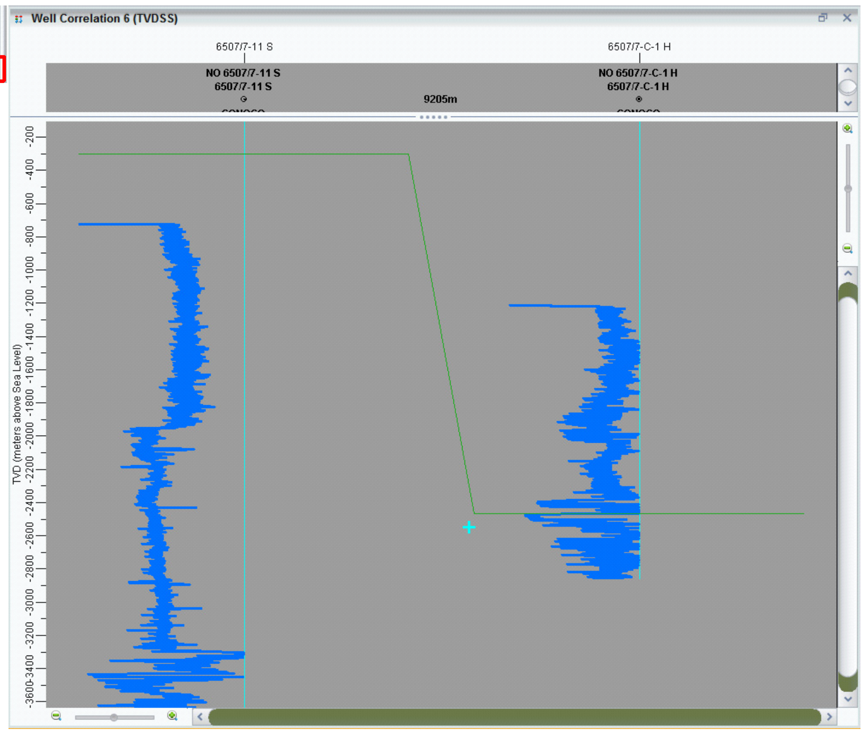
12. In the *Selected Well(s)* dialog, select well **6507/7-C-1 H**. Click **OK.**



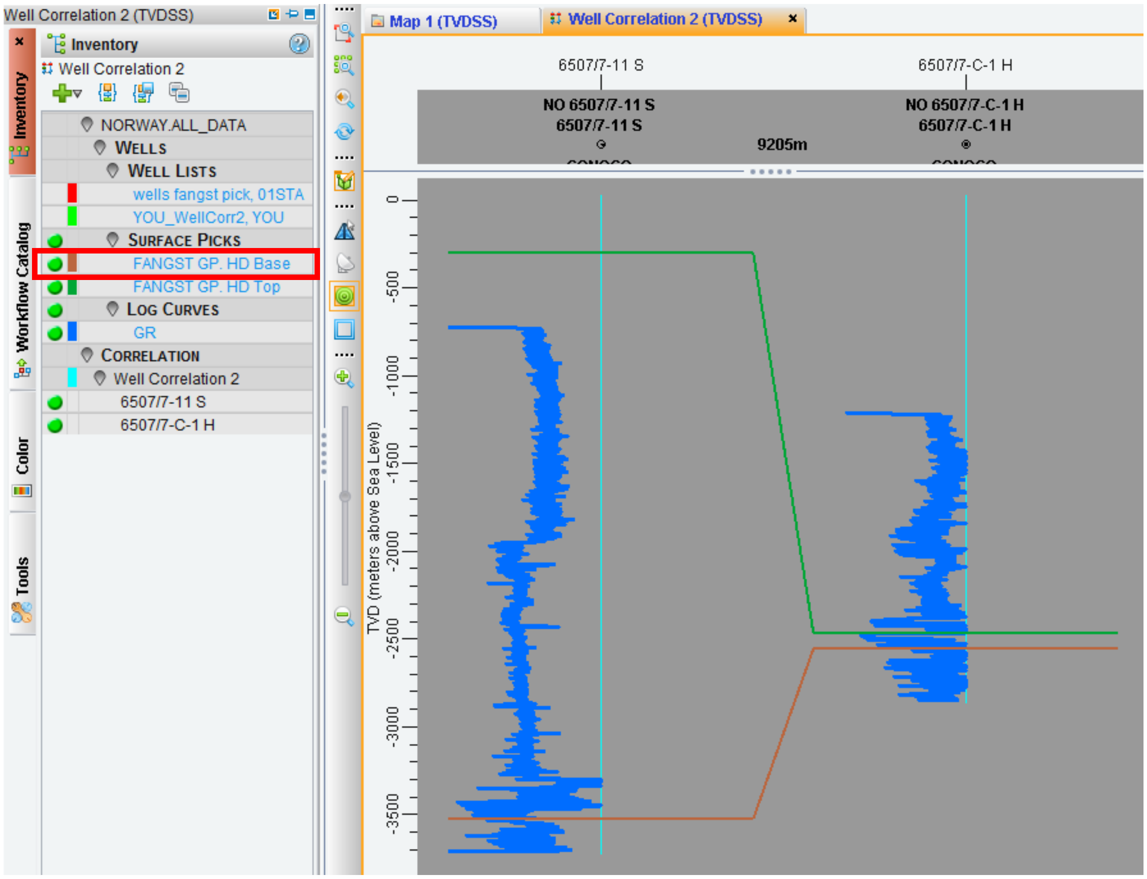
You can see that the surface pick for well 6507/7-11 needs to be deeper.

13. To find out where that pick belongs, you will display the GR log curve. Toggle on the **GR** log curve from the *Inventory* task pane.



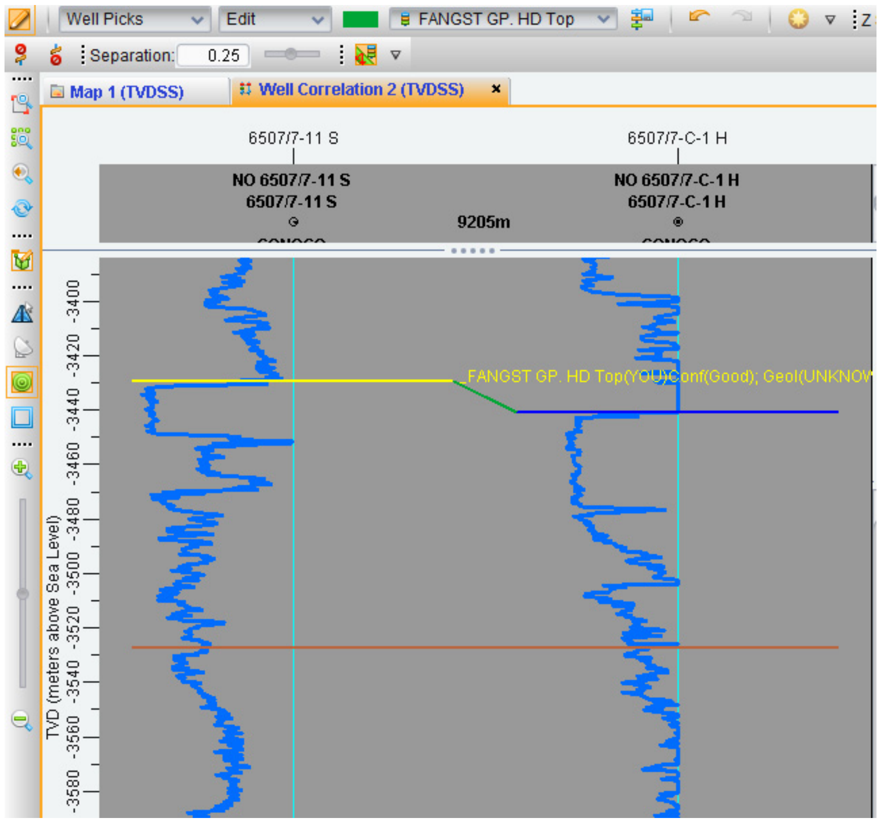


14. To help guide you to where the correct interpretation of the FANGST GP.HD Top should be, you can turn on another pick. In the *Inventory* task pane of the *Correlation* view, toggle on surface pick **FANGST GP.HD Base**. The trend of this pick suggests that GANGST GP.HD Top is thousands of meters from where it should be.

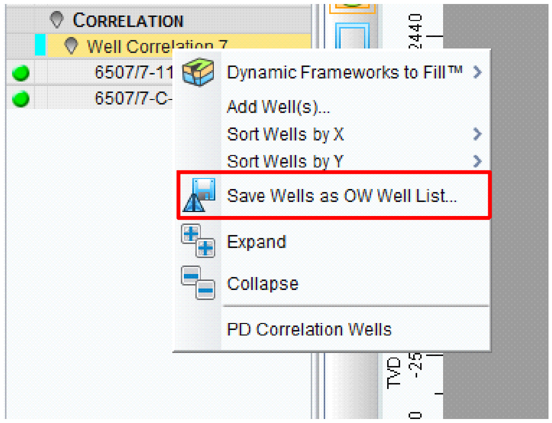


15. Toggle on **Interpretation Mode,** and in the *Interpretation* tool bar select **Well Picks** for the active data type, **Edit** for the interpretation action, and **FANGST GP.HD Top** as the surface pick for editing.

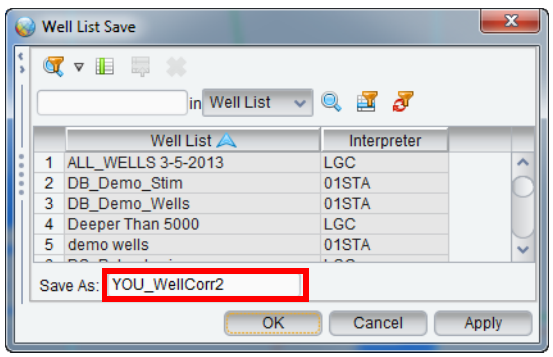
16. Use the tools you just learned about (flatten and zoom) to locate and correct depth for the FANGST GP.HD Top pick. Click-and-drag to move the pick to the correct location. Click **Save well pick changes to database** ( ).



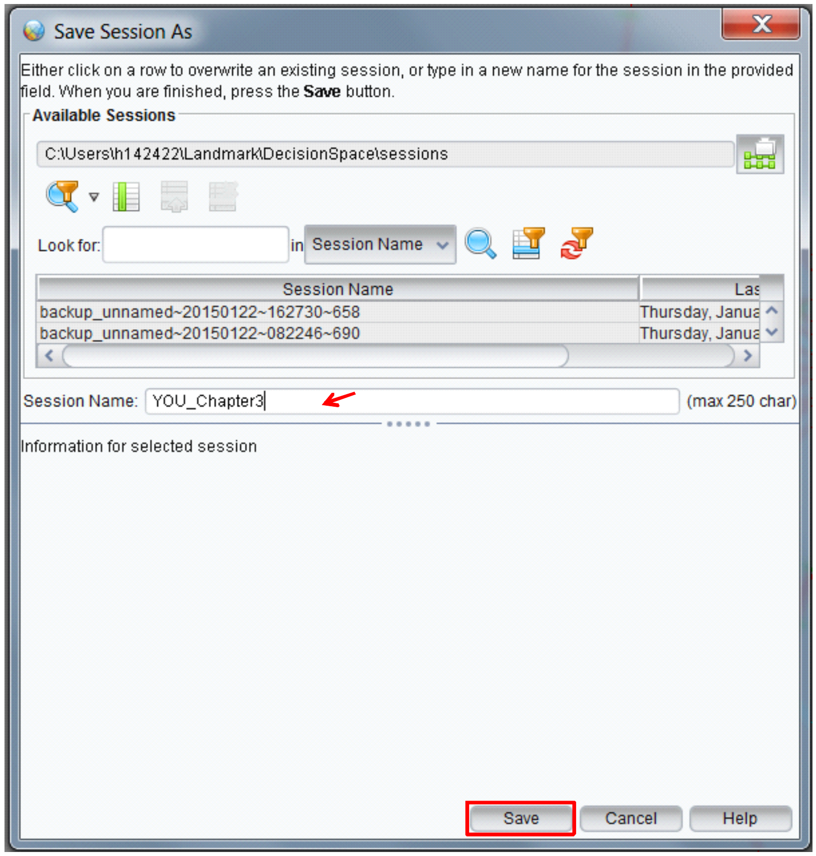
17. To save the wells currently displayed in *Correlation* view as a well list for future use, put your cursor on the **Well Correlation** tab name in the *Inventory* task pane and **MB3 > Save Wells as OW Well List...**



18. In the *Well List Save* dialog, enter **YOU_WellCorr2** in the Save As: text field.



19. You will continue in your session for the exercises of the following chapter. Select **File > Save Session**. In the *Save Session As* dialog, enter **"YOU_Chapter3"** for the Session name and click **Save.**



Chapter 4
Mapping with Dynamic Frameworks to Fill

Dynamic Frameworks to Fill gives you quick and powerful mapping capability. DFF is a new-generation mapping system that provides an integrated geological framework that relies on interpretation data to construct and automatically update structural and property maps.

Topics Covered in this Chapter

In this chapter you will learn how to:

- Create a unified structural framework.
- Integrate 2D and 3D seismic interpretation data.
- Use advanced mapping tools.
- Perform on-the-fly time-depth conversions.

Tight integration of geological and geophysical interpretation tools, which are tied directly to dynamically updated Framework mapping tools, provide an exponential increase in the efficiency and effectiveness of core exploration and development workflows.

The Benefits of Dynamic Frameworks to Fill

- DFF possesses integrated geological and geophysical interpretation tools that leverage framework surfaces in their respective workflows. For example, DFF gives you the ability to create and edit well fault picks from predicted intersections with seismic faults in *Correlation* view, which then triggers an update of DFF to respect the additional data.

- DFF has an advanced topology engine that properly grids surface data in the context of fault blocks (with an associated ability to automate the construction of fault polygons) and unconformity-bounded regions.

- The DFF conformance technology enables you to model surface-pick-based surfaces, guided by seismic horizons.

- The advanced DFF topology engine extracts zone properties for wells with incomplete penetrations, and allows multiple traversals of the same zone for horizontal wells.

- DFF updates to multi-surface framework, and property maps are tied to changes to the existing interpretation. This enables you to:

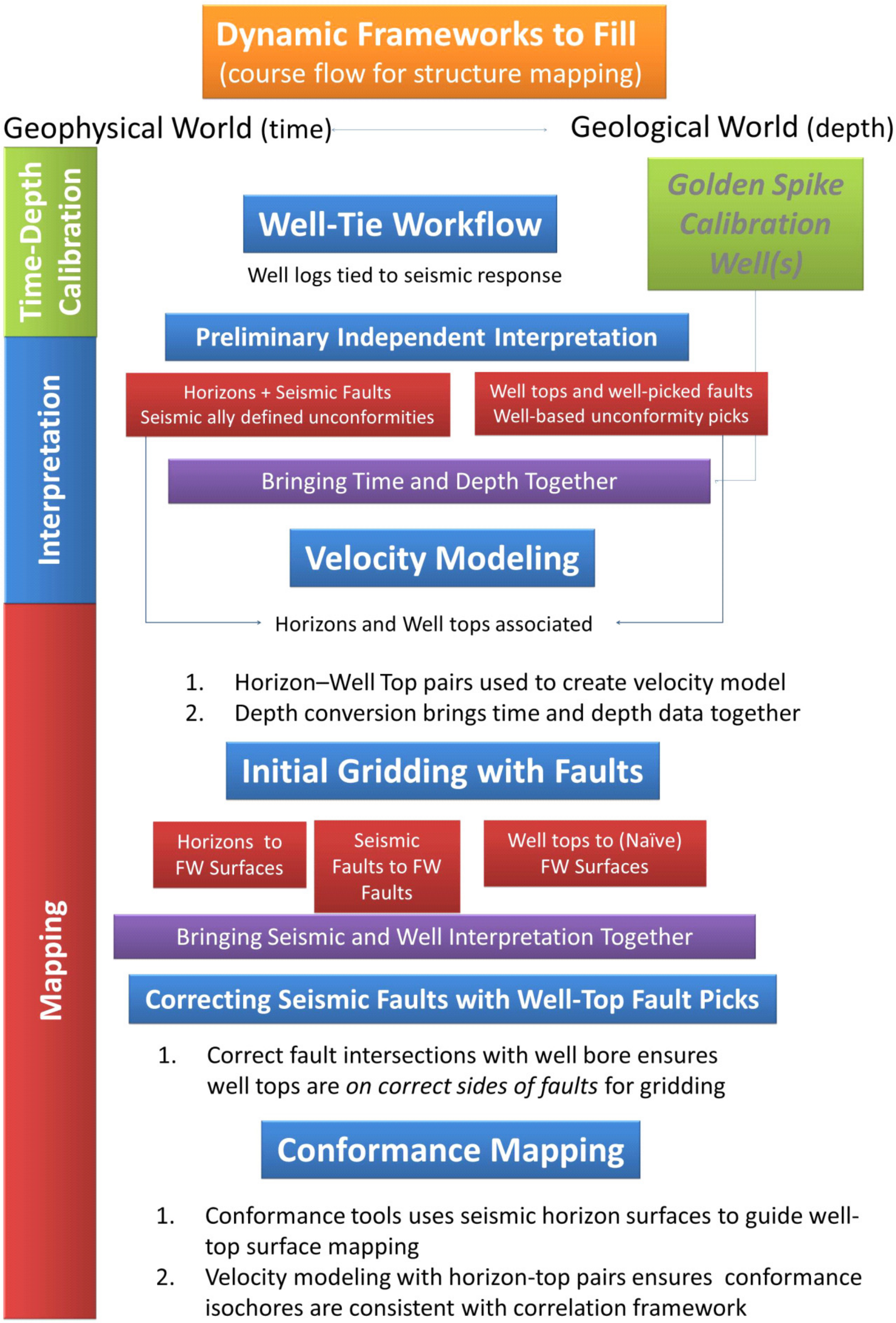
  — Associate or blend multiple data sources (e.g., surface picks, seismic horizons, point sets, geoshapers, and log curve data for property maps) with a given surface or property map.

  — Update all surfaces and property maps when additional data is loaded to OpenWorks (i.e., new wells are drilled and associated surface picks are loaded to OpenWorks) or interpretations are edited (e.g., horizon is altered after a new velocity model reveals an error in the original interpretation).

  — Update all dependent surfaces when primary faults or surfaces are altered (e.g., fault that intersects a surface is modified).

These are but a few of the many advantages of using DecisionSpace Geosciences Dynamic Frameworks to Fill.

The following figure shows Dynamic Frameworks to Fill workflow for structure mapping.



Introduction to Dynamic Frameworks to Fill (DFF)

DecisionSpace Geosciences Dynamic Frameworks to Fill makes single and multi-surface structure mapping easy. For example, intelligent defaults within the modeling system allow you to add horizons or well tops and faults to a new or existing Framework. This produces a preliminary set of structure maps, which are properly integrated with the fault plane data. When properly integrated with fault and unconformities, these structure maps are referred to as a sealed structural framework.

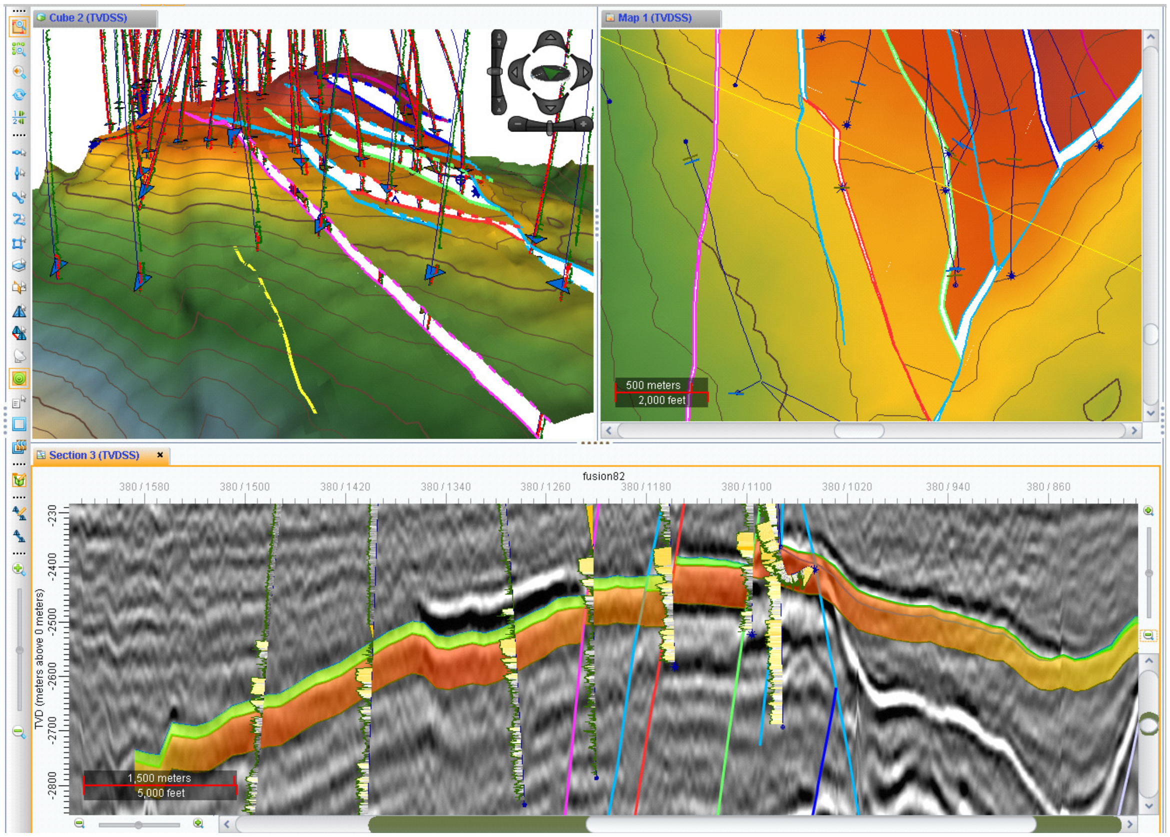
Overview

The power of the DFF workflow is the ability to use well surface picks to tie the surface to wells vertically and then use seismic horizons to guide that surface between the wells laterally. You can also tie surface picks and horizons basin-wide to create one DFF surface. For example, if there are no wells in an area where there is seismic data, and if horizons have been interpreted with associated well surface picks outside of the survey, the two data types can be combined to create one unified surface across the entire area of interest. Similarly, if an asset team has multiple faults that should be modeled as one, you can add the other faults as a data source to one, and then create a single fault from smaller interpreted faults.

DFF is a dynamic model and updating mapping tool. Surfaces in the model “listen” for changes in the data used to create the model and then automatically update the Framework, accordingly.

DFF combines traditional mapping, fault plane integration, fault networking, conformance mapping, unconformity trimming, and interval modeling into one tool.

DFF workflow allows for quick-look volumetrics calculations at any point in the interpretation life cycle. Geophysicists and geologists can build a Framework model of their environment, and the topology engine that is used to create the framework provides the basis for the interactive interpretation of fluid contacts and quick look STOOIP and recoverable reserves calculations.



Software Defaults in Dynamic Frameworks to Fill

Features Active by Default

When a DFF model is created, Fault Offset/Horizon Cleaning, Fault Networking, Conformance Mapping, Unconformity Trim, and Interval Fill are active by default.

Fault Offsetting

When you add surfaces and faults to the model and click **Apply**, the Offset Framework operation is automatically applied, and a preliminary structure map with fault off-setting and fault polygons are automatically created. For example, if you have added horizon and fault data to a model, the horizon will be offset at the fault unless Offset Framework is manually turned off. This is true for all the DFF operations.

