Contents

INTRODUCTION

This document describes the new features and enhancements that make up the T7.2 release and differentiate it from the latest T7.1xx releases. T7.2 is distributed as a full release and cannot be installed over a T7.1xx installation as a patch. For a more detailed description of the new features please refer to the relevant sections in the T7 user-manual. This document and the end-user manual uses the term "T7" when referring to the current release version of the software.

Important Notes:

1) T7 license feature versions are “7.2”. T7.2 will not function with a T7.1 (or ealier) license. Please send T7.2 license requests to support@badleys.co.uk.

2) T7.2 uses FlexNet 11.18.2 for its licensing. The installation will include the 11.18.2 version of the FlexNet license manager daemon.

3) Once installed, T7 will need to run a database upgrade on existing TrapTester projects. **Please backup you projects before using them with T7.2**. Once a project has been upgraded it will not be accessible using T7.1 or earlier.

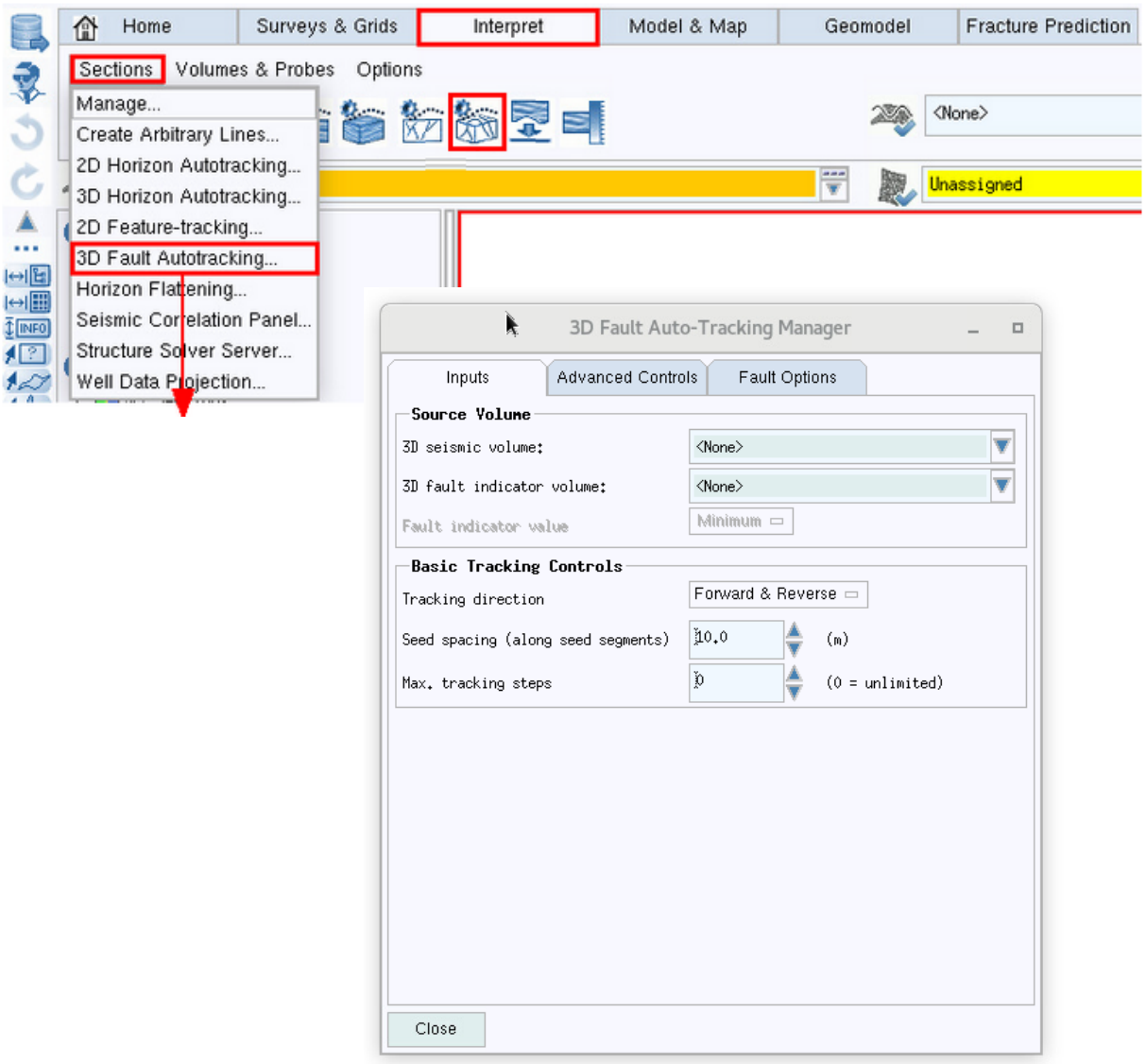
4) After a project has been upgraded, the volume editor default shortcut file (defining hotkeys) will be replaced with a more fully featured set of hotkeys and shortcuts. The original shortcut definition file will be renamed to "default.7.1xx".

MAIN FEATURES

3D Fault Auto-Tracker

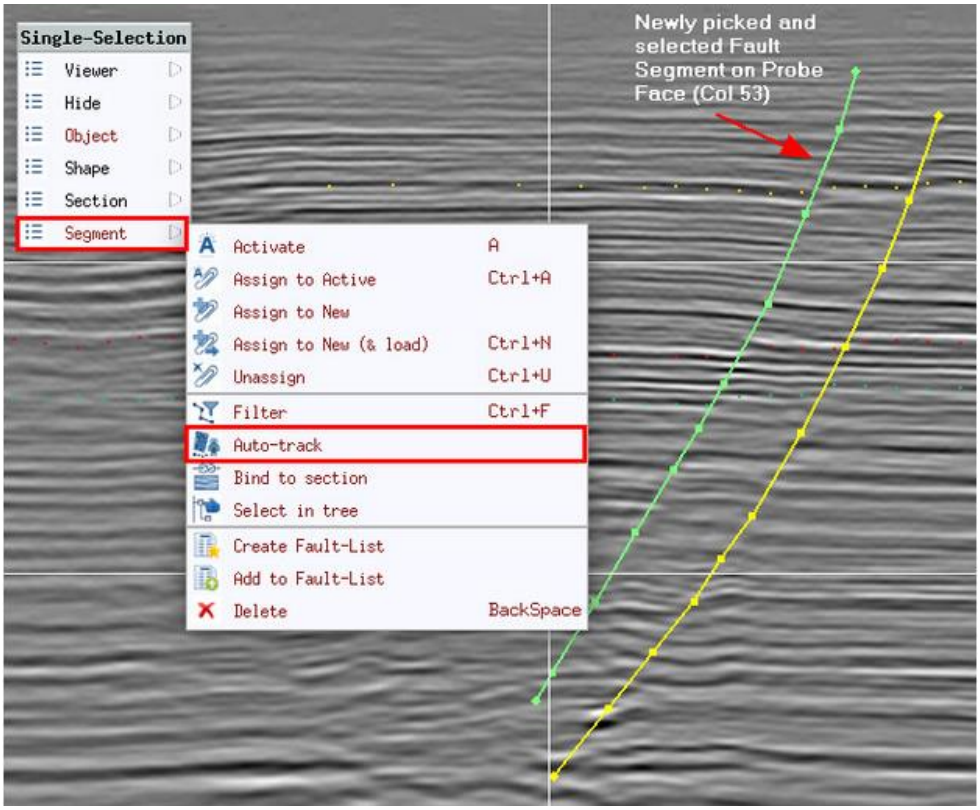
The Volume Editor's new **3D Fault Auto-tracker** takes advantage of in-memory 3D seismic volumes, incorporated in the **Interpret**, **Volumes & Probes** module. The 3D Fault Auto-tracker uses a 2-dimensional cross-correlation technique with optional control from a "fault Indicator" volume, to track a fault signal through a seismic volume starting from a user-defined seed segment (any existing fault segment displayed on a relevant section or probe face). The 3D Fault Auto-tracker breaks the seed segment down into a set of seed points which are individually tracked laterally through the nominated seismic volume. The tracked points are used to form a point-set from which a Fault Surface tri-mesh can be generated. Each seed segment is used to independently track a new fault, though the results of each tracking process may be edited and combined as necessary to create a final fault model.

The 3D Fault Auto-tracker controls are accessed from the Interpret Module menu as shown below.

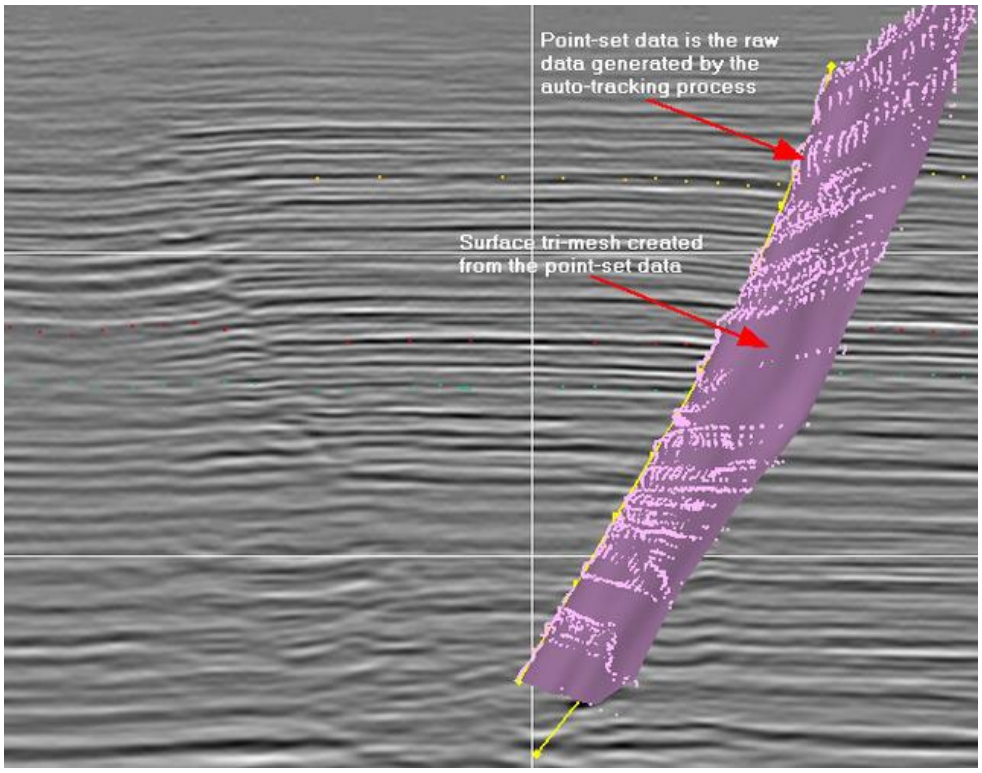


Once the 3D Fault Auto-tacker controls have been set up the auto-tracking process is accessed by selecting one or more fault segments on a relevant seismic section or probe face and using the viewer *<MB3> Pop-up menu: Segment -> Auto-track* option.

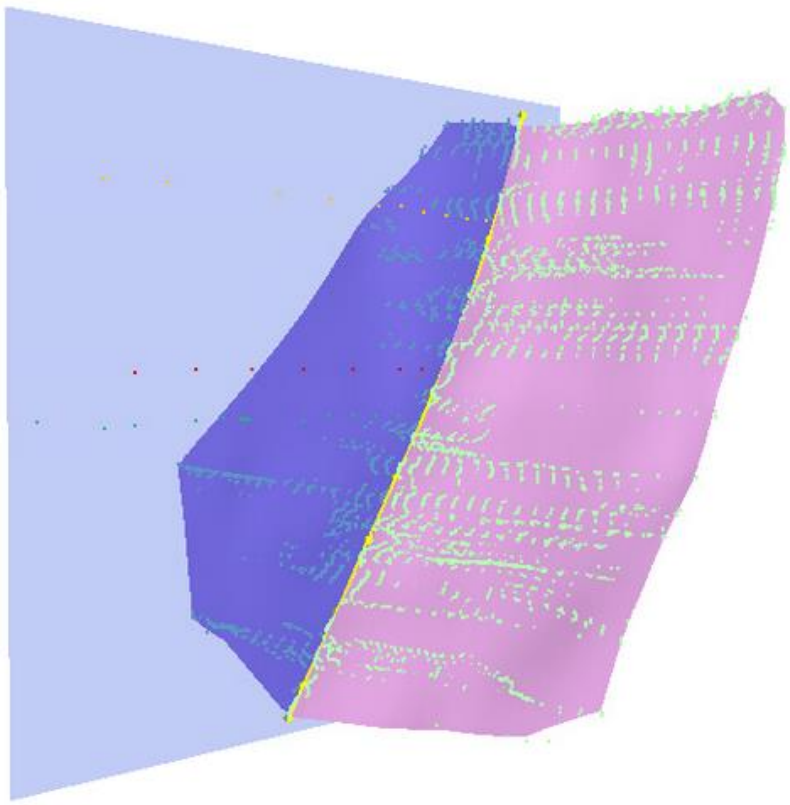
The following example shows the 3D Fault Auto-tracking process applied to a single unassigned fault segment picked on a seismic probe face.



The pictures below shows the results of the tracking process in the same view as above.



The following image shows the results from a different orientation. The probe face, on which the “seed” segment was picked, is shown as a clipped transparent blue section.



Auto-Throw Extraction

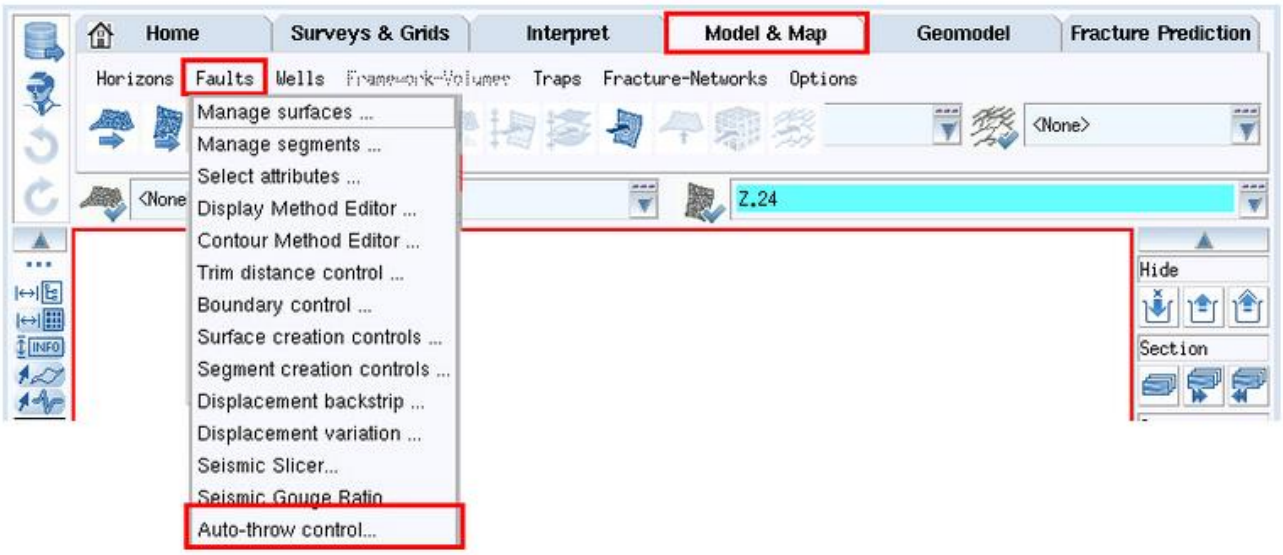
The Fault Surface Auto-Throw tracking system implemented in T7 is based on the long-window cross-correlation of seismic amplitude data on each side of the fault. The process can be broken down into the following four main steps:

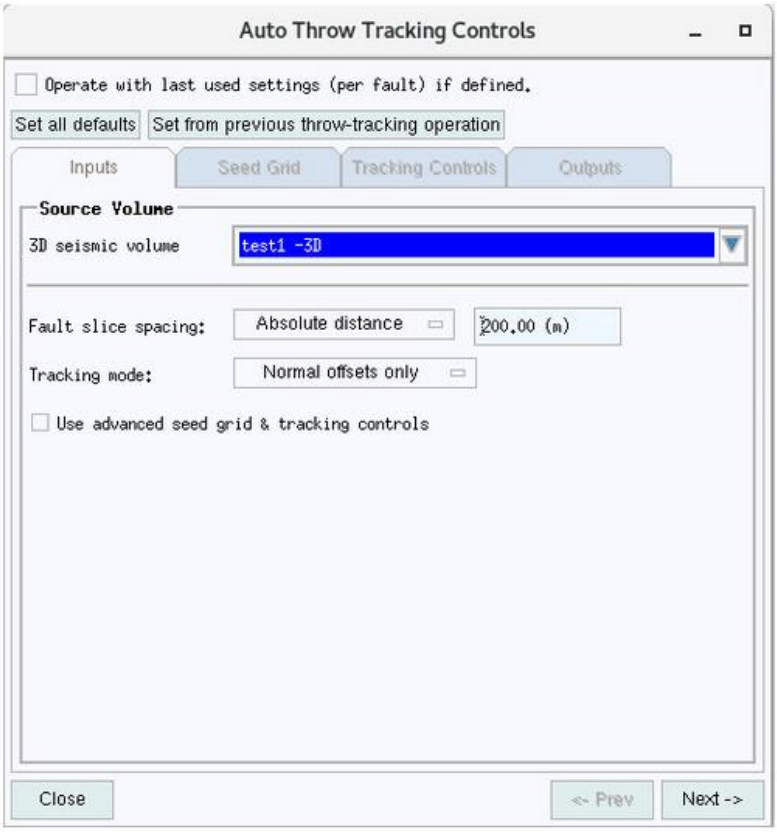
- Obtain seismic data as correspondent grids in the hanging wall and footwall of the fault.
- Define a starting seed grid by cross-correlation of hanging wall/footwall seismic at discrete locations on the grids.
- Apply filtering to the seed points to remove extrema/spurious data
- Auto-track the seed-point displacements to in-fill the remainder of the grid-space.

The Auto-Throw Tracking process is capable of generating the following fault surface attributes which can be displayed on the Fault Surface using a corresponding Display Method.

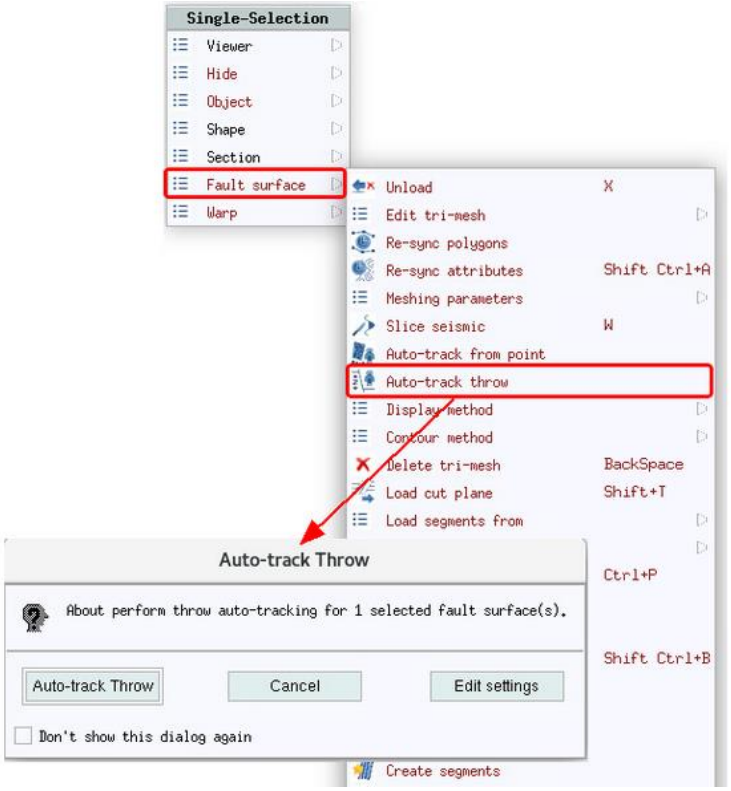
- **Auto-tracked throw**: the offset between hanging wall and footwall required to achieve the best correlation.
- **Auto-tracked strain**: the "stretching factor" between footwall & hanging wall required to achieve the best correlation.
- **Auto-tracked CC**: the best cross-correlation value.
- **Auto-tracked confidence**: the confidence value (a function of the Auto-tracked CC and Auto-tracked sequence).
- **Auto-tracked sequence**: the auto-tracking sequence number from a given seed point.
- **Seismic slice #1: F-wall**: the footwall seismic data can be stored in this attribute if required.
- **Seismic slice #1: H-wall**: the hanging wall seismic data can be stored in this attribute if required.

The Auto-Throw Tracking Controls are accessed from the Model & Map menu as shown below.



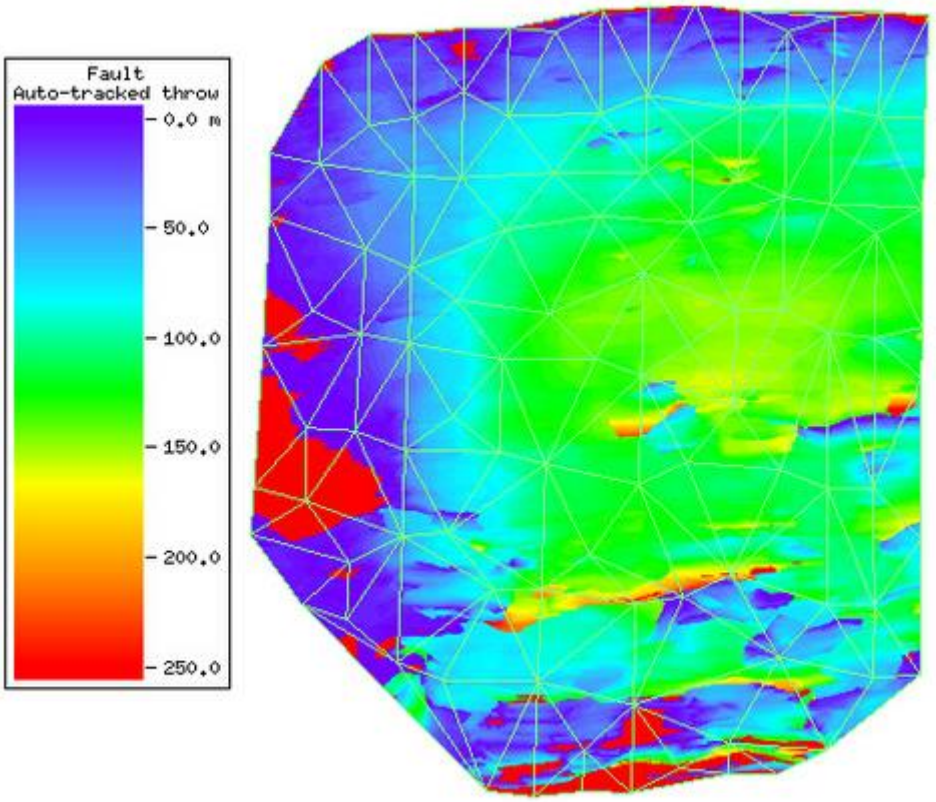


Auto-Throw Tracking can be performed directly on all the Fault Surfaces currently loaded, or on the set of Fault Surfaces selected in the Active Viewer using the *Apply* button from the Auto-Throw Controls window *Outputs* tab. Alternatively, the same process can be initiated by selecting one or more Fault Surfaces in a 3D Viewer and using the MB3-Popup Menu option *Fault surface -> Auto-track throw*. This option will popup a window from which the action can be confirmed, cancelled or access gained to the Auto-Throw Control settings.



The results of the Auto-Throw Tracking are stored in a number of different Fault Surface attributes. The attributes generated are controlled by the settings in the *Outputs* tab in the Auto-Throw Controls window and can be displayed on a Fault Surface by setting the appropriate Display Method.

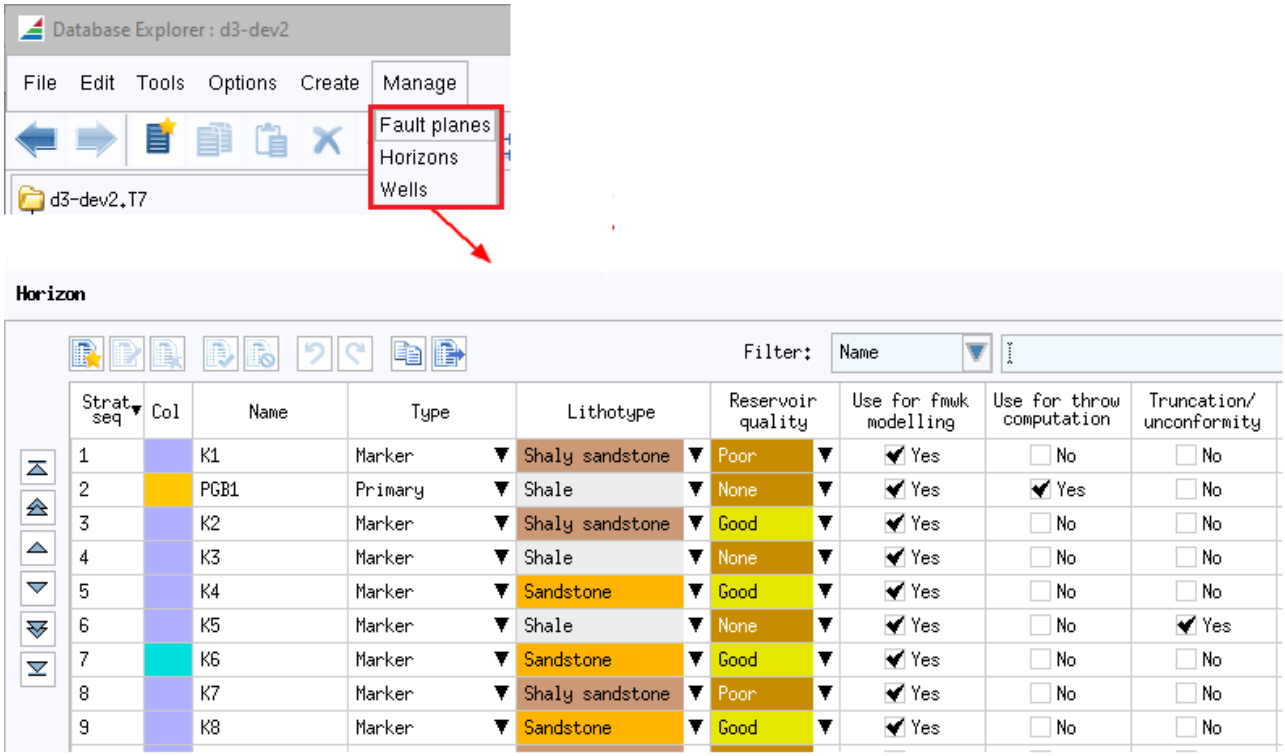
The following example is from the d3 demo dataset using the "FaultED-F1" fault and the "test1" seismic volume.



In this example it is clear to see that the general trend of the displacement pattern has been picked out reasonably well by the Auto-Throw Tracking system. However, there are areas on the fault where the results are caused by the process terminating (left-hand red patches - NULL data) and where the tracking or seed points have not been able to follow the "correct" displacement signal (anomalous patches in the central, right-central and lower-central areas).

Table-Based Object Managers for Faults, Horizons, Wells

Object managers in Database Explorer provide a convenient method of viewing and editing multiple object properties from a single table-based interface.



Strat seq	Col	Name	Type	Lithotype	Reservoir quality	Use for fmwk modelling	Use for throw computation	Truncation/ unconformity
1		K1	Marker	Shaly sandstone	Poor	Yes	No	No
2		PGB1	Primary	Shale	None	Yes	Yes	No
3		K2	Marker	Shaly sandstone	Good	Yes	No	No
4		K3	Marker	Shale	None	Yes	No	No
5		K4	Marker	Sandstone	Good	Yes	No	No
6		K5	Marker	Shale	None	Yes	No	Yes
7		K6	Marker	Sandstone	Good	Yes	No	No
8		K7	Marker	Shaly sandstone	Poor	Yes	No	No
9		K8	Marker	Sandstone	Good	Yes	No	No

The object managers provide the following functionality:

- Changes are made immediately with no Apply required
- Changes to an object property can be performed across multiple objects with a single operation
- Undo and redo for most operations
- Create and delete objects
- Activate/deactivate multiple objects in a single operation
- Copy table contents to system clipboard or export to text file.
- Change column visibility, width and order
- Sort the table by any column
- Filter the table rows by object name or object list.
- For the horizon object manager, modify the stratigraphic sequence of the horizons.
- Detachable as a separate dialog.