Unconformities

When surfaces are modeled and you have defined some of them as unconformities, the unconformities will automatically perform a truncation operation on the intersecting conformable surfaces when the model is applied.

Fault Networks

Fault Networking, even when turned on, will not perform the operation unless a fault hierarchy is defined in the Fault Networking user interface. Similarly, even though Conformance is on, conformance relationships will not be applied until surface-to-surface conformance relationships have been defined in the Conformance user interface.

Unconformity Trimming

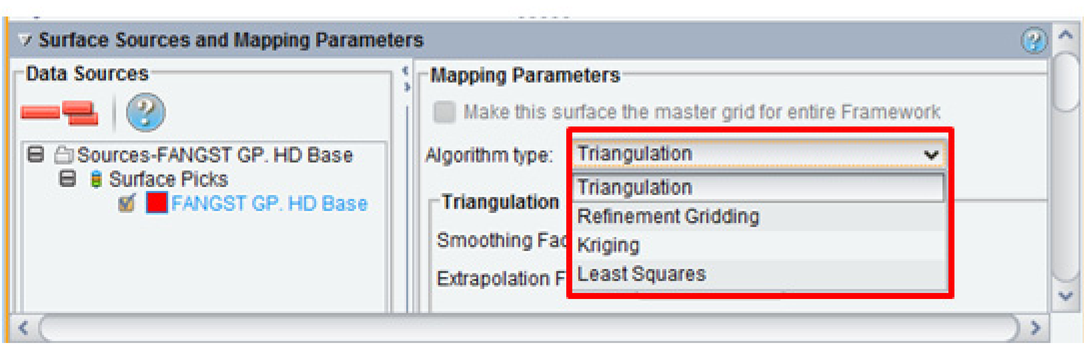
Unconformity Trimming will be applied if unconformity surfaces are defined and intersect with conformable surfaces. However, if there are two or more intersecting unconformities, you must define an unconformity-unconformity surface hierarchy in order for one unconformity surface to truncate the other.

Listening Mode

The Framework ‘listening’ mode is disabled by default. You need to switch the mode to ‘listen for live updates while interpreting’ to view changes made to the Model when the data has been edited, or click the Refresh Model button on the Frameworks to Fill task pane.

Gridding Algorithms

Four gridding algorithms are available for surface mapping and conformance. The gridding algorithm types are located in the **Surface Sources and Mapping Parameters** panel of the **Surface** tab.



Triangulation

Triangulation is used to create surfaces when data is sparse and when you wish to ensure that the generated surface strictly honors all data points. Triangulation is also fast; generated surfaces can be updated quickly. Triangulation is the default setting when well picks are the source for a generated surface and faults always use triangulation.

The triangulation algorithm has two parameters, with an additional parameter when applied to faults:

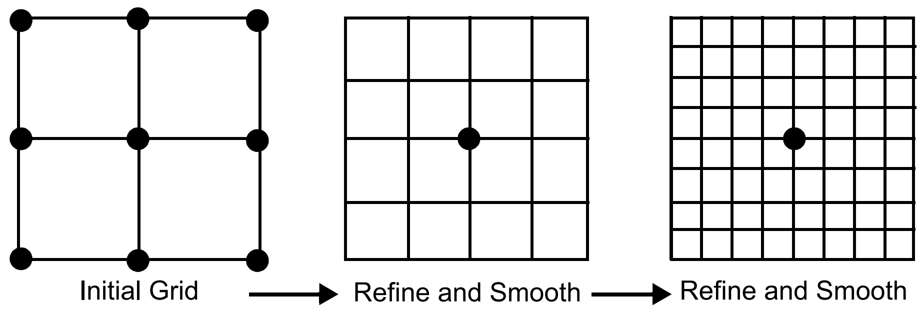
- **Smoothing Factor** — ranges from 0 to 1.0, with a default of 0.25. Smoothing factor controls the size of the triangles to create the meshed surface or fault. A larger value results in smaller triangles and a smoother surface. Increasing the smoothing factor also results in greater compute times and slower updates.

- **Extrapolation Factor** — ranges from 0 to 10, but values above provide limited additional benefit. Zero produces a triangulated surface extent equal to the data hull or area enclosed by the input data points. The extrapolation factor is a multiple of the data hull area added to the starting triangulated surface.

- **Tip Line Fit** (**Faults only**) — the tip line defines the edge of the fault where fault displacement goes to zero. The Tip Line Fit parameter controls how closely the edge of the modeled fault surface corresponds to the edge or the outline of the input fault. Tip Line Fit values range from 0 to 1, with 1 representing the closest fit to the input data and 0 representing more regular tip line shape. If the Tip Line Fit value is too close to 1 in areas where there is a lot of curvature on the fault surface, you may see ledges or other non-geologic artifacts near the edge of the fault. Reducing the Tip Line Fit value will help avoid this problem.

Refinement Gridding

Refinement Gridding is used when the data is very densely sampled (for example, seismic horizons). Refinement gridding performs data averaging with the defined grid cells, so particular data points may not be honored exactly.



At each refinement level, the surface model passes through a bi-harmonic filter, producing a minimum curvature surface. Each step ties the surface back to the actual data points, ensuring that the surface model closely honors the input data points.

Refinement gridding handles fault center lines but not fault polygons. Fault polygons are reduced to center lines just prior to passing them into the gridding algorithm.

Fault center line nodes may have vertical separation values assigned to them (fault polygons do not support vertical separation data); in this case, the vertical separation values allow the refinement gridding algorithm to look across fault barriers when estimating the value of a grid node, and to estimate restored (unfaulted) z values in adjacent fault blocks. If vertical separation data is not available for a fault, that fault is considered an opaque barrier, and the grid nodes are constrained by data points within the same fault block.

Incorporating fault vertical separation data during gridding may produce more accurate results than if faults are treated as opaque barriers, but only if there is a structural continuity between adjacent fault blocks.

Kriging

Kriging is used for surfaces and intervals than can be smoothed. It works well when the data is sparse.

Kriging is a type of spatial interpolation in which control points are weighted according to the degree of spatial correlation between them. The spatial correlation of a given attribute between control points is modeled using a variogram.

Kriging takes the following weighting factors into consideration:

- Closeness of estimated values to known values
- Redundancy between the data values
- Direction of continuity
- Magnitude of continuity or variability

Kriging accounts for redundancy between the data and a measure of distance specific to the data considered (i.e., the variogram model). The disadvantage of kriging is that it smooths, and thus reduces the heterogeneity in the model. This is acceptable for attributes that are already smooth, but in most cases, kriged outputs are not acceptable for mapping because the true heterogeneity is removed. Another issue that arises from smoothing is the failure of kriging to honor the histogram and the variogram.

> **Note**
>
> Because kriging requires hard data, in highly faulted areas you should check your DFF, as you may need to add more control data (i.e., inter-well points).

You can select Kriging as the algorithm type for:

- Any surface using the *Mapping Parameters* panel of the *Surface Sources and Mapping Parameters* panel

- Interval fills using the *Mapping Parameters* panel of the *Attribute Data Sources and Mapping Parameters* panel. There are two types of intervals for which the Kriging option will not be available:

  — Where the top surface is a triangulated surface

  — For Gross attributes if the Source (shown in the table on the Select Intervals sub-panel) is Surface Subtraction

When you select Kriging, a *Kriging Settings* panel is added with the following options:

- **Isotropic** — uses a built-in linear model variogram. This is often used as a quick screening tool for data QC or where data has mild trends.

- **Anisotropic** — includes directional information for scale and major direction azimuth. When you select this option, default parameters based on the data set are calculated using auto-fitting, and the search ellipse using these parameters is displayed in the

Map view. If you do not have a *Map* view open, a new DecisionSpace window with a *Map* view opens. A Display anisotropic parameters button appears to the right of the option. Click the button to hide or unhide the ellipse in the view.

The following parameters also appear below this option, so you can edit these as desired to change the search neighborhood:

— **Major Scale** is the scale (continuity distance or correlation scale) over which the major direction variogram is modeled. The values at either end of the slider bar are the minimum and maximum values of the ranges that could be expected from the selected data. The value shown in the text field is a “smart default” calculated by the software from the input data.

— **Minor Scale** is the scale (continuity distance or correlation range) over which the minor direction variogram is modeled. The values at either end of the slider bar are the minimum and maximum values of the ranges that could be expected from the selected data. The value shown in the text field is a “smart default” calculated by the software from the input data.

— **Major Direction Azimuth** is the direction in which the correlation scale is the longest (i.e., the data has the greatest spatial correlation and least variance over the longest distance). The minor direction (the direction with the shortest correlation scale) is perpendicular to the major direction.

For surface picks, the Kriging algorithm uses a maximum of 100 data points. For horizons, it uses a maximum of 20 data points. If the number of data points in the search ellipse exceeds these maximums, the values for the 100/20 closest to the center of the search ellipse are used, and the other points are weight-averaged.

Search across fault attempts to find data points that are behind a fault in relation to the center of the search ellipse. The results will depend on the extent to which the data points are blocked by the faults.

Least Squares

Least Squares is a data-fitting algorithm that attempts to minimize the overall differences in the resulting output map to the input sample points. It fully honors fault boundaries in sampling the input data points.

The user is given some basic controls for the input data point sampling, and is provided with an option to apply a final smoothing operation.

To turn on the Least Squares algorithm, select Least Squares from the Mapping Parameters Algorithm Type. The following parameters are provided on the *Least Squares Settings* dialog:

- **Minimum number of Sectors —** sets the minimum number of octants, which must satisfy the other input data criteria listed below for the input node to be initialized with a value. The default setting is 1, which is the least restrictive setting. You can override this setting by selecting a number from 1 to 8.

- **Minimum total points** — controls the minimum number of points in the search radius that must be found to initialize a value. The default is 1.

- **Desired points per sector** — sets the number of points to be used in the input node calculation. When this number of points is found no additional points are used in the calculations. The default value is 4. The actual input data will be weighted during least squares grid initialization based on the distance from the target grid node.

- **Search Radius** — controls the distance that is used to search around the input node for valid input data. The default value using the Auto selection is set to ½ of the grid diagonal, as determined from the Grid Extent parameters. You can override this setting, up to a value equal to the grid diagonal.

- **Number of refinements** — sets the number of input grid refinements, with a default of 1. Each time you refine a grid, a new node is created halfway between existing nodes. Additional refinements provide control over the shape of the model, but also required additional processing time and the potential to lose trends in the data. You can select 0 for no refinements, while the maximum allowable value will vary depending on the number of grids in the largest X or Y dimension of the map.

- **Number of smoothing passes —** provides overall smoothing of the output data. You can supply a value from 1-20, with the default value of 10.

- Refinement Gridding for Algorithm Type on the Mapping Parameters panel brings up parameters for the Grid Extent and Geometry Settings.

Conformance Mapping

Conformance is used to establish structural relationships between surfaces in a structural framework. Conformance improves the geologic consistency of modeled surfaces in areas where data may be sparse or noisy. It is used to estimate a series of structure surfaces that are near parallel with each other, suggesting a conformable succession in areas of little well control. The tool is especially useful, as the number of picks (or penetrations) on each horizon decreases dramatically from shallow to deep.

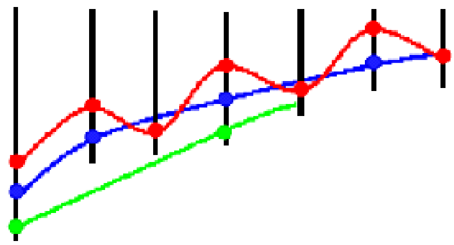
The Assumptions

The Conformance tool assumes that the rate of change in top-to-top thickness between two horizons is relatively low compared to structural variation. It assumes that formation thicknesses vary slowly over large distances.

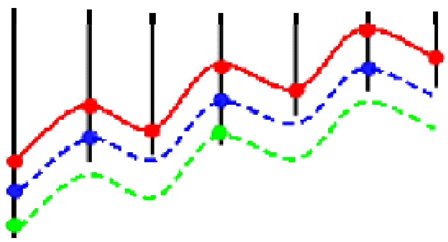
This assumption does not hold in areas with pronounced differential subsidence (e.g., in the vicinity of growth faults), in areas of pronounced differential compaction (e.g., within coal measures), in off-lapping shelf-to-slope sequences, and in areas around carbonate buildups, where there are rapid changes in depositional topology.

If you have surfaces that are either erosional, causing rapid changes to the surface-to-surface thickness, or show rapid variation in original thickness (e.g., flooded dunes, salt withdrawal structures, and so on), you should not include these surfaces in your conformance hierarchy.

The diagram below illustrates the use of the Conformance tool in an area where the deeper surfaces are penetrated by fewer wells:



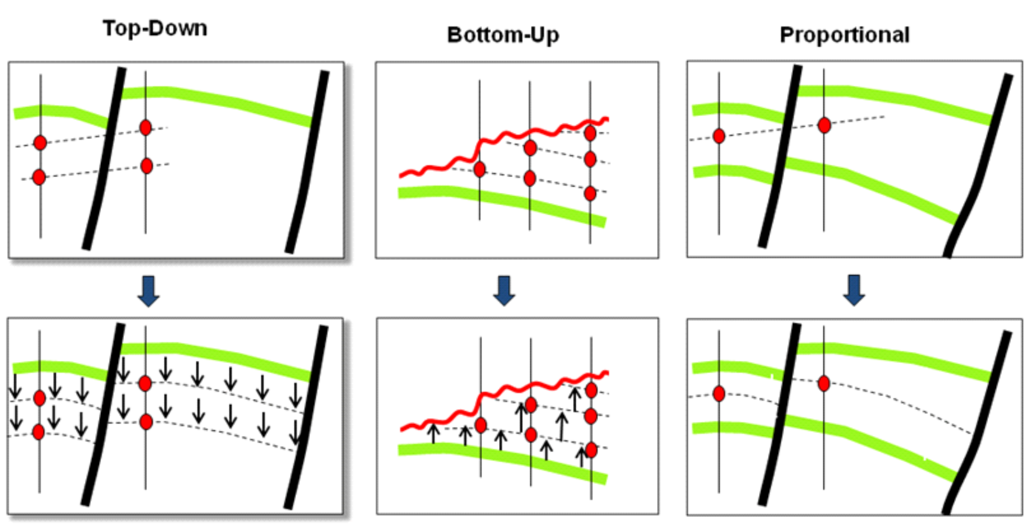
Without Conformance



With Conformance on Top Surface

Methodology

The Conformance tool works by first taking well top pairs on wells where both tops and base picks exist, and then subtracting them to create isochore values. The resulting isochore map is then automatically added to the constraining surface to predict where the deeper surface would be in the absence of well control.



Gridding

In determining the gridding algorithm to be used in conformance, the following rules apply:

- The gridding algorithms used for all surfaces in conformance relationships must be the same type (i.e., either Refinement Gridding or Triangulation).
- Conformance will use the algorithm selected in the Surfaces table for the selected surfaces (Refinement Gridding or Triangulation). If the algorithm types for the selected surfaces differ, a pop-up message will ask you to choose the algorithm to use, and the selections in the Surfaces table will then be updated to reflect your choice.
- Any time an additional conformance relationship is created using a surface with a differing algorithm than the previously selected conformance algorithm, a pop-up message will ask you to choose the algorithm for use again. This choice will then be applied to both the current relationship and all previously existing conformance relationships. The surfaces table will update to show the change in algorithms for all of the surfaces involved in conformance.

Note:

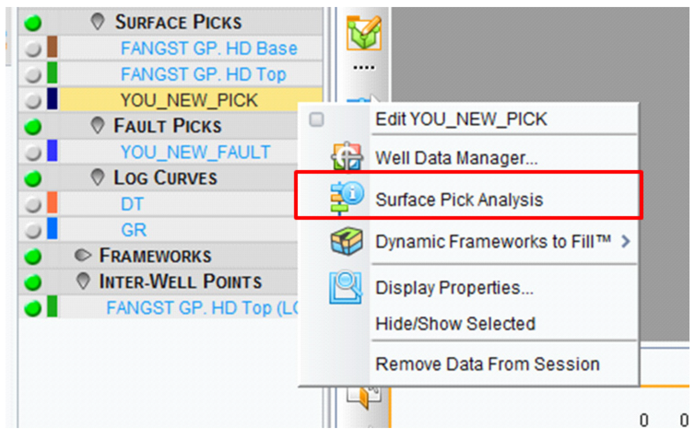
Conformance tries to honor every data point; however, if a data point is above or below a surface while all or most other data points are on the other side of the surface, it is unable to correctly honor that point. When this occurs, a warning icon (yellow triangle) is placed to the left of the Framework name. To view the error, click the Workspace icon, then go to the Build Status tab.

For additional information about gridding algorithms, refer to the section entitled "Gridding Algorithms," on page 4-7.

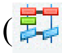
Exercise 4.1: Fast Creation of Surface Maps

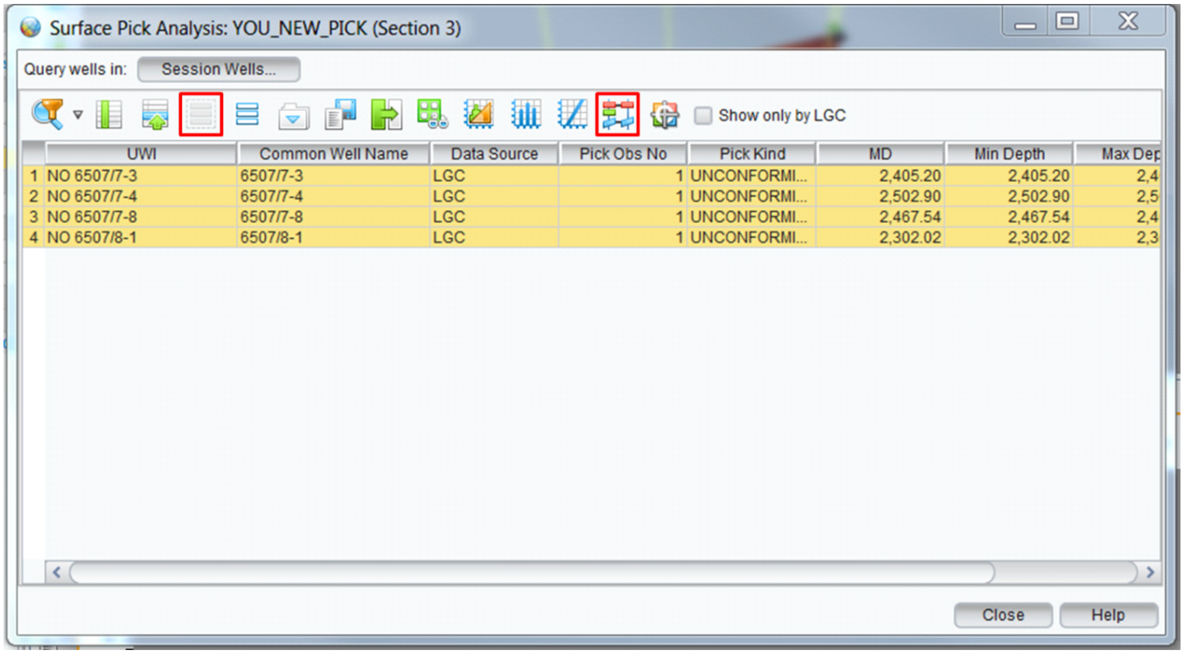
In the previous chapters you made an interpretation on four wells, and created a map using those four points in Dynamic Frameworks to Fill. In this exercise you will see the updatability of mapping in Dynamic Frameworks to Fill by continuing your interpretation on the surface pick in your framework.

1. In the *Inventory* task pane put your cursor on **YOU_NEW_PICK** and **MB3 > Surface Pick Analysis.**

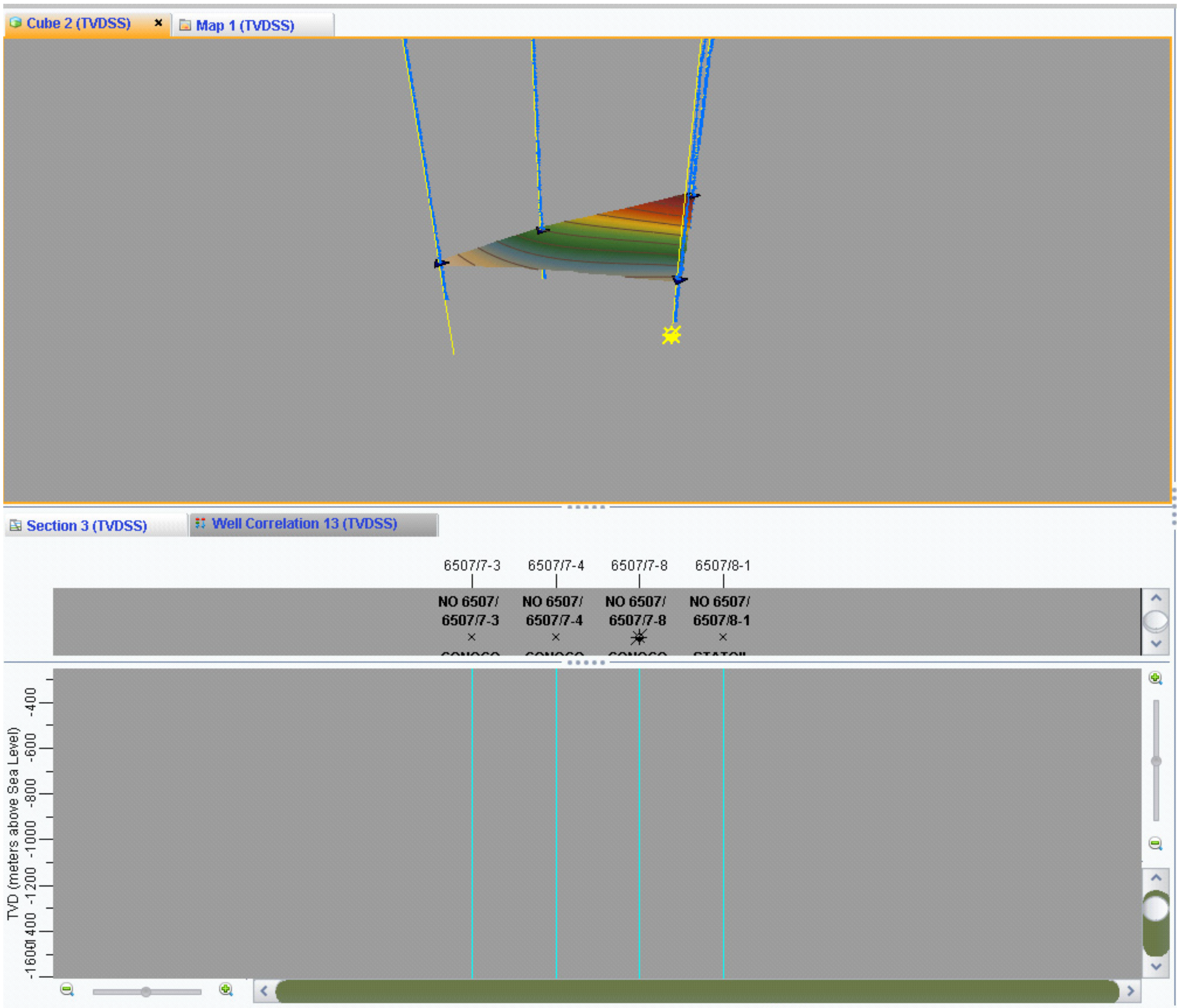


2. In the *Surface Pick Analysis* dialog, click the **Select All** () icon to highlight all of the wells that currently contain the YOU_NEW_PICK surface pick. Then click the **Display Selected**

Wells in New Correlation View () icon, to create a *Correlation* view containing all of those wells.