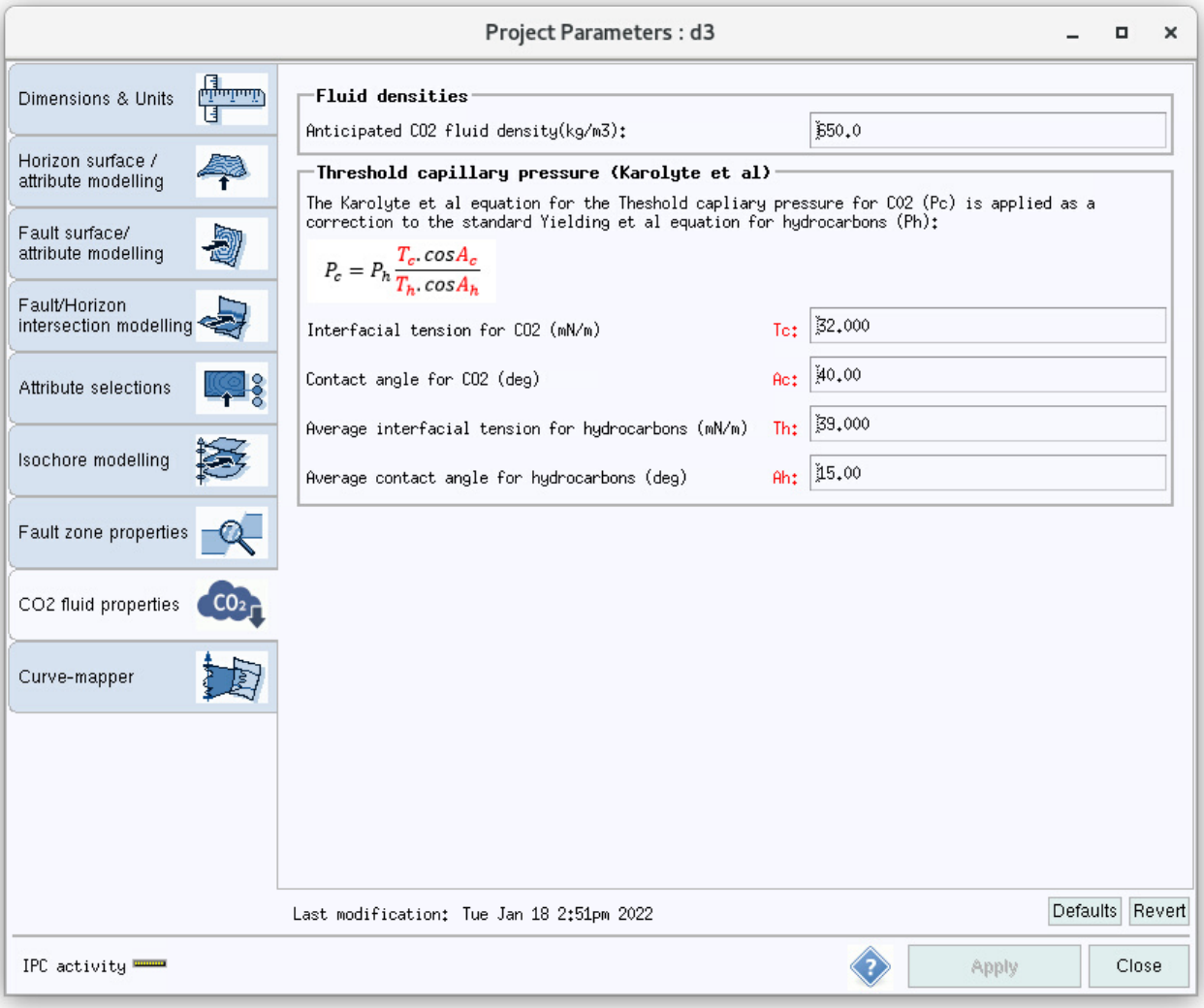
CO_2 Storage Support

T7.2 introduces support for CO_2-based property calculations for fault surfaces. In particular the following fault surface attributes can now be calculated as part of the T7Seal module:

- CO_2 Threshold capillary Pressure
- CO_2 Column Height
- CO_2 Contact Depth

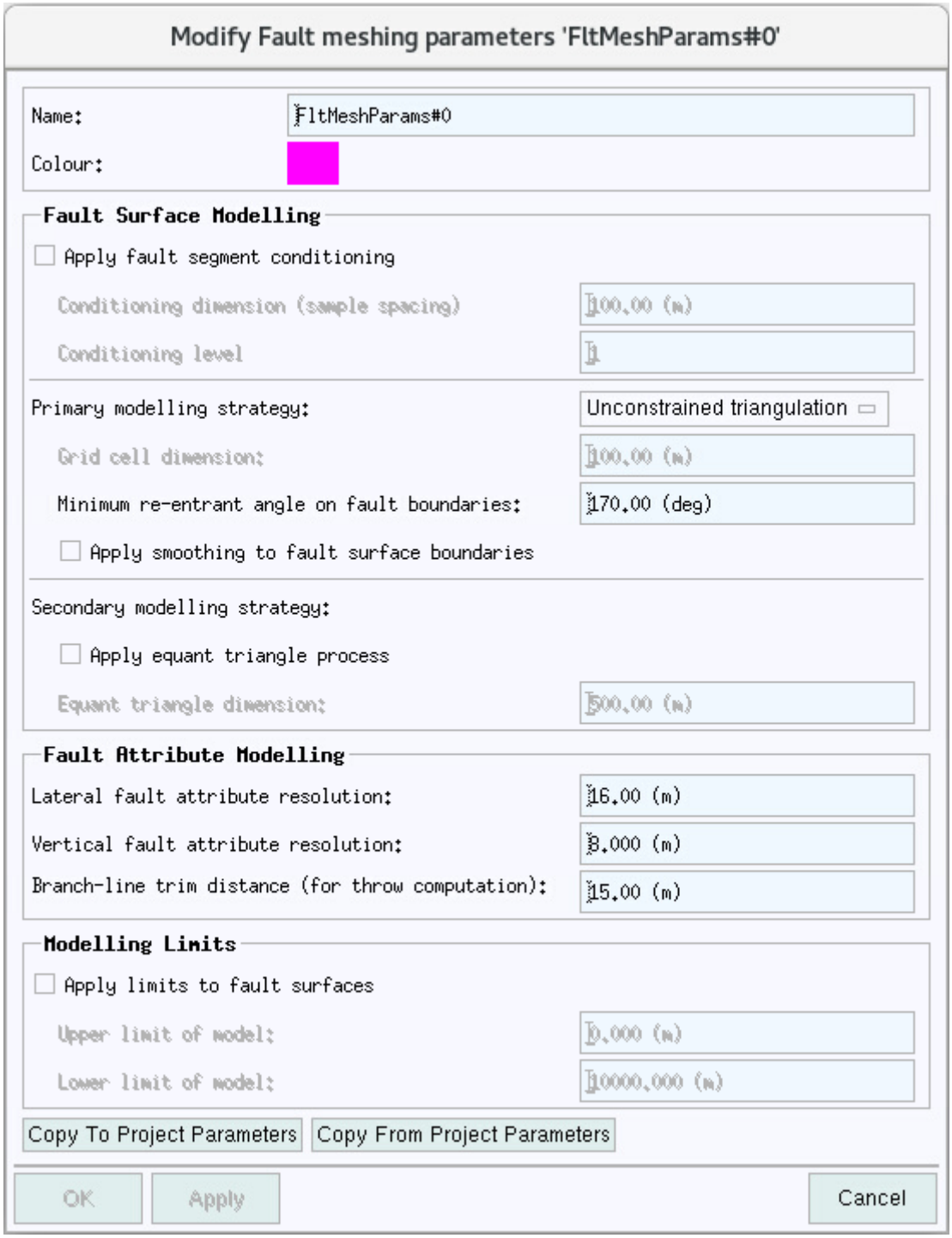
These attributes form part of the Carbon Capture and Storage (CSS) support in T7 and can help assess the suitability of a faulted structure for CO_2 storage. These attributes are based on the theory described in the 2020 Karolyte et al paper "**Fault seal modelling – the influence of fluid properties on fault sealing capacity in hydrocarbon and CO_2 systems**". The above attributes can be used in the T7 TrapAnalyst tool to detect the point on a fault surface that supports the shallowest $C0_2$/water contact relative to the spill point.

The parameters that control the CO_2 attribute calculations are found in a new tab in the Project Parameters, as shown below.

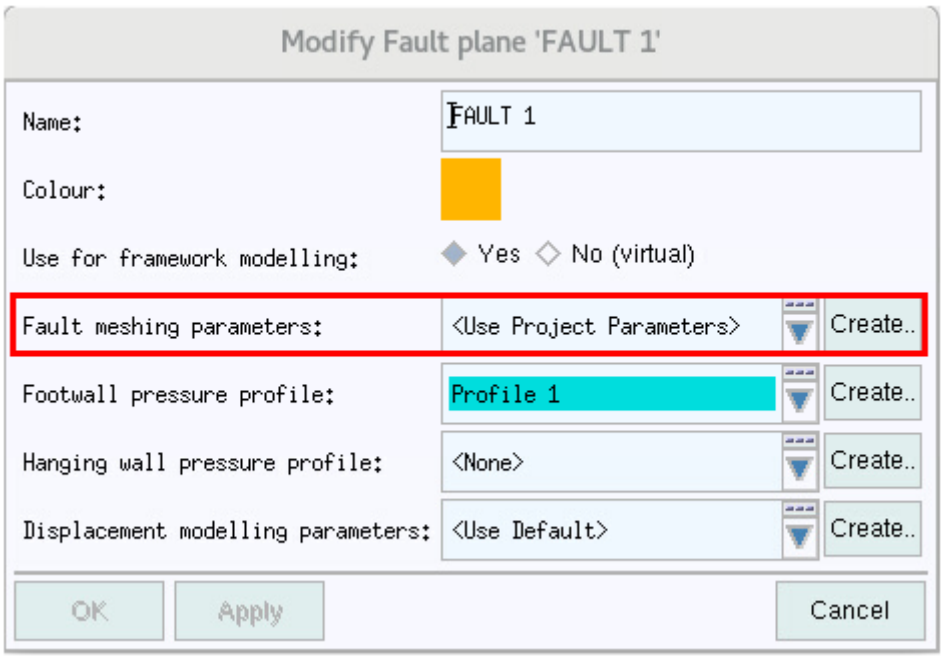


Fault-Specific Meshing Parameters

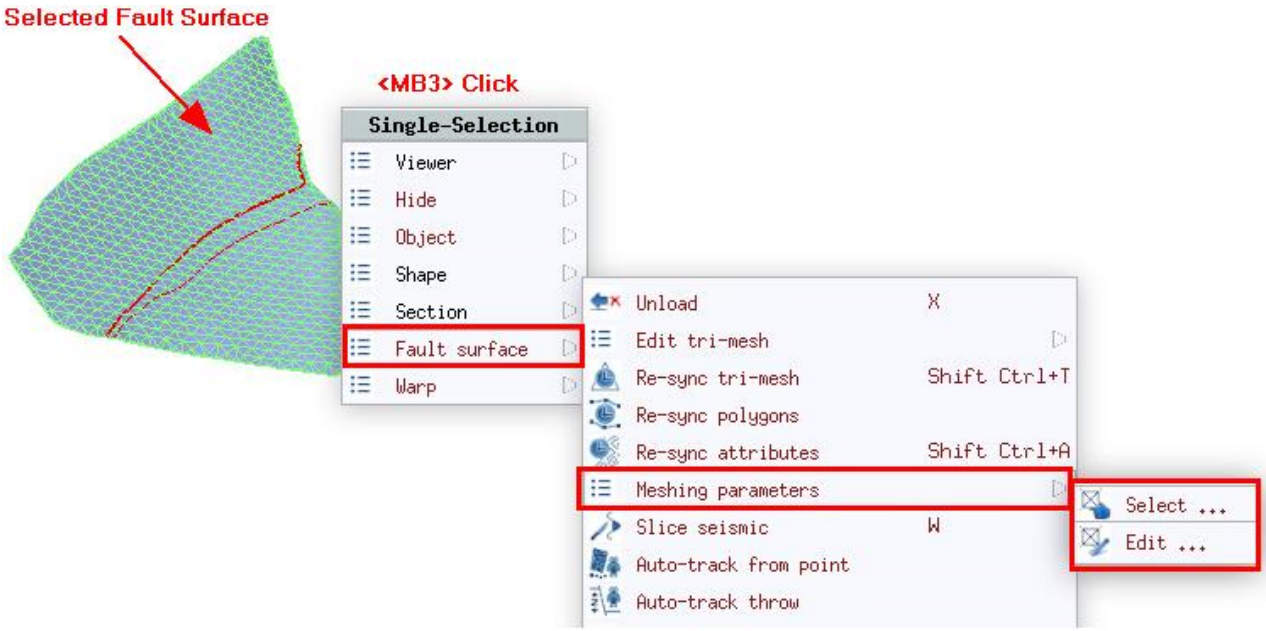
The process used to model fault surfaces in T7 has traditionally used the current settings in the *Fault Surface/Attribute Modelling* tab in the Project Parameters. The only way in which it was possible to use different settings on individual faults was to simply make the appropriate changes in the Project Parameters before modelling the required faults in the Volume Editor and then changing the settings again for other faults as required. A new Fault Meshing Parameters object had been added to the T7 database. This can be seen and managed in the Database Explorer and embodies all of the *Fault Surface/Attribute Modelling* settings as seen in the Project Parameters.



The Fault Meshing Parameters can be assigned to Fault so that when the Fault Surface or its attributes are next modelled it will use those parameters. By default, a Fault will be set to use the settings in the Project Parameters.



The Fault Meshing Parameters can be also be assigned to Faults using the new Fault Manager table in the Database Explorer (described earlier in this document). They can also be assigned and accessed for a current fault selection in the Volume Editor as shown below



The *Select* option will popup a list of existing Fault Meshing Parameters (including an item representing the settings in the Project Parameters) from which an item can be chosen and assigned to the current Fault selection. The *Edit* option (available if just one Fault is selected and specific Fault Meshing Parameters are assigned) will open the Fault Meshing Parameters editor window (as shown above) so that the current settings can be viewed or modified as required.

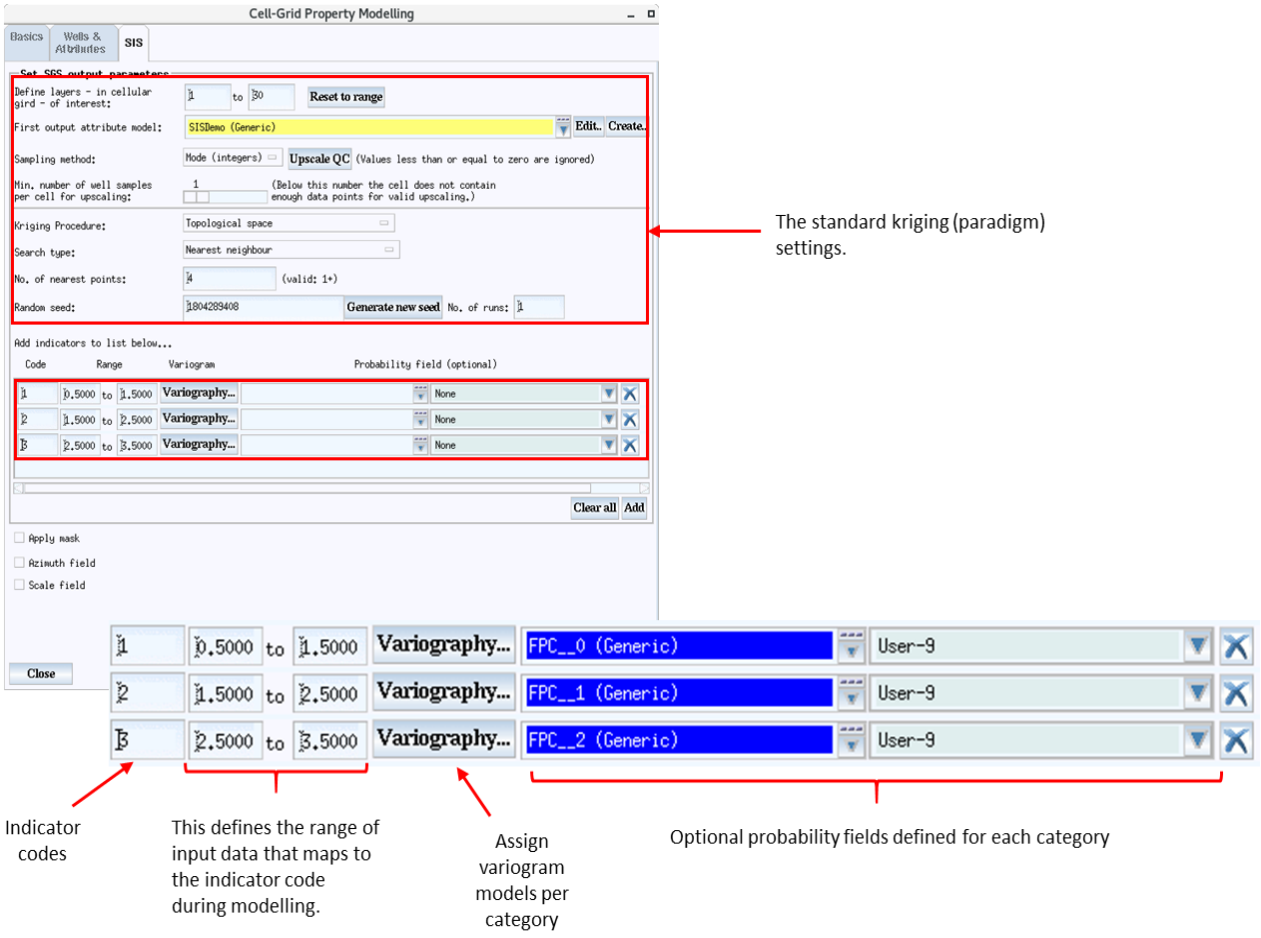
Cell Grid Property Modelling Enhancements

Three new tools have been added to the property modelling toolkit: Sequential Indicator Simulation; Arbitrary Probability Cube and Cell-to-Cell Transfer. All of these are made available by selecting the corresponding toggle on the Basics tab of the Cell-Grid Property Modelling dialog.

SEQUENTIAL INDICATOR SIMULATION (SIS)

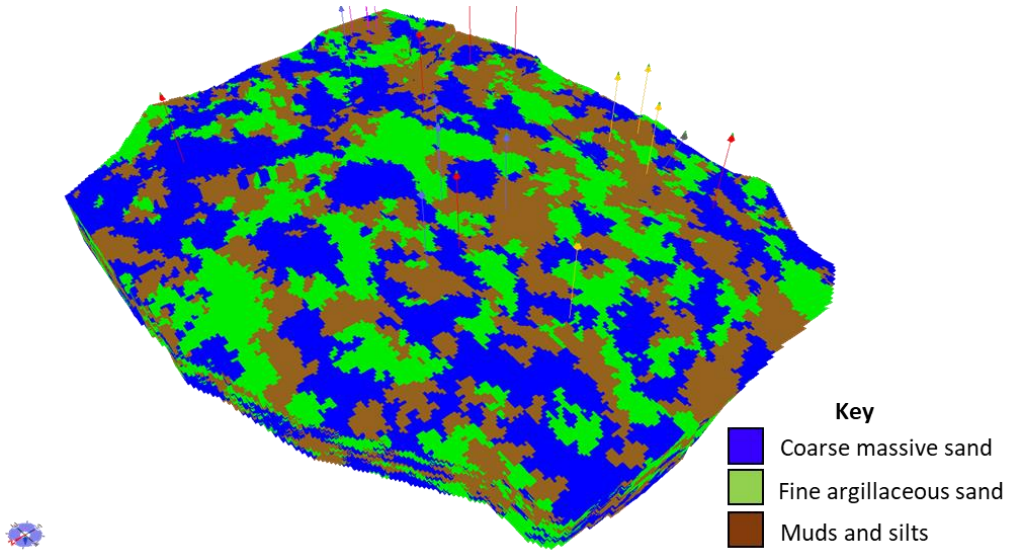
This is a common stochastic method used to simulate the distribution of domains. It's commonly used to model different facies types using well category variables as the input (facies codes). It is less commonly used to simulate the distribution of rock property domains using continuous variables such as porosity – e.g. converting porosity ranges into reservoir quality codes to model the distribution of reservoir quality categories.

The interface/workflow is similar to other tools based on the kriging paradigm (such as SGS). The main difference comes from the requirement to add indicator field(s). Each field has a range, corresponding code and variography (and model). The user also has the option of setting probability fields per indicator; these act as priori during simulations – *i.e.* secondary information that helps condition the output.



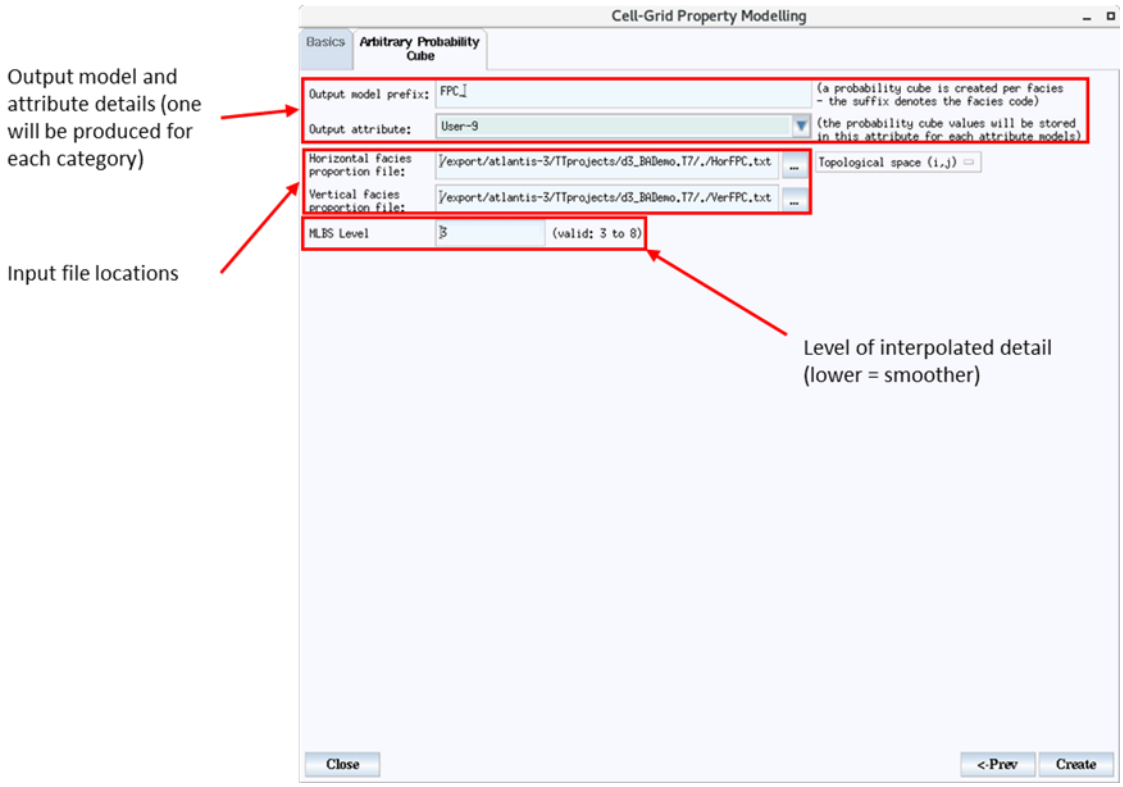
Like other simulation tools T7 provides the option to create more geologically richer SIS models using transformation fields that define local information such as trend and scale. The image below presents a facies model that was produced using the SIS workflow

without any auxiliary information – directly from the well data and indicator variogram models.



ARBITRARY PROBABILITY CUBE (APC)

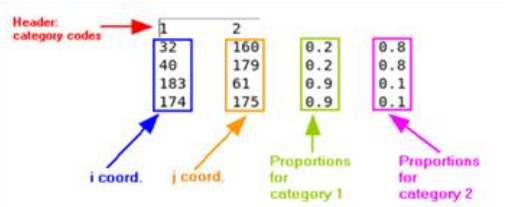
Sometimes property modelling requires secondary information to help condition modelling – e.g. sand probability cubes. These are often derived from seismic volumes where seismic attributes can be inverted into some lithological signature. However, such volumes are often unavailable. In some instances the only secondary information comes from maps produced by geological inference. It is therefore important to be able transfer this important soft information into a property model for further modelling. The APC tool presents a method of doing so. Using ASCII files, that list proportions of lithology/geological character through the modelled area, one can transfer such information into a reservoir property model in order to produce probability cubes.



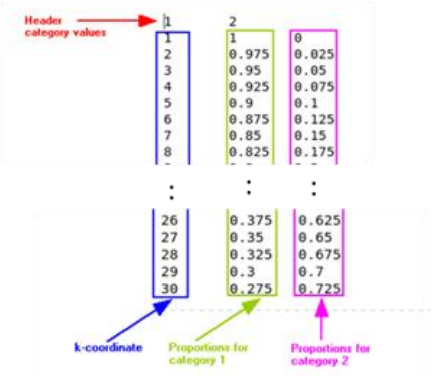
Two files are required, one listing the lateral variation at a number of locations (in terms of cell i,j) and another listing the expected proportions in each layer (in terms of k):

Example using two geological categories

Lateral file...



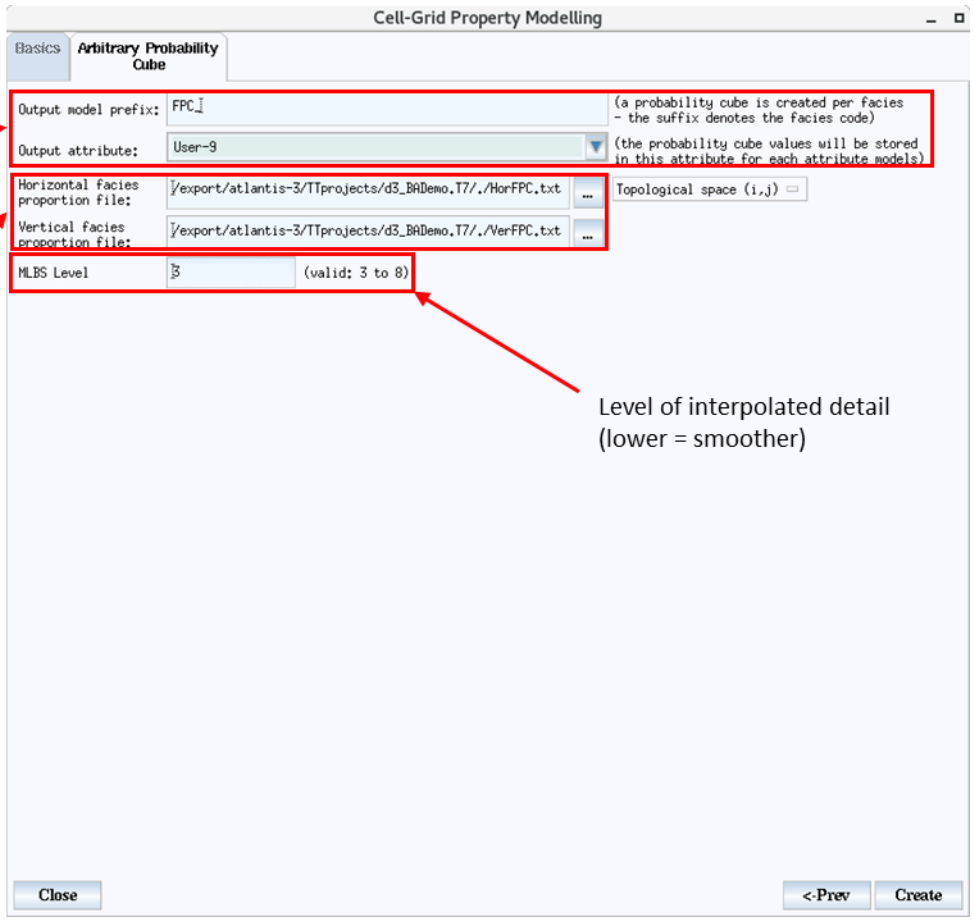
Vertical file...