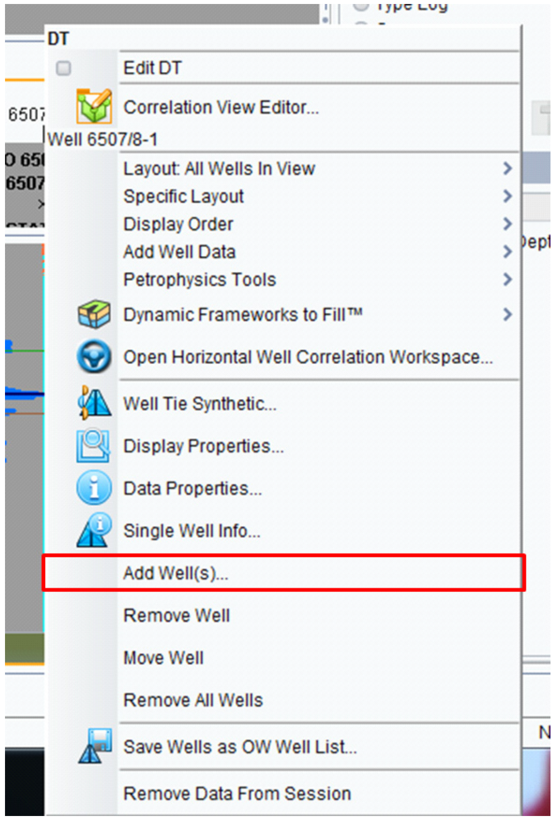


3. A new *Correlation* view opens, containing the four wells that you made interpretation for in the last chapter. Arrange your tabs as in the following image.

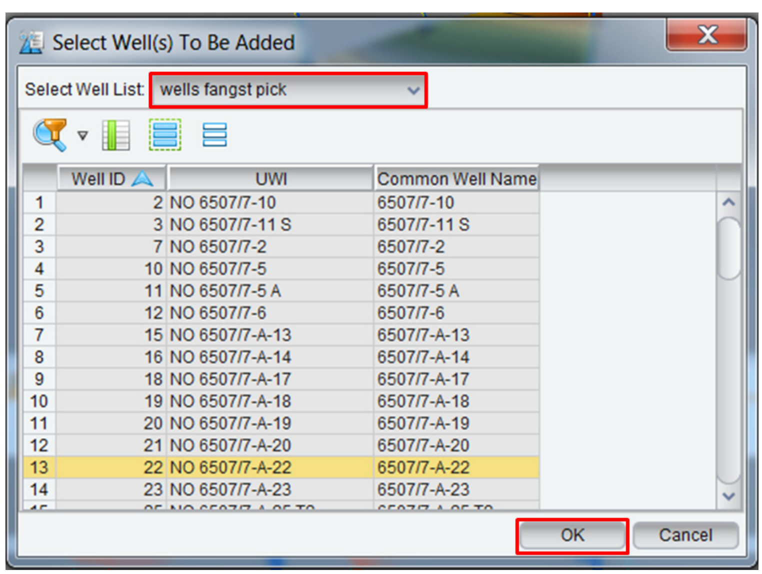


4. Activate *Correlation* view and toggle on all of your **Surface Picks** and **Log Curves**.

5. In *Correlation* view, put your cursor on one of the wellbores and **MB3 > Add Well(s)…**

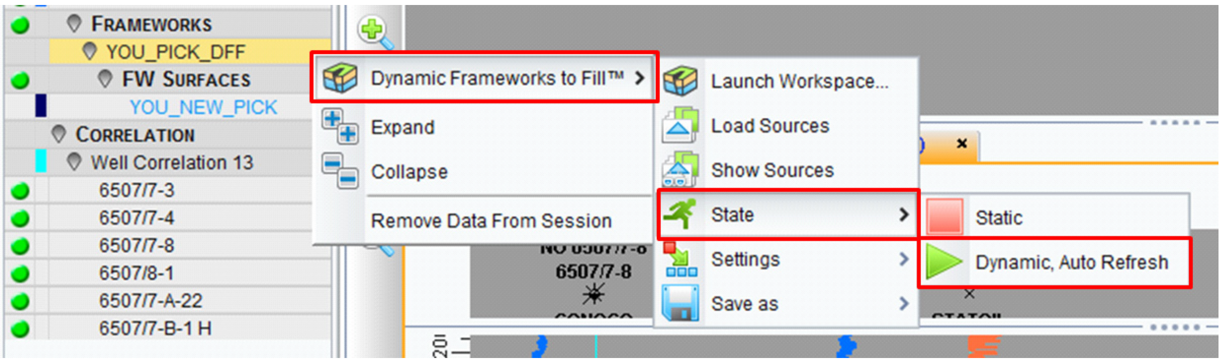


6. In the *Select Well(s) To Be Added* dialog, select **wells fangst pick** from the *Select Well List* pull-down menu, then select the wells **6507/7-A-22** and **6507/7-B-1H.** Click **OK.**

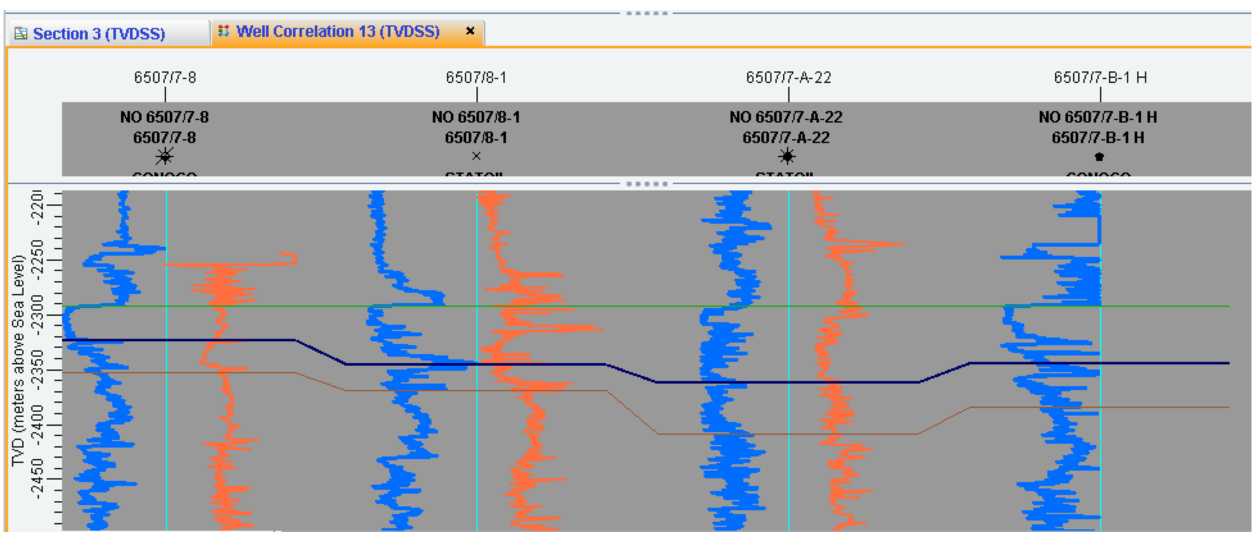


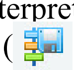
7. Before you begin interpreting, turn your framework to **Dynamic Auto Refresh** so that you can see your interpretations in your wells automatically reflected in your framework surface.

8. In the *Inventory* task pane put your cursor on **YOU_PICK_DFF** framework and **MB3 > Dynamic Frameworks to Fill > State > Dynamic, Auto Refresh.**

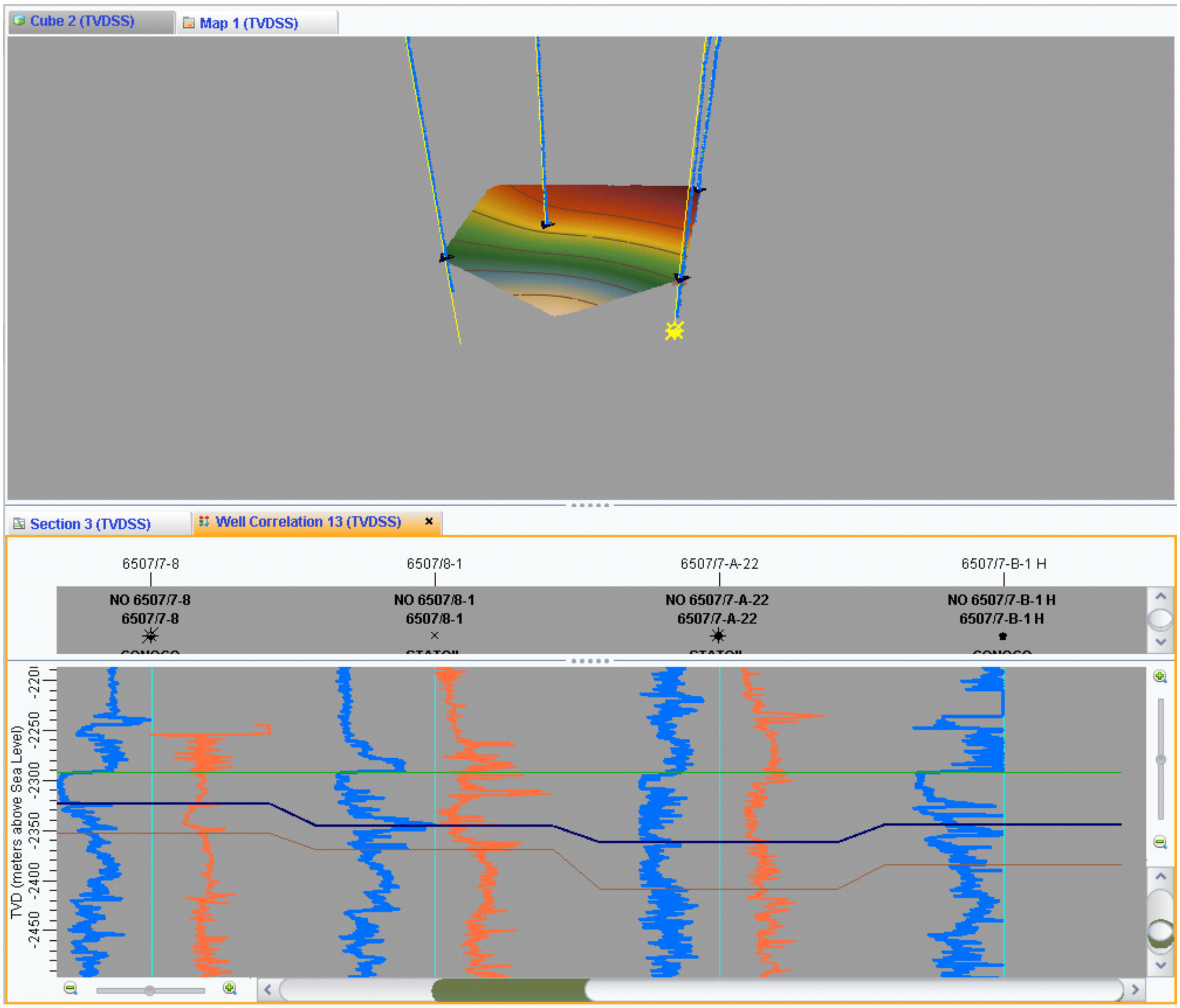


9. To aid in your interpretation click the **Select Pick for Flattening** () icon and flatten on the **FANGST GP. HD Top**. Activate **Interpretation** mode and interpret the **YOU_NEW_PICK** on the gamma ray spike that you saw in the previous chapter.



10. When you are finished with your interpretation, select the **Save well pick changes to the database** () icon on the

Interpretation tool bar. This will save your interpretation to the database. Your framework should automatically update.



Notice that the surface is very smooth. This is due to the lack of horizontal resolution in geological surfaces. You can change the gridding algorithm of the surface within the Framework Workspace, but the horizontal resolution will not change. In the next exercises you will set up your framework to begin to leverage the horizontal resolution of a seismic surface by incorporating it in to your framework with one the fly domain conversions and conformance.

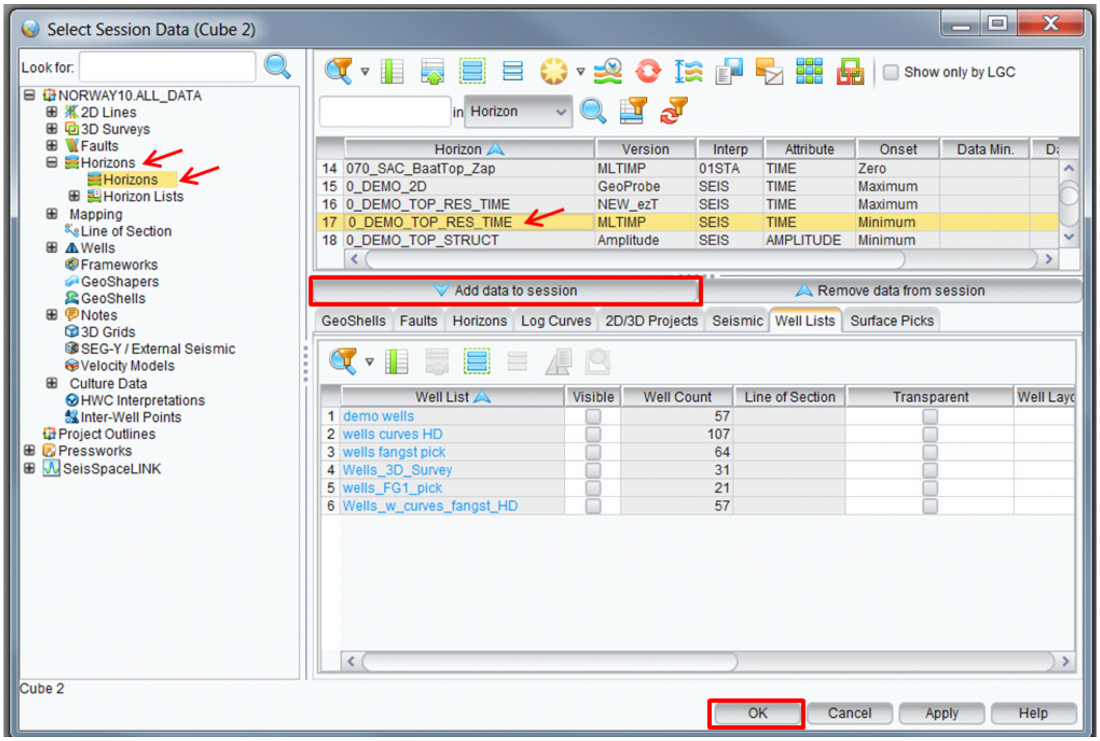
Exercise 4.2: Performing On-the-Fly Time-Depth Conversion of Framework Surfaces

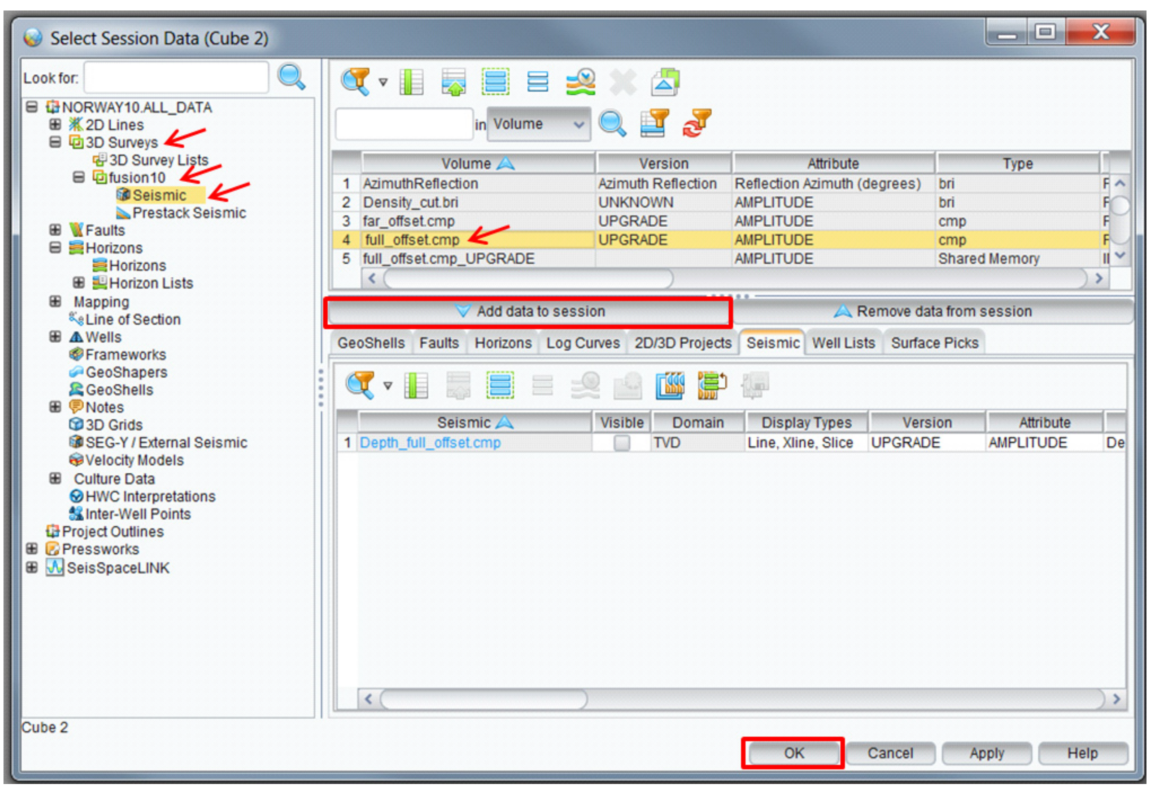
In this exercise you will bring in a seismic horizon, in the time domain, into your depth framework. The seismic horizon will be used later as a reference to conform the geological tops, and thus improve the resolution of the maps. For this purpose, DecisionSpace Geosciences uses on-the-fly TD conversions. Next, you will select an existing velocity model to start the process of integrating your geological and geophysical interpretation.

1. Click the **Select Session Data** () icon, and on the *Select Session Data* dialog select **Horizons > Horizons.** Then select the **0_DEMO_TOP_RES_TIME_MLTIMP** time horizon and add it to your session data.

   You will also need to add a seismic survey to your session; select **3D Surveys > fusion 10 > Seismic**, and then select **full_offset.cmp.**

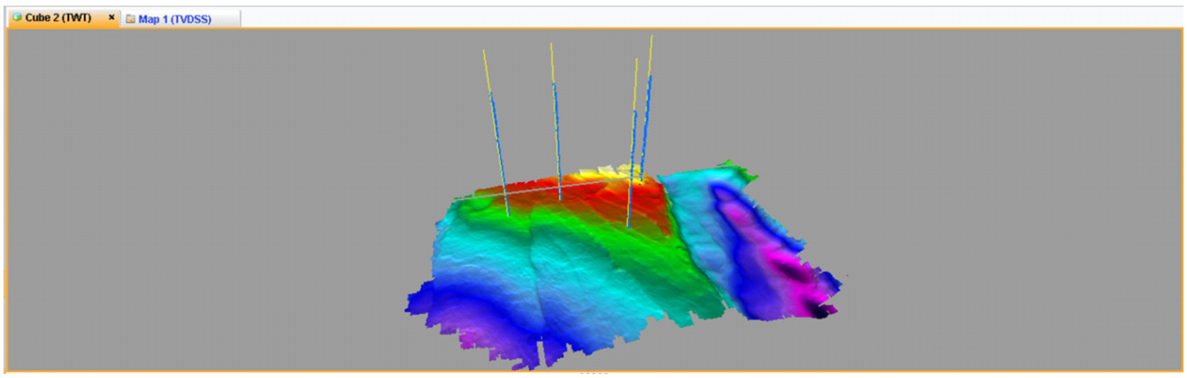
Add this to your session data and click **OK** to close the *Select Session Data* dialog.



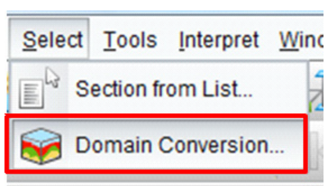


Note that even though your Horizon and Survey are toggled on you cannot see anything. This is because they are in the time domain, and our session was created in depth domain.

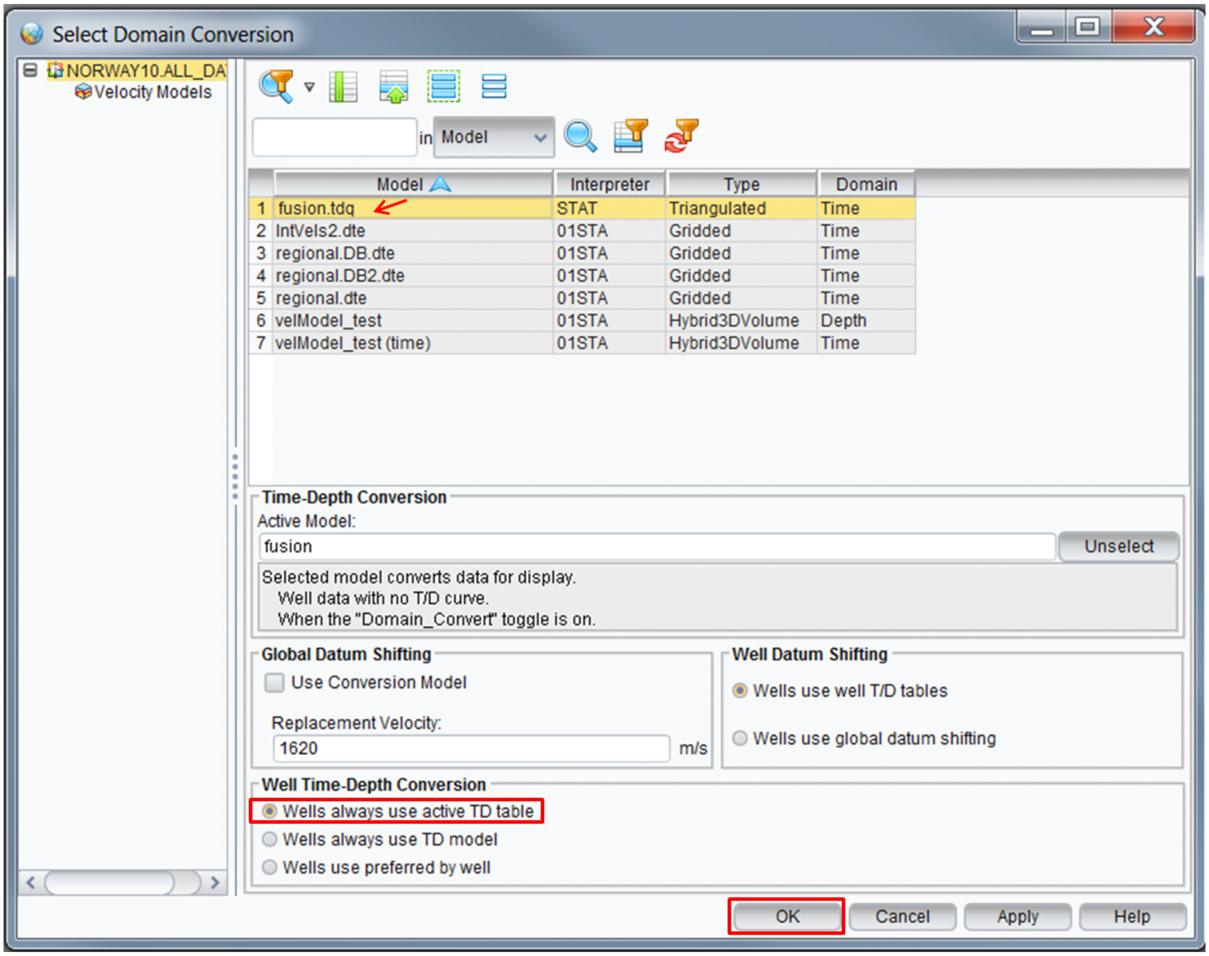
2. In *Cube* view, toggle on **0_DEMO_TOP_RES_TIME** if it is not already toggled on, and switch your domain to **TWT**. Now you can see your seismic horizon, but you can no longer see your depth framework surface.