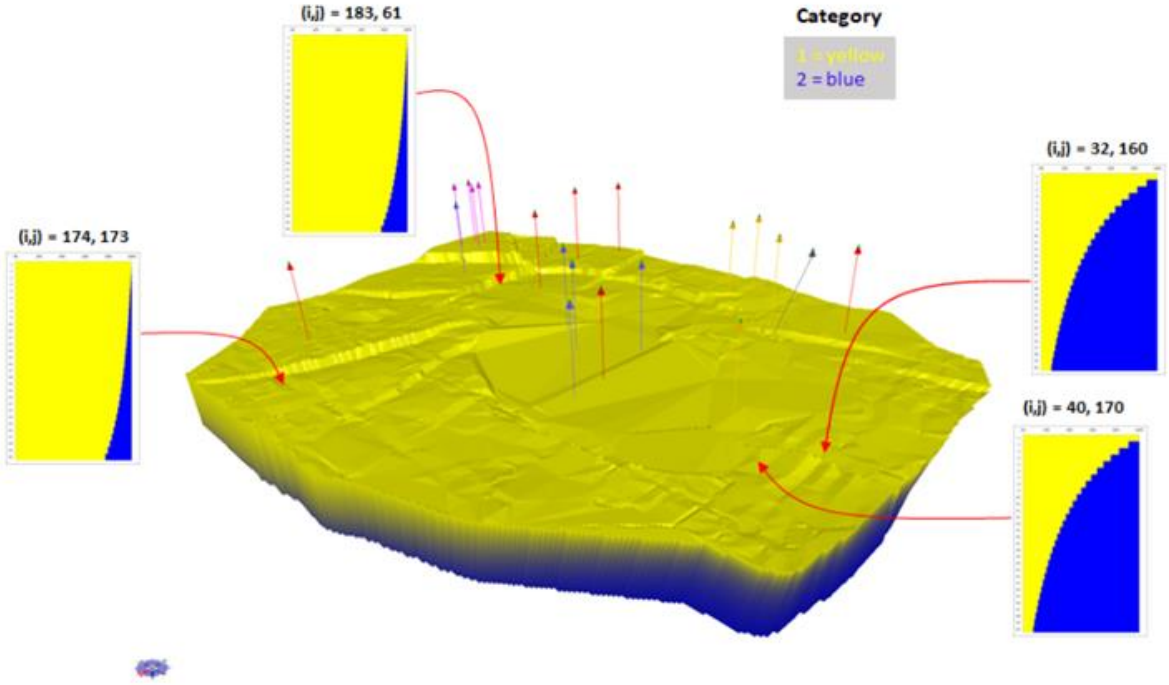
Effectively, when combined the vertical and horizontal proportions form an interference field combining both the gross lateral and vertical proportions:

Output model and attribute details (one will be produced for each category)

Input file locations

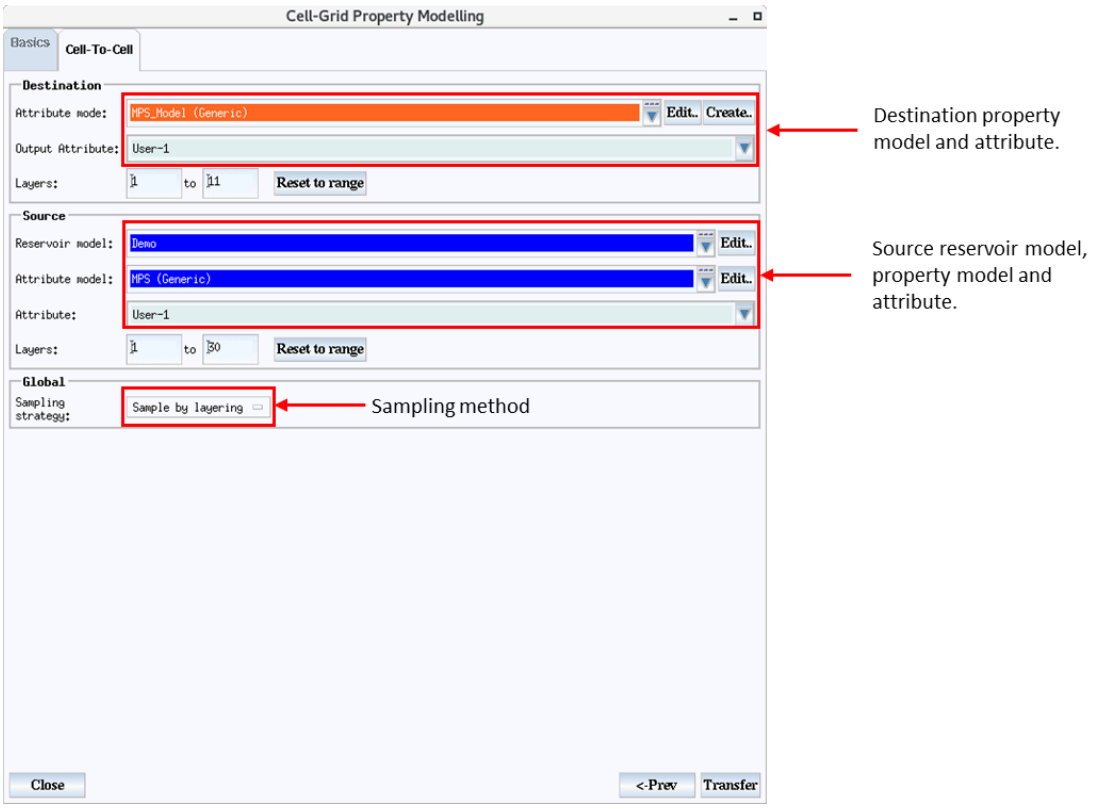


Level of interpolated detail (lower = smoother)

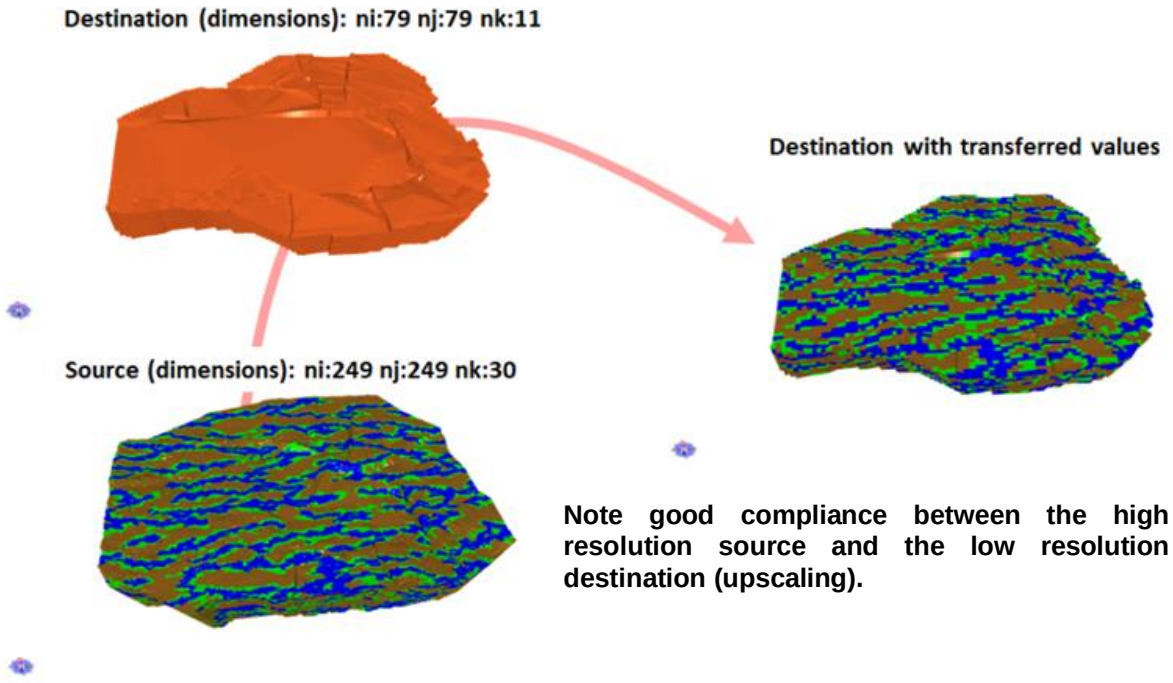


CELL-TO-CELL TRANSFER

This tool enables the transfer of attributes between reservoir models (CPG). This is particularly useful for upscaling from finer to coarser grids.

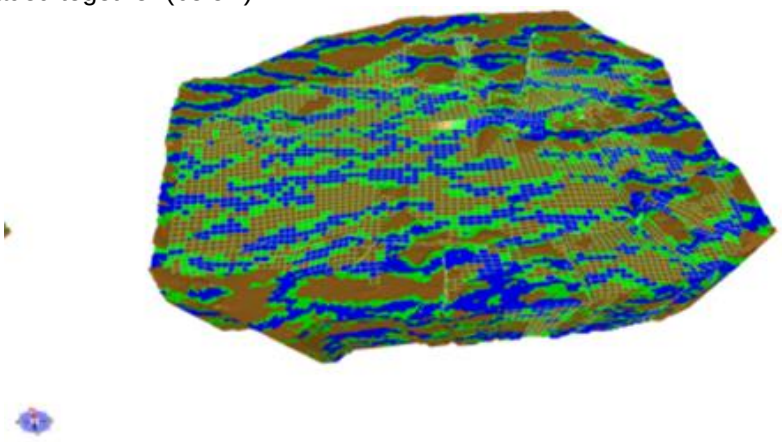


There are two methods of sampling: Sampling by layering or Free form. In **Free form** mode, all cells in the source CPG that overlap with a destination cell (in model space), are used in the computation of that destination cell's value. In **Sample by layering**, the corresponding cell(s) in each model is computed based on their relative position within their respective models – effectively each reservoir model (CPG) has an internal mapping that can be used to gauge which source cells should be used for each destination cell. This method is excellent for upscaling or downscaling properties between CPGs with different dimensions and resolutions:



Note good compliance between the high resolution source and the low resolution destination (upscaling).

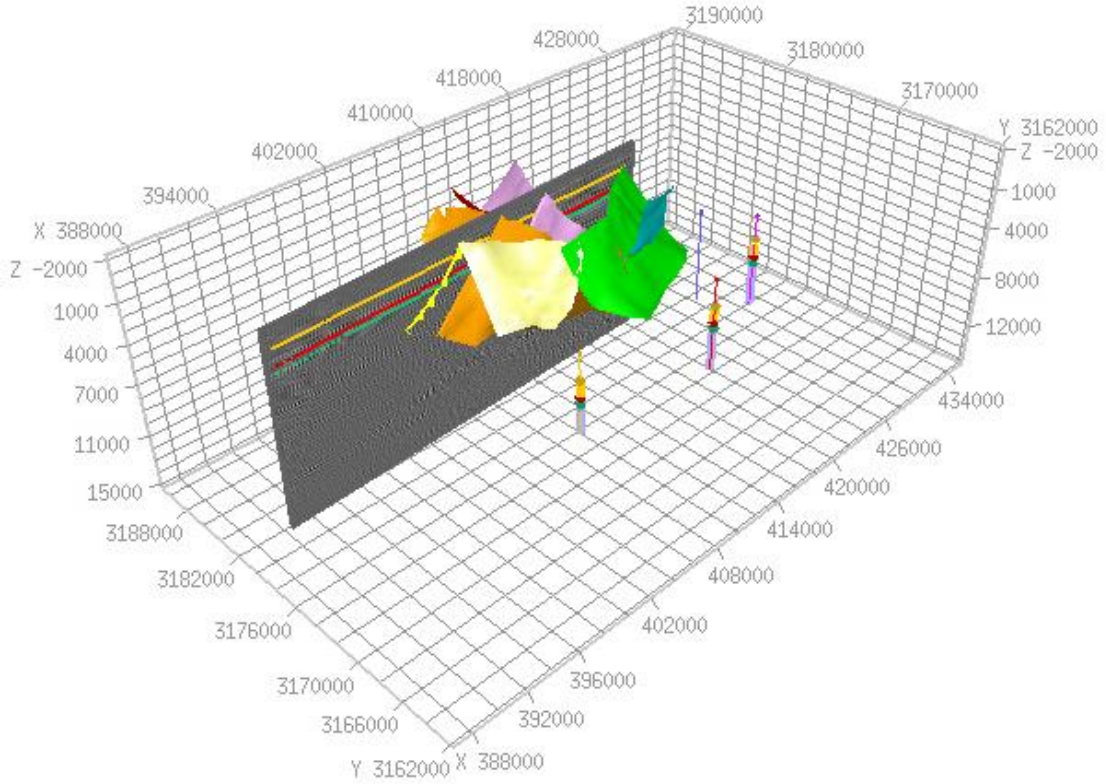
Both models loaded together (below):



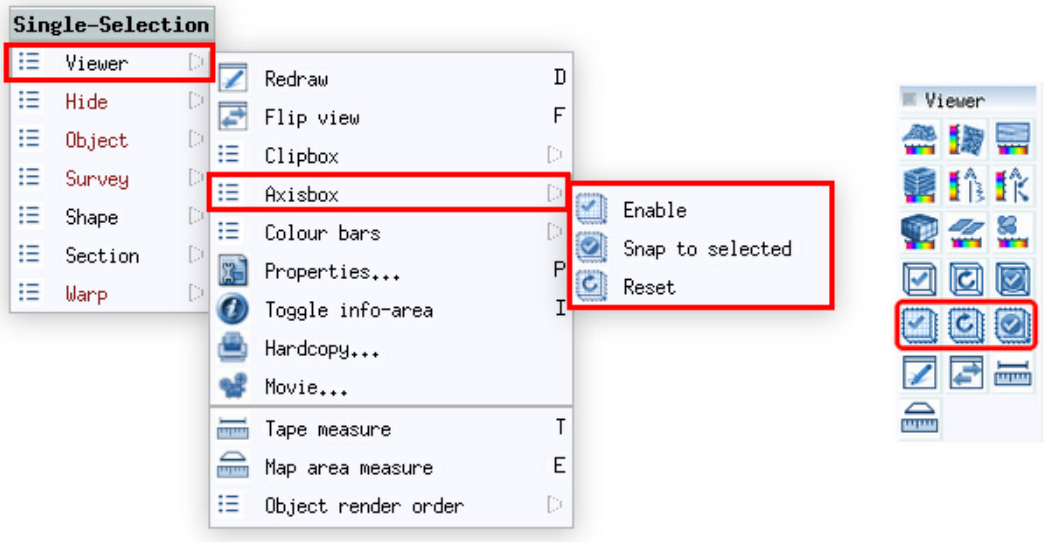
The destination is selected (white grid). Note that it is hard to tell them apart even though they knit in and out – both are "co-located" but have different geometries and topologies.

Axisbox

The Axisbox is a 3D box which is drawn in the Volume Editor's 3D Viewers and is optionally graduated and annotated with lines of constant X,Y and Z. It provides scale and positional context for objects loaded into the viewer(s). Those sides of the Axisbox that outwardly face the viewer are switched off dynamically as the view is rotated so that objects within are not obscured.



The Axisbox visibility and size is controlled from the Viewer Popup Menu options together with the Clipbox controls.

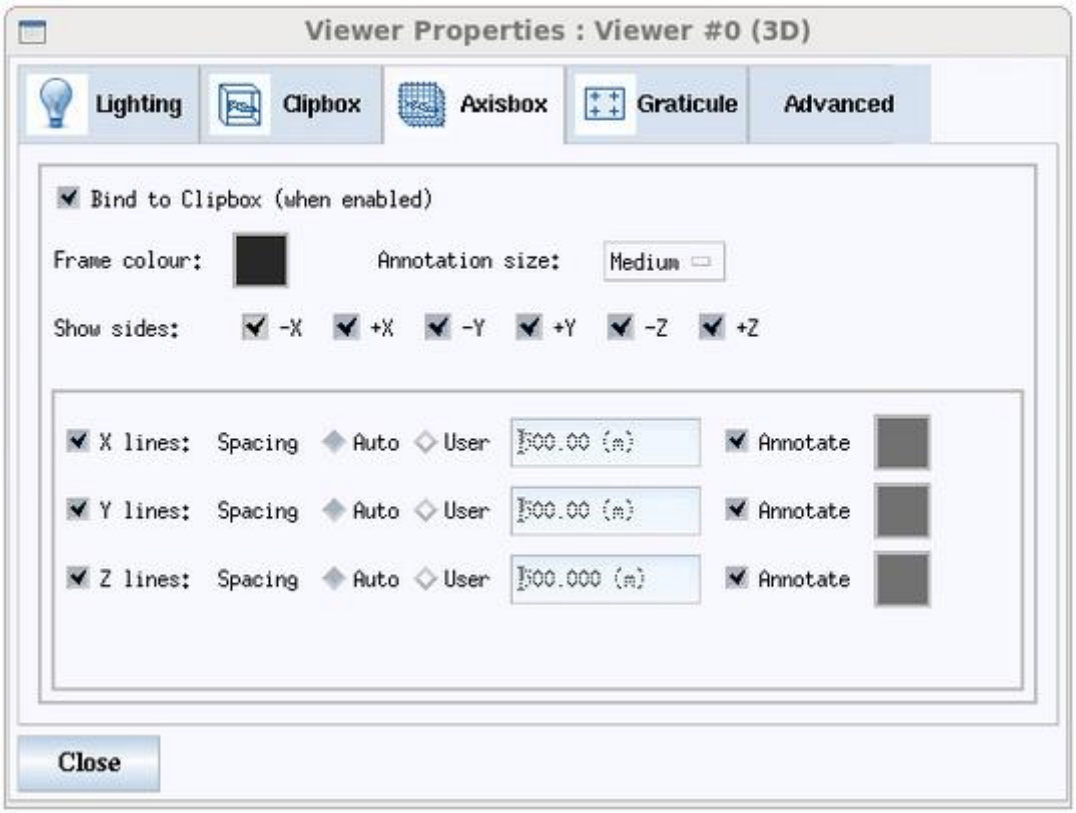


By default, the Axisbox is "bound" to the Clipbox. It may be "unbound" using the <MB3> Popup menu options: "*Viewer->Axisbox->Unbind from clipbox*" or the equivalent option in the Shortcut Toolbar. The act of binding the Axisbox to the Clipbox means that when they are both enabled, the Axisbox size and position can be changed by changing the size and/or position of the Clipbox (via the usual Clipbox controls).

When the Axisbox is not bound to the Clipbox or the Clipbox is disabled, its size and position can be controlled using the "Reset" or "Snap to selected" options shown above.

- **Reset**: This option will set the Axisbox to encompass the entire project extents.
- **Snap to selected**: This option (only available when one or more objects are selected in the viewer) will set the Axisbox to the combined XYZ extents of the selected objects.

The appearance and style of the Axisbox is controlled via the Viewer Properties window. Here there are options to control if the Axisbox will bind to the Clipbox, colour settings, controls for which sides are displayed and annotation controls.

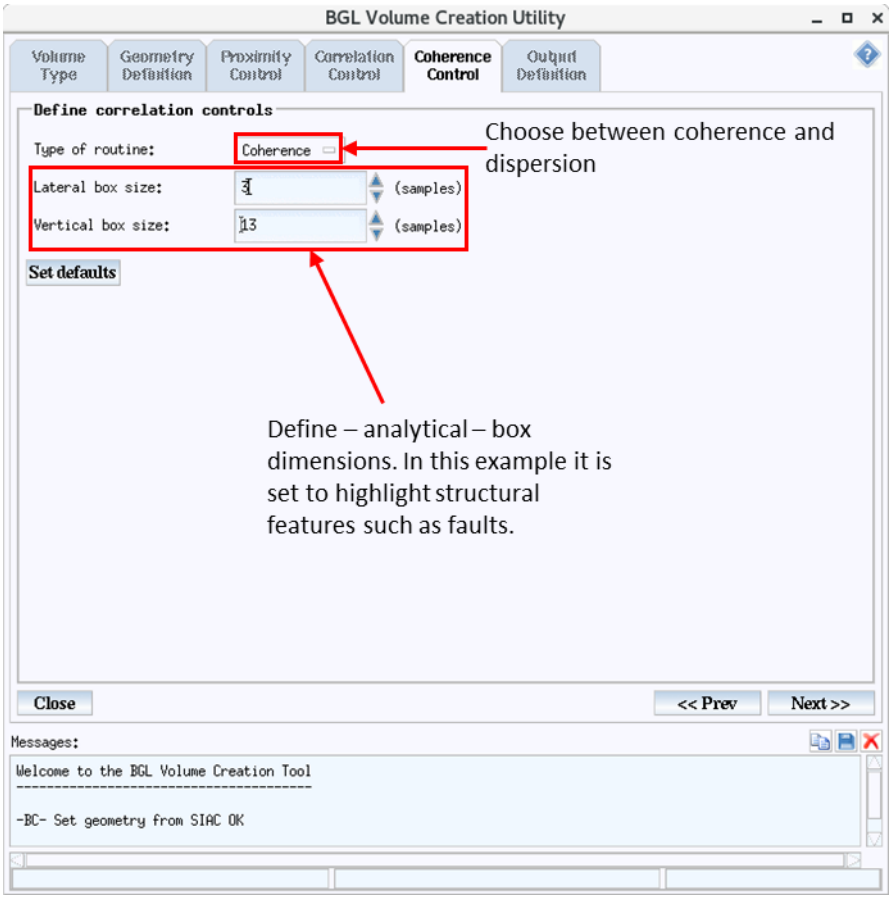


FUNCTIONAL ENHANCEMENTS

Seismic Volume Creation: Coherence (C3) and Dispersion Functionality

A new seismic tool has been added to the BGL Volume Creation Utility that computes either coherency or spectral dispersion. This can be activated by selecting the corresponding toggle on the “Volume Type” tab.

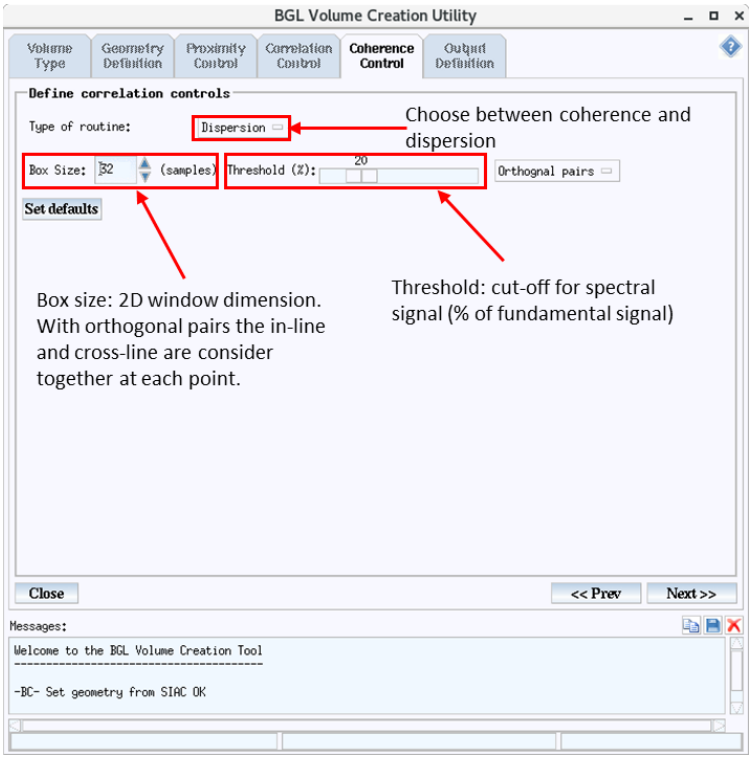
The **Coherence** – C3 – tool implements the algorithm described in Gersztenkorn and Marfurt (1999). Like most coherence methods this highlights lateral contrasts in “signal” between neighbouring traces. A number of options are available in the “Coherence Control” tab while in this mode. The principal settings are the – analytical - box size dimensions. If the user wishes to enhance structural features the vertical dimension should be greater than the horizontal. Conversely, if one wishes to enhance sedimentological features such as channels then the horizontal dimension should be greater than the vertical dimension.



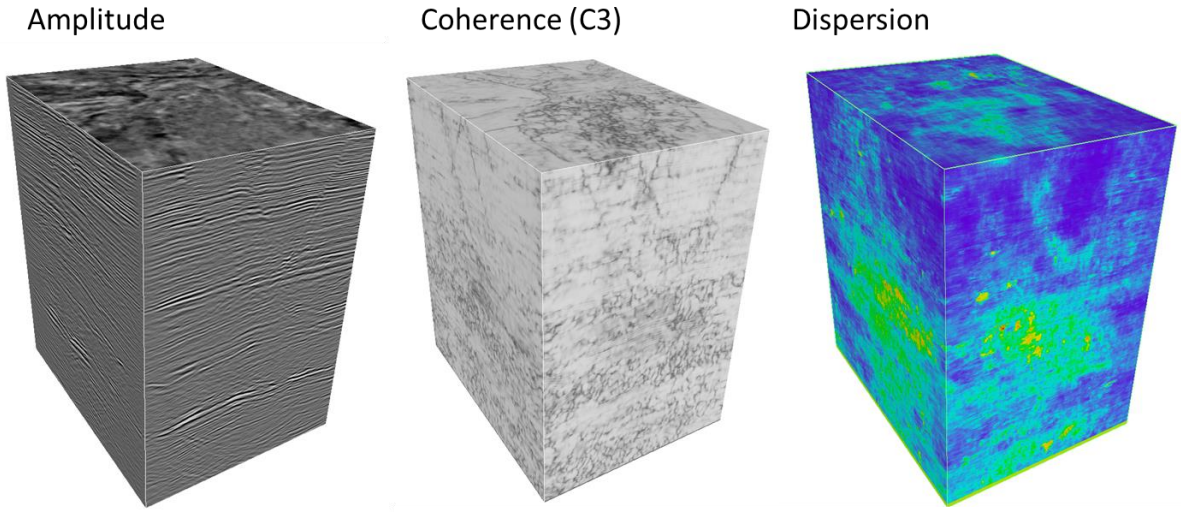
In **Dispersion** mode the tool calculates the spectral dispersion for the analytical window(s) centred on each location within the input volume. This is a good proxy for seismic entropy and therefore good at highlighting areas of poor signal to noise ratio (higher the value the lower the signal to noise).

There are a number of settings that can be configured in order to get different results. The window size will ultimately determine the relative influence of geological features on the

dispersion value – small box sizes will pick up faults along with large scale structures such as those related to salt tectonics. Of the other settings, threshold has the greatest impact; this is the cut-off for the spectral signal that will be considered in the estimate of dispersion (expressed as a percentage of the maximum fundamental frequency signal).

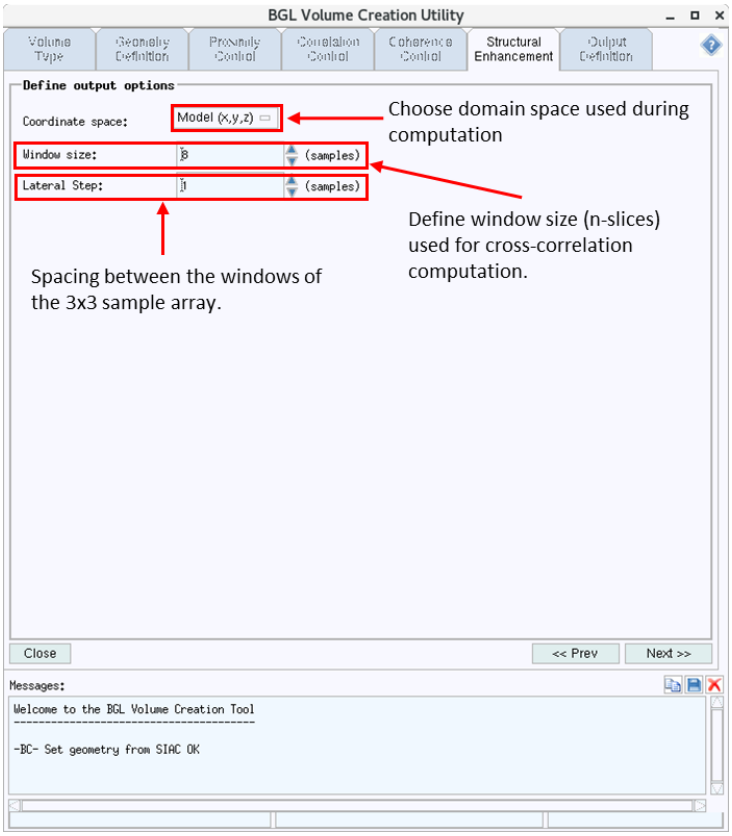


Examples of coherence and dispersion along with amplitude volume:



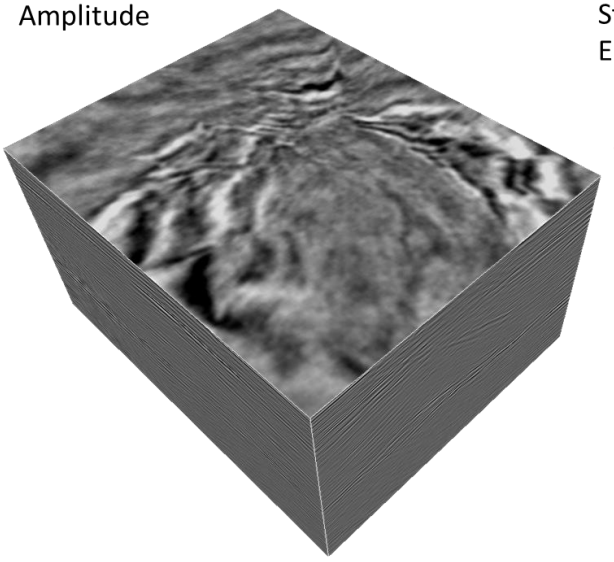
Seismic Volume Creation: Structural Enhancement Functionality

Using this method a pseudo-curvature value can be computed at each location within the selected volume definition. The computation is based, in-part, on analysis of the mutual cross correlation between neighbouring traces arranged in a lateral 3x3 sample array. The resulting attribute is very good at highlighting “hidden” structure that isn’t well defined in coherence volumes.