3. To see both at the same time you have to have an active velocity model within your session. In the main menu bar, click **Select > Domain Conversion.**



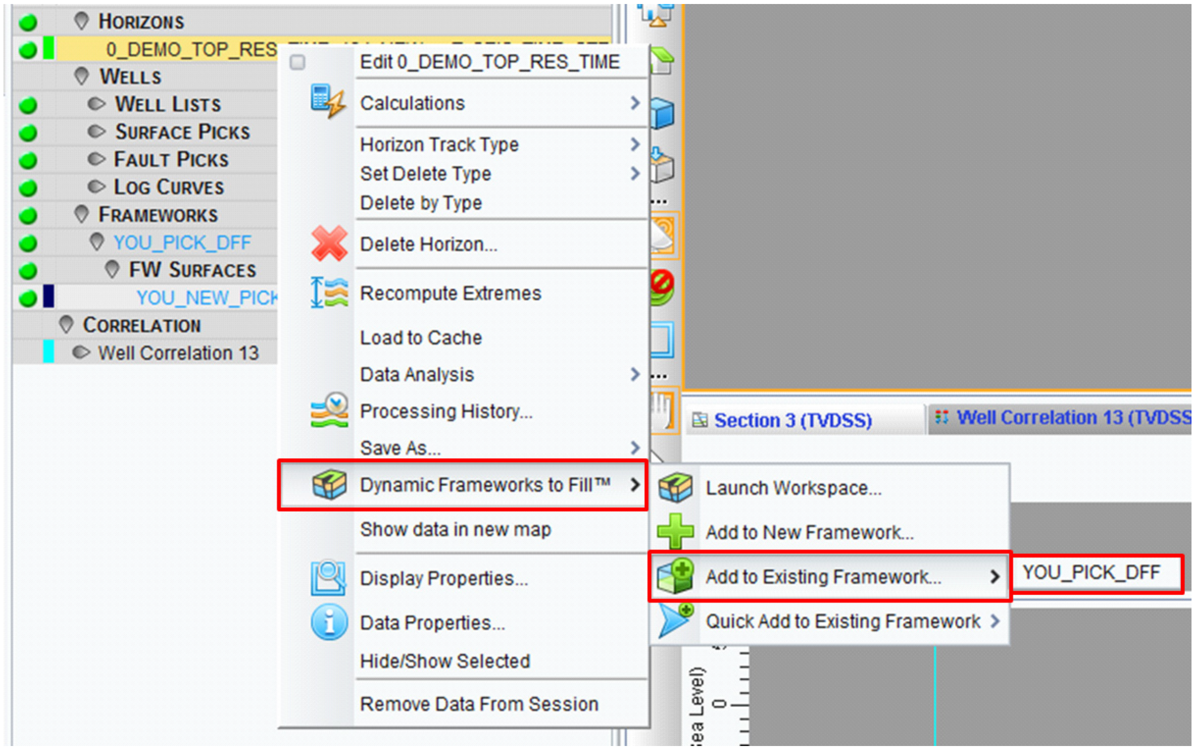
4. In the *Select Domain Conversion* dialog, select the **fusion tdq** velocity model and click **OK.**



With an active velocity model you can now visualize your depth framework surfaces and your seismic horizons together.

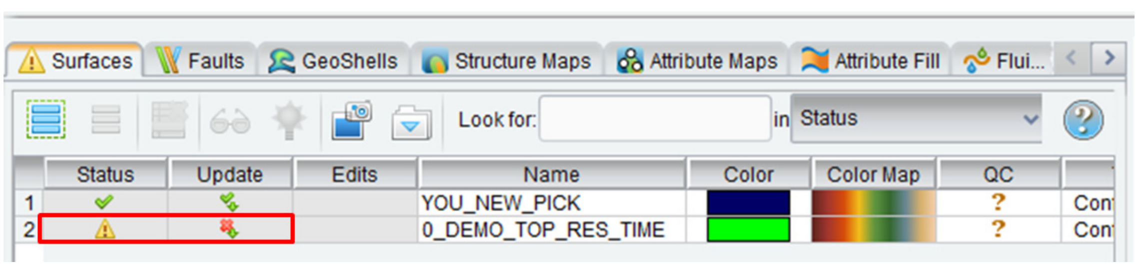
5. In the *Inventory* task pane put your cursor on the **0_DEMO_TOP_RES_TIME** horizon and **MB3 > Dynamic**

Frameworks to Fill > Add to Existing Framework > YOU_PICK_DFF.



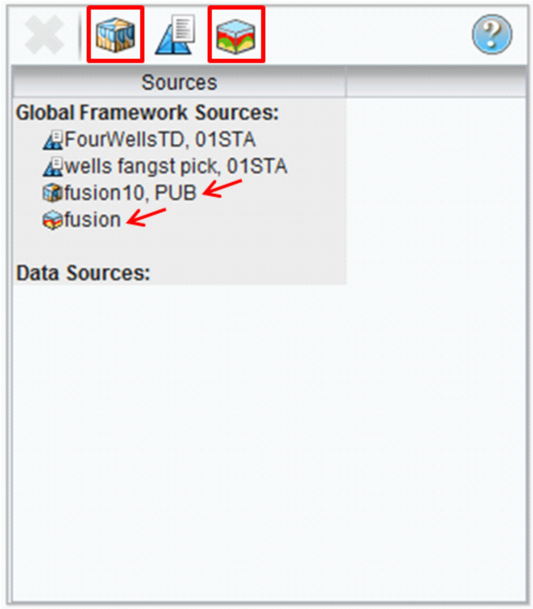
6. From the *Dynamic Frameworks to Fill* task pane select the **Launch Framework Workspace** ( ) icon.

On the *Dynamic Frameworks to Fill Workspace* you will see that the **0_DEMO_TOP_RES_TIME** horizon has been added to the *Surfaces* object tab, but there is a warning next to it. This is because there is no seismic survey for the area, or a velocity model for domain conversion is listed as a global source for the framework. When the framework was created only well lists were available in the session, and therefore were not automatically brought into the framework.

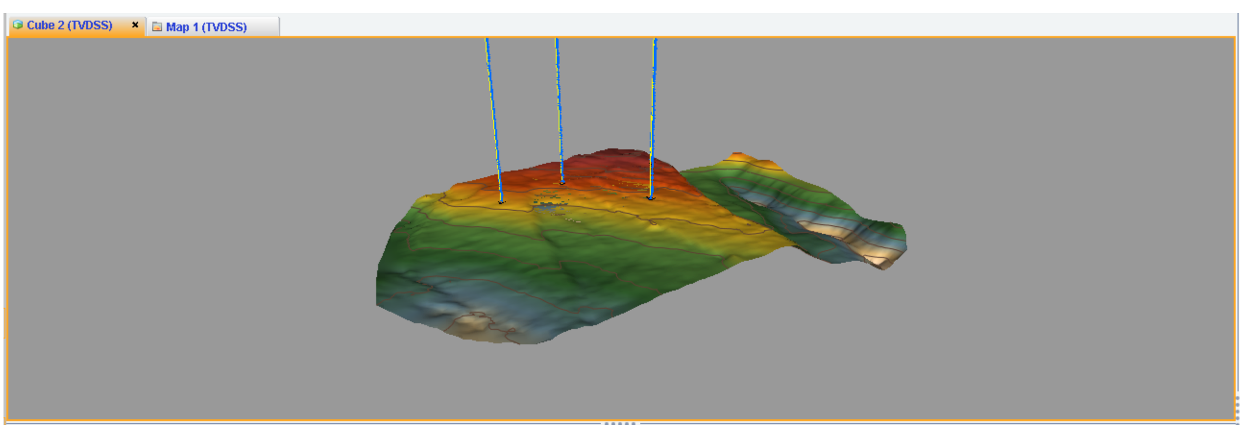


7. In the *Sources* panel select the **Replace framework survey** ( ) icon. This will make the survey you currently have active in your session the active survey for your framework. Then click the

Replace framework velocity model () icon. This will change the active velocity model in your framework to match the one in your session.



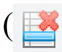
8. When the velocity model and survey have been applied to the framework, it will automatically update and build the 0_DEMO_TOP_RES_TIME framework surface. Navigate back to your *Cube* view and toggle off the original **0_DEMO_TOP_RES_TIME** horizon. Change your view back to **TVDSS**. As you can see, the newly created surface is still visible, because of the domain conversion applied.



Note the difference in detail between the two surfaces. The surface made from the seismic horizon is significantly more detailed due to the higher horizontal resolution from seismic data. You can change the gridding algorithms within frameworks for the surfaces, but changing the algorithms for the surface is made from the surface picks. In the next exercise you uses Dynamic Frameworks to Fill to leverage the resolution from the seismic surface and apply it to all of your other surfaces.

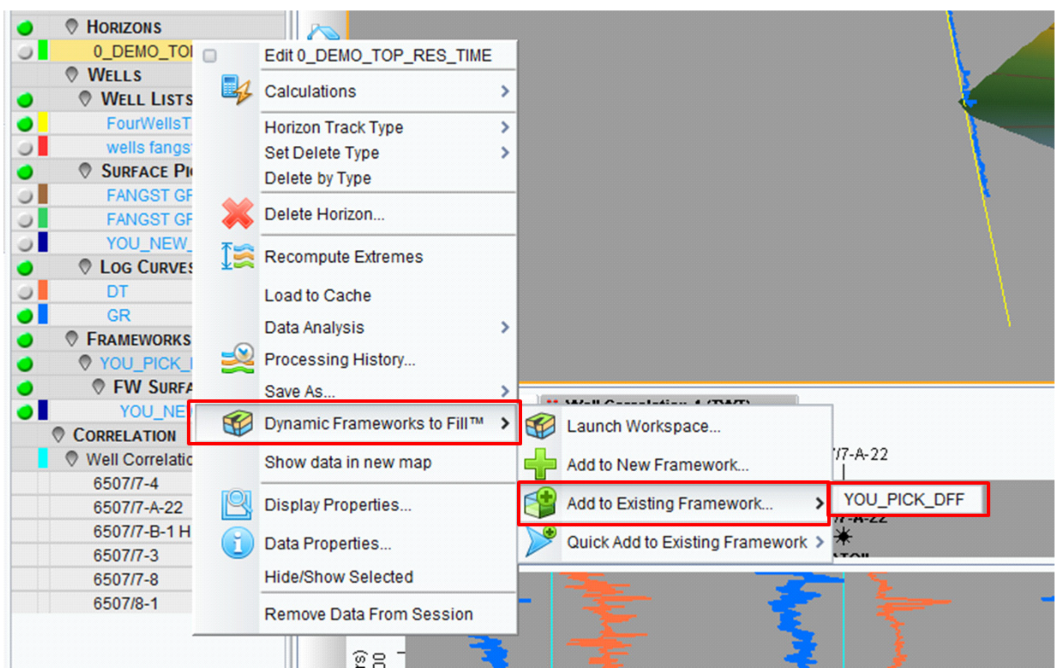
Exercise 4.3: Mapping Surface Picks

Using the Conformance technology in Frameworks enables you to take advantage of the horizontal resolution of the seismic horizons as well as the vertical resolution from surfaces created from surface picks.

1. In the *Dynamic Frameworks to Fill Workspace* select the **0_DEMO_TOP_RES_TIME** surface and then select the **Remove the selected model entry** () icon.

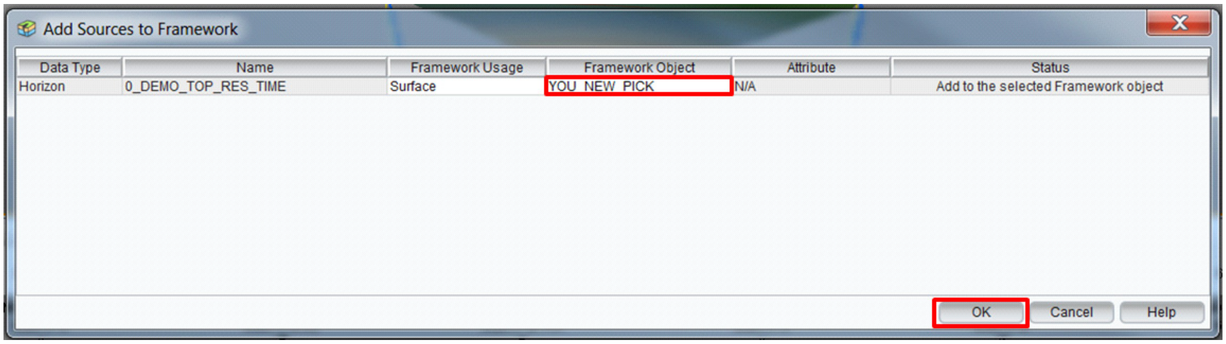
 0_DEMO_TOP_RES_TIME and YOU_NEW_PICK are the same surface, so instead of having them as separate surfaces you will add the 0_DEMO_TOP_RES_TIME as a secondary source to your geological interpretation.

2. In the *Inventory* task pane, put your cursor on **0_DEMO_TOP_RES_TIME** horizon and **MB3 > Dynamic Frameworks to Fill > Add to Existing Framework > YOU_PICK_DFF.**

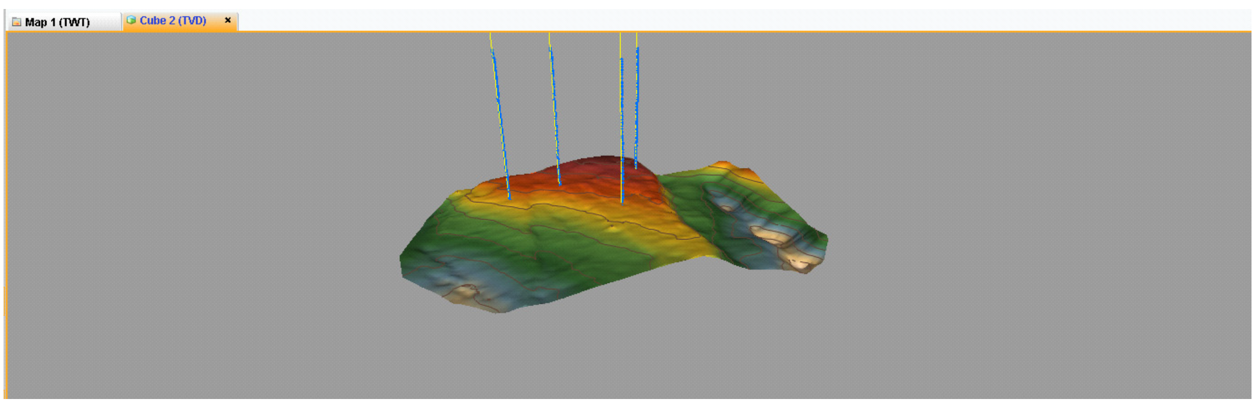


3. In the *Add Sources to Framework* dialog, change the Framework Object to **YOU_NEW_PICK**, and click **OK**. This will set the 0_DEMO_TOP_RES_TIME horizon as a secondary source to the YOU_NEW_PICK framework surface. This means that if any data

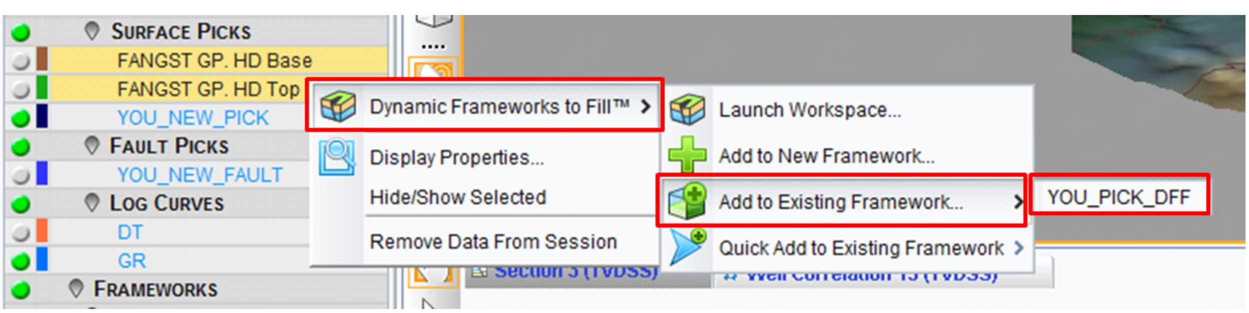
is changed in the 0_DEMO_TOP_RES_TIME horizon, the YOU_NEW_PICK framework surface will change as well.



Notice now in *Cube* view that the YOU_NEW_PICK surface has increased in size, as well as resolution, because the seismic horizon is a secondary source to the surface. In the next steps you will add other geological tops and apply the increased resolution to those surfaces through conformance in Dynamic Frameworks to Fill.

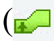


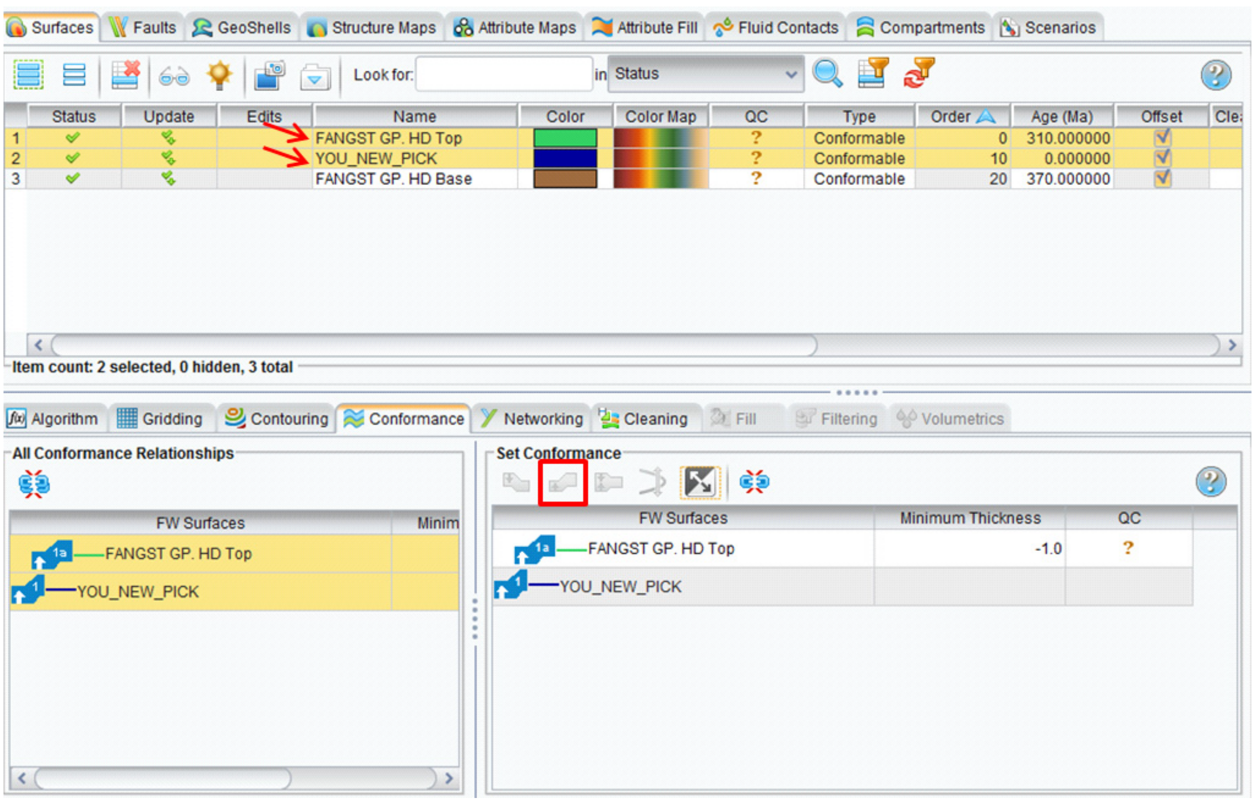
4. In the *Inventory* task pane select the **FANGST GP. HD Top** and **FANGST GP. HD Base** surface picks, then **MB3 > Dynamic Frameworks to Fill > Add to Existing Framework > YOU_PICK_DFF**. This will add the surface picks to your framework. In the *Add Sources to Framework* dialog accept the defaults and click **OK**.



5. Before making changes to your Framework, activate and maximize your *Section* view, then navigate to **IL 350.**

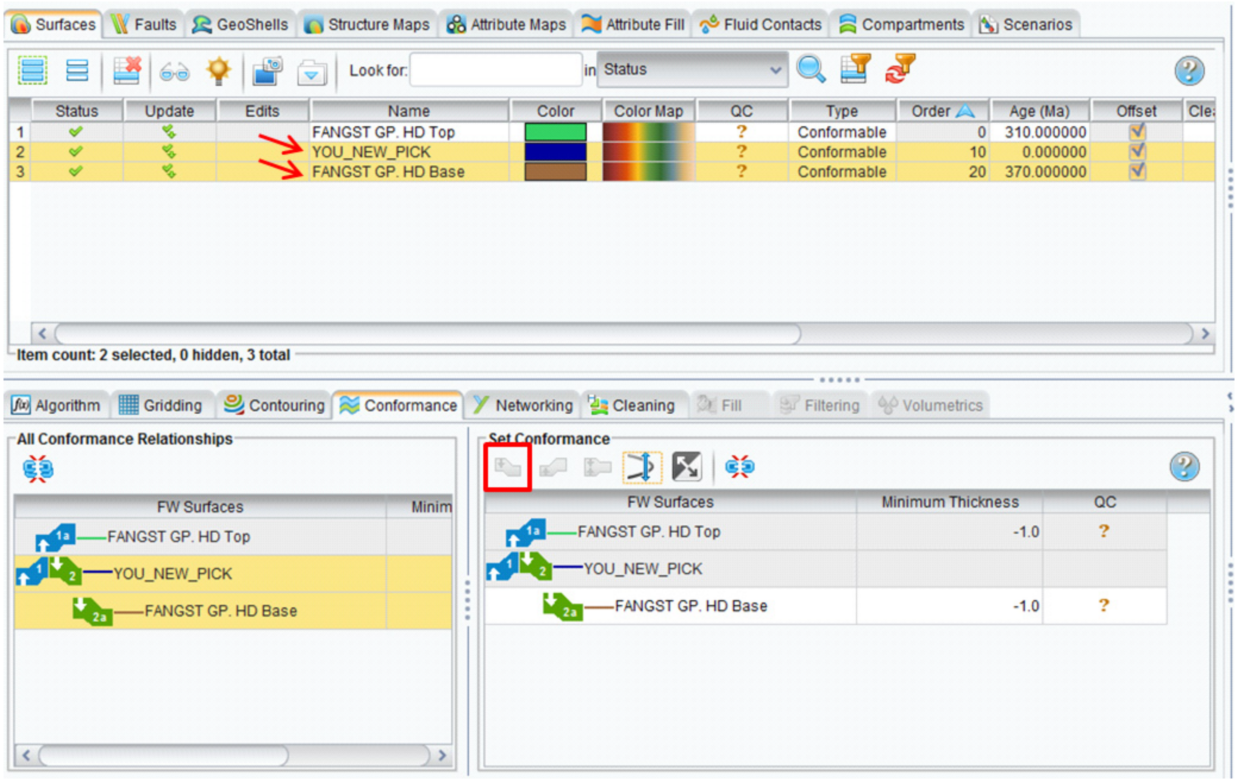
6. In the *Dynamic Frameworks to Fill Workspace*, notice that in the *Surfaces* object tab the two new surfaces have been created. Select the **FANGST GP. HD Top** and **YOU_NEW_PICK** surfaces.

7. In the *Conformance* action tab select the **Conform surfaces bottom up** () icon, to apply a bottom up conformance relationship. This makes YOU_NEW_PICK the parent surface and therefore applies the detailed resolution of that surface to FANGST GP. HD Top.