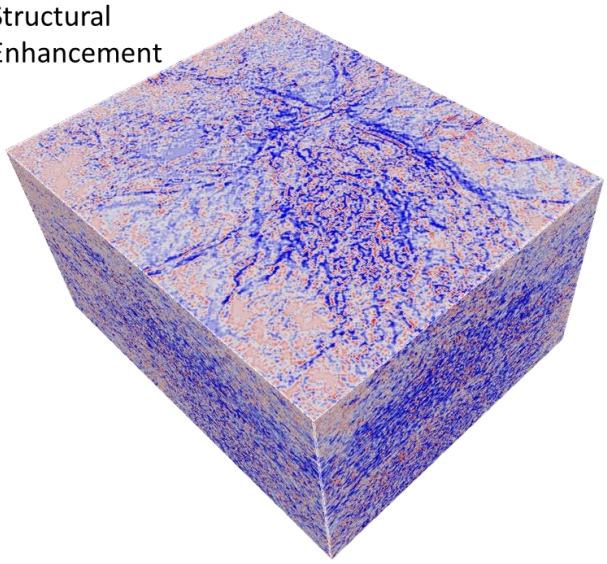


An example is presented below:

Amplitude

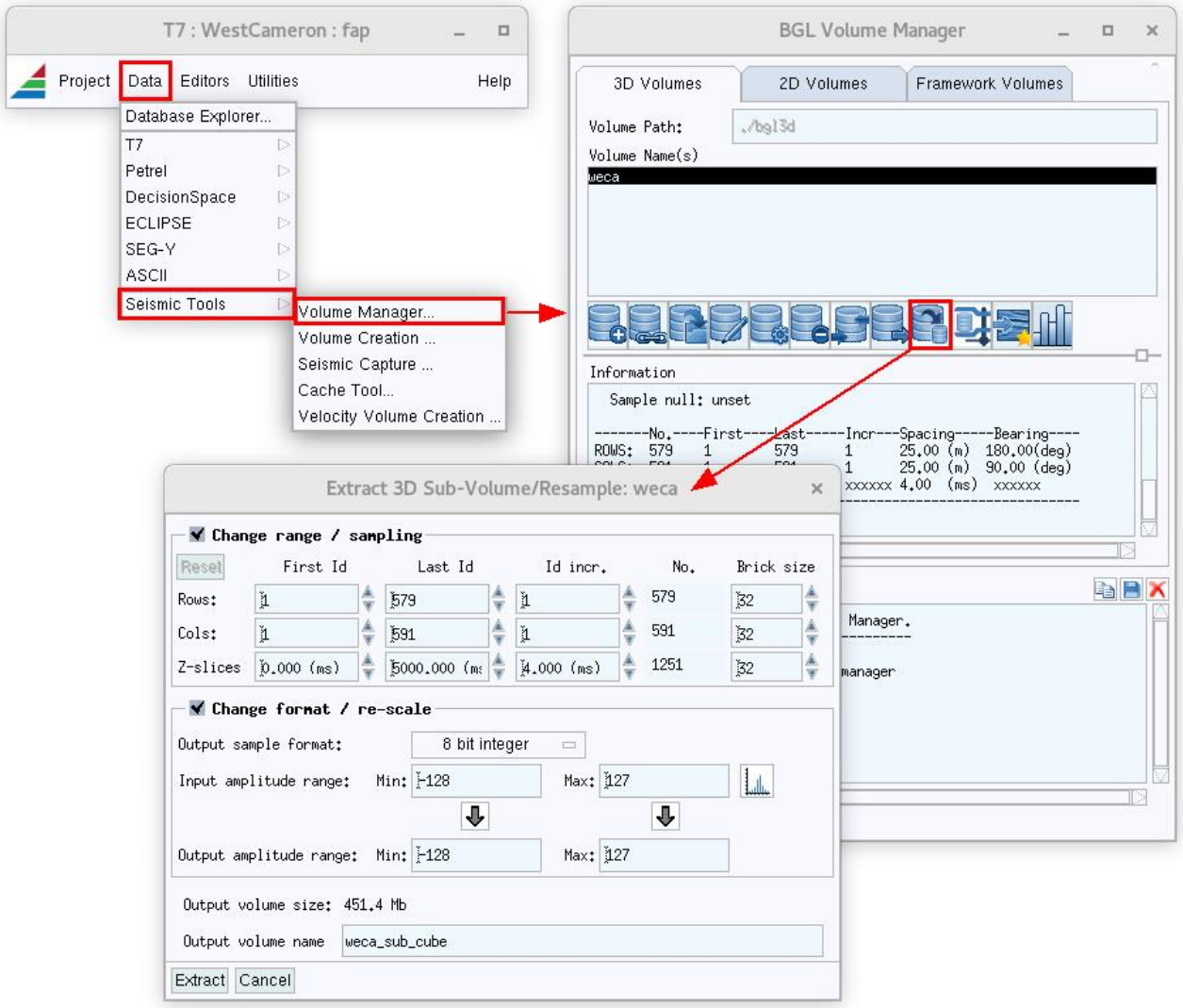


Structural Enhancement



Seismic Volume Manager: 3D Sub-volume Extraction/Reformat

The Seismic Volume Manager (accessed from the T7 main Menu: *Data->Seismic Tools->Volume Manager*) has been fitted with a new tool for creating new 3D seismic volumes by extracting sub-volumes from an existing volume and providing options for re-scaling and changing the sample format if required.



The new option can perform any combination of the following processes to create a new 3D volume based on the content of an existing 3D volume:

- Extract a sub-volume
- Change the row/col/Z sample rates
- Change the row/col/Z brick size
- Change the sample format
- Re-scale the sample data

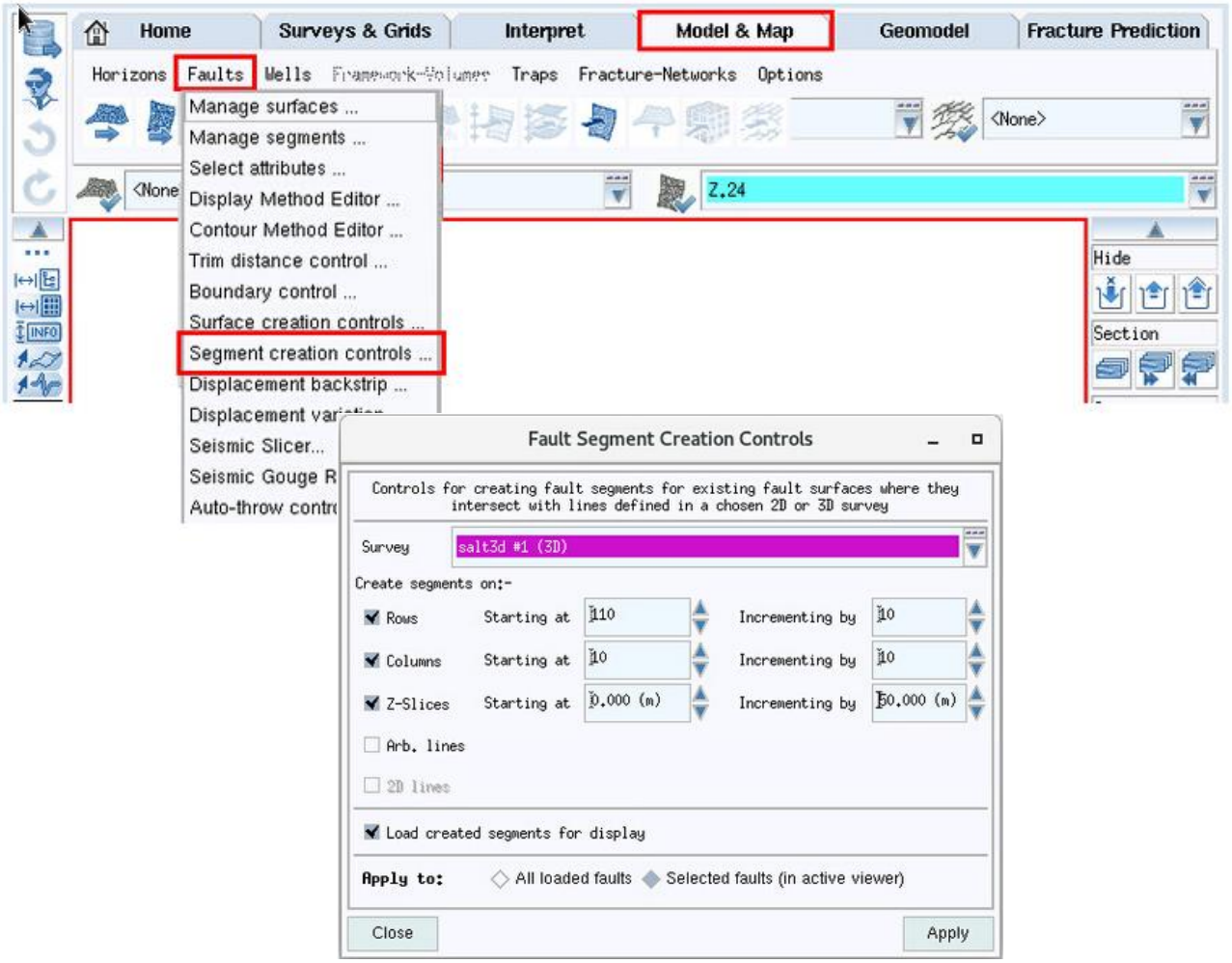
These actions will be performed on the 3D volume selected at the time the option was selected. The input volume name is shown in the title of the Extract 3D Sub-Volume/Re-sample window.

Volume Editor: Fault Segment Creation Tool

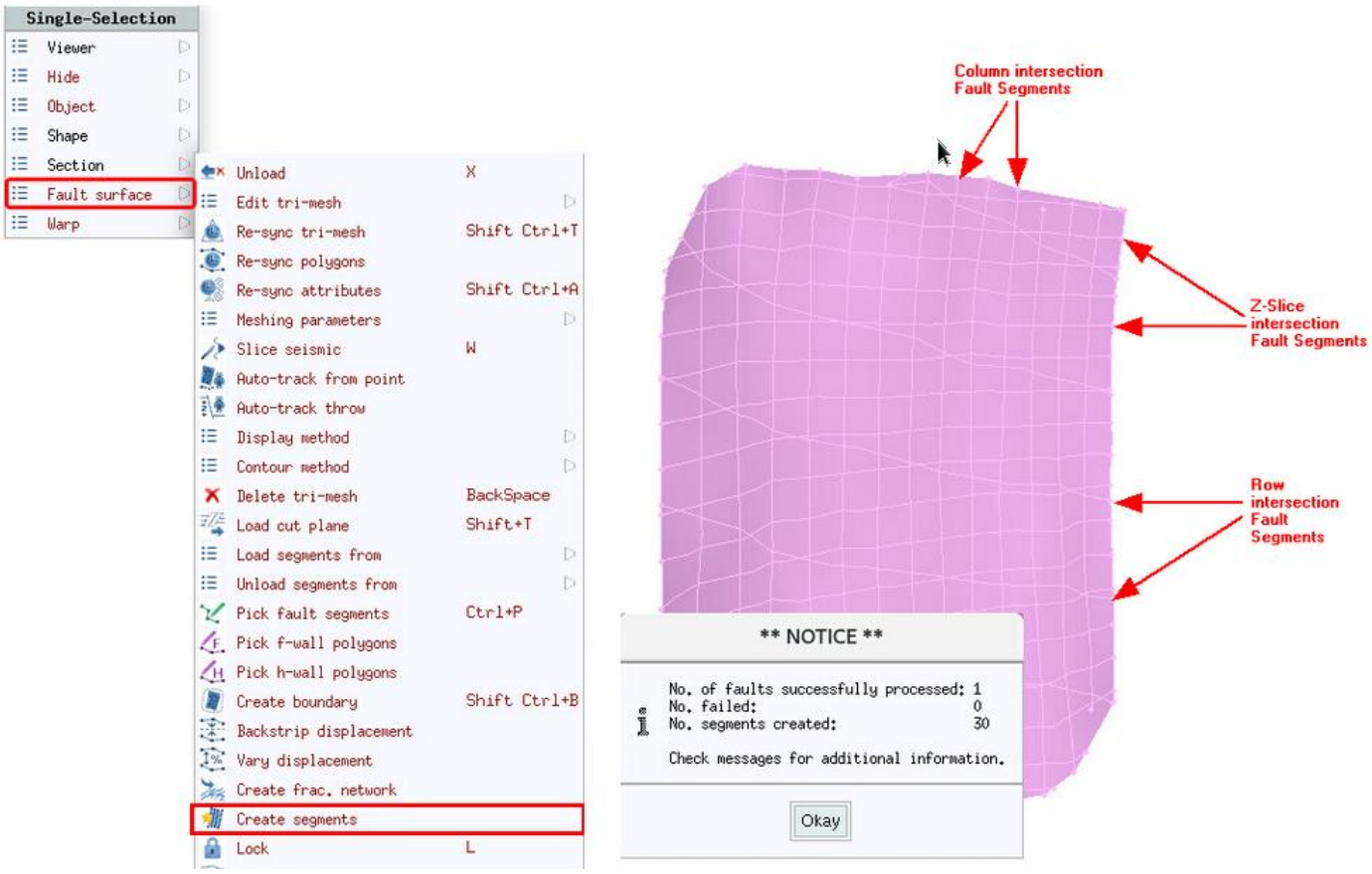
This new tool provides the user with the ability to create fault segments in bulk where one or more fault surfaces are intersected by 2D or 3D survey lines (rows, columns, z-slices, arbitrary lines). This can be a very useful feature when the fault data imported in to the T7 project is in the form of surface data only. Once the fault segments have been created (and automatically assigned to their respective faults) they can be used as the basis for adjusting the interpretation and updating the surface representation.

The action taken by the Fault Segment Creation Tool can be automatically invoked from the new Fault Surface Auto-tracking system so that Fault Segments can be created as part of this process.

The Fault Segment Creation Controls are accessed from the Model & Map menu as shown below.



The settings in the Fault Segment Creation Tool can be applied to Fault Surfaces from the control window itself – by choosing to apply to “All loaded faults” or the “Selected faults”. Alternatively the current settings can be applied to the Fault Surface selection in a viewer by using the <MB3> Popup menu option: *Fault surface -> Create Segments* (as shown below).



A popup window provides a summary of the process results. If there are any failures then further details will be reported in the Volume Editor Messags window.

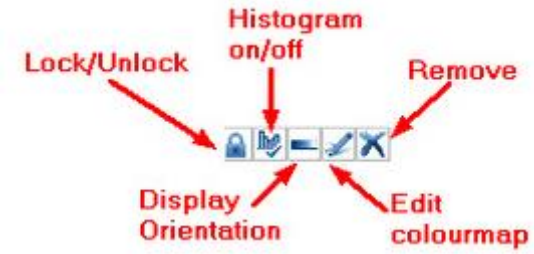
- Created fault segments will be automatically assigned to the appropriate fault plane.
- To avoid duplication, a segment will not be created on a given section for a given fault surface if a segment already exists in this context.

Volume Editor: Colour Bar Histograms

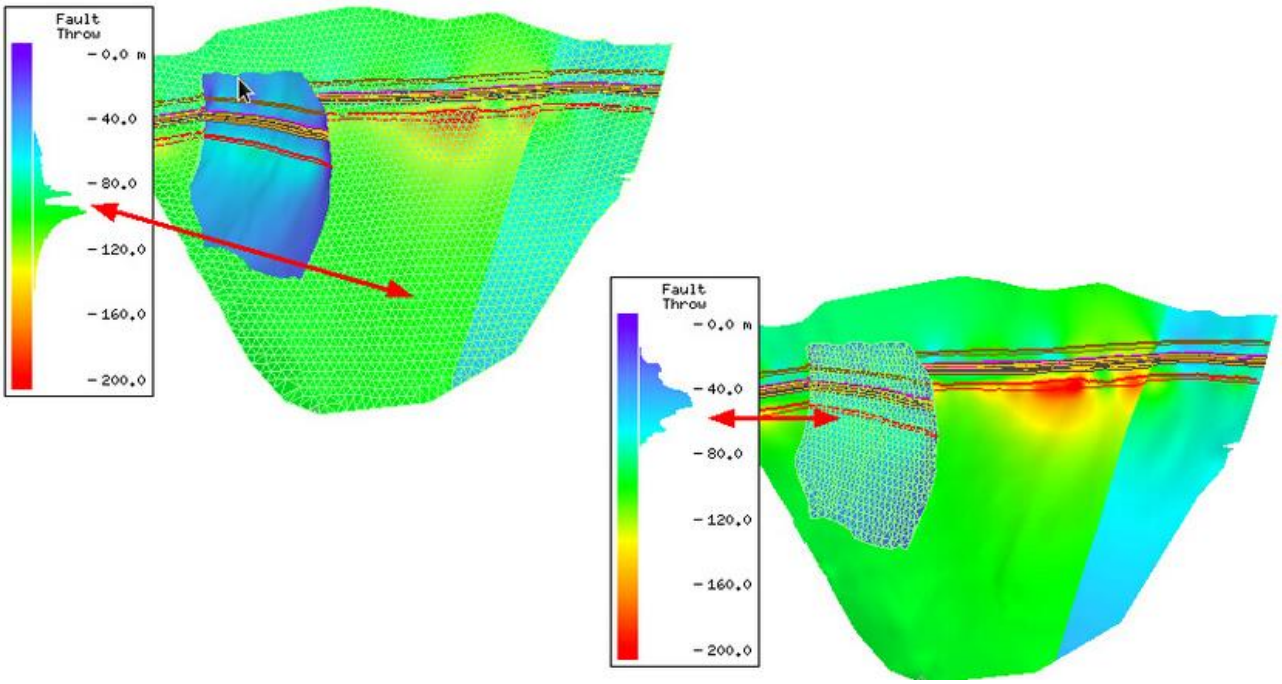
The viewer-based colour-bars in the Volume Editor have, for some objects and display modes, been extended to provide a histogram display showing the data-value distribution within the colour-bar range. Currently, this facility is available for those objects whose style is set to use a “Display Method” (eg. Faults, Horizons, Cell-Grids etc).

The Volume Editor’s viewer-based colour bars are specific to a particular object type and will, when displayed, “attach” to an object of the appropriate type when that object is selected. In this way – the colour bar will show the colours appropriate for that object and will provide an option for showing a histogram. The histogram can be toggled on/off using the appropriate tool-bar button that is displayed temporarily within the colour-bar when the mouse pointer is moved within it.

The colour-bar toolbar options:



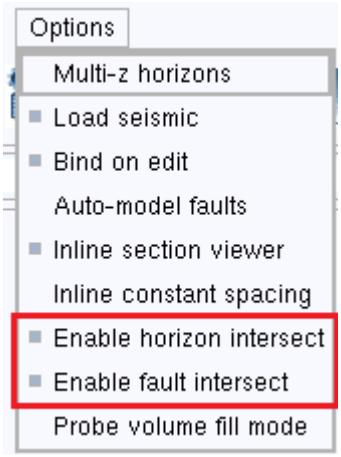
The following image shows the colour-bar histogram for a fault throw attribute and how the histogram and colour-bar display is updated according to the current Fault Surface selection.



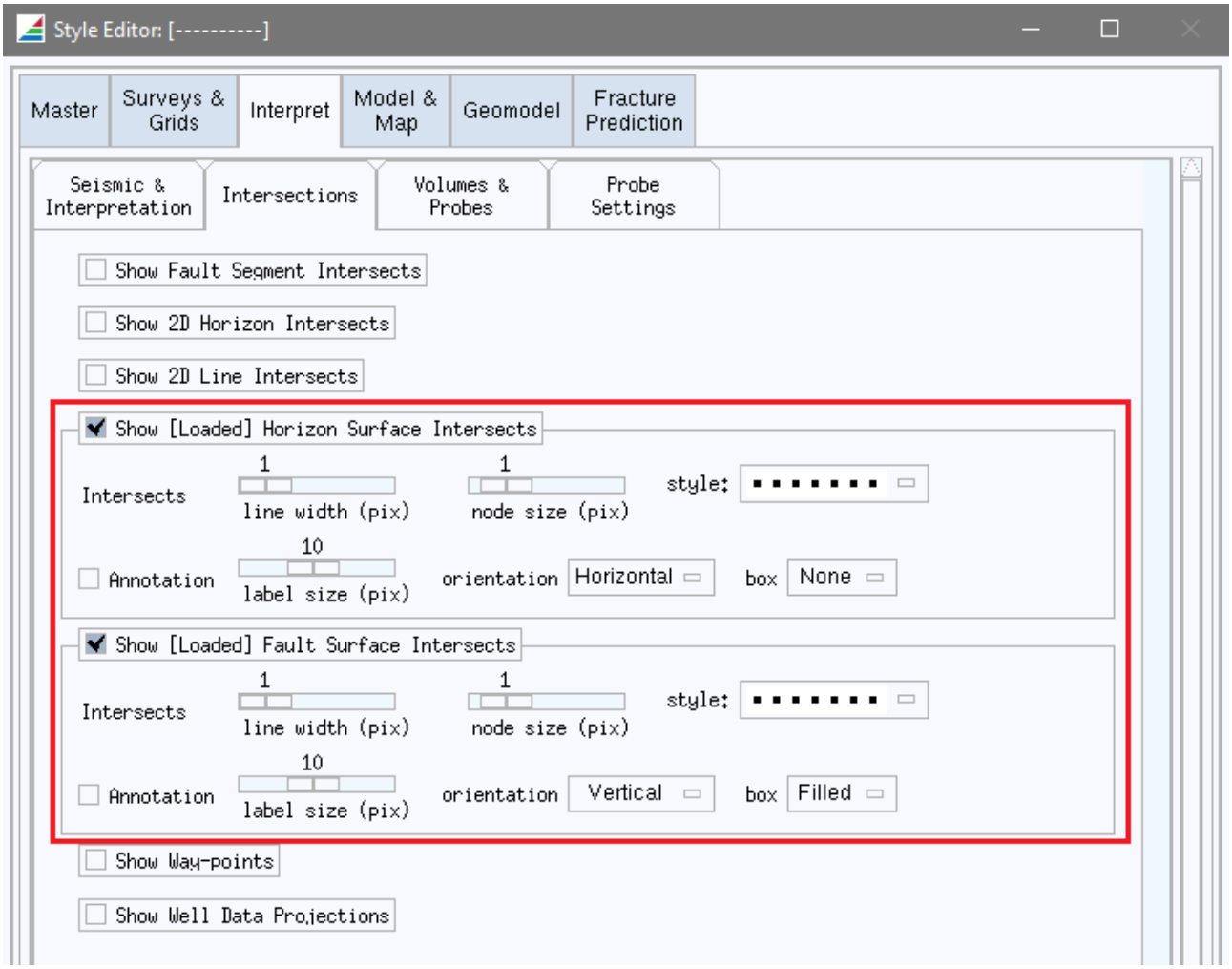
Volume Editor: Surface Intersections on Planar Probes

Planar probes in the Model & Map module now support rendering fault and horizon surface intersections.

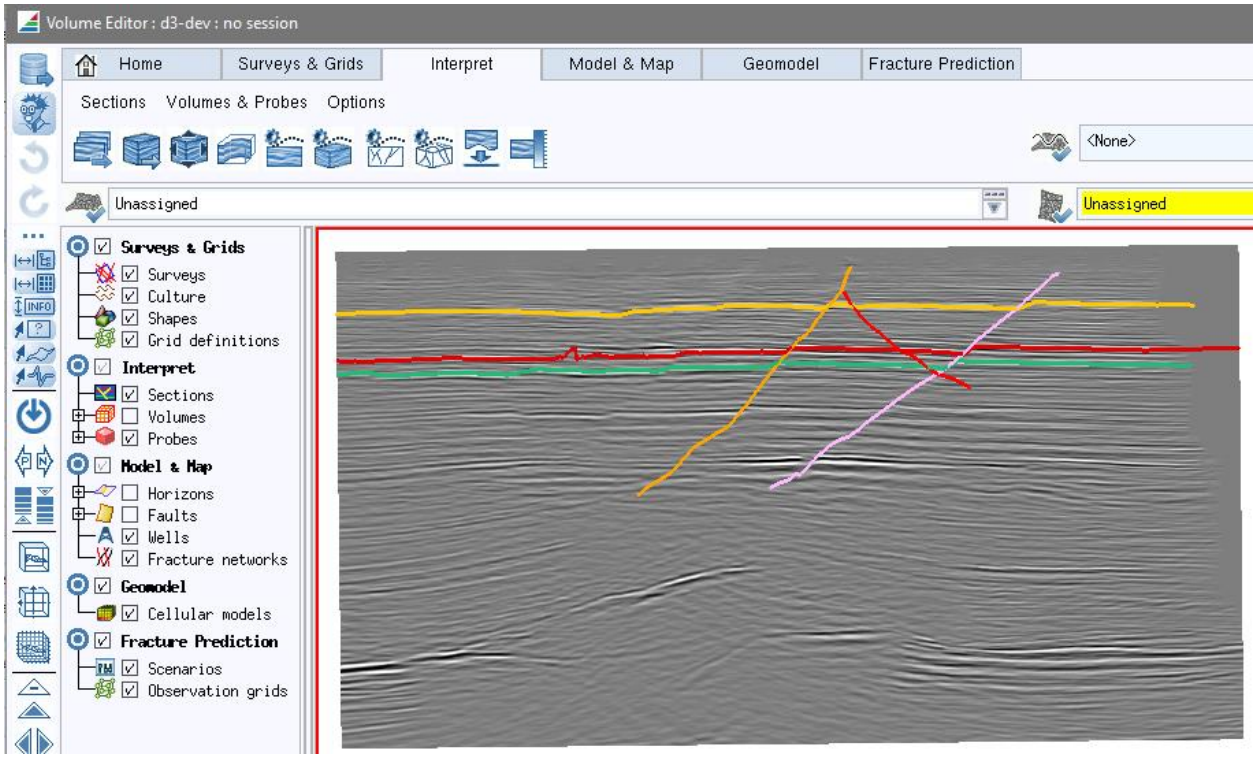
To enable intersections, ensure the “Enable horizon intersect” and “Enable fault intersect” are checked in the Model & Map menu:



The current Style must also have intersections enabled, they are disabled by default:

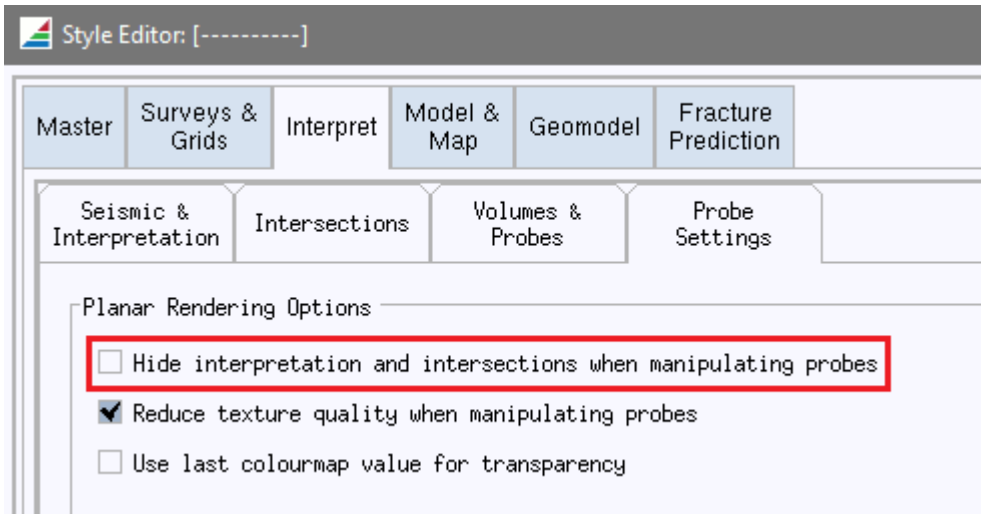


With one or more surfaces (horizon or fault) loaded in Volume Editor, enabling interpretation mode on a planar probe will show the intersections:



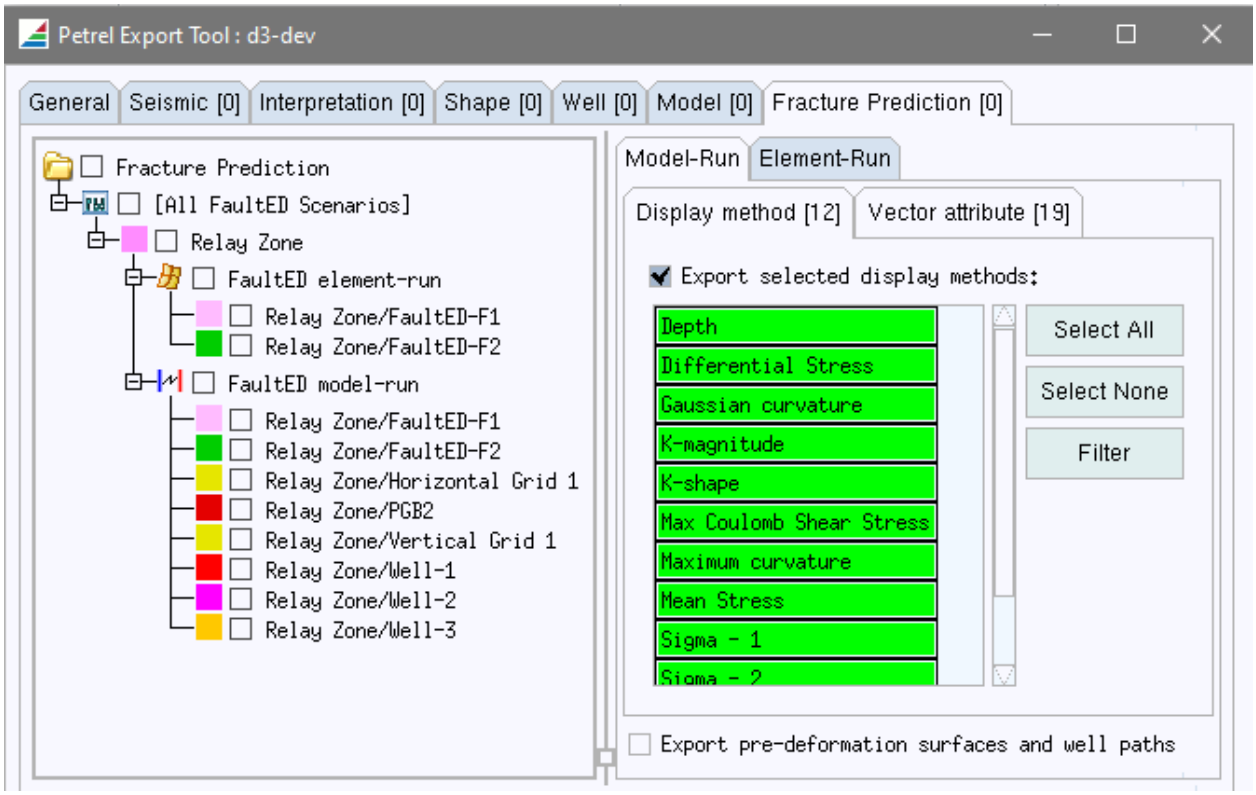
Note that in the image above, horizon and fault surfaces have been hidden.

If there are a large number of fault or horizon intersections, moving or resizing the probe may be negatively impacted. An option exists in the Style Editor Probe Settings to prevent rendering of intersections when manipulating probes:



Petrel/T7 Link: FaultED Objects and Attributes

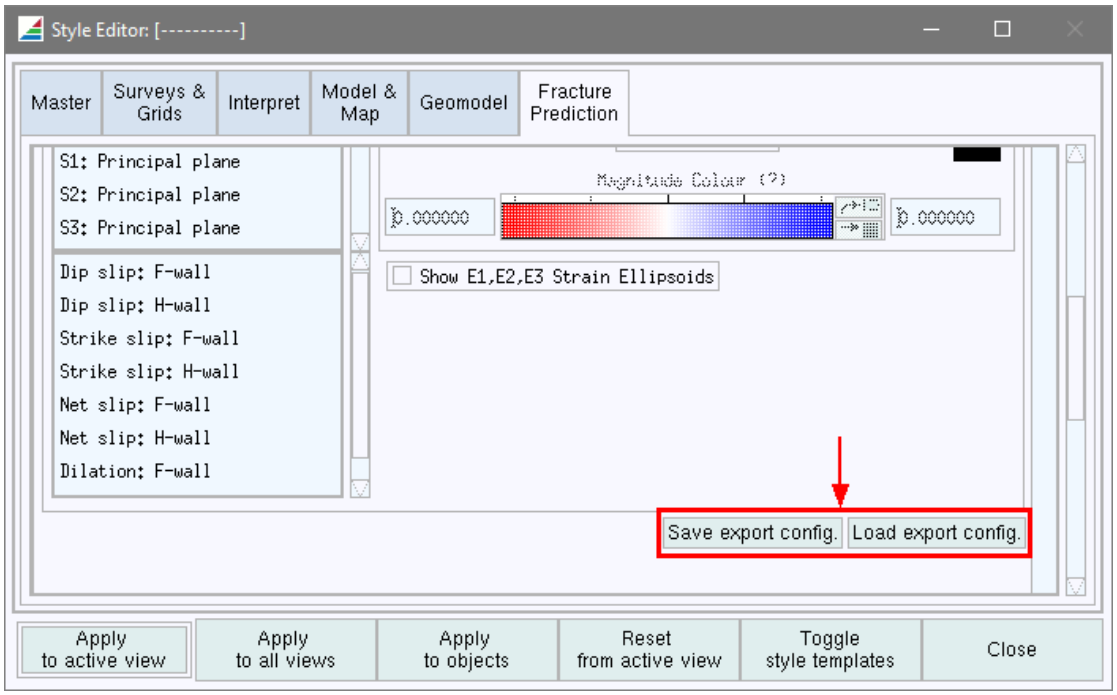
The Petrel and T7 transfer links now provide the ability to transfer FaultED objects and attributes:



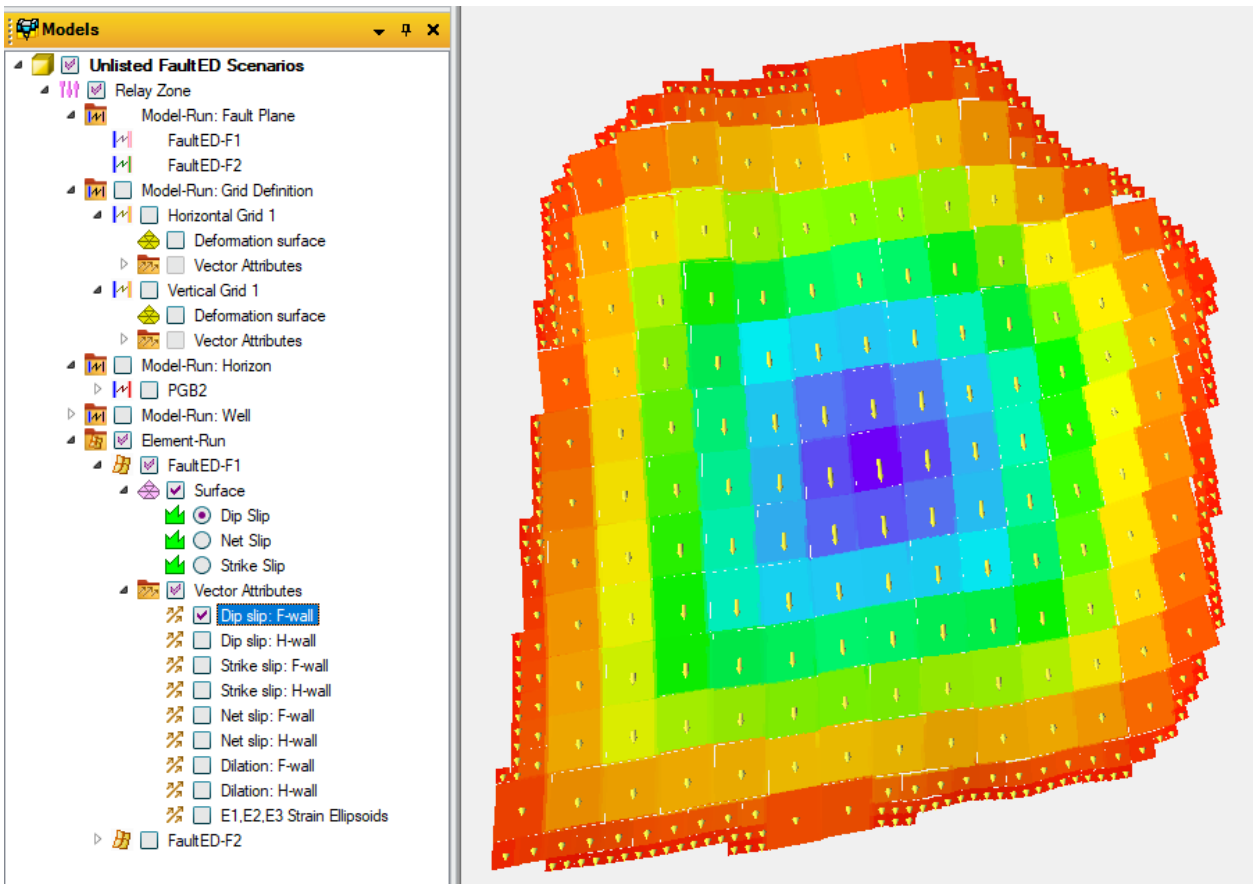
The following FaultED objects can be transferred to Petrel or to another T7 project:

- FaultED scenarios
- FaultED model-run and element-run objects
- FaultED surfaces (deformation and pre-deformation)
- Display method output (Petrel) or raw attributes (T7)
- Vector attributes

Vector attributes are specified using Volume Editor Style Editor settings, which are comprehensive. To avoid manually reproducing the vector style settings, buttons are available in Style Editor that allow the current vector style settings to be exported or imported:



To allow visualisation of FaultED objects in Petrel, the Badley Petrel Plugin has been extended with custom data objects and visualisation in the 2D/3D Petrel viewers:

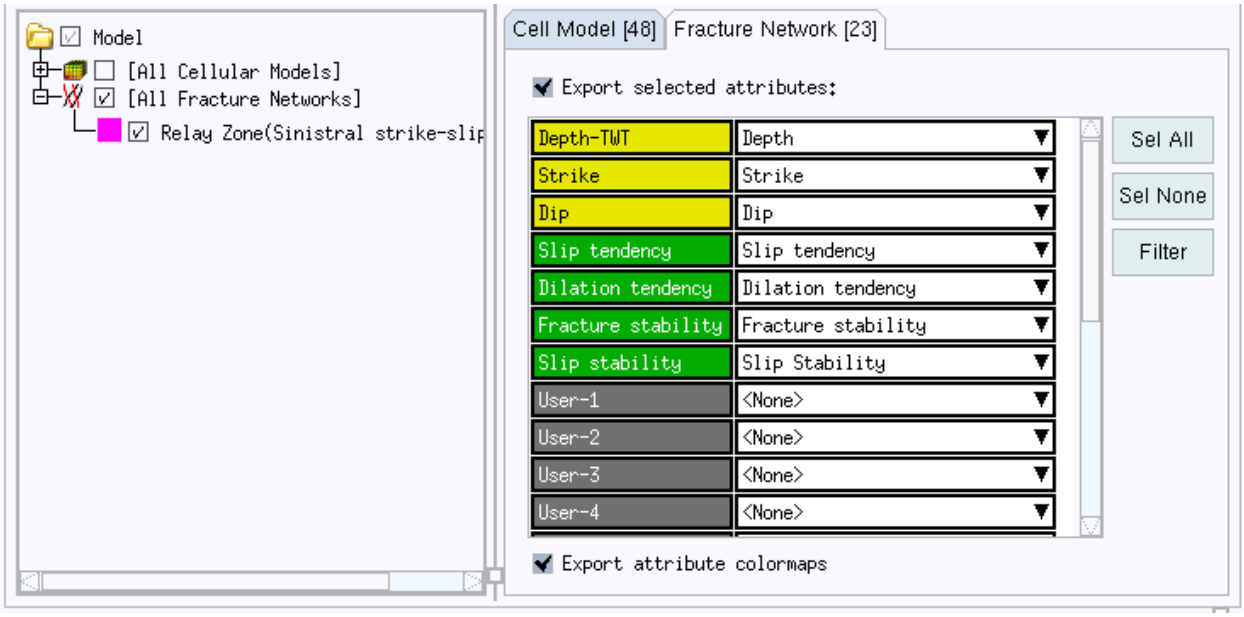


Petrel/T7 Link: Additional new functionality

In addition to FaultED transfer, there have been various other improvements to the Petrel and T7 links, as detailed below.

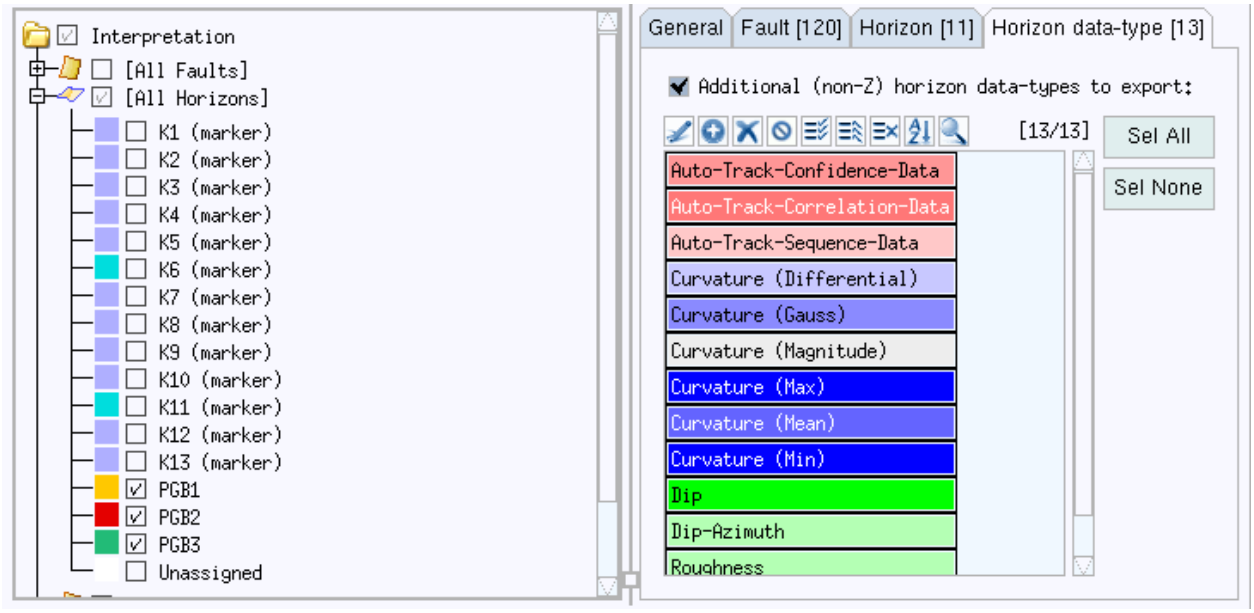
Fracture network attribute transfer

The Petrel and T7 export tool now support transfer of Fracture Network attributes. For Petrel, an option is also available to reproduce the T7 colormap for the Petrel attribute.



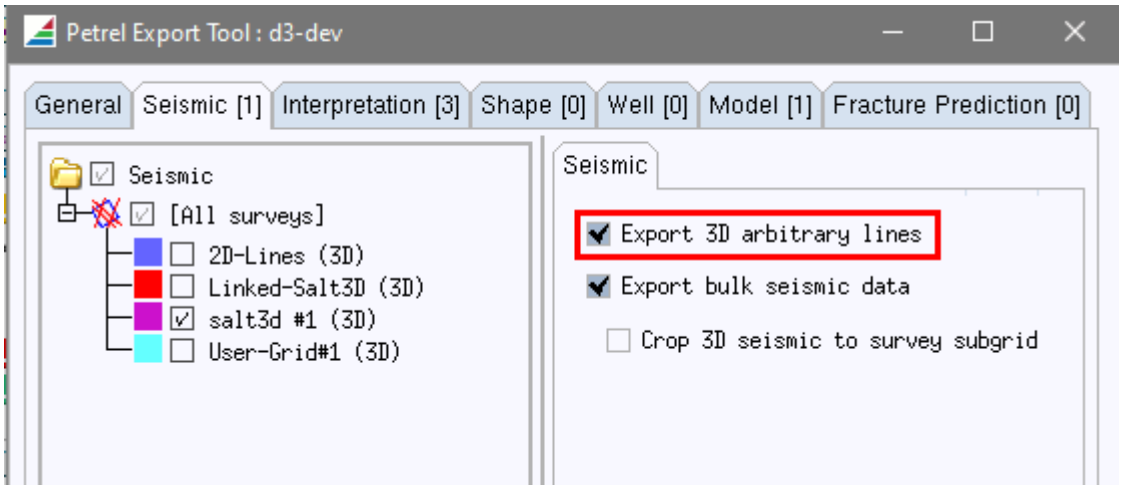
Horizon data-type transfer

The Petrel and T7 export tool now support the transfer of (non-Z) horizon data-types. In Petrel, these are created as Continuous Attributes.



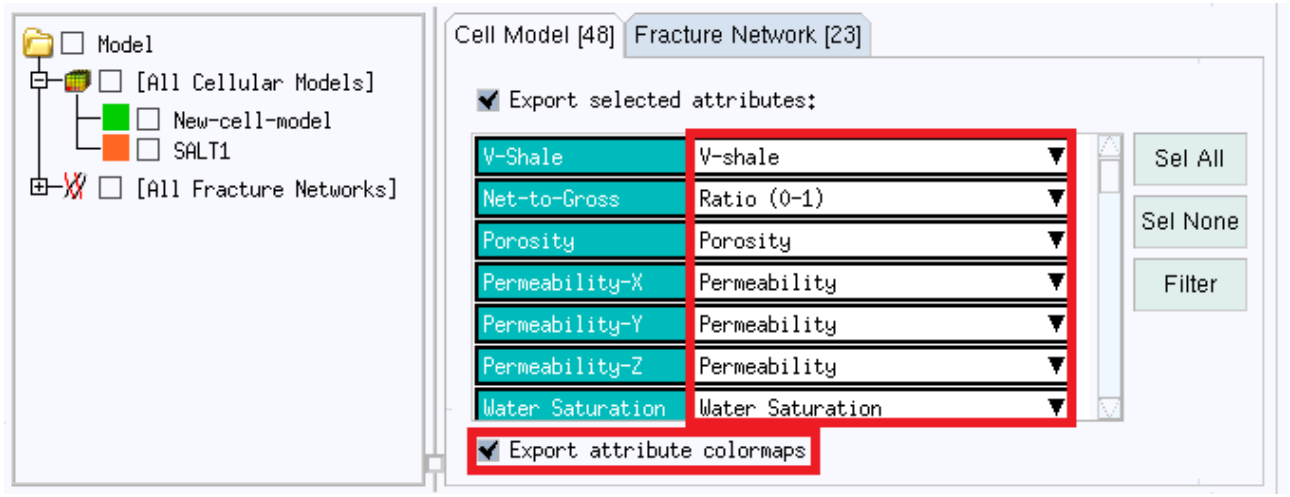
Arbitrary line transfer to Petrel

Previously, arbitrary line transfer was only available between T7 projects. The Petrel export tool has now been extended to allow arbitrary transfer to Petrel:



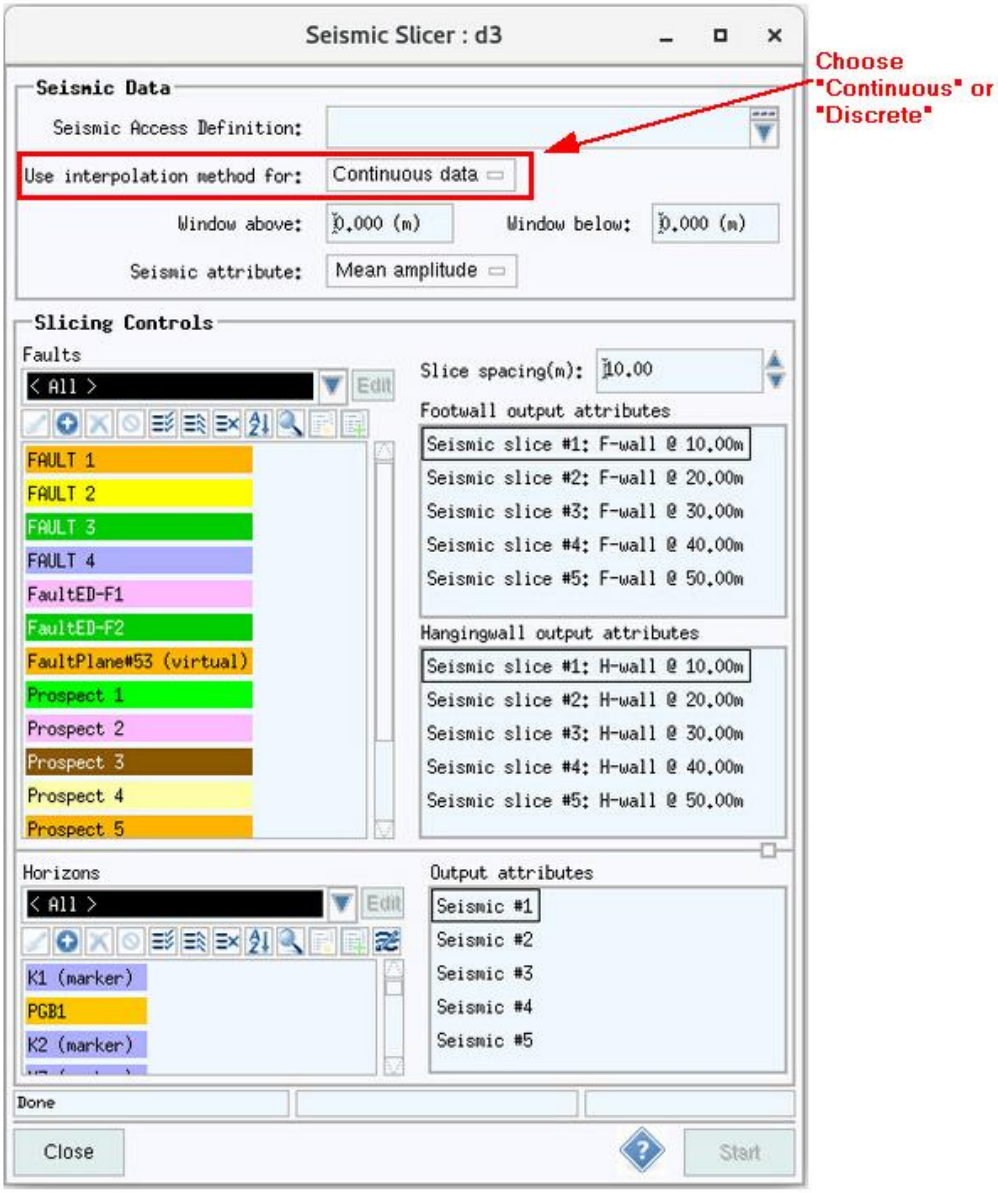
Colormap transfer for Cellular model attributes

An option is now available to transfer cellular model attribute colormaps into Petrel:



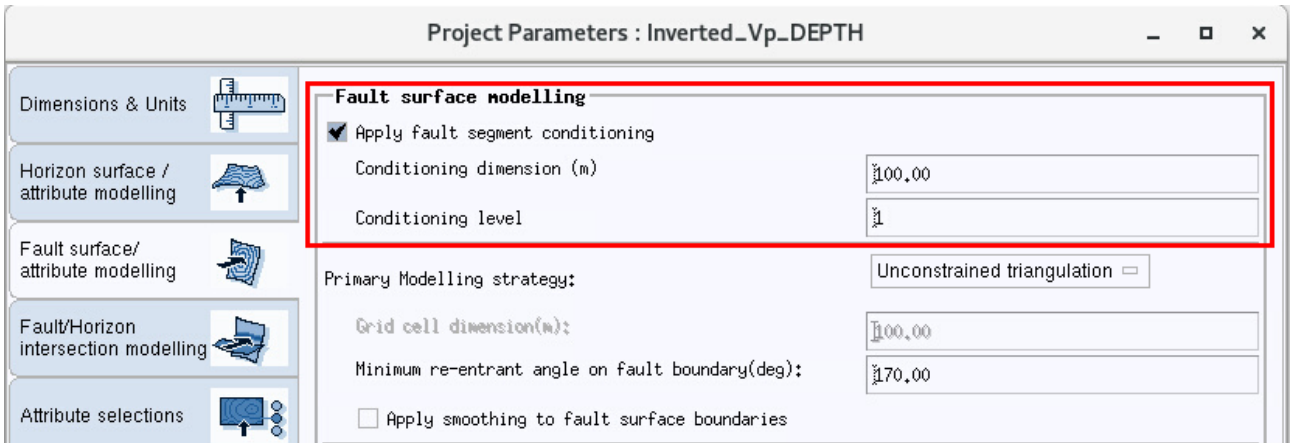
Seismic-Slicer: Interpolation for Discrete Data

The Seismic Slicer tool is used to sample seismic data at fault and horizon surfaces. It is invoked via the Model & Map tab in the Volume Editor and accesses 3D seismic data through the specification of a Seismic Access Definition. The results can be displayed on the faults/horizon surfaces in the Volume Editor as attributes using an appropriate Display Method. The process of sampling the 3D seismic volume on to the chosen fault and/or horizon surfaces has been extended to permit the tool to operate with 3D volumes that contain discrete data (eg. lithology type). This new sampling option will retain any discrete nature of the data in the volume by using a “nearest neighbour” approach rather than interpolation.

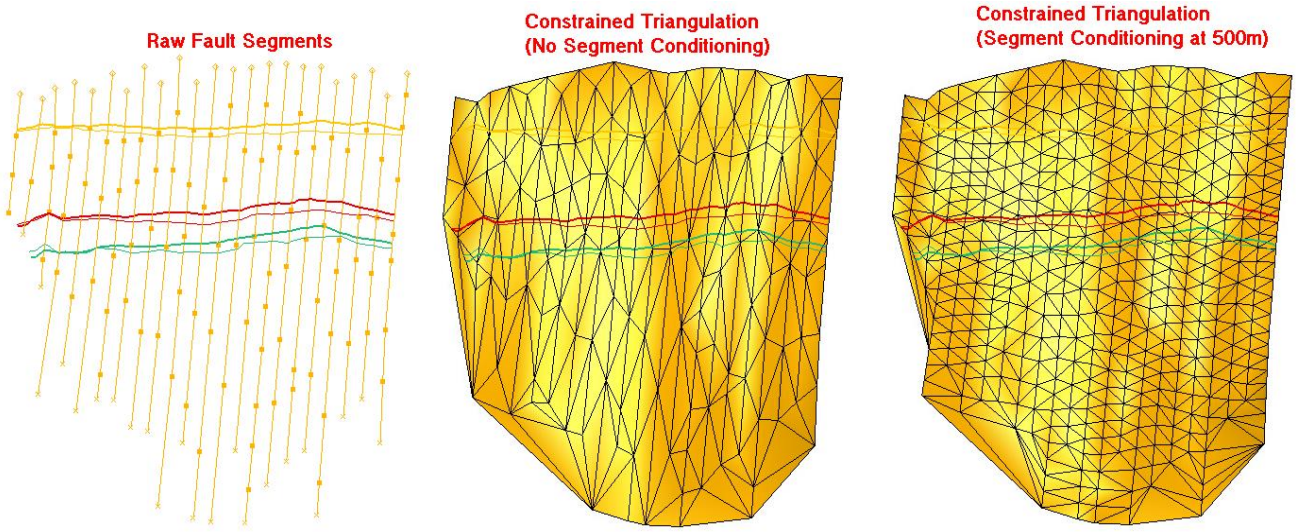


Fault Meshing Parameters: Fault Segment Conditioning

Both the new Fault-Specific Meshing Parameters and the corresponding section of the Project Parameters (shown below) hosts a new set of controls referred to a Fault Segment Conditioning.



When the Fault Segment Conditioning is enabled it results in any Fault Segments, that act as raw data input for the creation/update of a Fault Surface tri-mesh, being re-sampled at the chosen dimension and chosen level of smoothing. The resultant tri-mesh is then guided by these modified segments. This process has most impact when using the constrained/unconstrained triangulation methods for surface modelling and when the picked Fault Segments have few points.

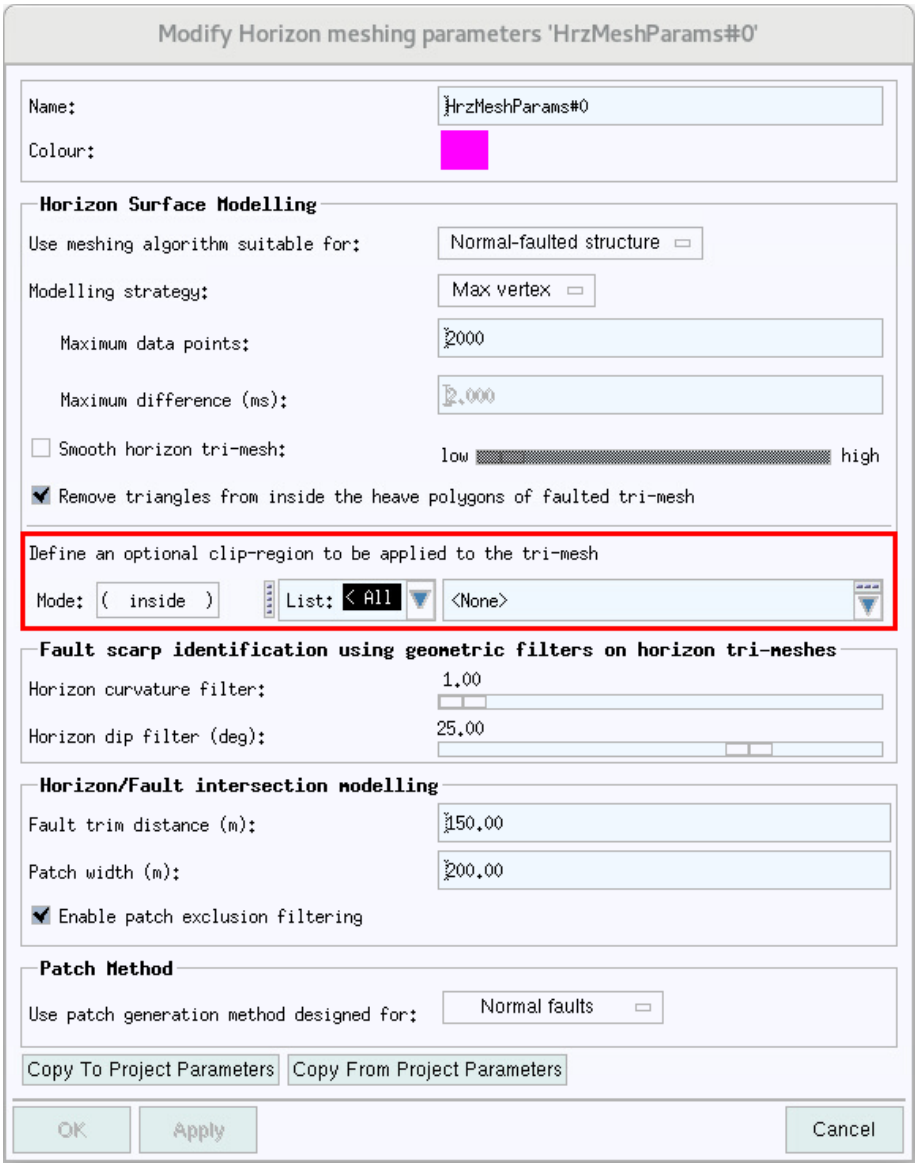


Note that the modification to the Fault Segments is not applied to the segment data as stored or as displayed – rather it is applied temporarily at run-time solely for the surface modelling process.