8. Now select the **YOU_NEW_PICK** and the **FANGST GP. HD Base** surfaces, and in the *Conformance* actions tab select the **Conform Surface top down** () icon. This makes

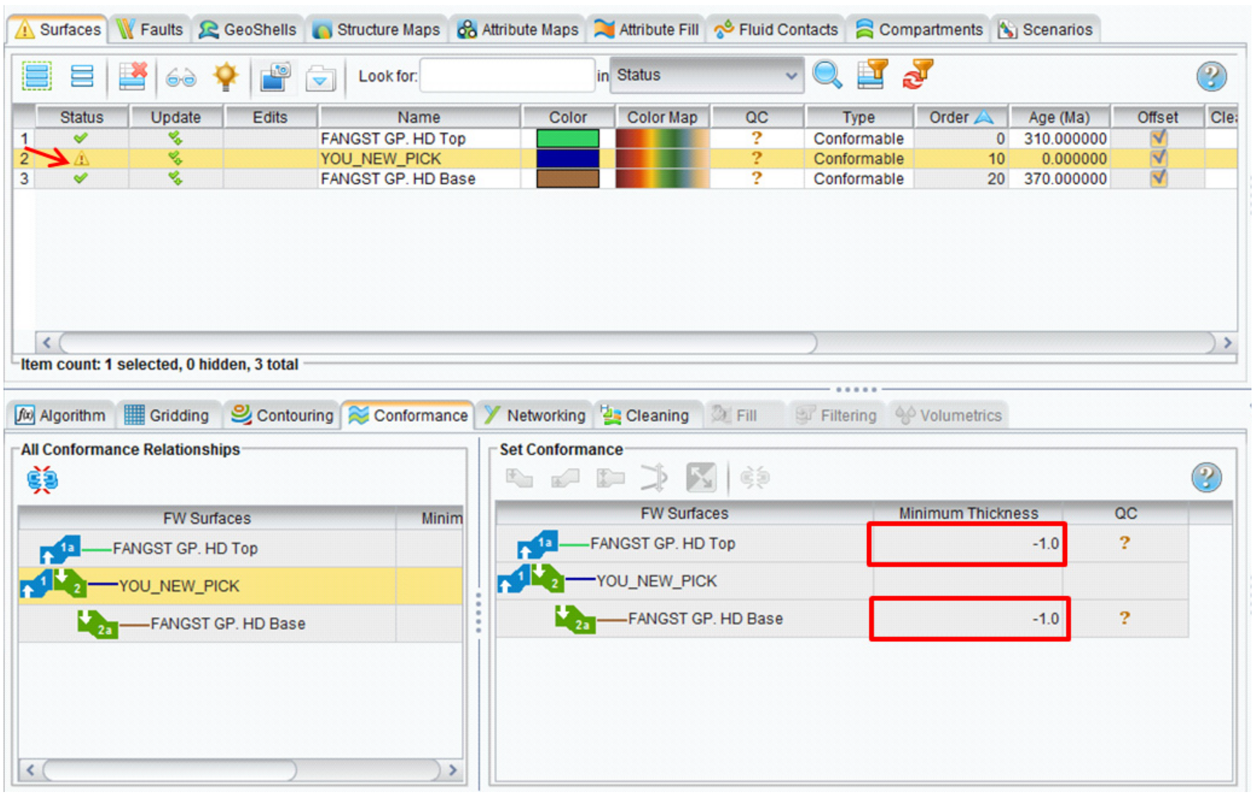
YOU_NEW_PICK the parent surface and therefore applies the detailed resolution of that surface to FANGST GP. HD Base.



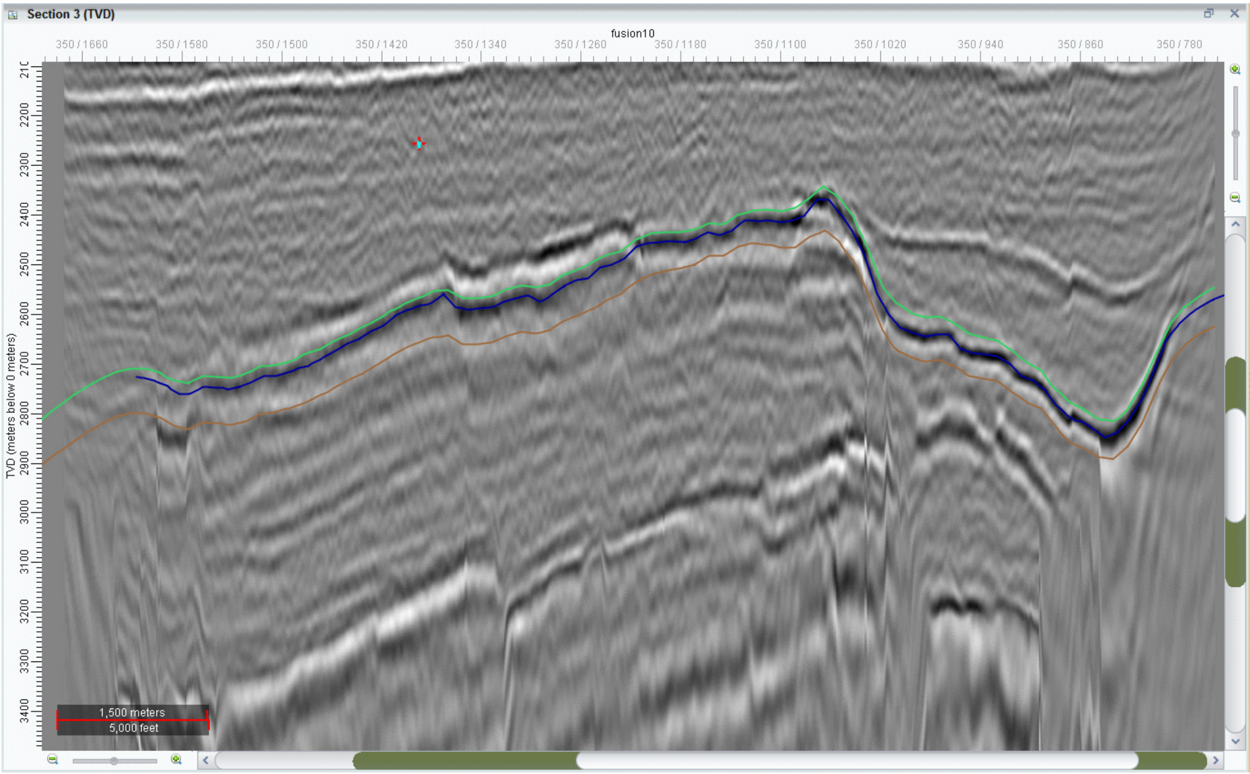
Note:

If you get an error with one of your surfaces after setting the conformance relationships, it is due to the crossing of your surfaces. In many areas the surfaces are interpreted very close to one another and can cause some crossing.

It is a best practice to review the original interpreted data of your horizons to ensure that the framework surfaces are made from the best data possible. If you are satisfied with your interpretation, use the option in the *Conformance* action tab to set a Minimum Thickness for each surface. This forces the software to maintain a distance of at least that designated amount between surfaces.



9. If not already displayed, toggle on all of the **FW Surfaces** in your *Section* view. Notice that the two surfaces created from surface picks now have the horizontal resolution of the seismic horizon.

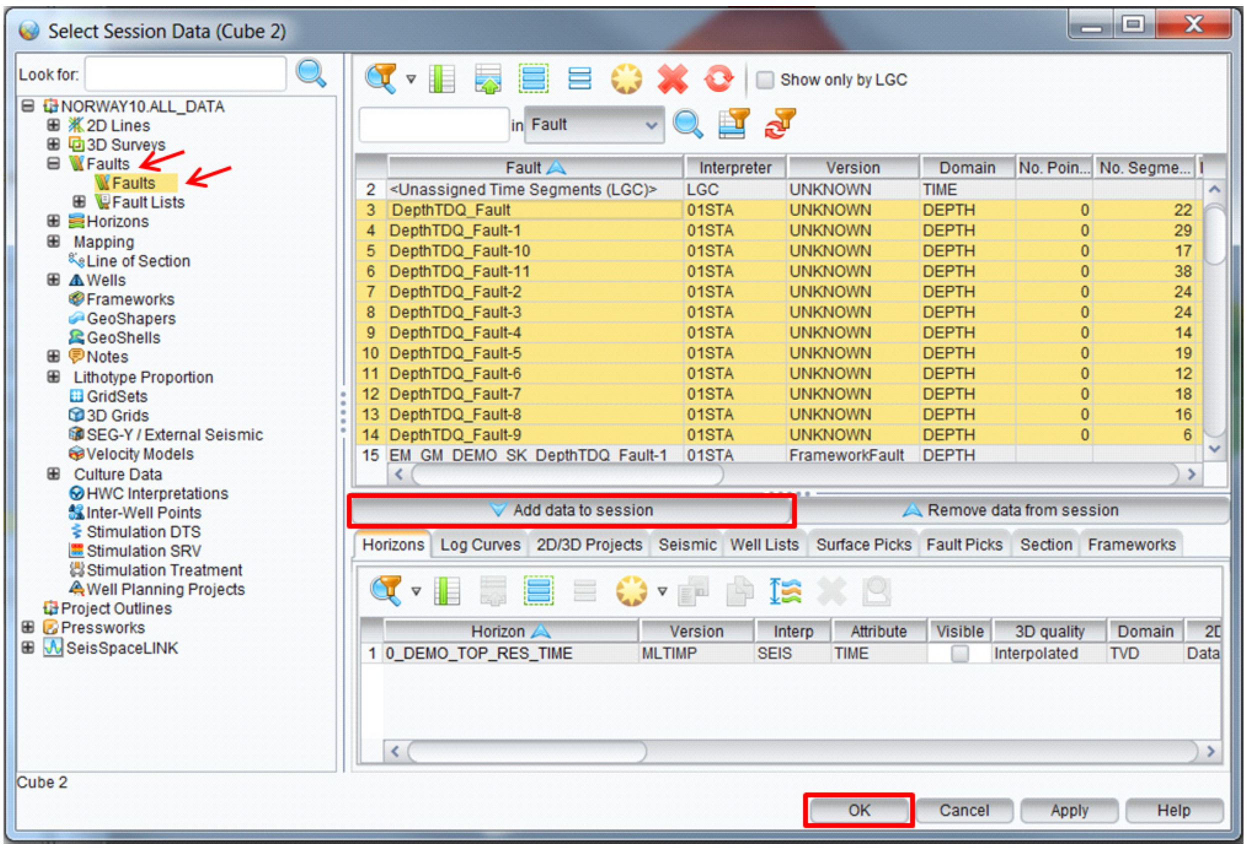


In the next exercise you will add faults to your current framework to build a complete structural framework.

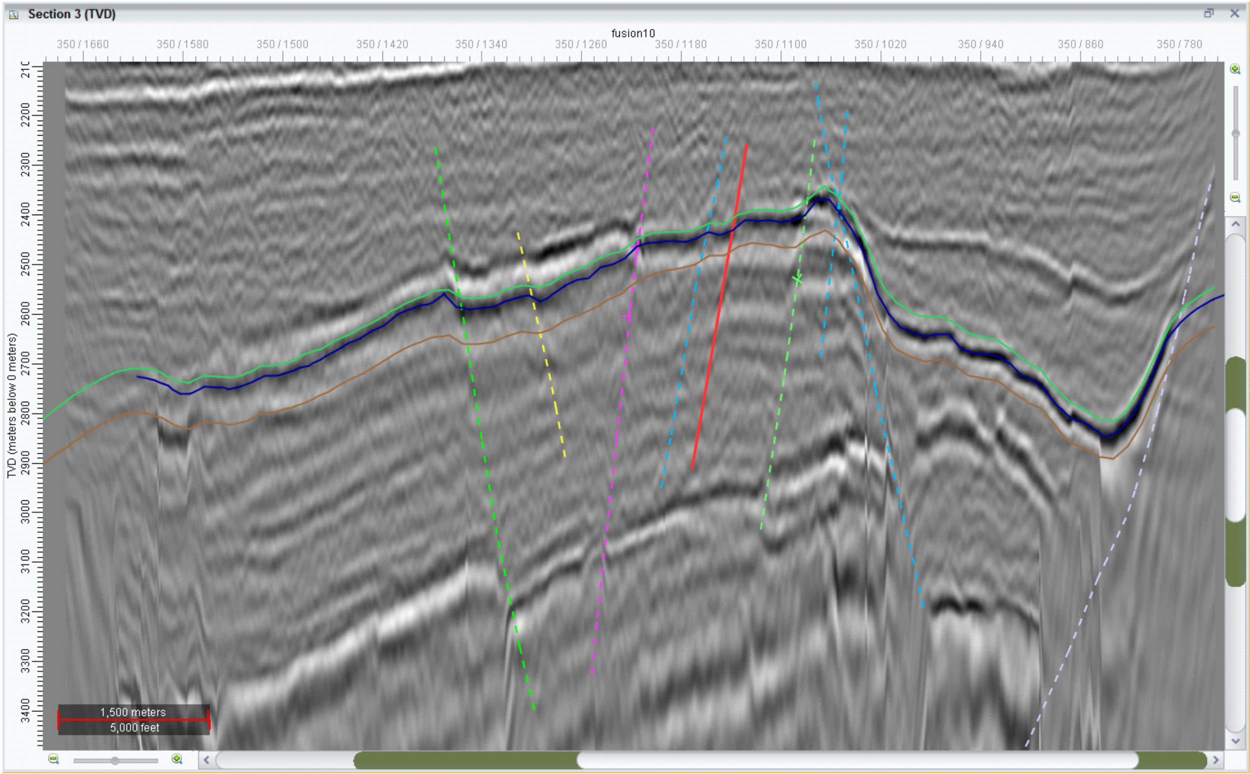
Exercise 4.4: Generating Fault Networks

Adding faults to your framework will allow the frameworks to create relationships with each of the faults, as well as the surfaces those faults intersect. This will enable you to create a sealed 3D structural framework from those surfaces and faults.

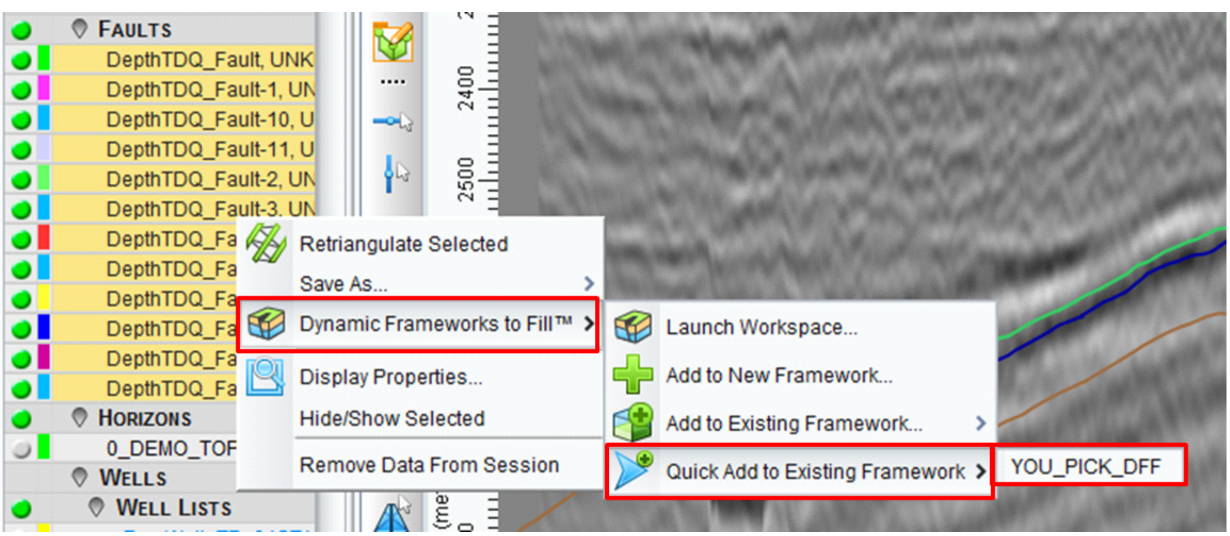
1. Click the **Select Session Data** ( ) icon, and in the *Select Session Data* dialog select the depth faults **DepthTDQFault** through **DepthTDQFault-11**. Click the **Add data to session** button, and click **OK.**



2. Display the newly added faults in your *Section* view and observe where they intersect the surfaces.



3. Select all of the faults in your *Inventory* and **MB3 > Dynamic Frameworks to Fill > Quick Add to Existing Framework > YOU_PICK_DFF.**

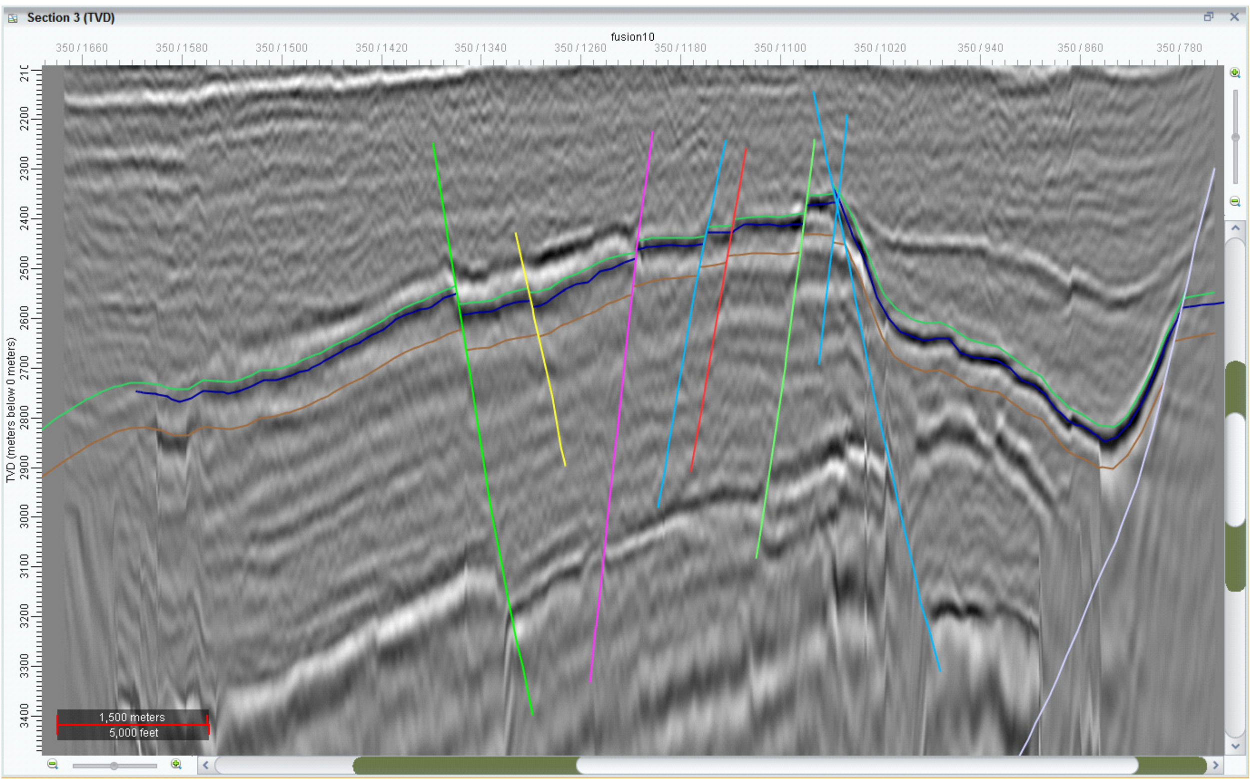


4. In your *Section* view toggle off the original seismic faults, leaving only the Framework faults toggled on.

Notice that the Framework faults, like the seismic faults, are crossing the framework surfaces; but those surfaces are not taking into account those intersections. This is because the current parameters in your framework are set to not acknowledge the fault intersections with the framework surfaces. Activate the Fault Offsetting parameter to change this.

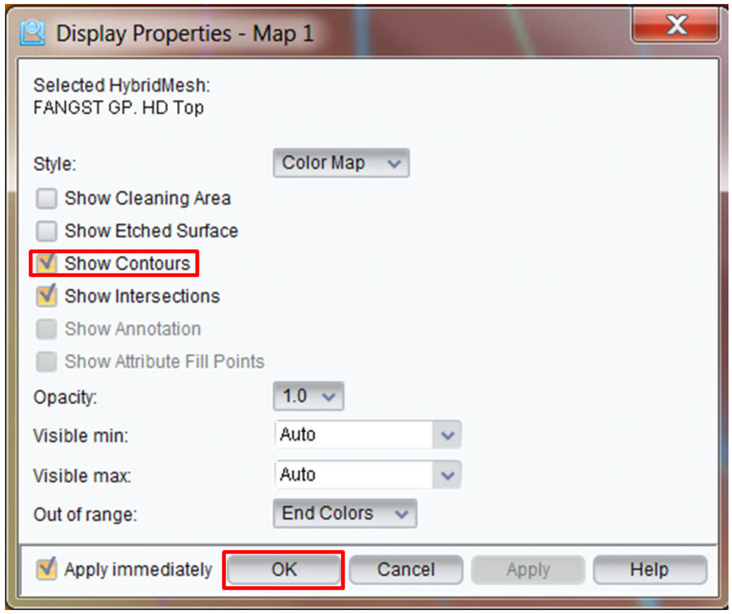
5. In the *Dynamic Frameworks to Fill Workspace*, click the **Fault Offsetting** () icon.

When the framework refreshes, the surfaces will be offset at the fault intersections. Your *Section* view should look similar to the following image.

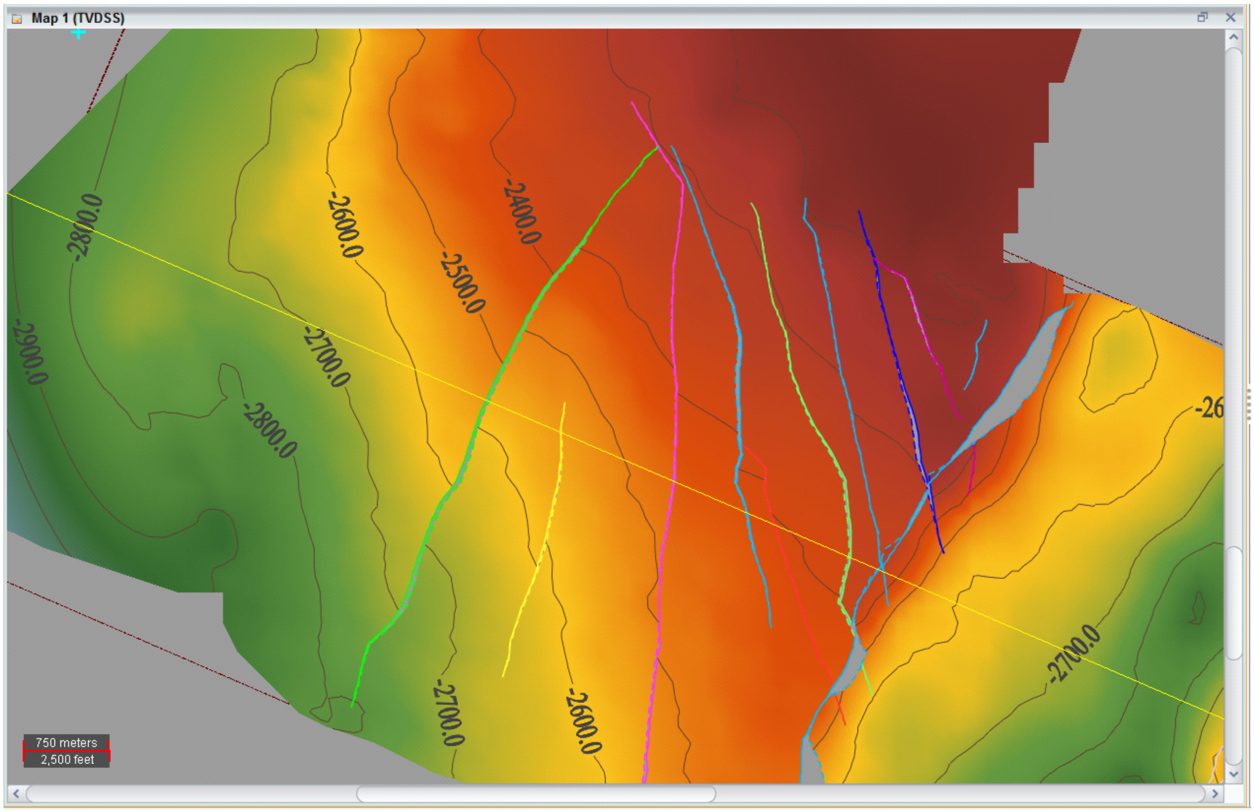


6. Activate *Map* view and toggle on the FW Surface **FANGST GP. HD Top,** and turn off all other objects**.**

7. With your cursor on the surface, **MB3** > **Display Properties**. In the *Display Properties* dialog toggle on **Show Contours,** and then click **OK**.