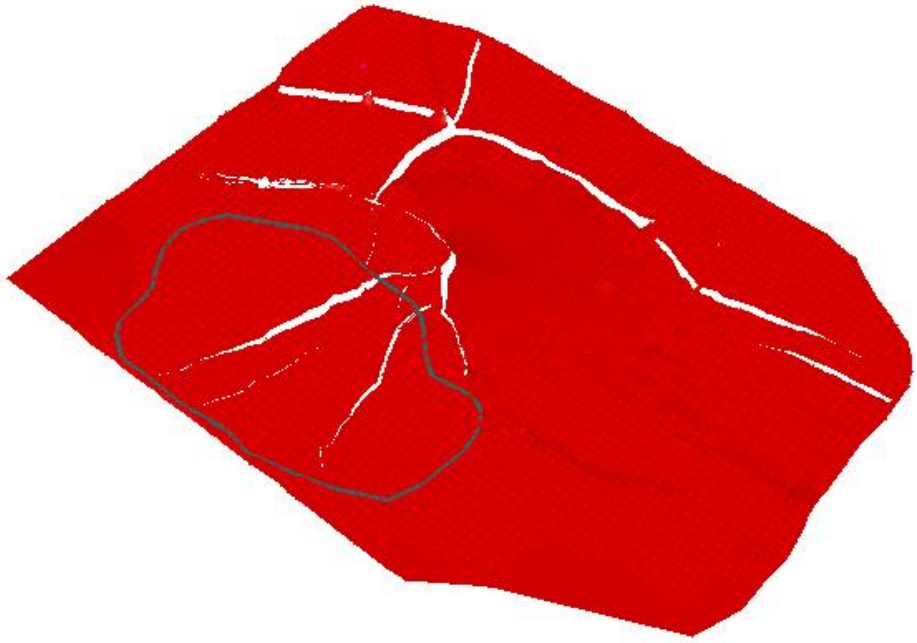
Horizon Meshing Parameters: Surface Clip Polygon

The Horizon Meshing Parameters have been extended to include the optional specification of a clip-polygon to constrain the extent of a modelled horizon tri-mesh. Horizon Meshing Parameters can be assigned to one or more horizons and are used when the surface tri-meshes for those horizons are (re)modelled; they can be created and managed from the Database Explorer and can also be accessed and assigned for a horizon selection in the Volume Editor.

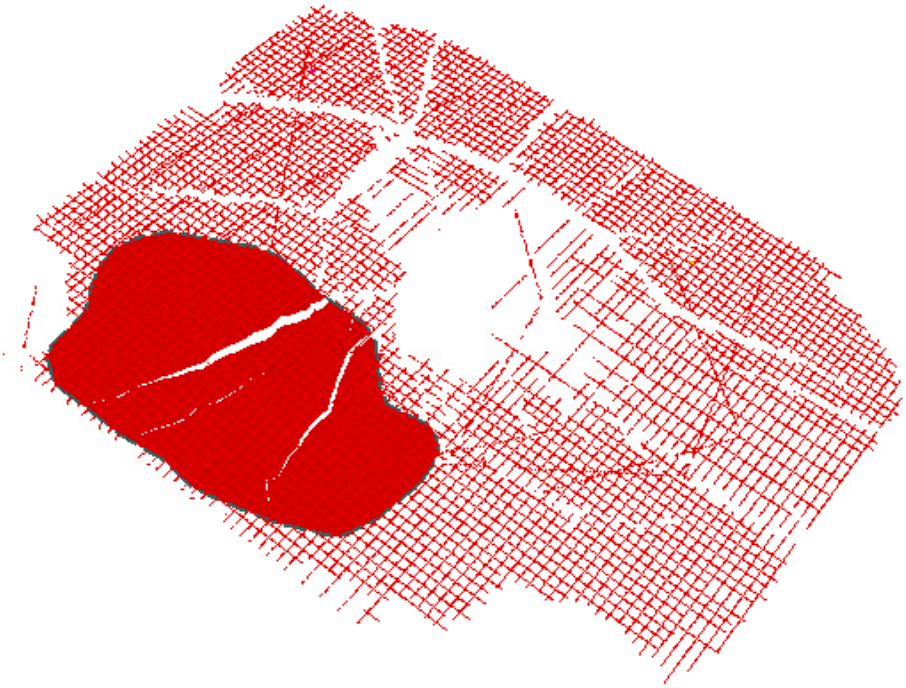
The specification of a clip-polygon can be used to force the horizon tri-mesh to be constrained to a particular geographic region within the extent of the raw data that would otherwise be used to create the surface tri-mesh. The clip-polygon itself can be a single Polygon Shape or it can be a Polygon-Set Shape (a group of polygons that act together).



The clip-polygon is applied to the horizon surface in map view and need not itself lie immediately at the level of the horizon data. The below example shows a horizon tri-mesh before and after the application of a clip polygon set in the Horizon Meshing Parameters. Note how the vertices that make up the clip polygon (as projected to the un-clipped surface) are included in the clipped tri-mesh.



Horizon surface tri-mesh covering all raw data, polygon not set as a clip-polygon

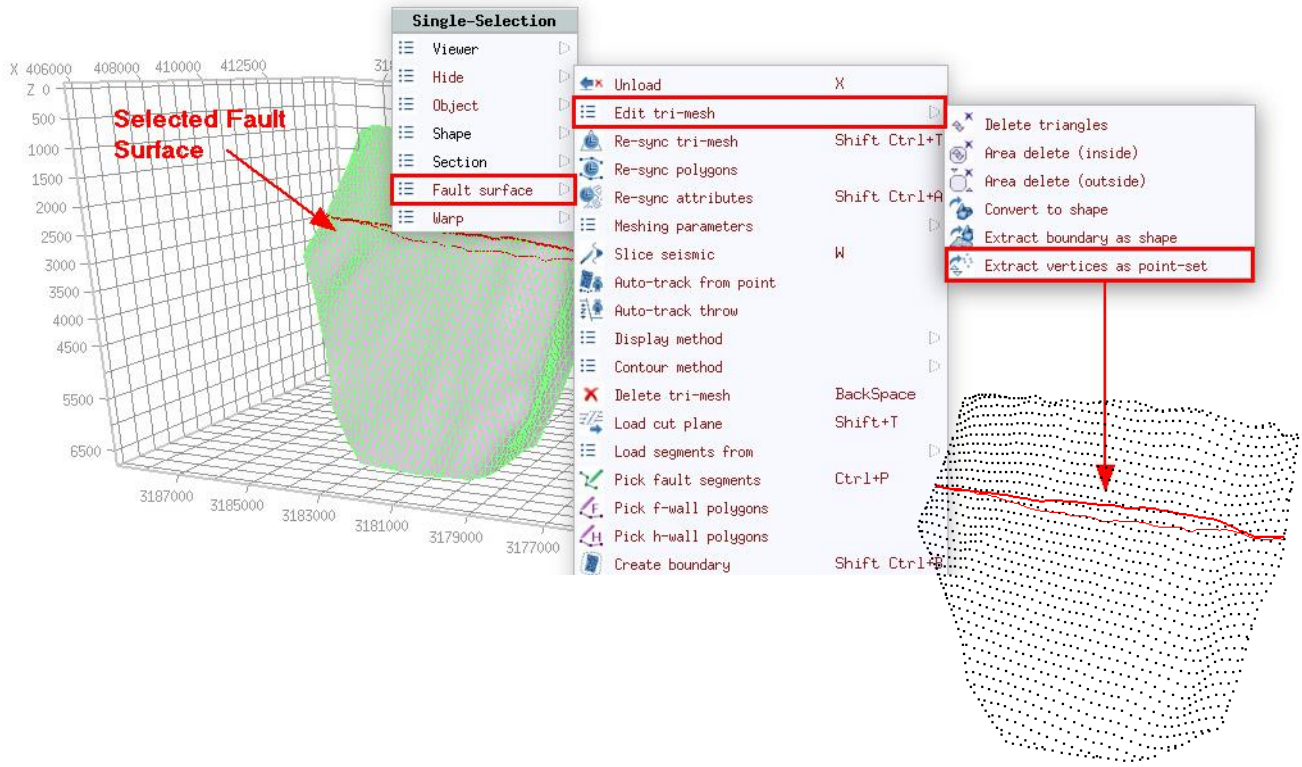


Horizon surface tri-mesh re-modelled with polygon set as clip-polygon

Point-Set: Creation from Fault/Horizon Tri-mesh

It is possible for Fault & Horizon tri-mesh surfaces to be imported into T7 without any supporting raw data (eg fault segments, point-set data). In such cases, if a tri-mesh is deleted it is not possible to recreate it as there is no raw data from which to do so.

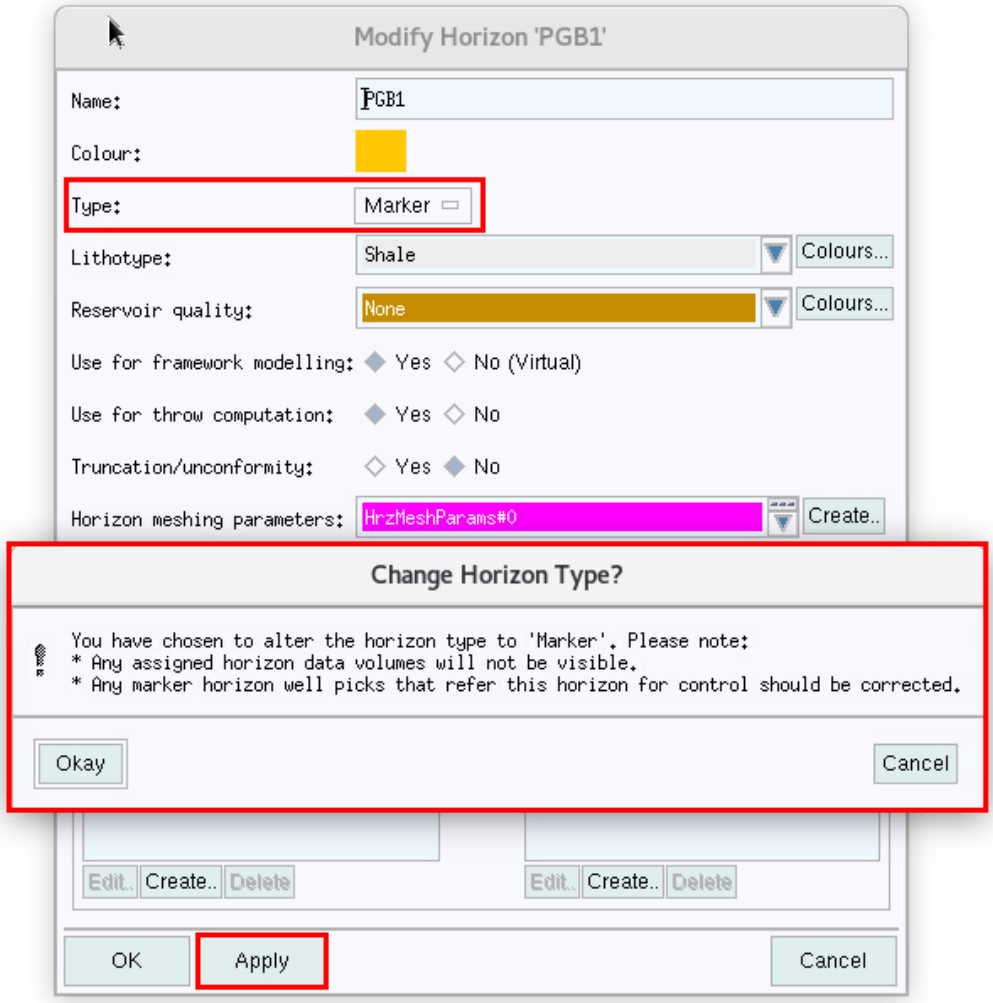
A new option has been added to the Fault & Horizon surface tri-mesh editing popup-menu in the Volume Editor to permit the surface tri-mesh vertices to be extracted as a point-set. This action provides a means of recreating the tri-mesh from the new raw data if required and also gives access to the point-set functionality – such as editing, export etc.



The point-set(s) created will replace any that may have already existed for the selected fault(s) or horizon(s).

Horizon: Editable Primary/Marker Type

One of the fundamental properties on a Horizon in T7 is its “Type”: primary or marker. A primary Horizon is one that may be picked on seismic and whose modelled tri-mesh surface is defined by its raw data. A marker Horizon is one that is defined solely by specific rules on well picks; it does not support raw data (eg interpretation data, point-set data). Up until this release the primary/marker type of a Horizon was set upon creation and could not be modified. With this release it is now permitted to modify this setting. This enables a surface tri-mesh (and fault polygons) belonging to a marker Horizon to be easily altered to belong to that of a primary Horizon where it then gains the ability to host raw data. The act of switching a primary Horizon to be a marker Horizon, though permitted, has less obvious benefits and comes with the warning that any existing raw data belonging to the Horizon (in its primary state) will not be accessible when its type is changed to marker.

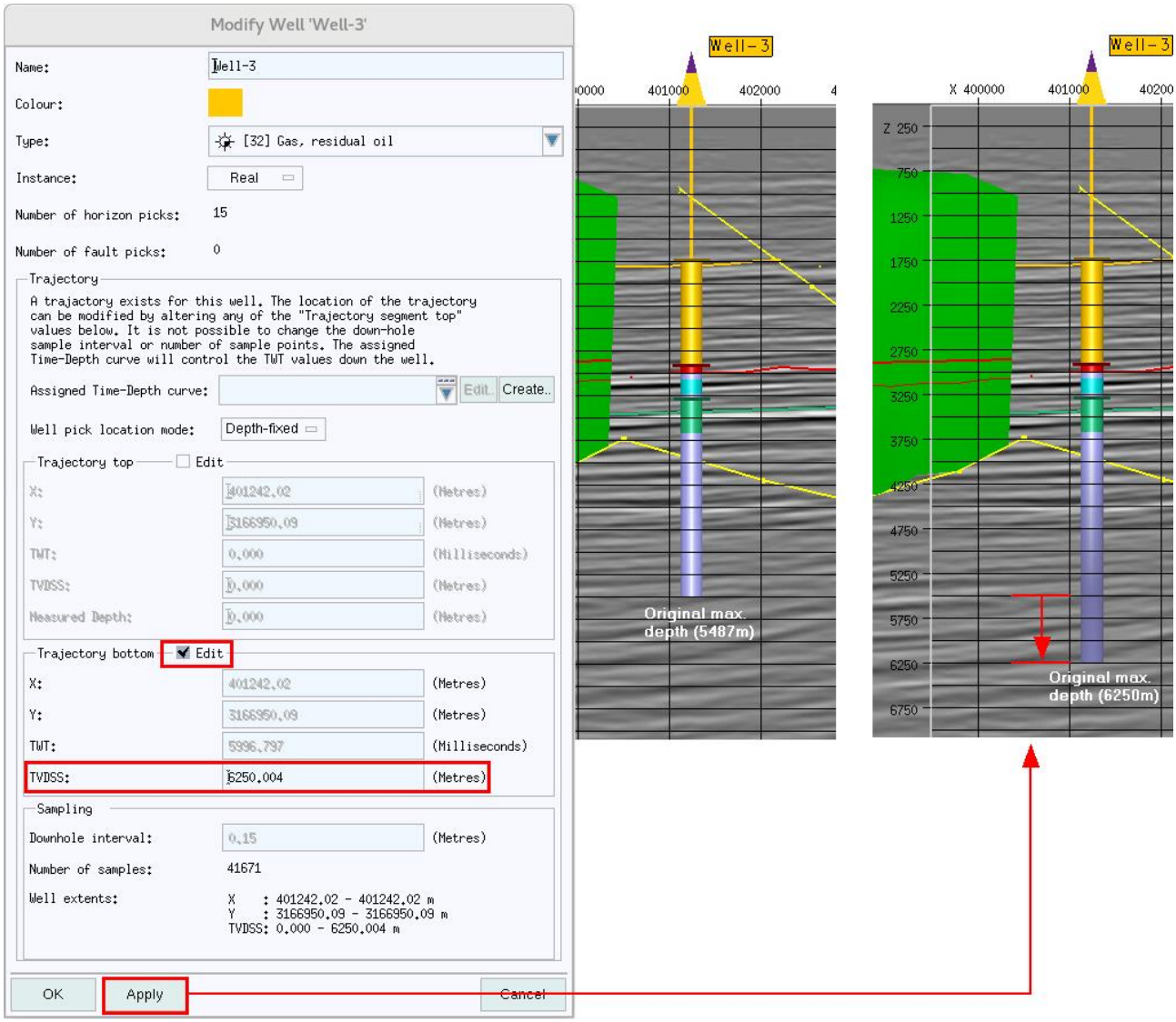


Well: Trajectory Extension

T7 uses well data to assist in modelling the structural framework by providing raw data in the form of horizon (both marker and primary) and fault picks. Well log data is a vital component to fault and fault-seal analysis and also to the cell-grid property modelling system. Well data can originate from a variety of sources: ASCII import, direct import from Petrel, DecisionSpace or from another T7 project. Well data can also be created in T7.

On occasions the well trajectory can be shorter than is required for the purposes of projecting attributes on to faults or for hosting horizon picks that will help define the framework model. Up until now, this has been a difficult problem to work around and has required a significant effort for the user to create a new well of the required depth and then copy the picks and log data on to it.

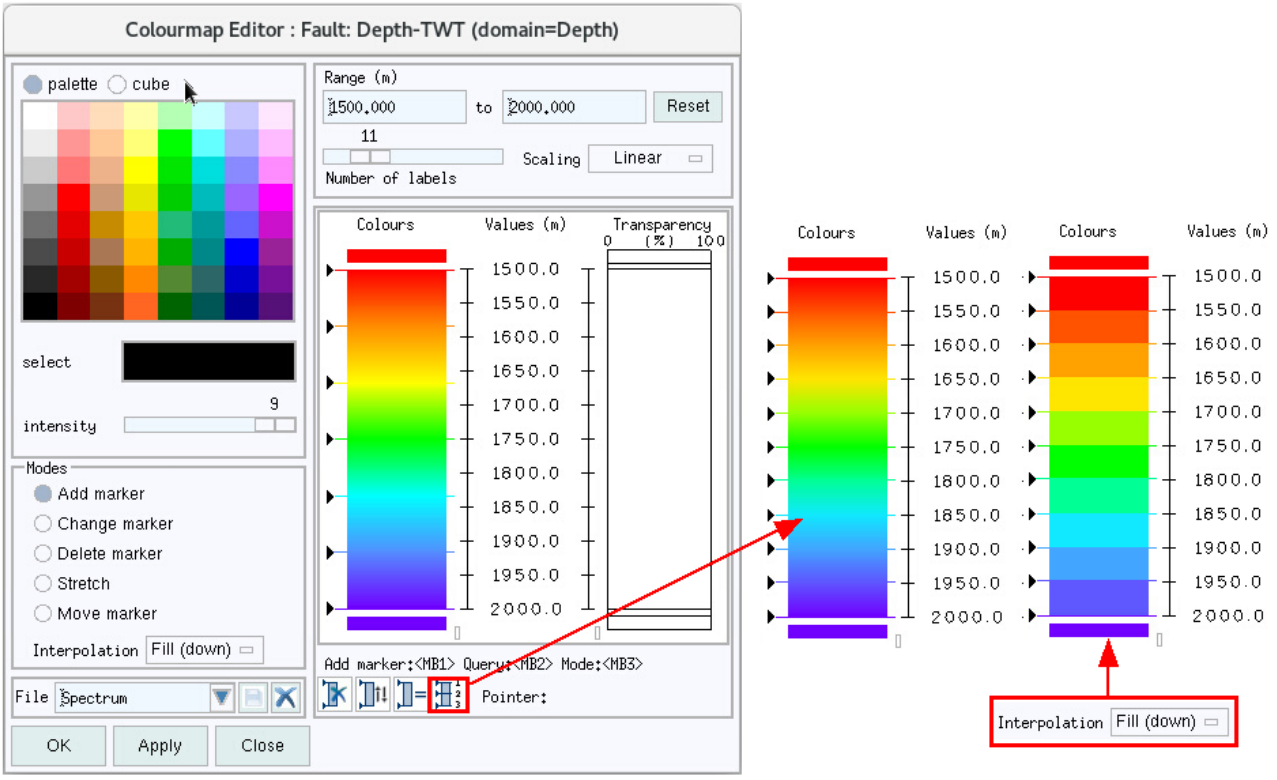
The 7.2 release includes a system to allow for the natural extension of a well trajectory – simply by using the Well edit window (in Database Explorer) to specify a new bottom depth value.



The well trajectory is extrapolated to the new bottom depth value. Well picks and well log data can then simply be moved, copied or added in the extended trajectory.

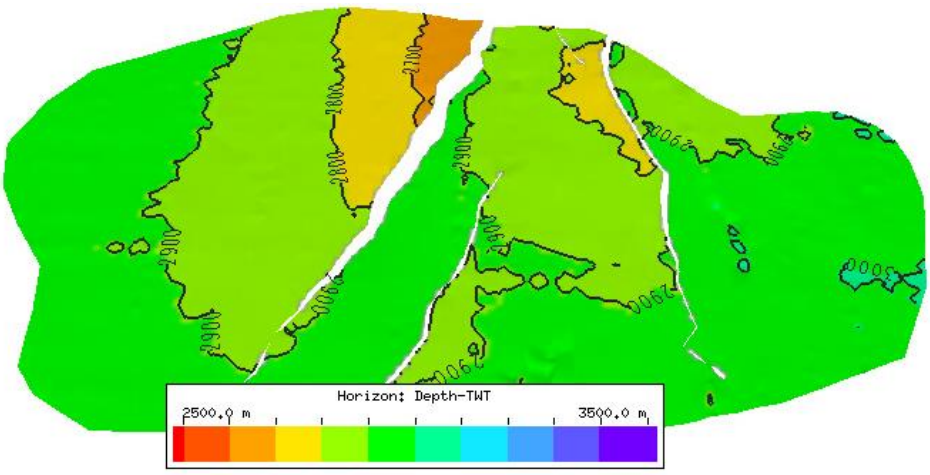
Colourmap Editor: Set Markers at Labels

This new option in the T7 Colourmap Editor simply provides a function to set the colourmap marker loccations to the current label points. This is a useful tool when using a block-fill colour map that is originally based on a smooth gradation as illustrated below.



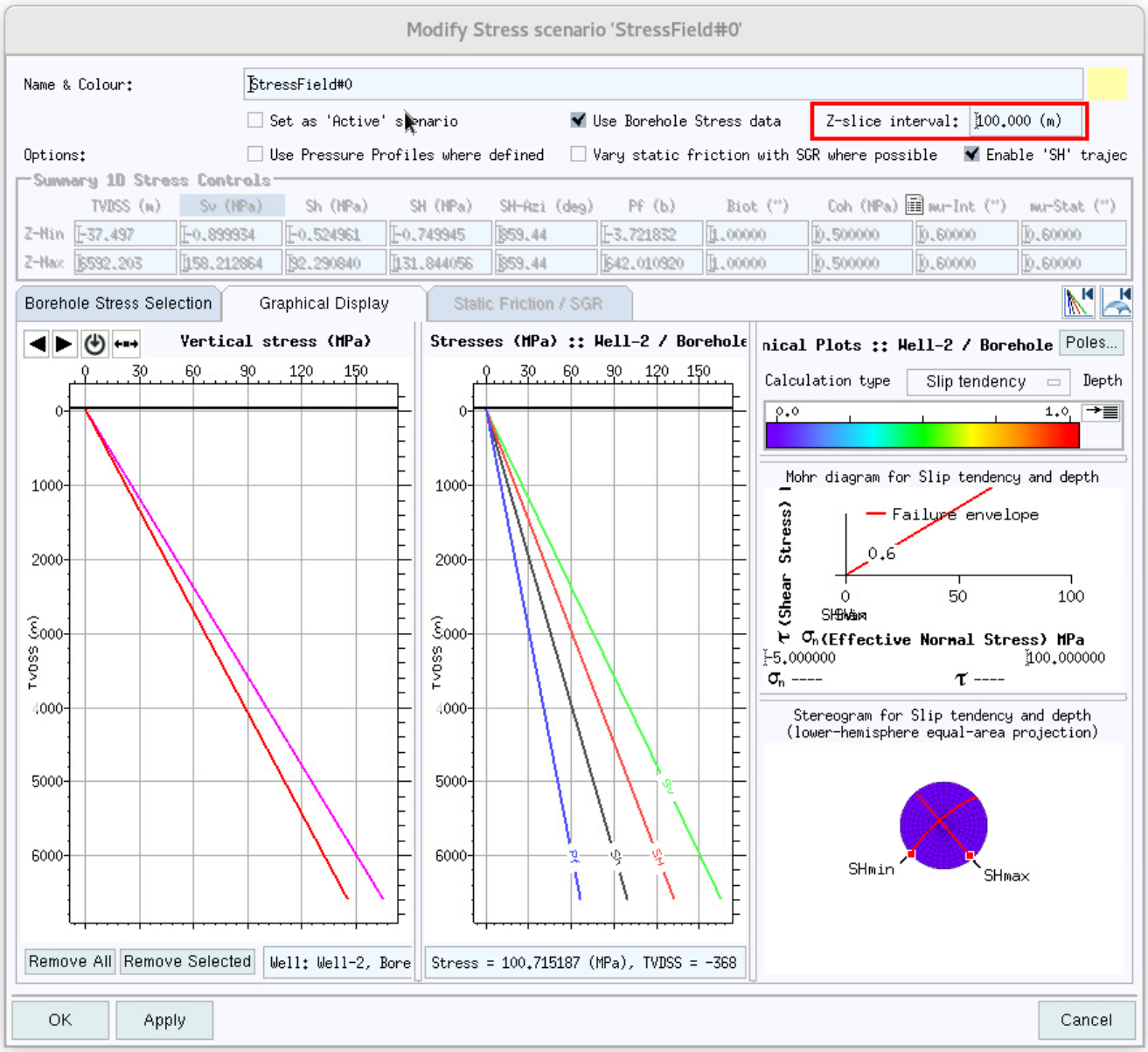
1. An initial colourmap is loaded, the range and number of labels (11 above) set as required.
2. The new *Set Markers At Labels* function is used to replace the existing markers with new ones at the location of the labelling points. The marker colours are set to the colourmap colours at the labelling points.
3. Set the interpolation mode to *Fill (down)* or *Fill (up)* to create a block fill colour map.

This process can be used to create a colourmap that can be used to compliment a contour display by using a block-filled colour between contour lines (as shown below for a Horizon Surface).