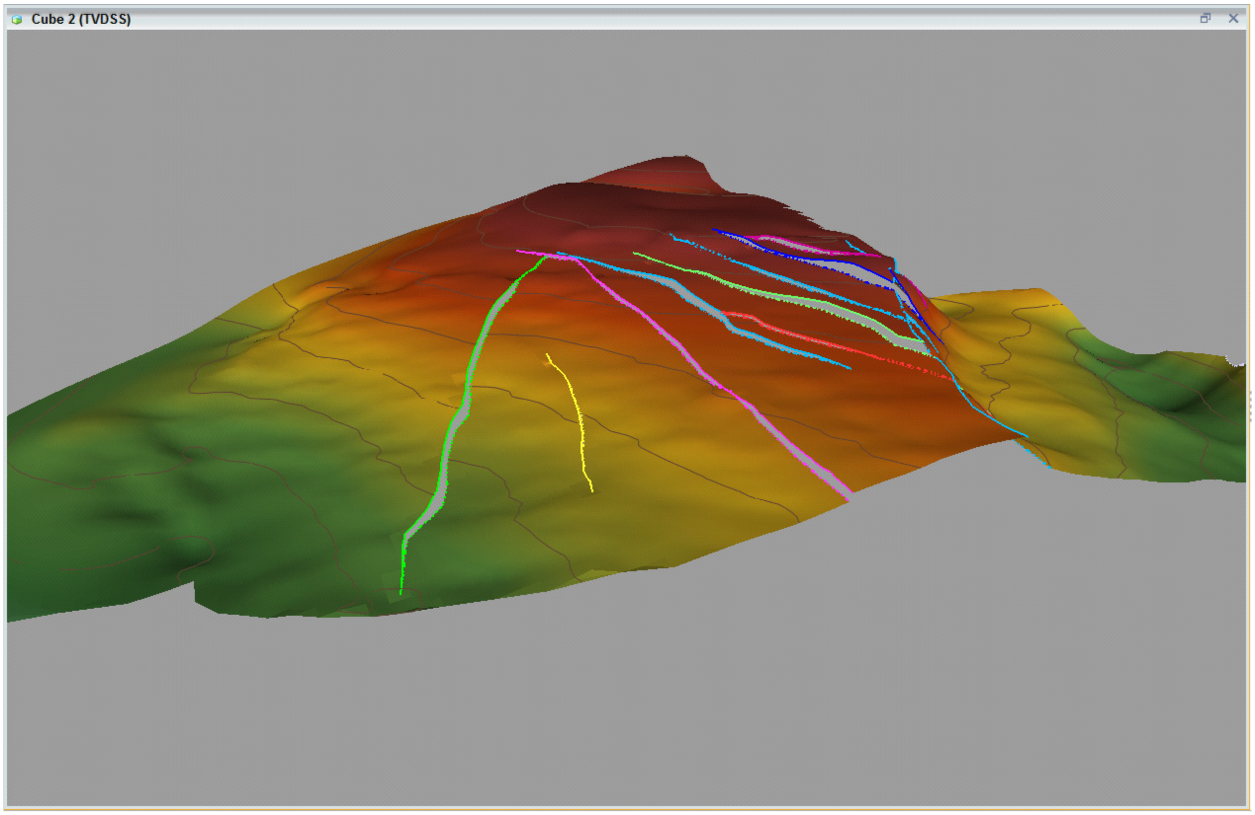


Your *Map* view should look similar to the following image. Notice that activating Fault Offsetting has offset the surfaces in *Section* view and that fault polygons have been automatically generated on the surfaces. Fault polygons will automatically be generated for every framework surface when Fault Offsetting is enabled. These fault polygons will also update when any of the surfaces or faults are altered.

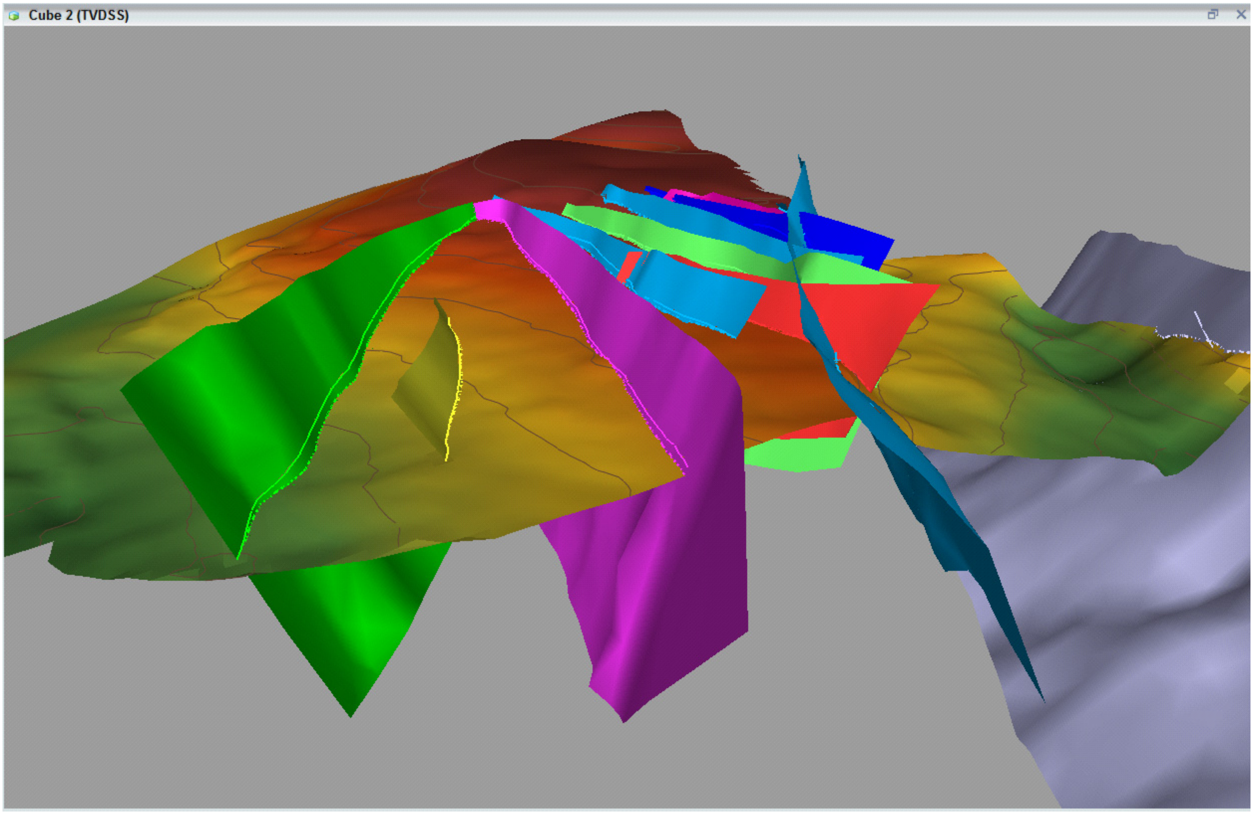


8. Activate *Cube* view, toggle on the **FANGST GP. HD Top** FW surface, as well as the intersections in display properties. In addition, toggle off all other objects in the view.

Your *Cube* view should look similar to the following image. Notice that in *Cube* view the fault polygons and offset are calculated for the surfaces.



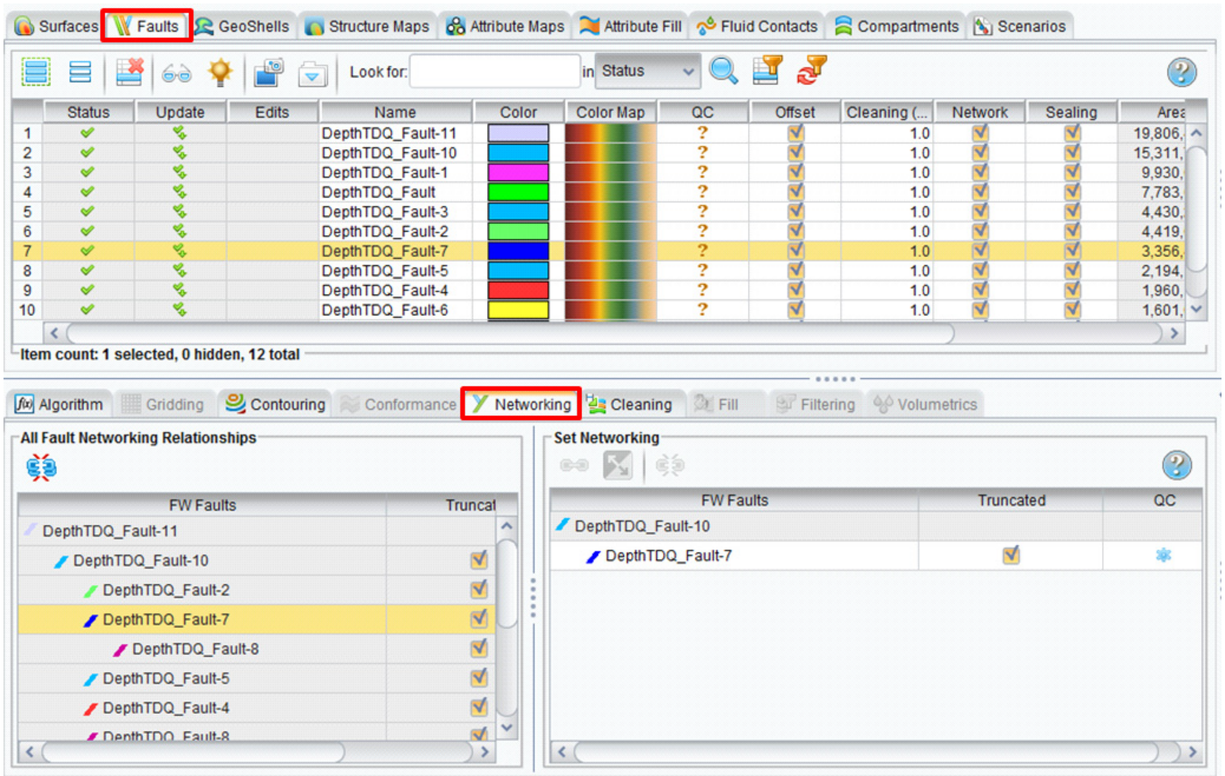
9. In the *Inventory* task pane toggle on all of the **FW Faults** in your *Cube* view.



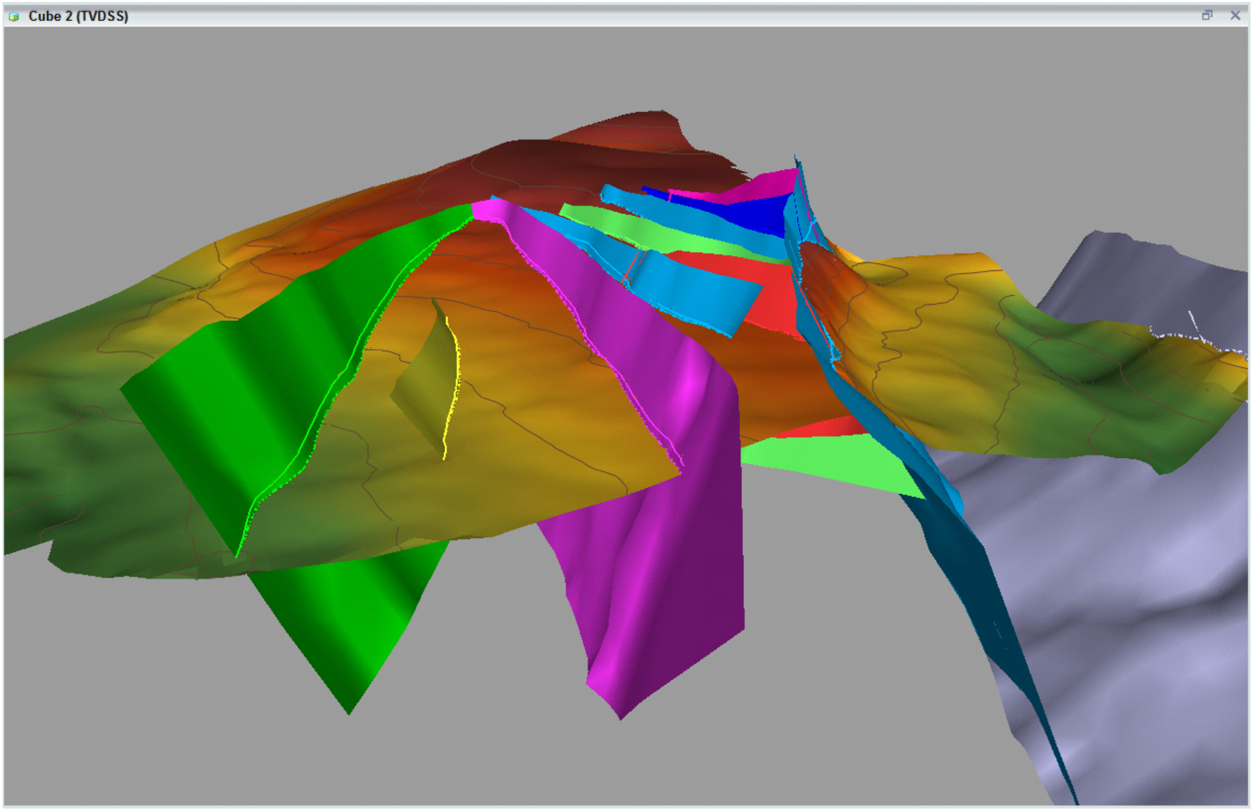
Note that some of the faults are crossing one another in relationships that are not geologically reasonable. You can automatically create a fault hierarchy that will establish parent-child relationships between your faults, within frameworks, and begin to appropriately truncate them.

10. In the *Dynamic Frameworks to Fill Workspace* activate the **AutoNetwork Faults** () icon. This will automatically determine truncating and crossing relationships between the faults within your framework.

11. Navigate to the *Faults* object tab, and the *Networking* actions tab. All of the relationships created will appear in the *All Fault Networking Relationships* panel and the ones specific to highlighted faults will appear in the *Set Networking* panel.


Surfaces
Faults
GeoShells
Structure Maps
Attribute Maps
Attribute Fill
Fluid Contacts
Compartments
Scenarios
Look for:
in Status
Status
Update
Edits
Name
Color
Color Map
QC
Offset
Cleaning (...
Network
Sealing
Area
DepthTDQ_Fault-11
DepthTDQ_Fault-10
DepthTDQ_Fault-1
DepthTDQ_Fault
DepthTDQ_Fault-3
DepthTDQ_Fault-2
DepthTDQ_Fault-7
DepthTDQ_Fault-5
DepthTDQ_Fault-4
DepthTDQ_Fault-6
Item count: 1 selected, 0 hidden, 12 total
Algorithm
Gridding
Contouring
Conformance
Networking
Cleaning
Fill
Filtering
Volumetrics
All Fault Networking Relationships
FW Faults
Truncat
DepthTDQ_Fault-8
Set Networking
Truncated
QC

You are also able to see the change in the fault relationships in your *Cube* view. Your view should look similar to the following image.

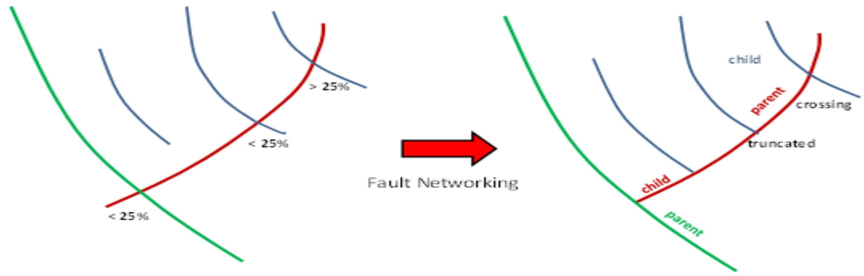


Fault Networking

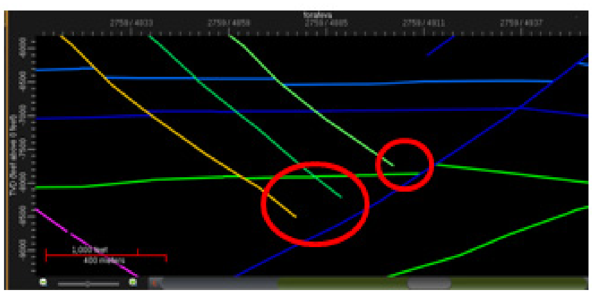
Automated Fault Networking auto-generates parent-child fault network relationships based on fault size. The relationships populate a fault hierarchy that you can review and edit.

The fault hierarchy established by the software is based on area size relationships. At each fault intersection the fault with the larger area is defined as the parent and the fault with the smaller area is defined as the child. The parent fault truncates the child fault unless the area removed by truncation on the child is at least 25% of the area of the child fault. In this case, the fault intersection type is set to Crossing. All parent-child relationships are listed in an inventory tree in the panel, starting with the parent fault first. Child faults are listed under the parent faults.

Different parent-child relationships result from various fault intersection geometries. This is illustrated in the figure below.



Fault networking affects the surface geometries and therefore affects fault displacements. In addition to reviewing the fault relationships, the individual fault displacements have to be carefully examined for geologic consistency.

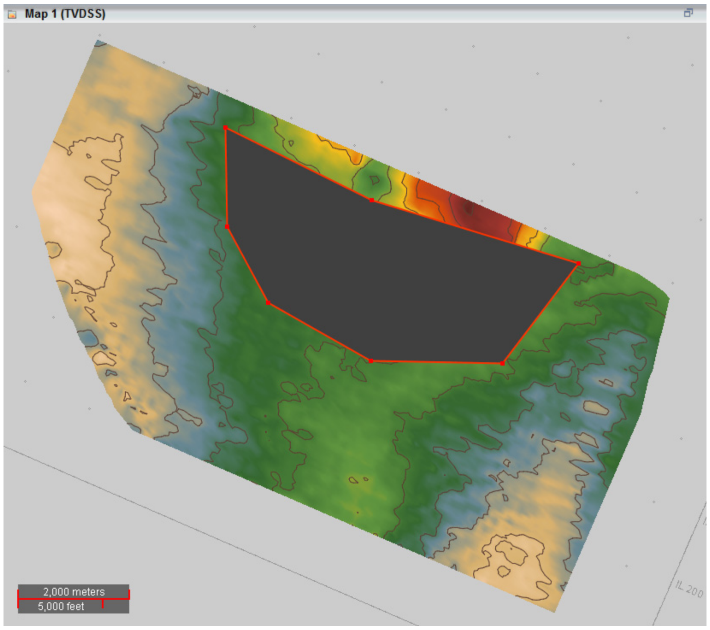


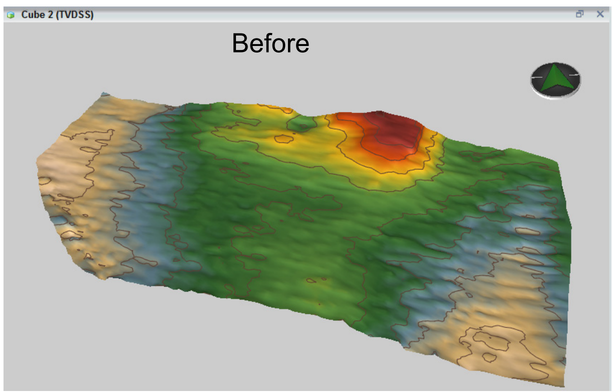
Be aware that faults containing potentially bad or stray data are automatically removed from the network. In such a case the original fault must be edited and Fault Network must be rerun.

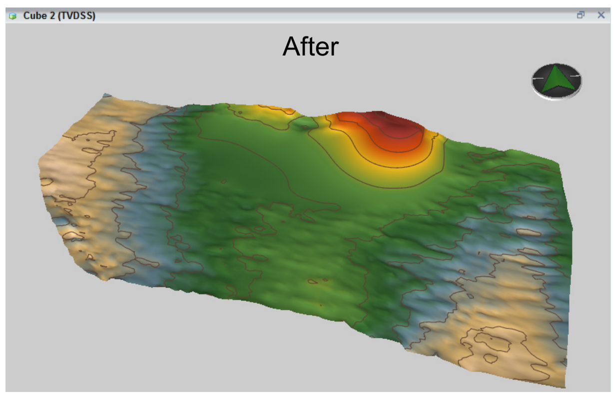
Exercise 4.5: Framework Editing Tools

After you create your preliminary structural framework you may want to fine tune of your model. The *Dynamic Frameworks to Fill Workspace* provides editing tools for this purpose.

The Source Data Suppression Editing Tool enables you to use a polygon as a secondary data source for a surface, to clean (remove) the source data of the surface in that particular area.