3D Stress Scenario: Z-Slice Interval

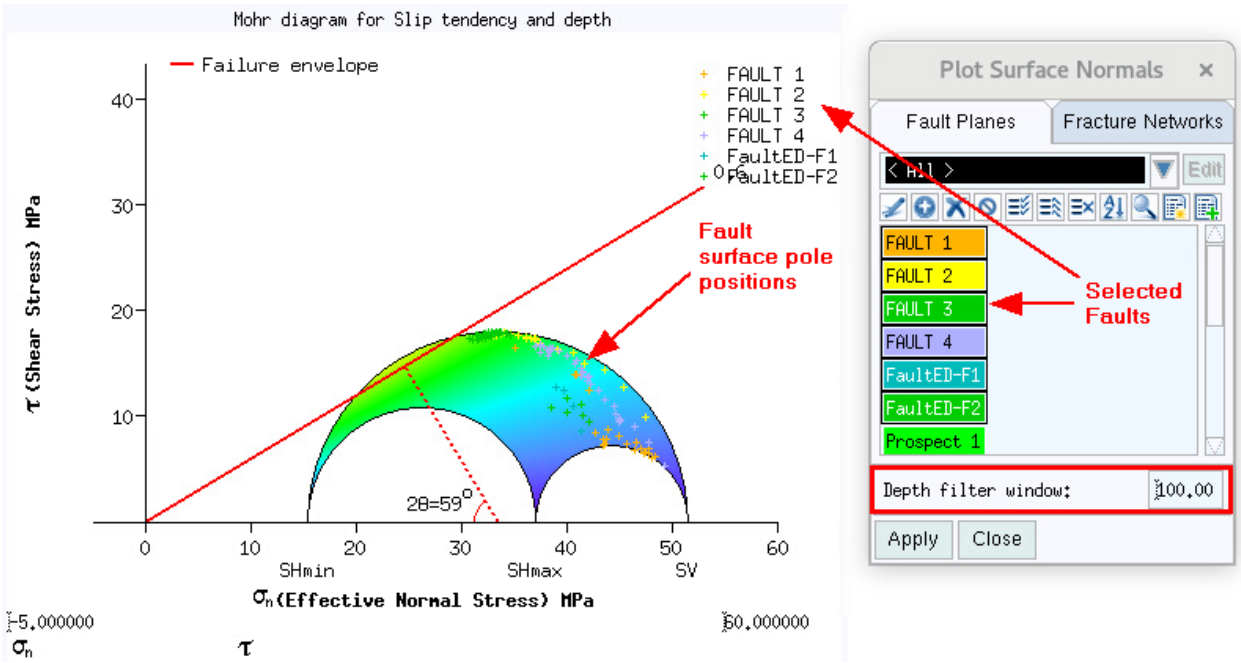
The 3D Stress Scenario has been provided with an additional option to enable the resultant 3D stress-field to be computed in a manner independent of the faults and/or horizons for which the stress attributes may be generated.



The new *Z-Slice interval* is used internally when the 3D stress-field is configured. It is not relevant when using the Summary 1D controls. It specifies the vertical resolution of the interpolation surfaces that are created for each of the "components" (Sv, Sh, SH etc) whose profiles are defined by the assigned Borehole Stress data.

3D Stress Scenario: Pole Plot Depth Filter Window

Both the 3D Stress Scenario editor and the Borehole Stress editor include geomechanical plots – that is, a Mohr diagram and Stereogram. The plots indicate the result of the current stress field settings at the currently defined depth. It is possible to display the location of fault (or fracture network) surface normals (or poles) on these plots to provide a comparison of the orientation of a particular fault surface with the calculated geomechanical attribute at a specified Depth. An example Mohr diagram showing the poles to a selection of Fault Surfaces is shown below.



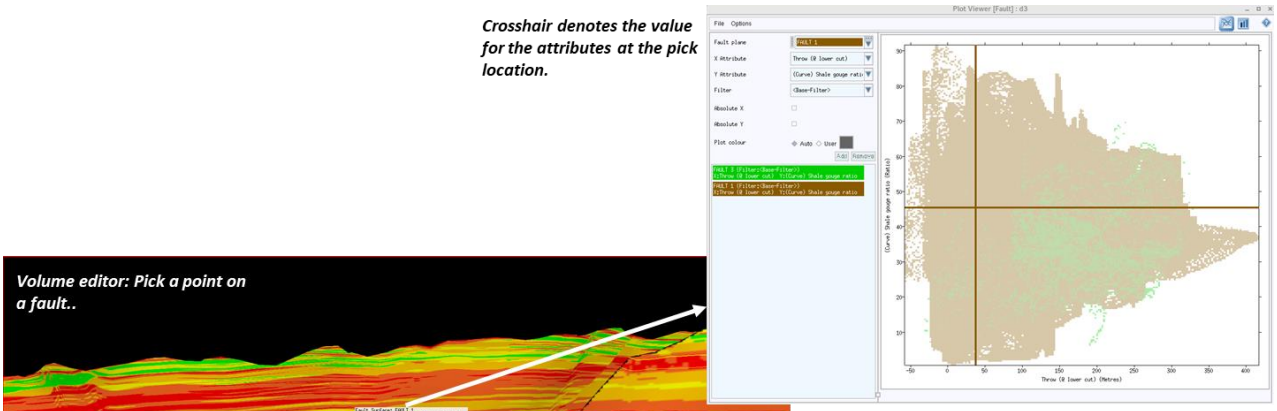
The new Depth filter window is applied to the poles such that only those poles whose surface location is within the Depth filter window either side of the current calculation depth are displayed. This provides a more meaningful representation of the fault orientation at the calculation depth.

Plot Viewer: Cursor Tracking Function

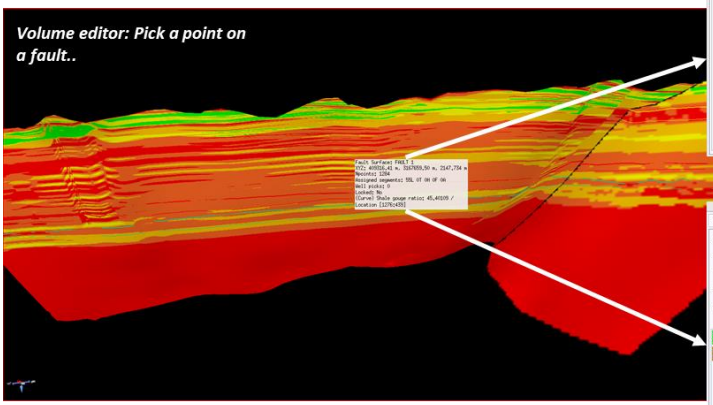
Any picking/query events in other applications are now passed to Plot Viewer, and if relevant to the object whose data is being displayed (e.g. for a fault/horizon surface attribute), the relevant data point (or ranges) will be highlighted in the plot. This can prove very useful during the data interrogation phase of a project. For example, it is often desirable to see how the data at a specific location on an object (e.g. at a point on a fault surface in Volume Editor) relates to the spread of data for the entire object (see below).

When data is plotted as a Cross-Plot, a cross-hair is focused on the data value (in terms of both plotted attributes) that corresponds to the pick point on the geological object. When data is presented as a Frequency-Plot, the relevant data range (into which the data at the pick point belongs) is highlighted.

Crosshair denotes the value for the attributes at the pick location.



Volume editor: Pick a point on a fault..

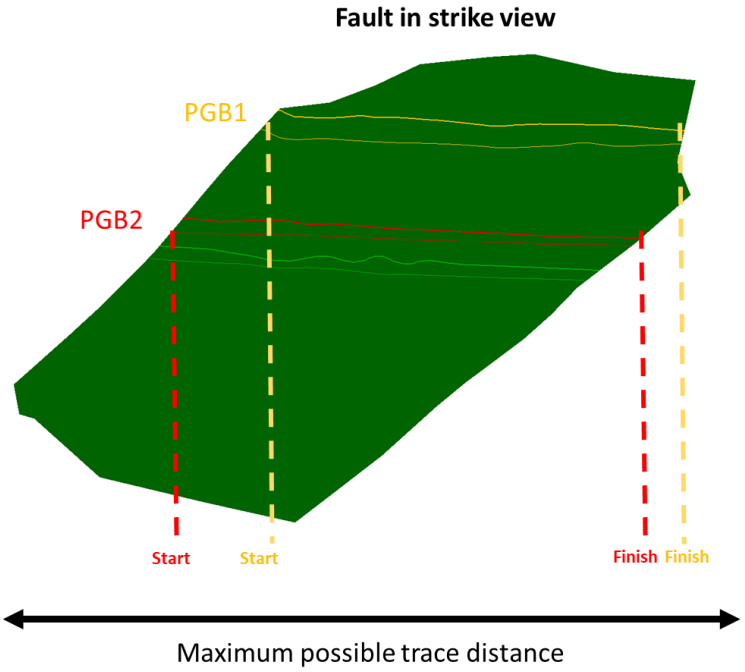


The highlighted column denotes the data range to which data at the pick location belongs.

Fault Statistics: Displacement Profiles In Terms of Distance Along Fault Trace

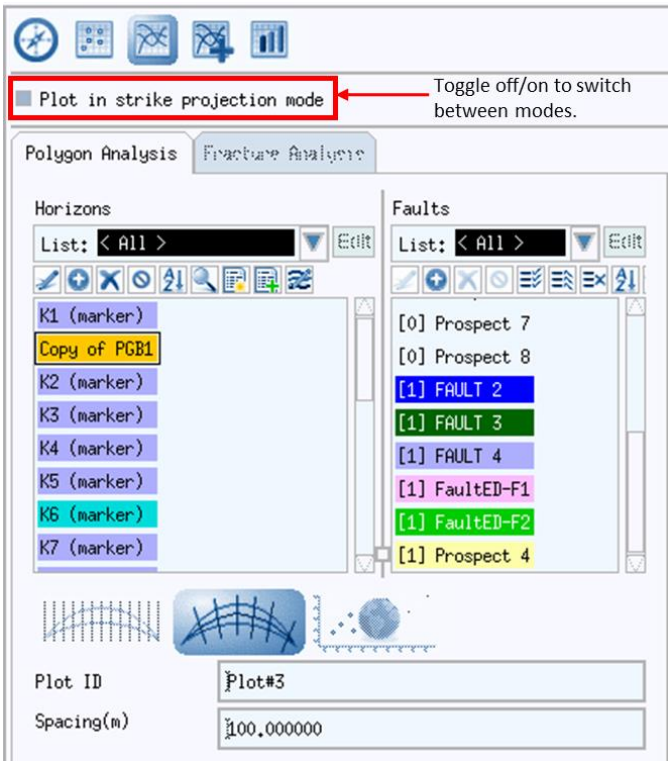
A new option is available in the fault-displacement profiles tool. In this tool fault displacements are plotted based on sampling (e.g. throw/heave) of the polygon pairs (hanging wall and footwall) for a given horizon along a fault. Previously, these could only be plotted in terms of length along the polygons not in terms of their position relative to the start and end of the maximum possible fault trace. This can make it difficult to compare the displacement for different horizons on the same fault (*i.e.* the fault outline is not rectilinear so some horizons polygons may have different lengths).

We can see this below. Here the PGB1 and PGB2 polygons start and finish at different locations along the faults maximum trace distance.

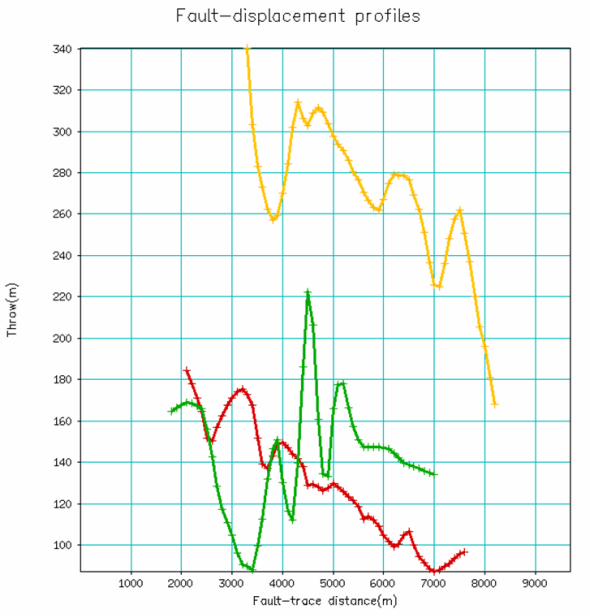


Therefore, each displacement value for the profile is plotted in terms of its distance along the respective polygon “trace”.

A new option is available for the Fault-Displacement Profile tool: “Plot in strike projection mode” toggle. When toggled ON, the data for each polygon displacement analysis point are plotted in terms of their respective position along the fault trace length (trace is curvilinear in map view). The polygon displacement data for all horizons on the same fault have the same reference frame (coordinate system) making direct comparison possible.



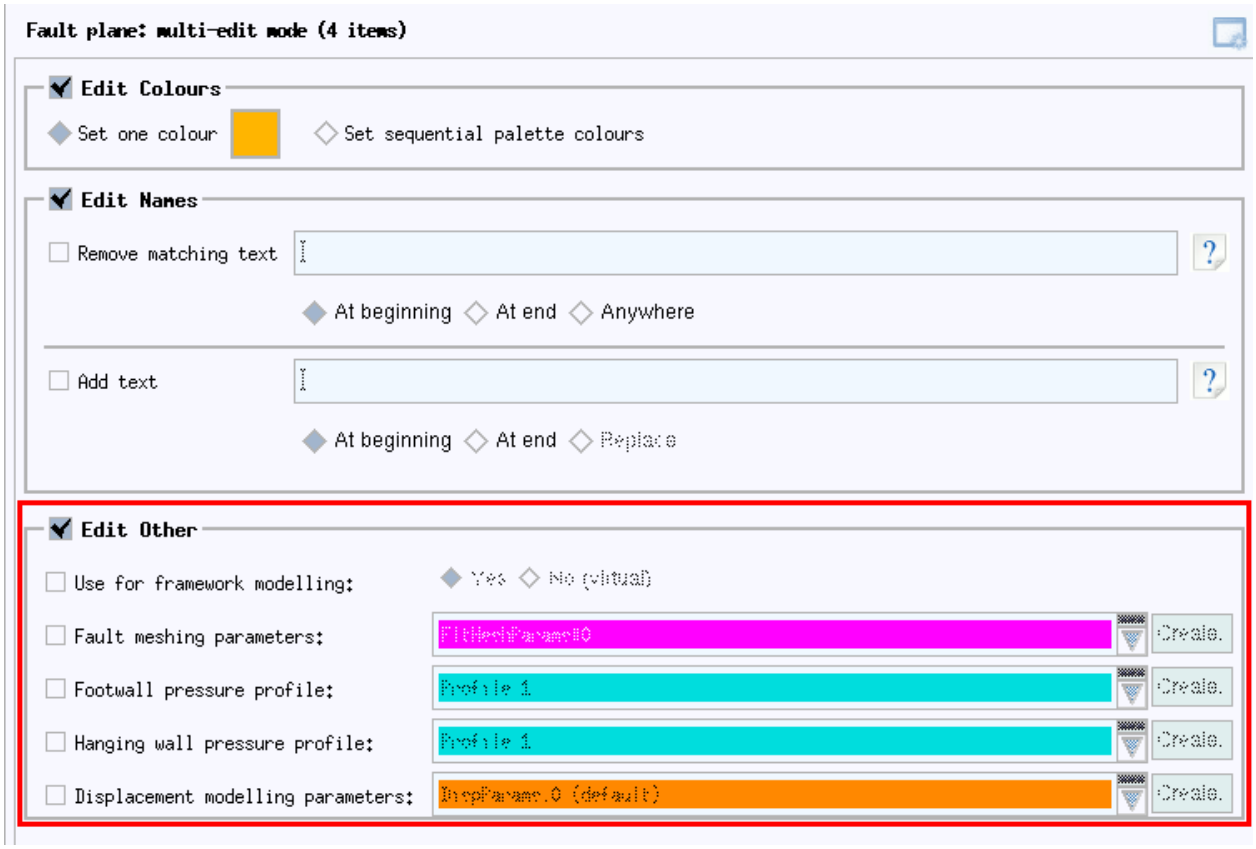
The same data plotted using the “Plot in strike projection mode” ON:



USABILITY IMPROVEMENTS

Database Explorer: Improved Multiple Object Edit for Faults, Horizons & Wells

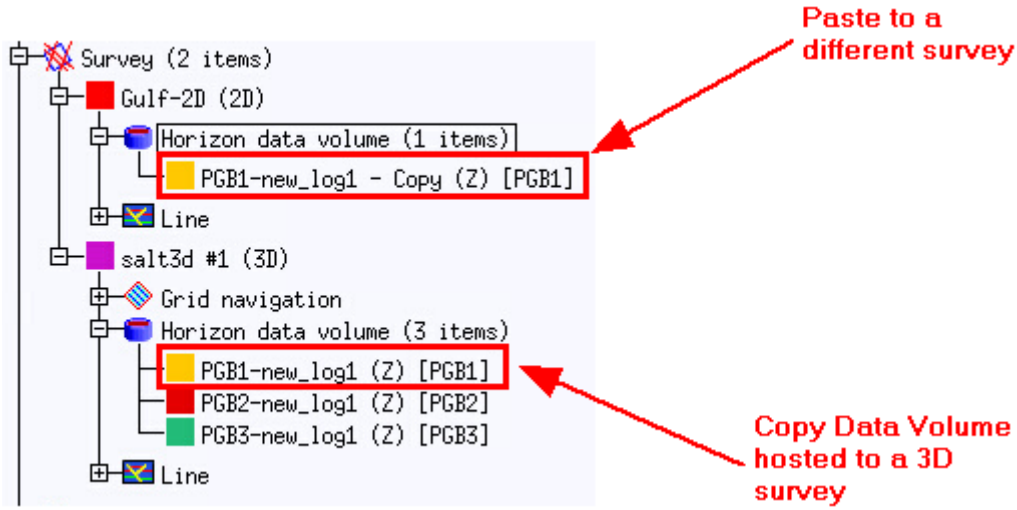
In addition to the new Object Managers, the Database Explorer Multi-edit mode has been augmented with object-specific controls:



Database Explorer: Horizon Data Copy/Paste Improvements

Horizon Data Volumes

The copy and paste provision in Database Explorer for Horizon Data Volumes has been improved to handle the act of copying between different horizons and different surveys. It is now possible to copy Horizon Data Volumes hosted to a 2D or 3D survey to a different 2D or 3D survey. The Horizon Data Volume stores horizon data according to the geometry of the parent 3D survey grid or 2D survey lines. When copied to a different survey, the data that is copied will be that from the source data that "fits" the new geometry defined by the target parent survey. For example, if copying a 3D Horizon Data Volume to a 2D Survey the data actually copied will be that from the source volume where the nodes of its parent survey lie on the Lines contained in the 2D Survey.

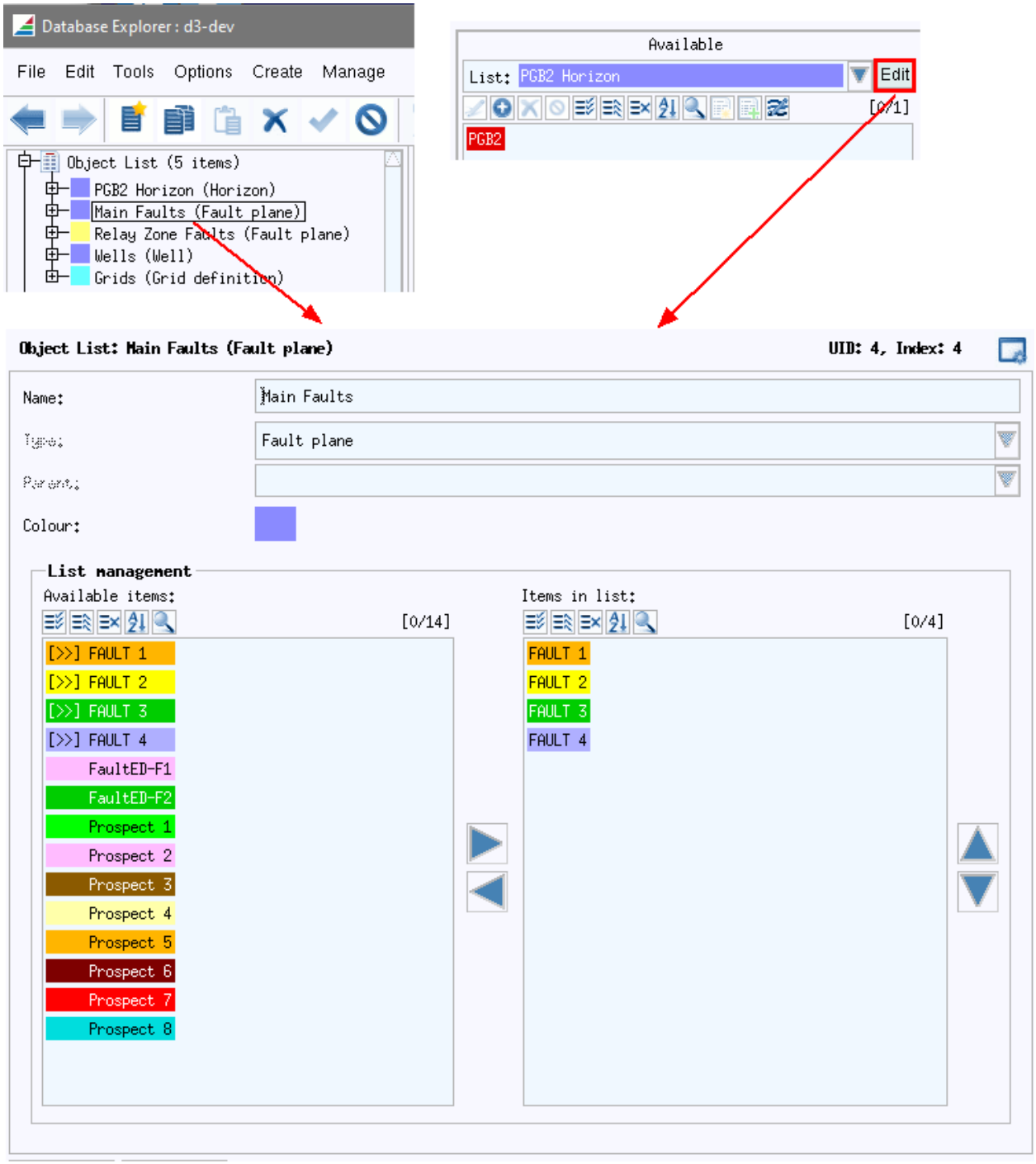


Horizon Attribute Texturemaps

The internal base-grids used for Horizon Attribute Texturemaps are different for each Horizon Surface and are controlled by the required resolution (in Project Parameters) and the geographic extent of the surface tri-mesh. The copy and paste provision in Database Explorer for Horizon Attribute Texturemaps has been improved to handle the act of copying between different horizons. The texturemap data is now re-sampled from the source horizon to the base-grid used for the target horizon.

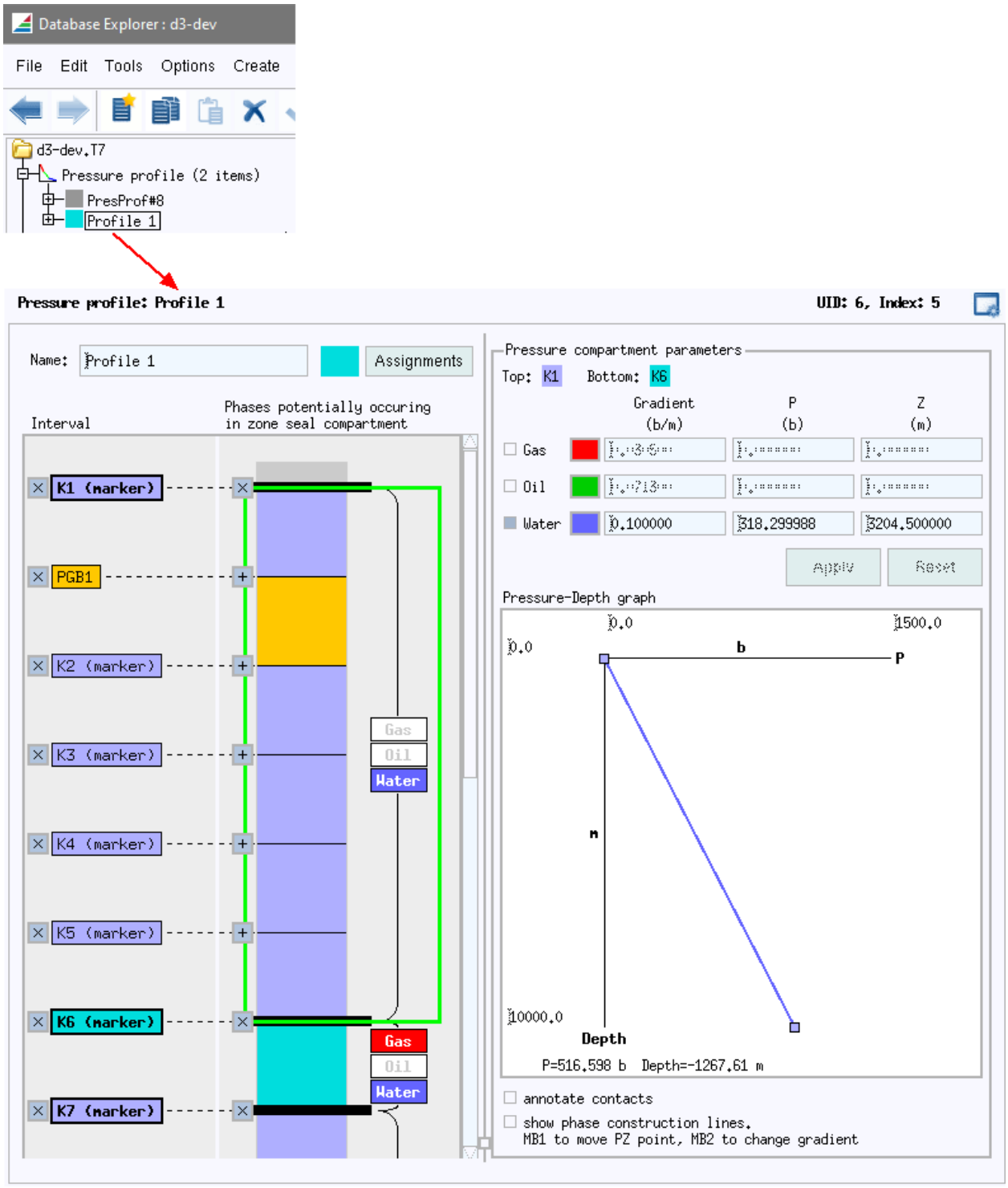
Database Explorer: Embedded List Editor

The List Manager dialog has been replaced with a list management interface embedded directly in the Database Explorer List editor:



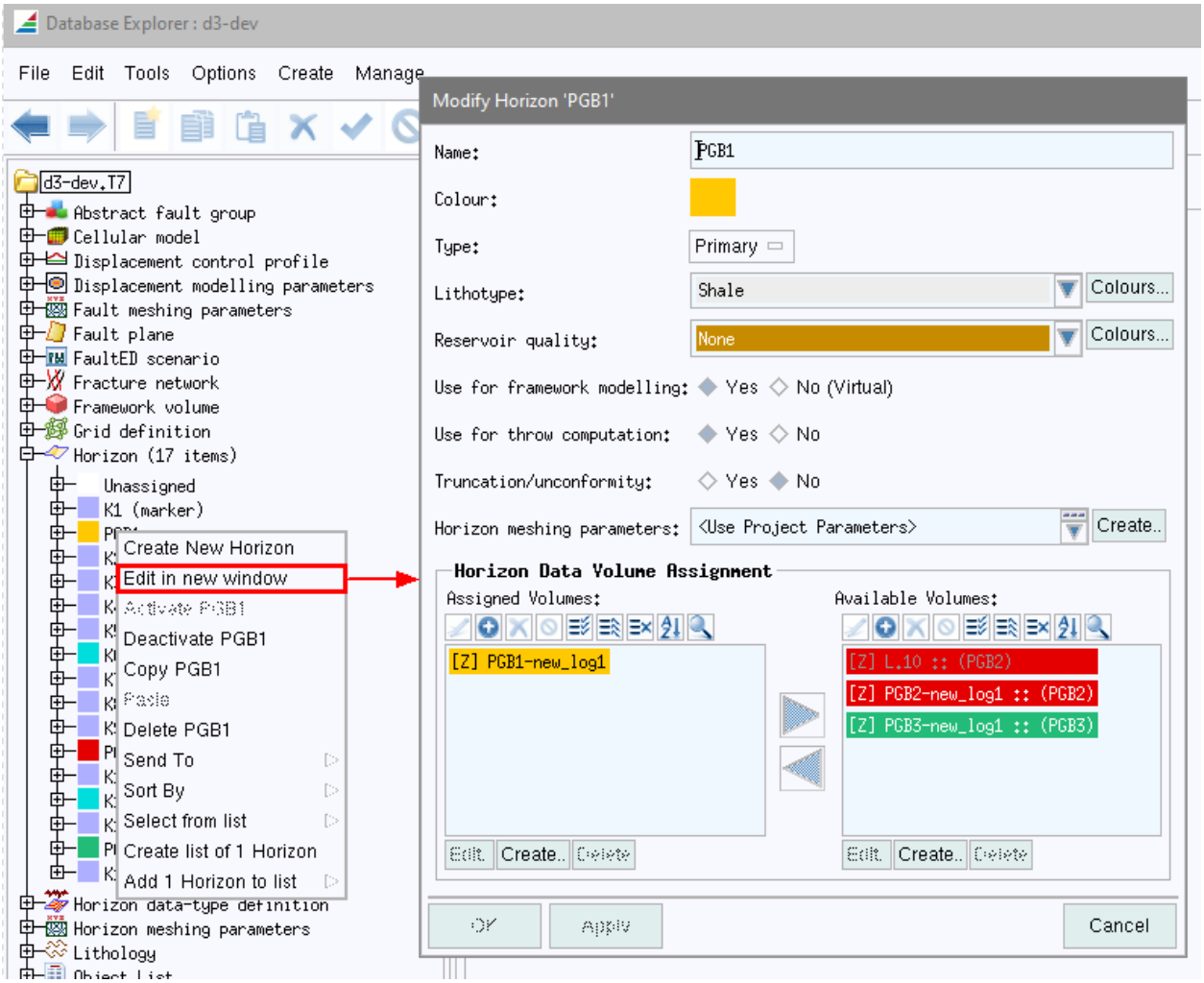
Database Explorer: Embedded Pressure Profile Editor

The Pressure Profile Editor application has been moved directly into Database Explorer:



Database Explorer: Edit in New Window Popup Menu Option

An option has been added to the Database Explorer context menu to display the editor interface for the associated object in a new window:

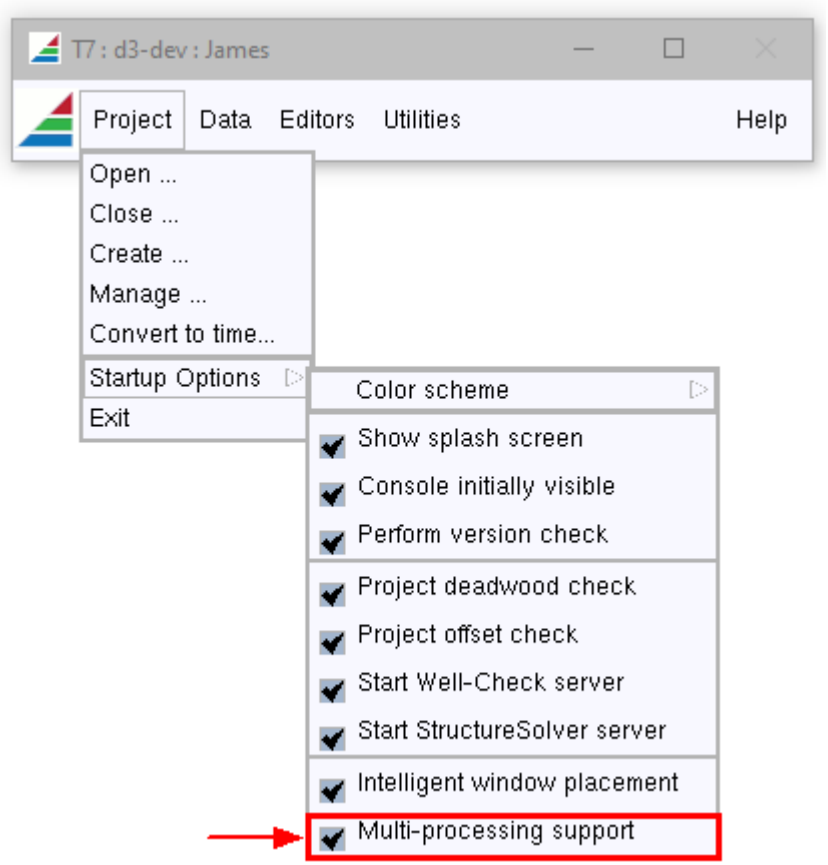


Control Menu: Startup Option for Multi-processing Support

Multi-processing has been gradually added to T7 over the years to reduce the time required for lengthy operations.

Whilst this is usually of benefit, there can be situations where using multi-processing is not appropriate, *eg.* when running other applications using multi-processing, or where processors are shared between multiple concurrent users.

Therefore a new option has been added to the Startup Options in the T7 Control Menu that allows multi-processing to be disabled:



Note that multi-processing can also be controlled in a more fine-grain manner using the following environment variable (or setting in the faps.conf configuration file):

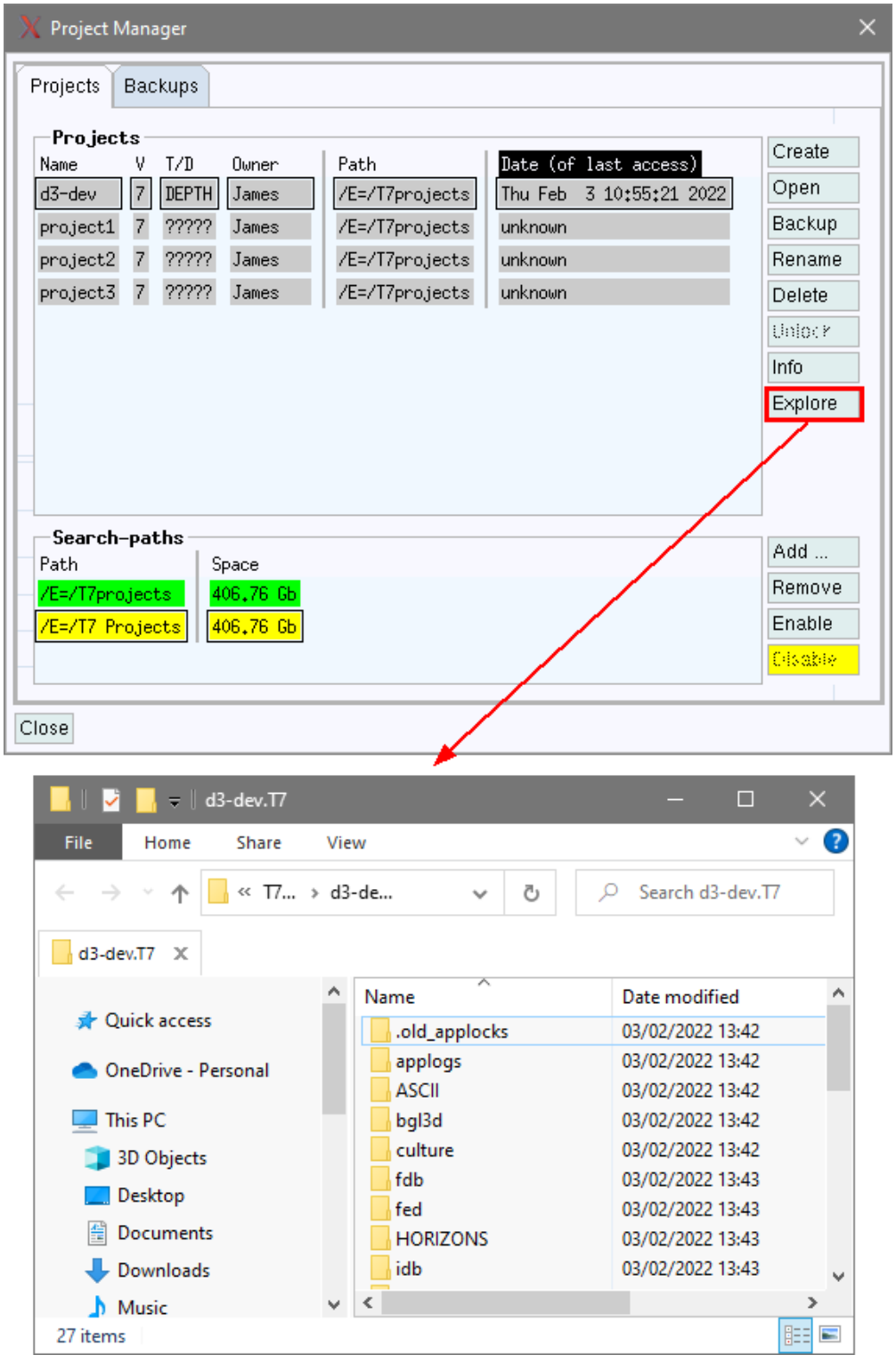
```
FAP_MT_NTHREADS
```

The variable value is numeric and specifies the maximum number of processors that will be used by T7 for multi-processing. If this variable is set it will override the option specified in the Control Menu interface.

Finally, new to T7 7.2, attribute generation and polygon sync now utilise multi-processing to reduce the time required for both operations.

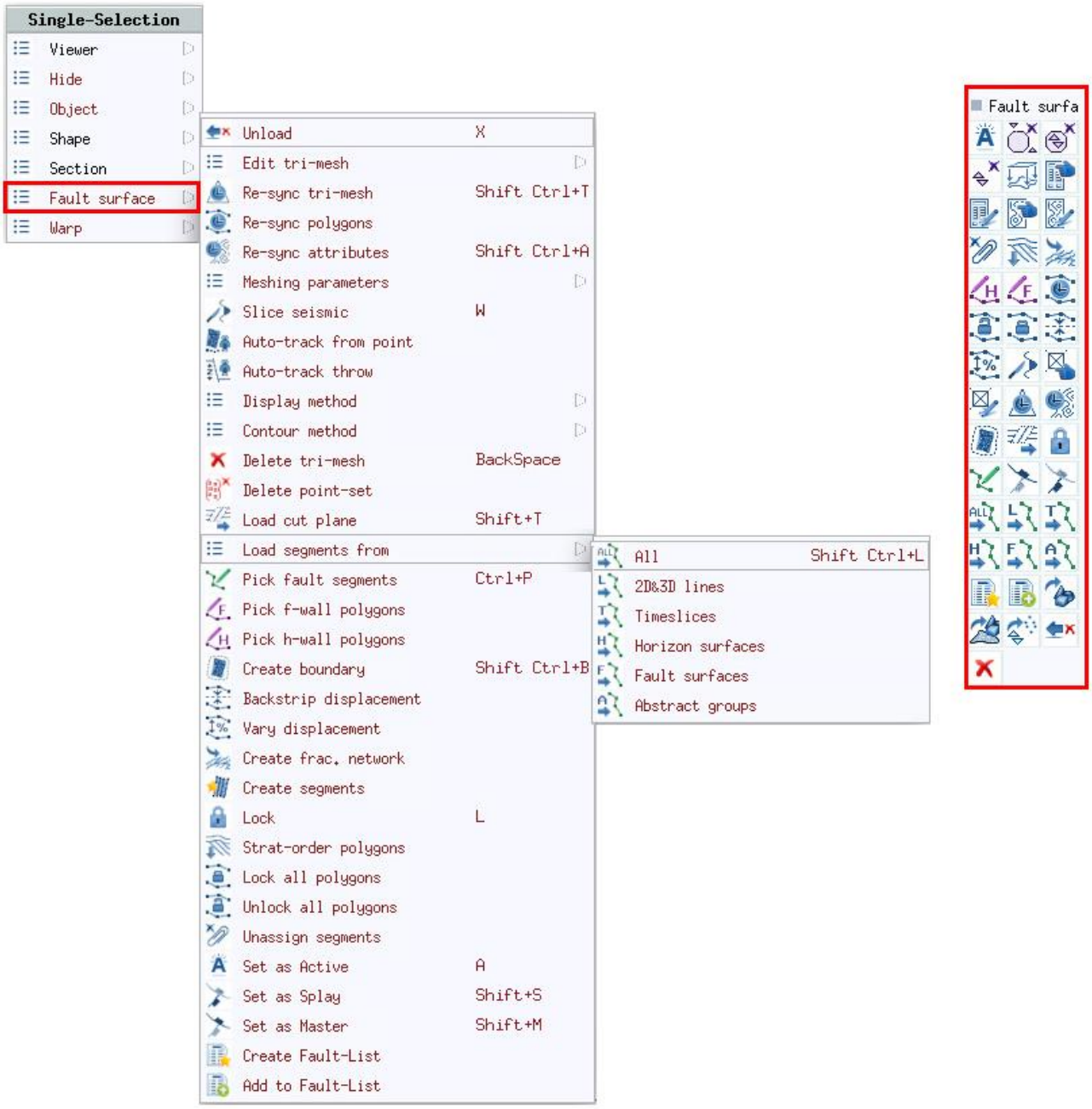
Control Menu: Project Manager Explore Option

A new **Explore** button is available on the Projects and Backups tabs in Project Manager that will show the project/backup folder in the operating system file browser:



Volume Editor: Viewer Popup Menu Icons

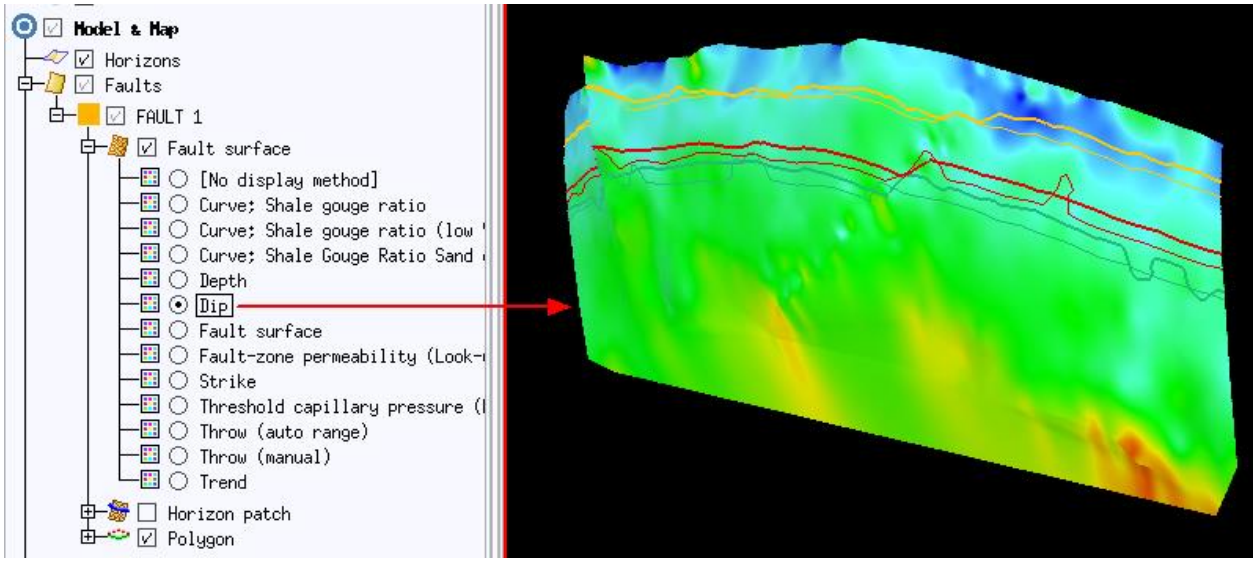
The Volume Editor <MB3> Viewer Popup Menu has been improved to show icons for each of the action items. These icons match those that are enabled (via the Shortcut Editor tool) for display in the context tool-bar (to the right of the viewer window). The icons help to locate and identify a required item in the menu as well as assisting with the user identifying the corresponding item in the context tool-bar. An example of the content of the new popup menu is shown below together with the corresponding items in the context tool-bar.



The menu item text colour is red for those items that relate to the current object selection in the viewer. Those items that are independent of the current selection use black text.

Volume Editor: Tree-based Access to Display Methods

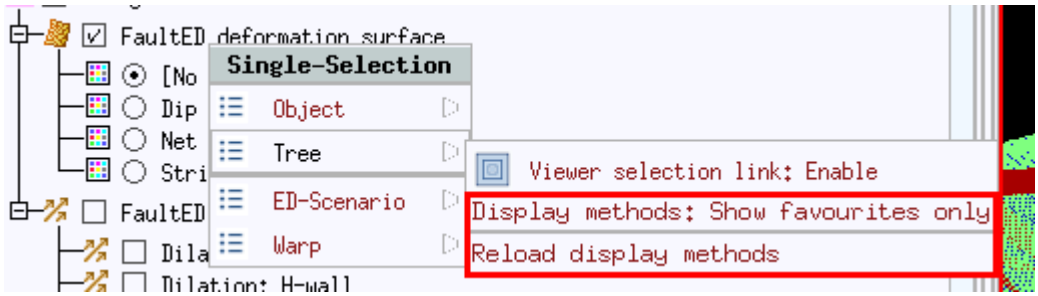
The Volume Editor object tree has been augmented to include support for specifying the active display method for an object:



The following objects in the Volume Editor tree support selecting display methods:

- Fault surface
- Horizon surface
- Fracture network surface
- Cellular grid
- Cellular fault surface
- FaultED deformation surface
- FaultED deformation well-path
- FaultED element run

Two context menu options are provided on the surface tree node:



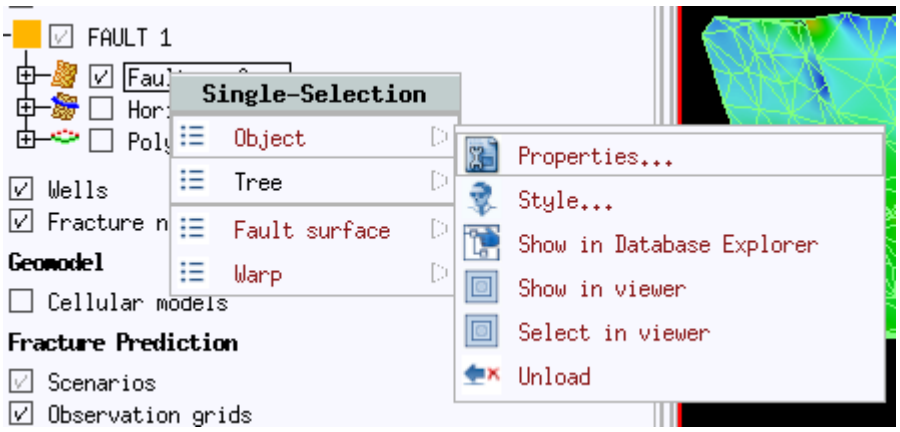
- **Display methods: [Show favourites only|Show all].** Toggles between showing all display methods for the surface, or only display methods that are marked as Favourite in the Display Method Editor.

- **Reload display methods**. Manually refresh the list of display methods if attributes have been recomputed or display methods have been marked/unmarked as favourites in Display Method Editor.

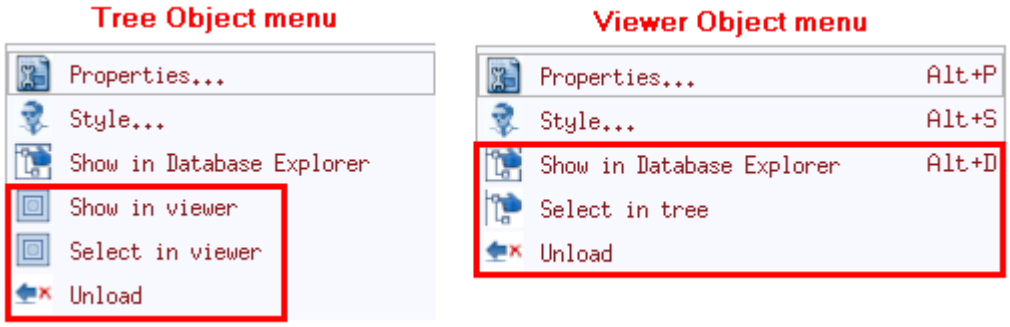
Volume Editor: Context Menu Improvements

In addition to providing display methods for surface objects, some further improvements have been made to the Volume Editor Tree.

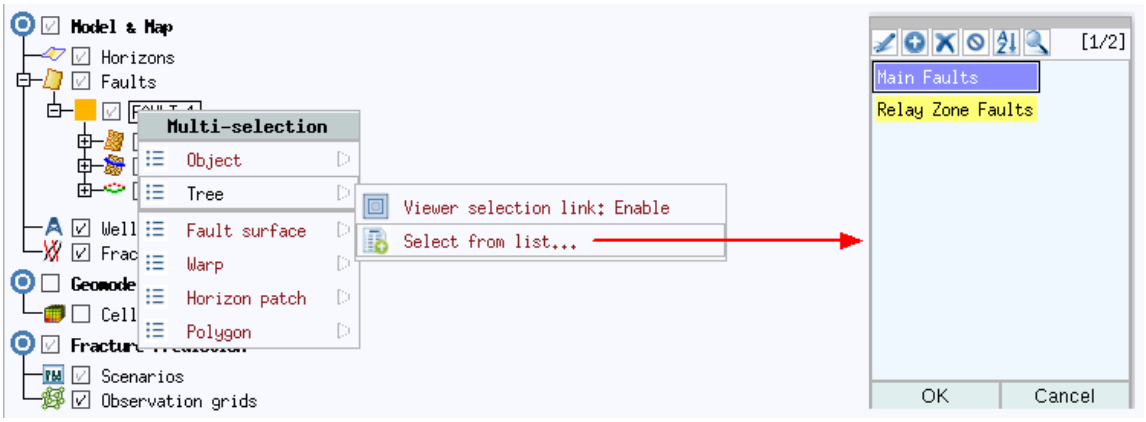
The Object menu is now available from the tree as well as the viewer:



Certain menu items have been moved or copied into the Object tree menu hierarchy for convenient access:



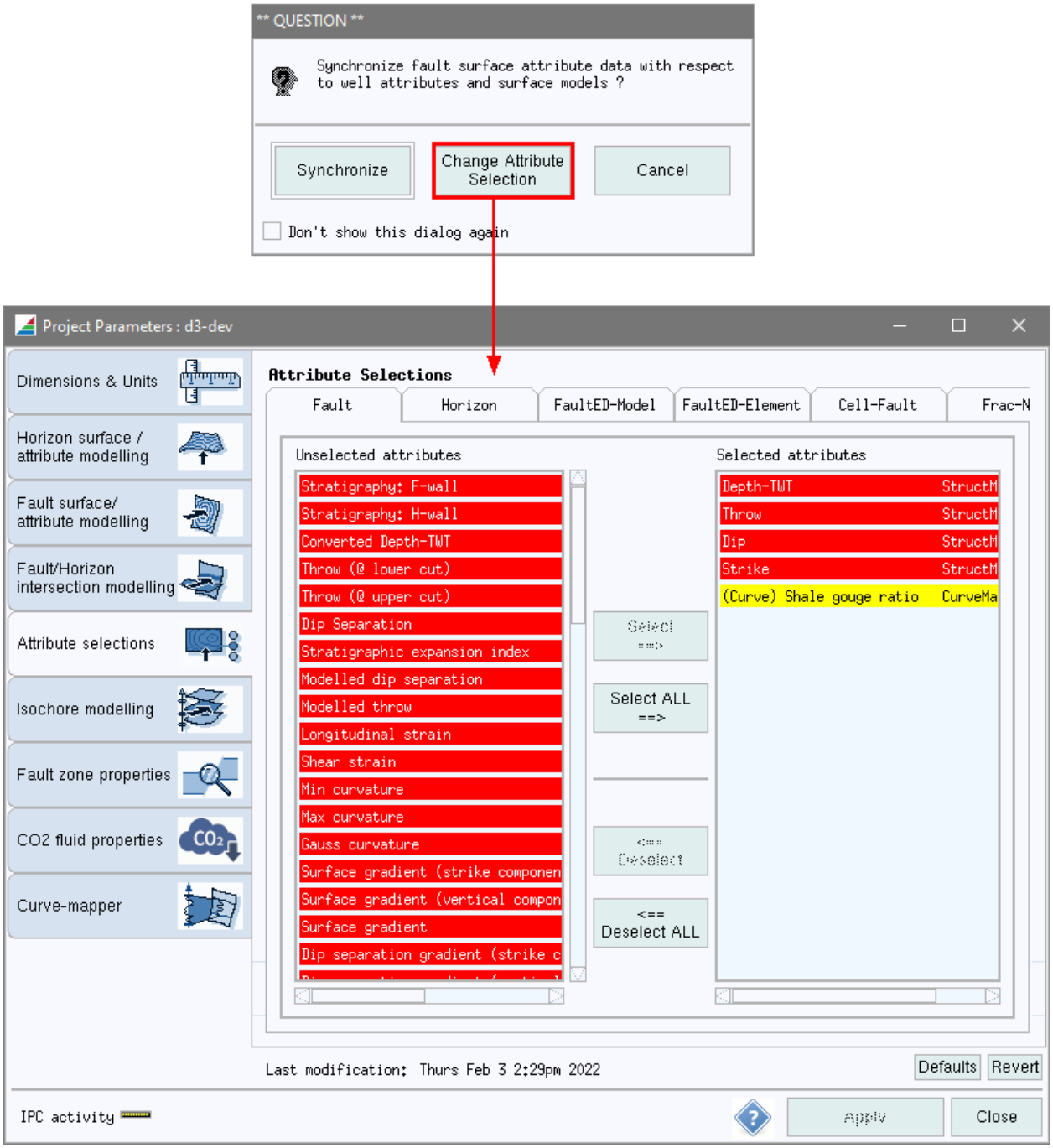
Finally, an option is available on the Tree menu for all listable T7 object types (*eg.* Faults, Horizons, Wells, *etc*):



Choosing this menu item will display a list chooser dialog. Upon selecting a list, the items contained in the list will be selected in the tree.

Volume Editor: Attribute Sync Access to Attribute Selections

As a convenience, the surface synchronisation dialogs in Volume Editor now provide an option to change the attribute selection. Selecting this option will launch the Project Parameters application with the relevant tab selected:

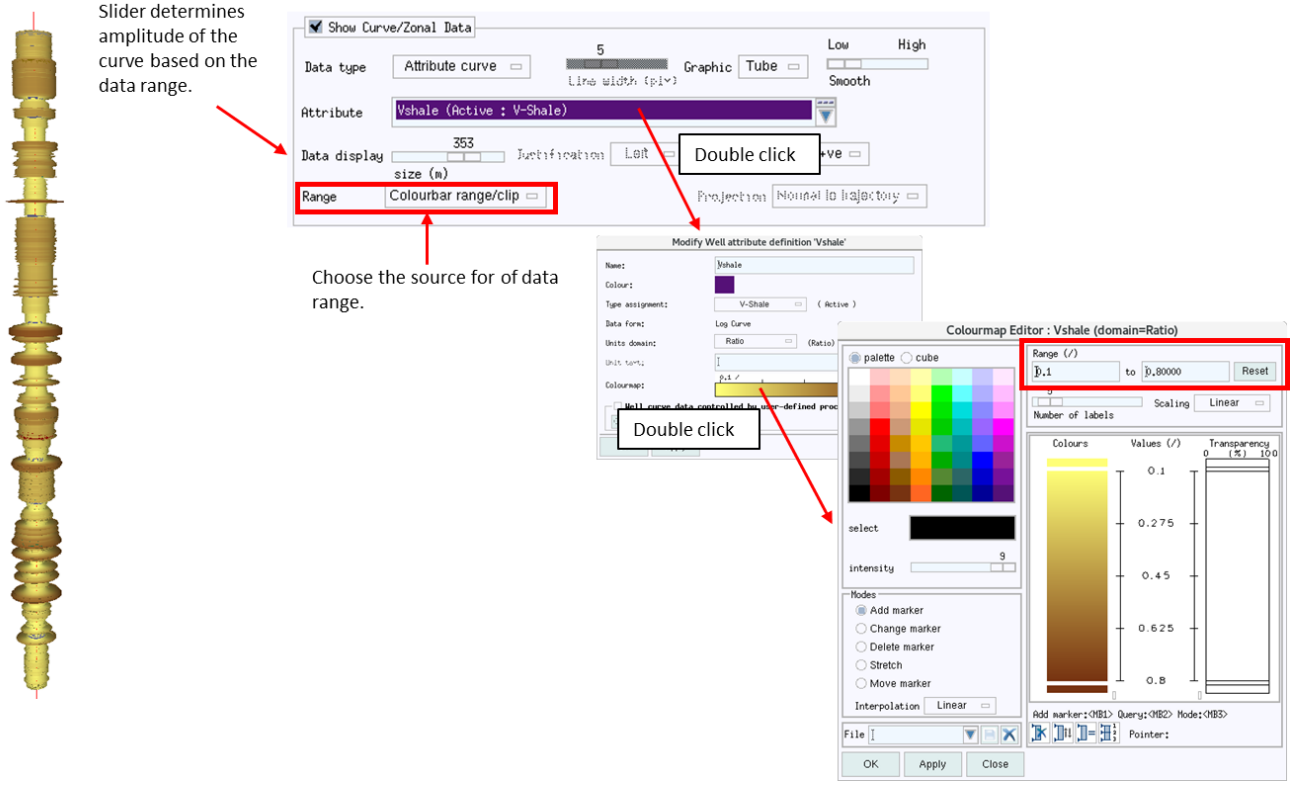


Volume Editor: Select Well Attribute Range

Well attributes can be displayed as either curves or tubes down a well path in Volume Editor. The nature of the curves (their style) is controlled in Volume Editor's style editor.

Previously, the amplitude of the variation in this curve data was determined by a slider that determined the spatial extent of the maximum amplitude (maximum value) as derived from the attribute data range for a given well. This is then used to normalise and scale all the values between the minimum and maximum value for that well. While useful it did mean that comparison between wells was difficult as the attribute curve for each well likely represented a different range.

A new option has been added to the "Well->Show Curve/Zonal Data" style options (see below). This allows the user to choose the source of the data range: Automatic/Colourbar. If automatic is chosen the system behaves as before (range is determined per well). If Colourbar is chosen then the minimum and maximum values (and subsequent normalisation and scaling) come from the attribute's colour bar range. When this option is applied, well attribute curves will share the same range, making direct comparison possible.



Note that values above and below the colour bar range will be clipped.