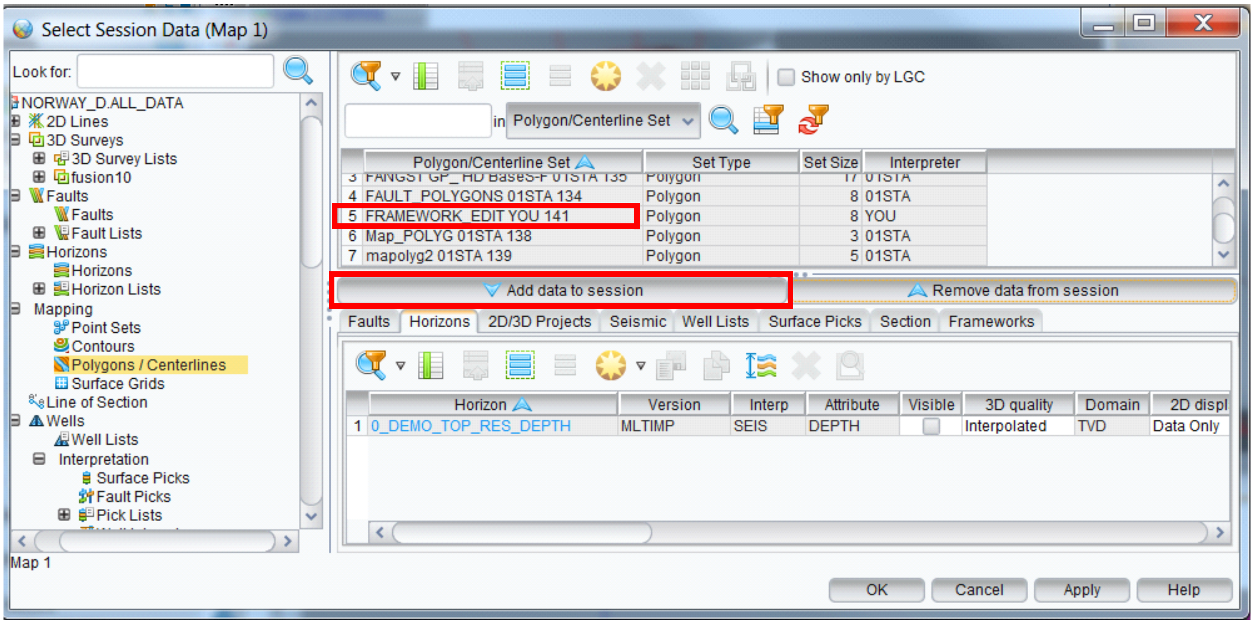




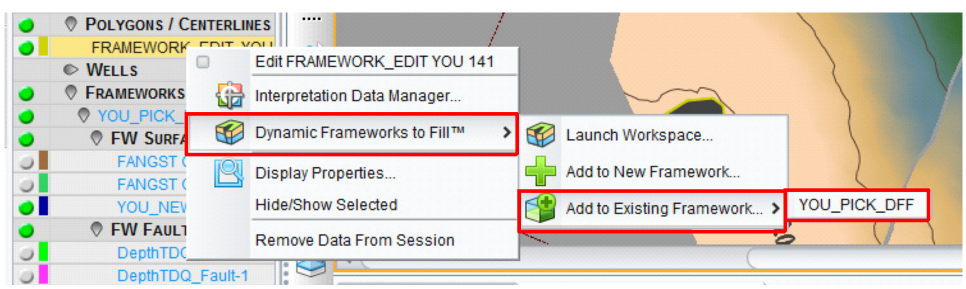


1. On the main menu, click the **Select Session Data** ( ) icon. On the *Select Session Data* dialog, choose **Mapping > Polygons/Centerlines.** In the right upper panel, select

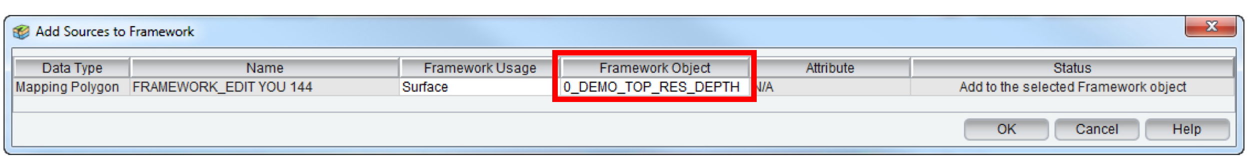
FRAMEWORK EDIT YOU 141. Click the **Add data to session** button, then click **OK.**



2. In *Map* view, toggle on the **YOU_NEW_PICK** framework surface and toggle off all other objects**.** Toggle on **FRAMEWORK_EDIT**. Put your cursor on **FRAMEWORK_EDIT** and **MB3 > Dynamic Frameworks to Fill > Add to Existing Framework > YOU_DFF.**

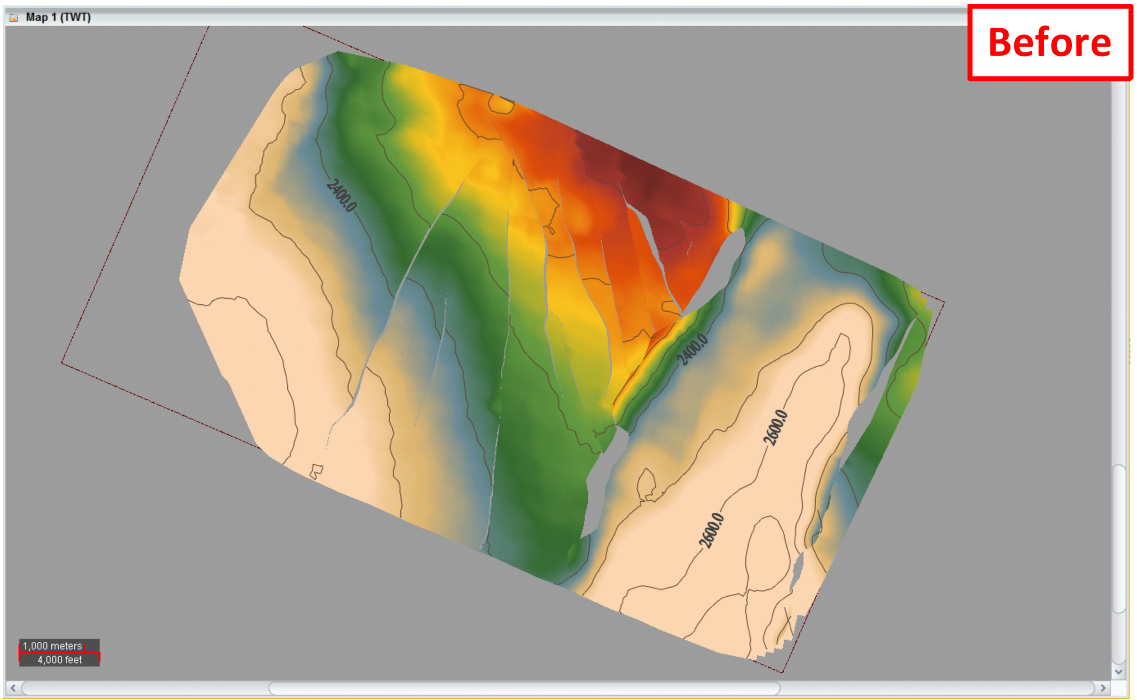


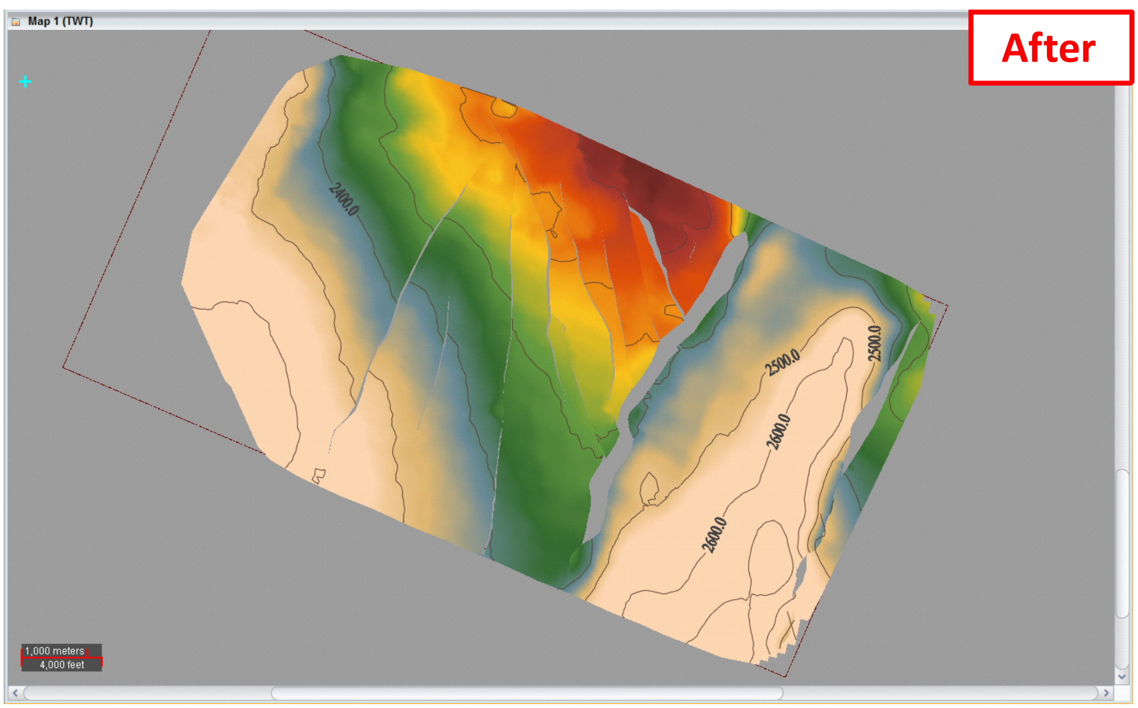
3. In the *Add Sources to Framework* dialog, select **YOU_NEW_PICK** on the Framework Object pull-down menu. Click **OK**.



4. In the *Inventory* task pane of the *Map* view, toggle off **Polygon/ Centerline FRAMEWORK_EDIT**.

5. In the *Frameworks to Fill Workspace*, click **Refresh**. In *Map* view, note the difference that was made by suppressing the source data that fell within the bounds of the polygons. The image on the left is before suppressing the source data that fell within the bounds of the polygon, and the image on the right is after.





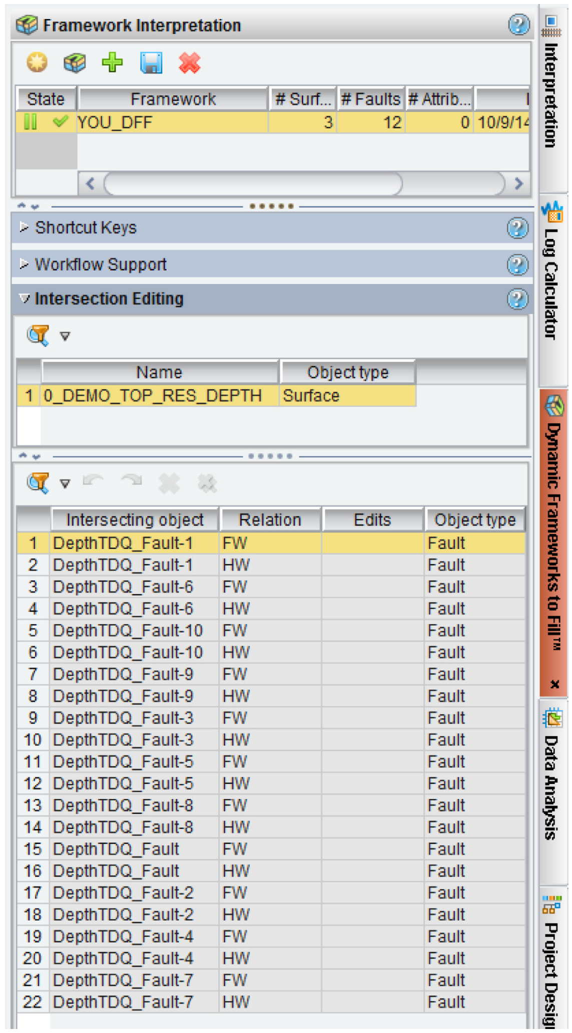
Exercise 4.6: Editing Framework Intersections

Using the Intersection Editing Tool

In some situations you know precisely how the fault is interacting and intersecting with the surface. If suppressing source data is not giving you the results you want, you can manually alter the fault polygons and intersections with the framework surface. The Intersection Editing Tool has the following capabilities and features.

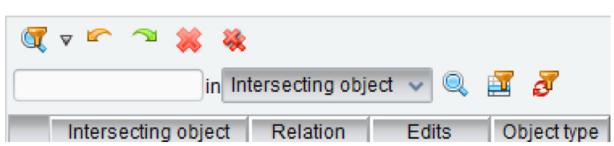
- Provides an organized display of all intersecting Framework objects.
- Has tables showing all committed intersection edits.
- Provides management of all intersection edits through a task pane interface.
- Shows hanging wall and foot wall relationships.
- Provides improvements to the modeling engine to better honor intersection edits.

In *Intersection Editing* panel of the *Dynamic Frameworks to Fill* task pane you will find the Intersecting Objects Table. This table displays the intersecting object name, relation, whether edits have been performed, and object type. The following image shows the available Relation types.



- **HW** — hanging wall (surface fault intersections only)
- **FW** — foot wall (surface-fault intersections only)
- **Onlap** — above unconformity (surface-surface intersections only)
- **Subcrop** — below unconformity (surface-surface intersections only)

Along the top of the Intersecting Objects table the following icons can be found.



- **Advanced search and filter within table** — displays the dialog in which you may search and filter intersecting objects, using multiple column filters at one time.

- **Simple row filter** — provides the simple filter bar to enable you to quickly search and filter the intersecting objects, based on data in the selected column.

- **Undo** — enables you to undo recent add, move, or delete operations.

- **Redo** — enables you to redo recent add, move, or delete operations.

- **Clear selected edit** — removes the intersection edit from the selected intersecting object.

- **Delete all intersection edits in table** — Removes all intersection edits currently shown in the table, according to current filtering.

Entering Interpretation Mode

To perform an intersection edit operation, you must enter Interpretation Mode, Intersection Editing.

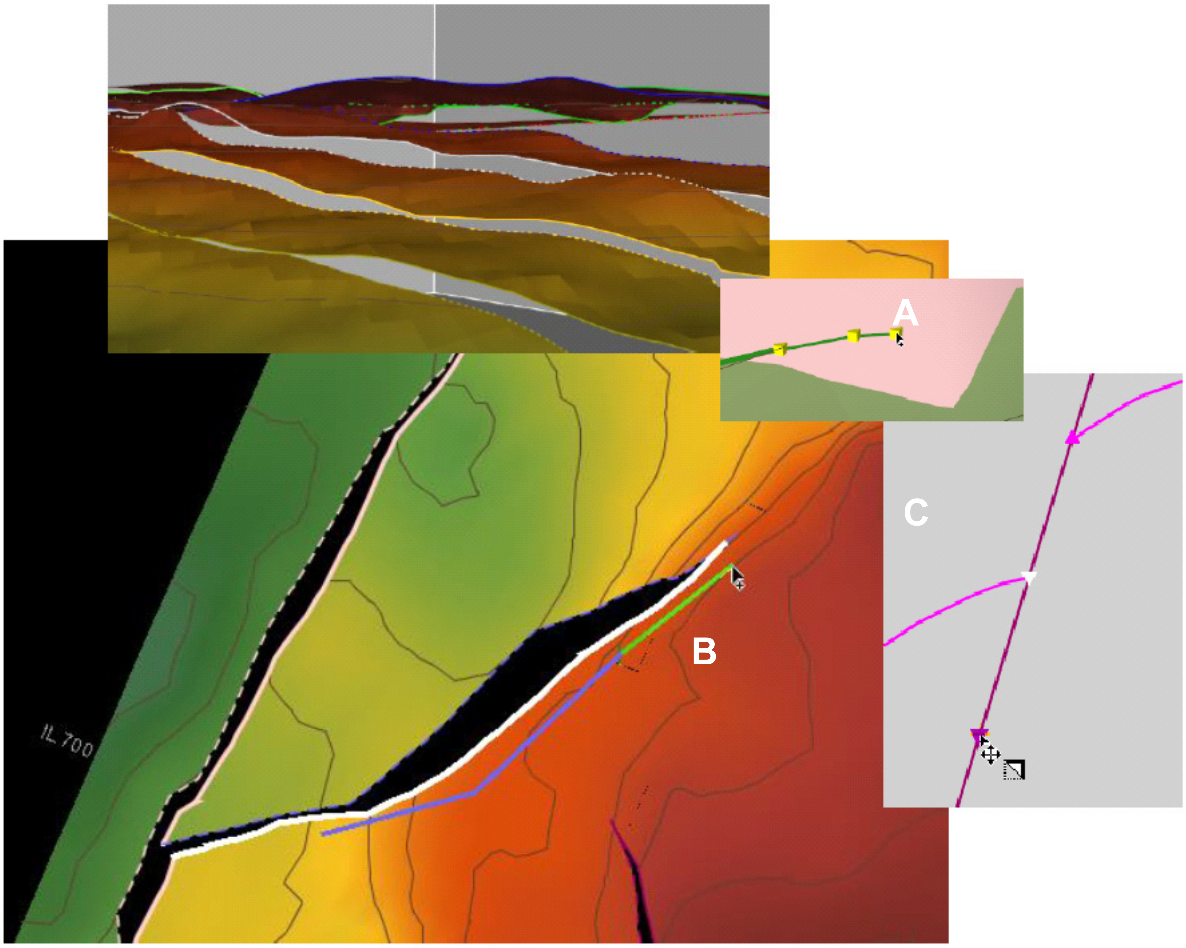
While a Framework object is toggled on in the *Inventory* task pane, click the **Interpretation Mode** icon ( ), or put your cursor over the desired framework intersection until the cursor changes to the Interpretation cursor , then double-click the **framework intersection** of interest. When you enter interpretation mode all intersections for the selected framework are displayed in the active view.

In interpretation mode you may directly select and change an intersection by clicking in the view, or you can select the desired intersection in the *Framework* task pane, *Intersection Editing* table. The currently selected intersection will always be highlighted in the tables and will display white highlight in the view.

Using Cursors

When hovering over surface-fault intersections in the view, the cursor will change to show whether the intersection is a hanging wall ( ) or a foot wall ( ). When hovering over a surface-surface or fault-fault intersection, the cursor will remain generic.

Intersection editing can be performed from *Cube* view, *Section* view, and *Map* view.



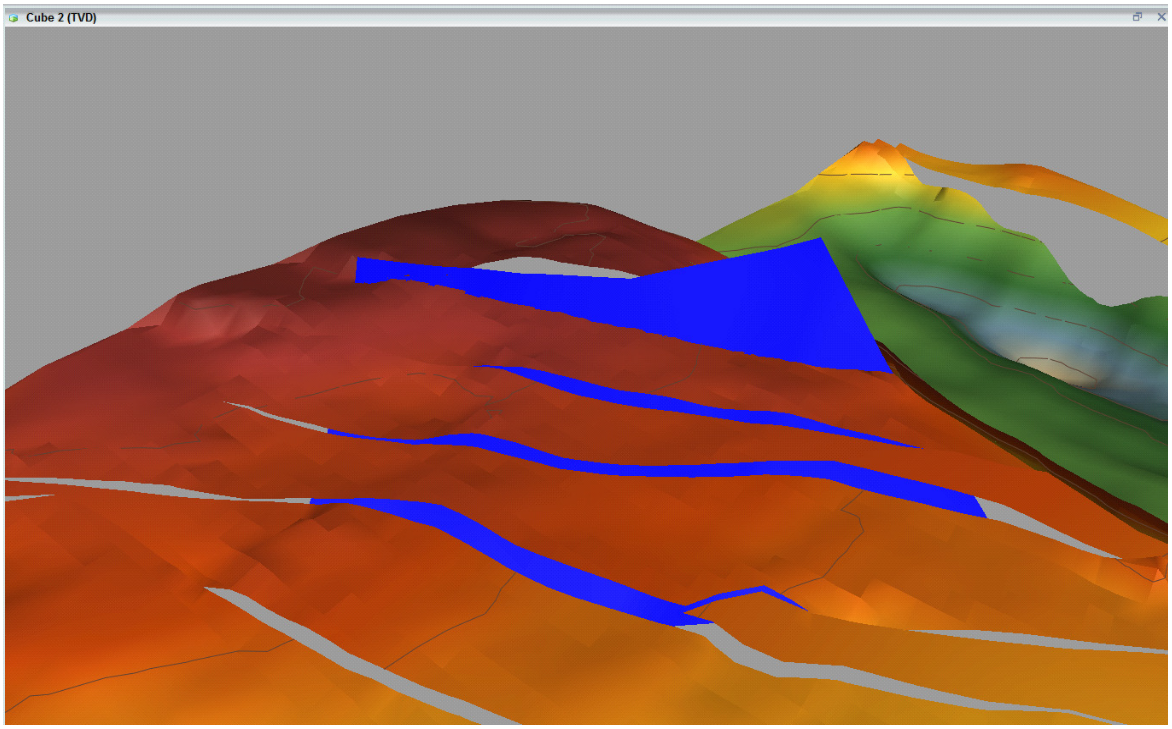
A — image shows intersection editing along the plane of a fault in *Cube* view.

B — image shows Surface-Fault intersection editing in *Map* view, wherein the intersect edit line will respect the z-value of the fault at the specified xy location.

C — image shows editing a Surface-Fault intersection in *Section* view.

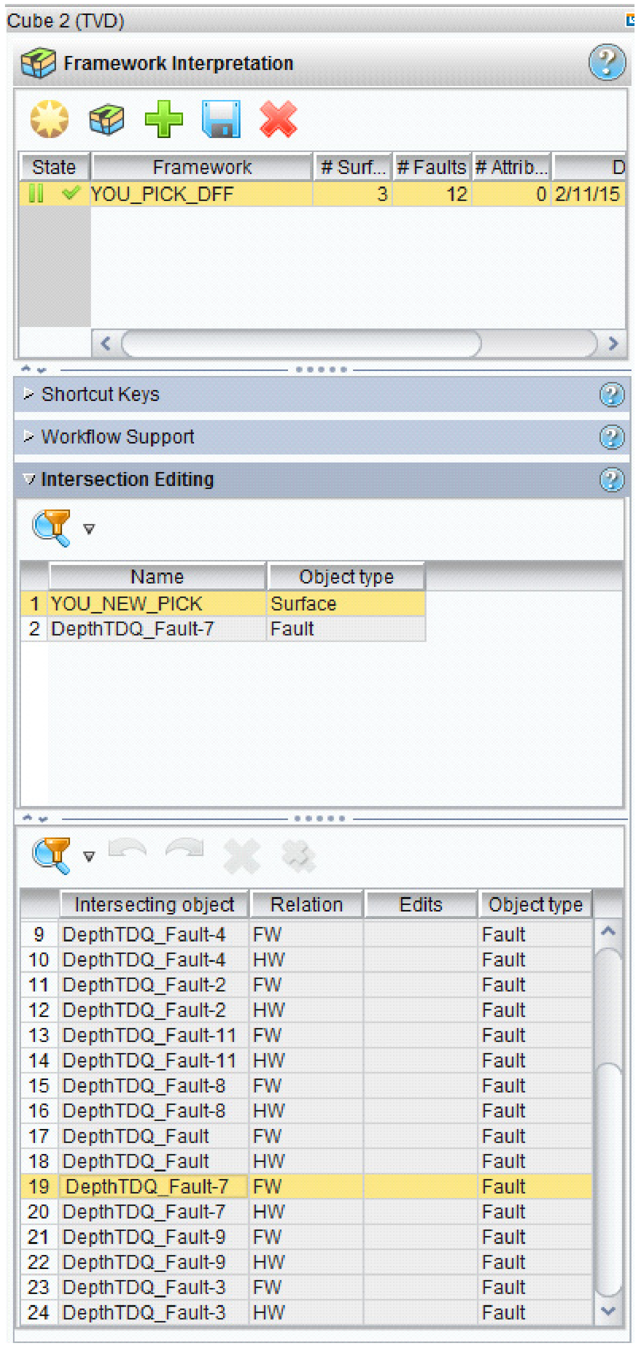
1. Activate the *Cube* view, and in the *Inventory* task pane toggle off all Framework faults except fault **DepthTDQ_Fault-7** and toggle on Framework surface **YOU_NEW_PICK.**

2. Zoom and rotate the **view**, so the DepthTDQ_Fault-7 is viewed from the west/hanging wall.



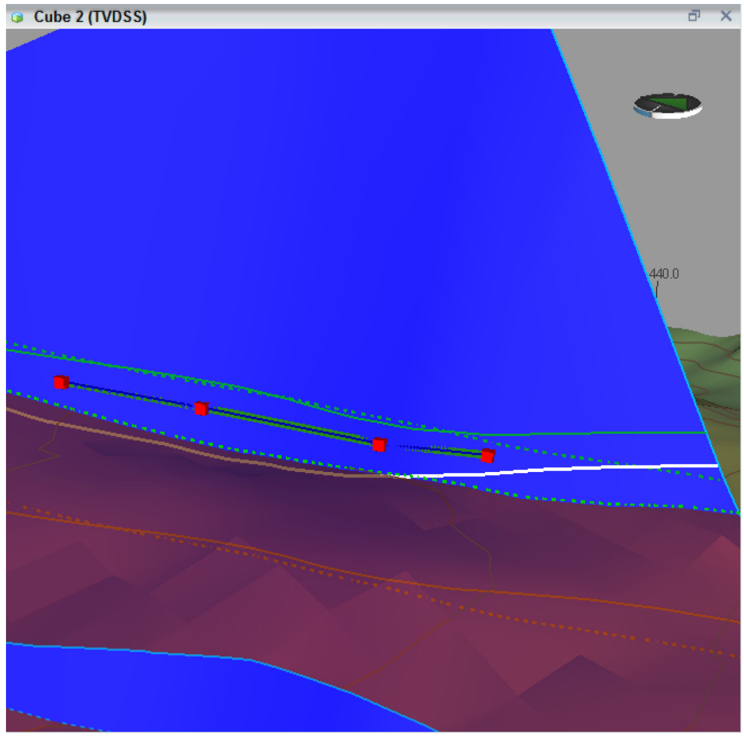
3. In the *Dynamic Frameworks to Fill Workspace,* change your framework mode to **Dynamic, Manual.** Intersection editing is not available in Dynamic, Auto Refresh.

4. On the main toolbar, click the **Interpretation Mode** icon ( ). In the *Intersection Editing* panel of the *Frameworks to Fill* task pane, select the Framework surface **YOU_NEW_PICK** and then on the *Intersection Editing* table, select **DepthTDQ_Fault-7, FW**.

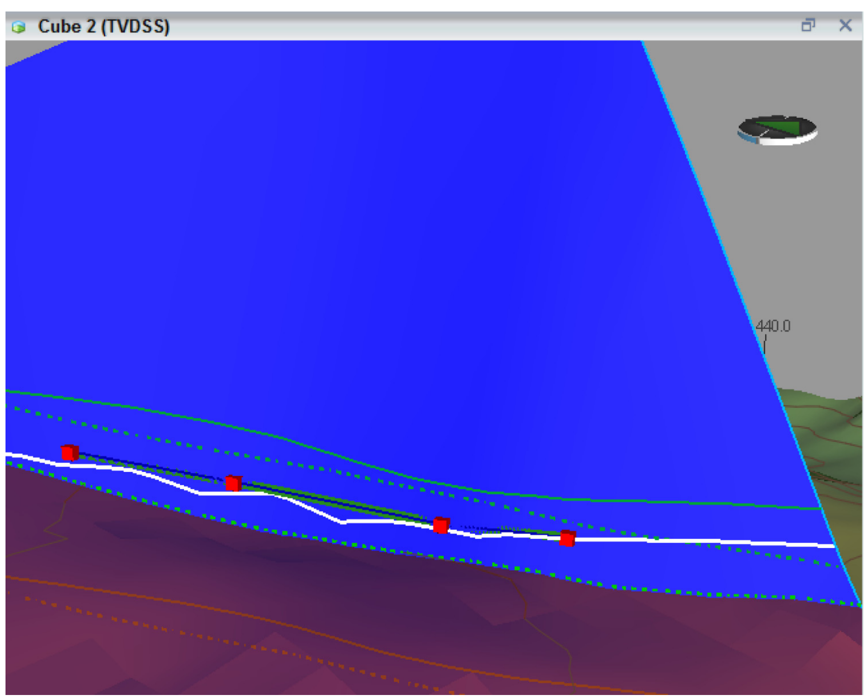


The surface now has some opacity to facilitate intersection editing, and the intersection of the surface and DepthTDQ_Fault-7 displays in white.

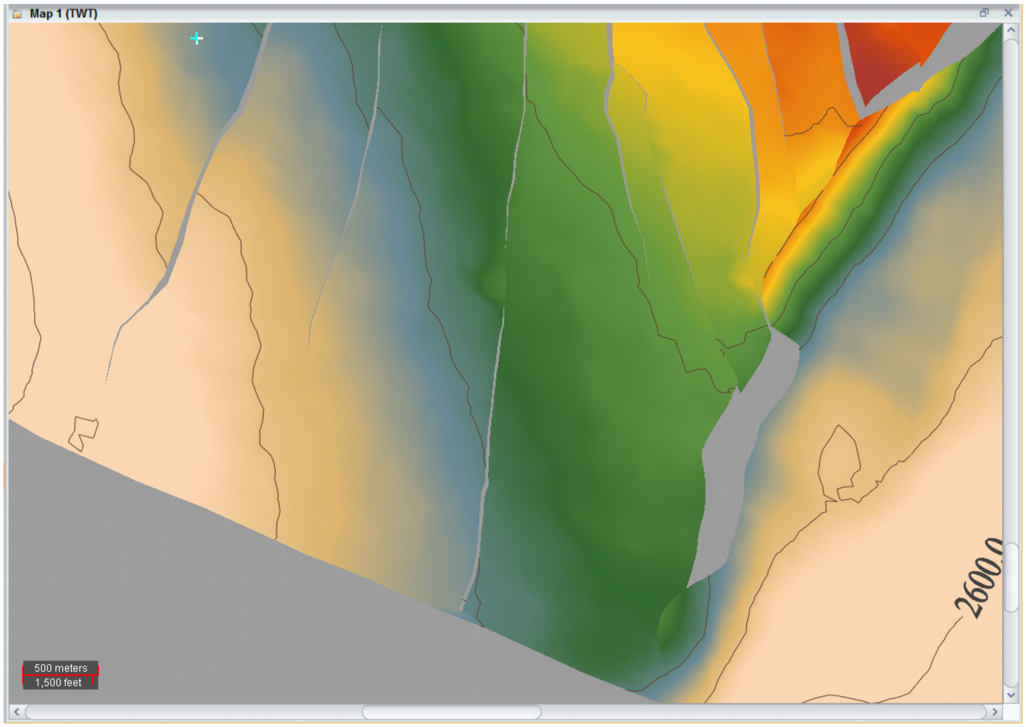
5. Click along the **fault plane** to digitize several points on the southern edge of the fault, to tell the Framework that the intersection of the foot wall of this normal fault needs to remain above the hanging wall.



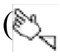
6. In the *Framework Interpretation* task pane, click the **Refresh** ( ) icon. The foot wall now follows your intersection edit points.

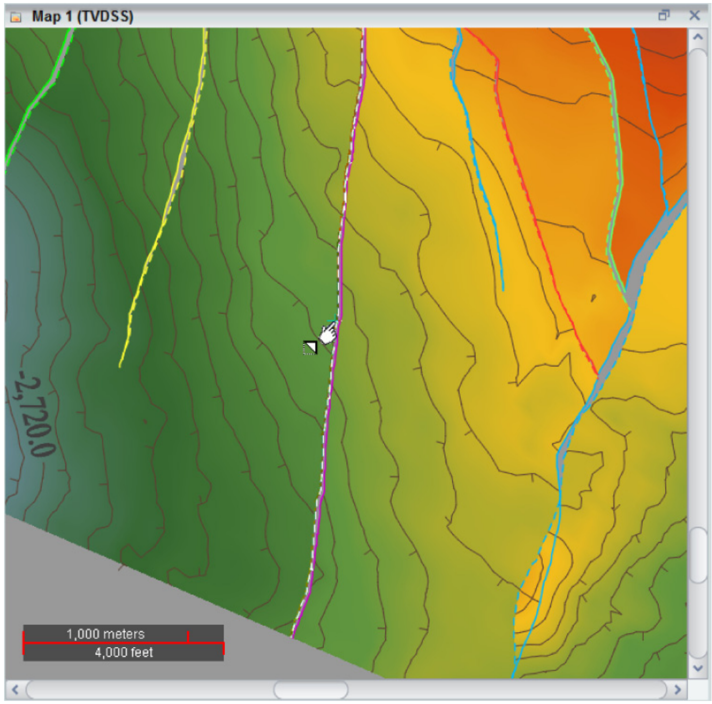


7. In the *Map* view, toggle on **YOU_NEW_PICK,** if it is not already on, and zoom in on the southern part of fault **DepthTDQ_Fault-1**.

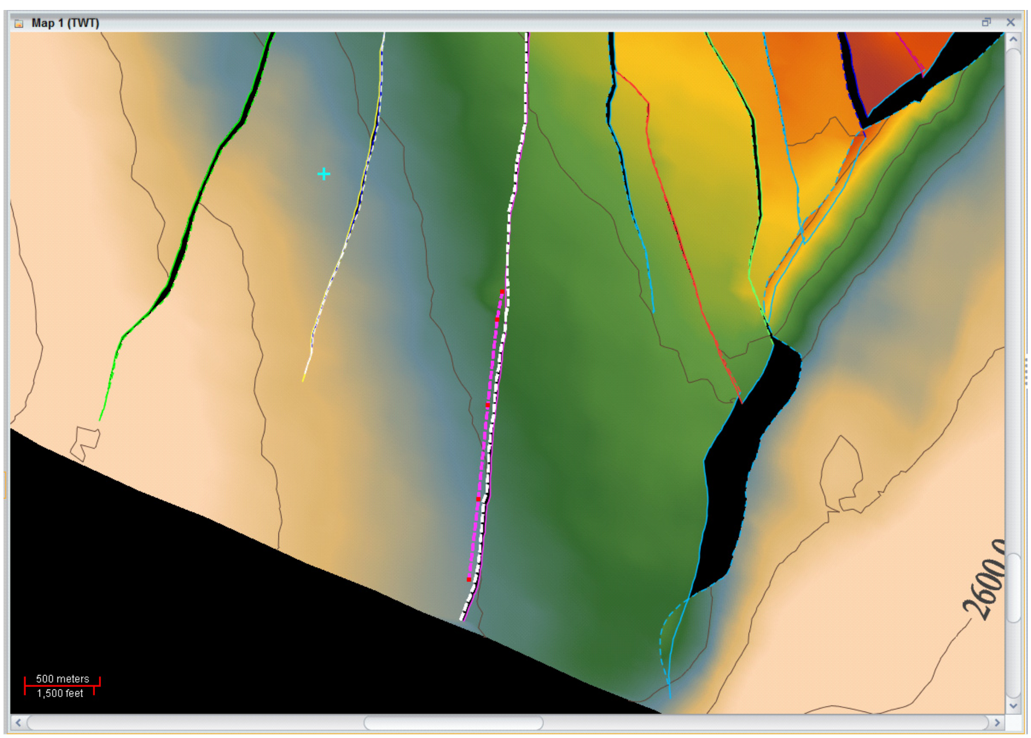


8. Click the **Interpretation Mode** icon ().

9. Put your cursor on the **hanging wall** (western intersect of the fault) until you see the Hanging Wall Selection () icon. Click to select this intersection for editing.



10. **MB1** to digitize several points, to designate the intersection of the hanging wall, and **MB2** when you are finished.



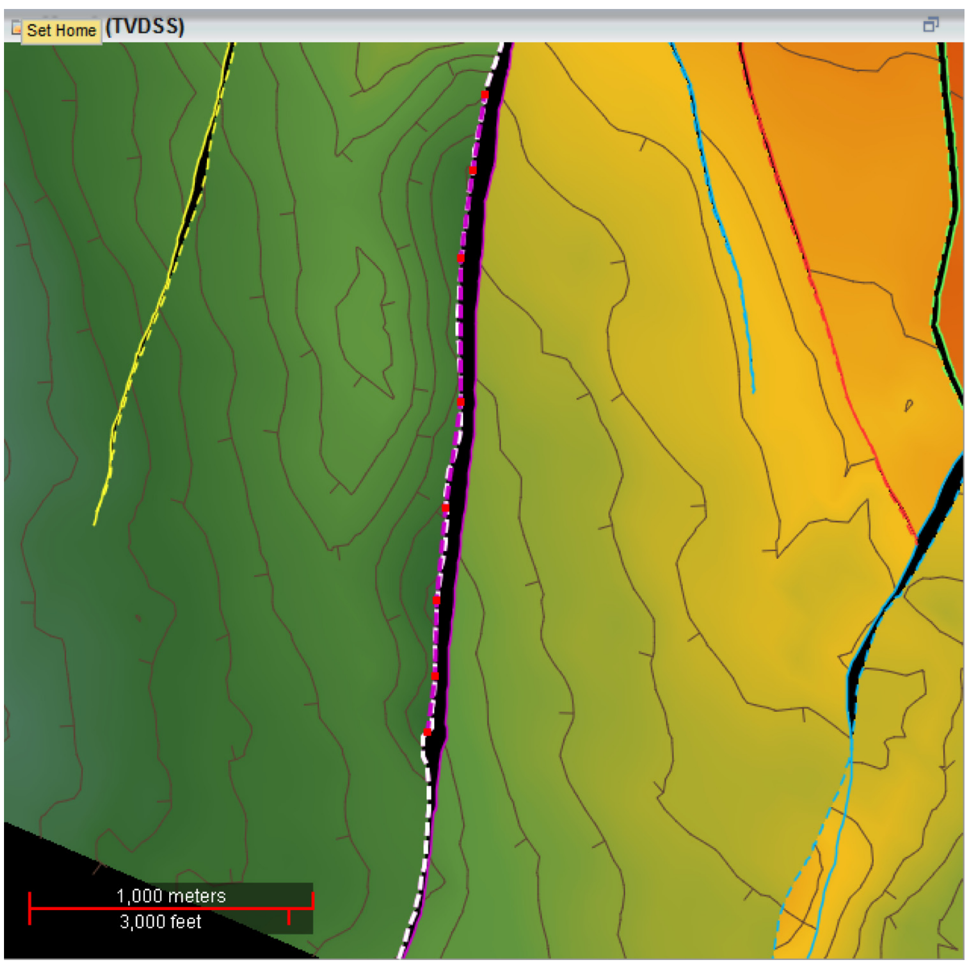
Note:

The z-value of the fault at the digitized xy location will be used to update the intersection. This will give a very small area to work with the steeply dipping faults. If the unavailable icon ( ) appears, your cursor is outside the xy area of the fault for this relationship, and an intersection cannot be made at that point.

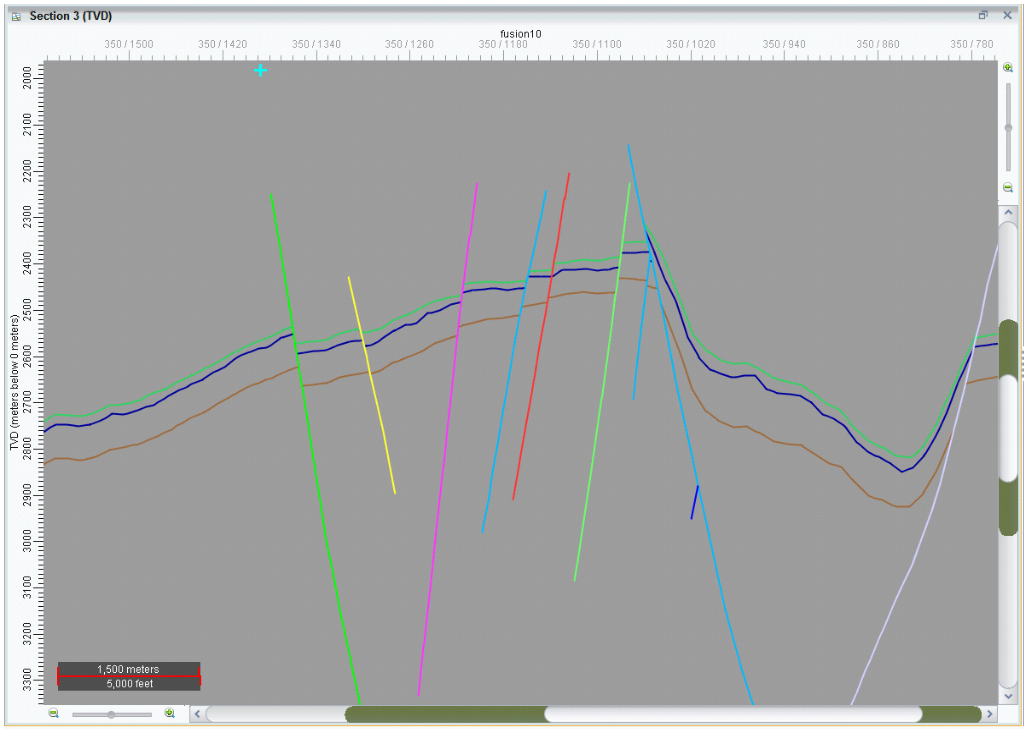
Note:

When editing intersects for faults that follow the strike, use the contour lines of the surface as a guide to get a very smooth intersect.

11. Click the **Refresh** icon in the *Dynamic Frameworks to Fill* task pane. Note that the hanging wall now intersects DepthTDQ_Fault-1 at the intersection points.

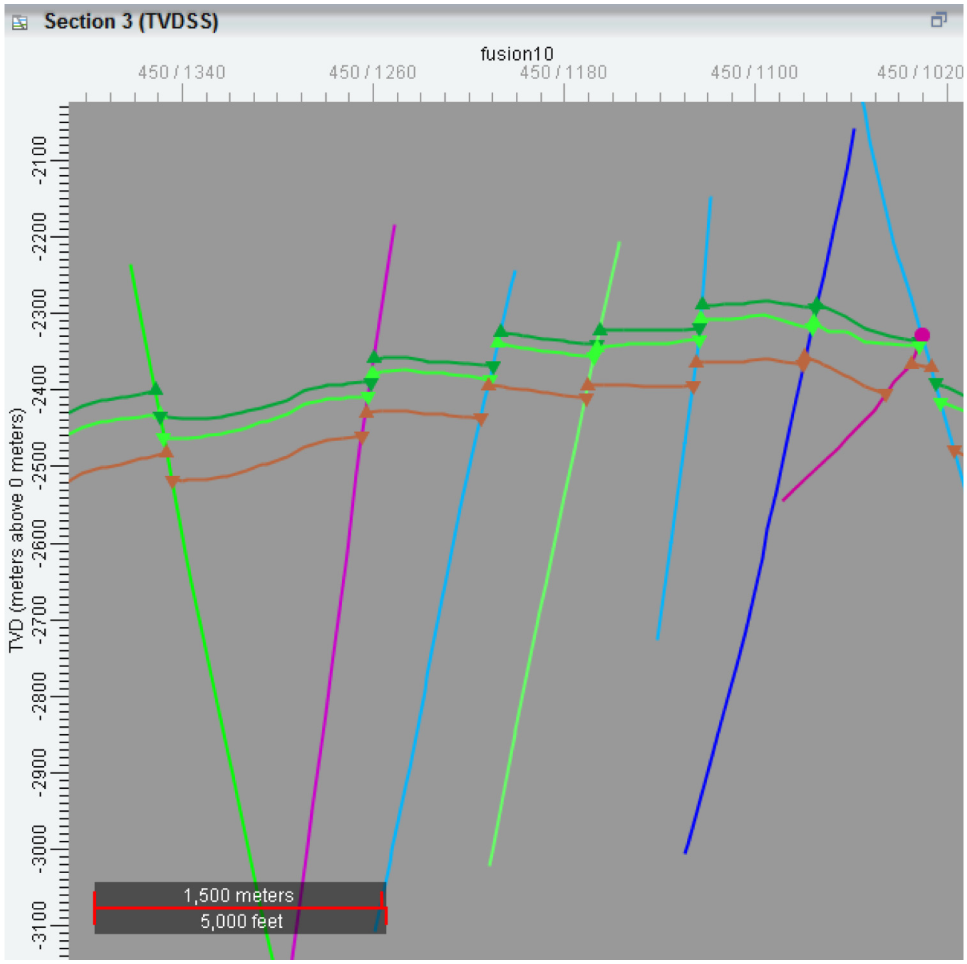


12. In *Section* view make sure that all of the framework **surfaces** and **faults** are toggled on. Toggle off your **seismic** to get a better view of your surfaces.



13. Click the **Interpretation Mode** icon ().

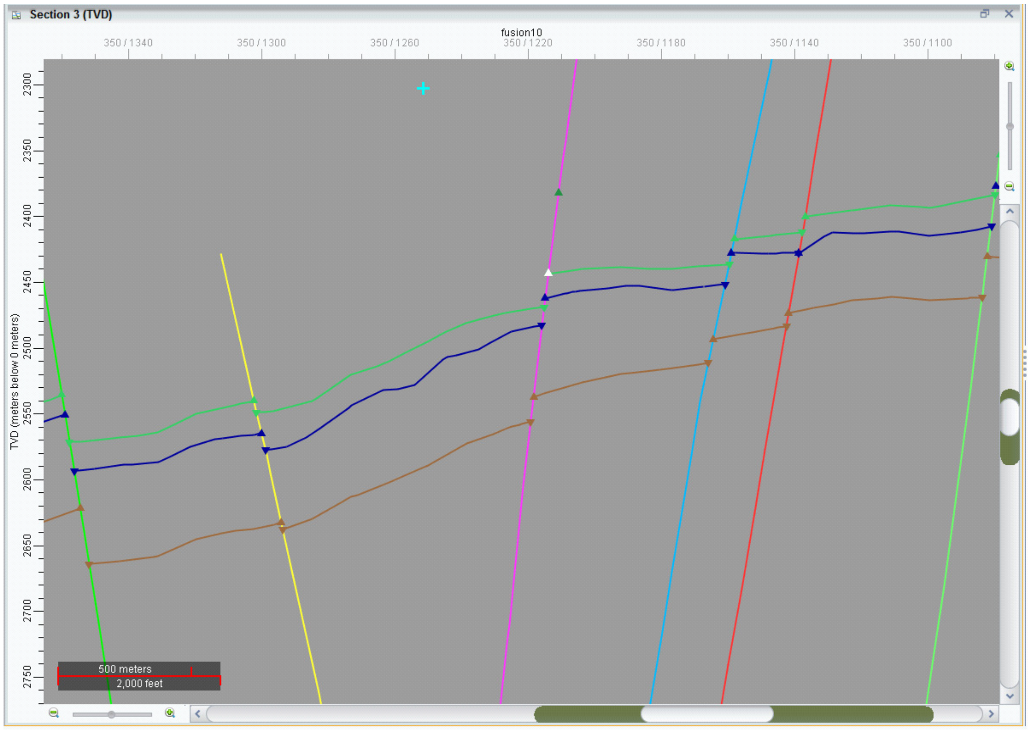
The intersections of the surfaces and faults are displayed as triangles for the hanging walls and foot walls. This visualization will enable you to quickly edit multiple intersections of interest.



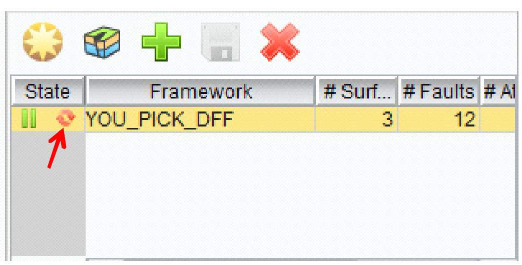
Note:

Surface-Fault intersections are displayed as triangles.
Fault-Fault intersections are displayed as circles.
Surface-Surface intersections are displayed as circles.

14. Click the triangle denoting the intersection of **DepthTDQ_Fault-1** and **FANGST GP.HD Top**, then drag up and release.



Click the **Refresh** button in the *Dynamic Frameworks to Fill* task pane.The surface follows the intersection that you edited.



15. In the *Intersection Editing* table of the *Dynamic Frameworks to Fill* task pane, click the **Delete all intersection edits in table** icon ( ). In the *Confirmation* dialog, click **Yes**. Click the **Refresh** icon ( ). All intersection edits have been removed from the Framework.

16. On the main toolbar of the DecisionSpace main menu, select **File > Save Session,** and then select **File > Exit.** In the *Save Framework* dialog, click **Yes**.

You have built a structural model of your area using Dynamic Frameworks to Fill. In Chapter 5 (see Volume 2 of this manual) you will run some petrophysical calculations and use those calculations to fill your structural model with attributes.