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MOVE 2024, IPM 13.5 - Overview

- ***MOVE 2024*** is a part of the **IPM 13.5** release:
  - Single installer with ***MOVE, RESOLVE, REVEAL, GAP, PROSPER, MBAL, PVTP.***
  - Important for API and workflows that utilise both ***RESOLVE*** and ***MOVE.***
  - Options for deploying ***MOVE*** and ***IPM*** either together, or separately.

- Kinematic Modelling in ***MOVE 2024***:
  - Sessions support for 2D Move-on-Fault and Horizons from Fault has been added in IPM 13.5 improving efficiency when restoring/ forward modelling fault movement.
  - New horizon-fault angle compatibility check between hanging wall and footwall in the 2D Section Analysis tool.

- Constrained model building and data analysis in ***MOVE 2024***:
  - Horizons From Template can now use overturned dip data for kink band construction from point data.
  - Query tool improvements: Multiple objects can now be used as a source; Queries are now saved and recalled.
  - Surface from Points (Delaunay) has a new constrain to boundary line option.
  - Added option to preserve boundaries when using Adaptive Sampling.

- Fault Analysis in ***MOVE 2024***:
  - New Hydrocarbon Column Height Calculation (Yielding et al. 2010).

- This release further extends the API for both ***RESOLVE*** and ***OpenServer***.
  - More ***MOVE*** tools exposed to the API including the ***MOVE*** Calculator tool.
  - Addition of 2D Move-on-Fault and ***MOVE*** Sessions functionality without GUI via the **MOVE** Engine **RESOLVE** data object.

- Import and Export format improvements; General UI and View improvements:
  - Improved the ASCII import of data with known headers / attributes.
  - Added brand new Alias Wavefront OBJ export format.
  - Improved DXF and TSURF import and export compatibility.
  - New export Grid and Mesh Surfaces as GeoTIFF or Points ShapeFile format.

- ***MOVE*** links to Petrel, GST and OpenWorks updated to support latest versions.
  - Dramatic speed improvement in communicating Petrel project contents.
  - Transfer dipmeter data from Petrel to ***MOVE***.
  - GeoCellular Volumes can now be transferred from ***MOVE*** to Petrel.

- Numerous additions and improvements are listed in more detail in the ***What's New in MOVE 2024, IPM 13.5*** section that can also be found in the ***MOVE*** *Knowledge Base*.

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What's new in MOVE 2024, IPM 13.5

MOVE 2024 is now available and is part of the ***Integrated Production Modelling (IPM) 13.5*** release. The release date was 1st February 2024 and the new version is available to all our maintained clients and academic users.

As with ***MOVE 2022, IPM 13***, there is a single installer which includes Petex's engineering and geological software, including ***MOVE, RESOLVE, REVEAL, GAP, PROSPER, MBAL, PVTP*** and ***OpenServer***. This single installer is important for the creation and execution of visual workflows that utilise both ***RESOLVE*** and ***MOVE*** via the Application Programming Interface (API). There is also an option to install the ***IPM*** suite without ***MOVE***, or alternatively, ***MOVE*** without the rest of the ***IPM*** suite.

The ***MOVE 2024*** release includes many new features, as well as improvements to existing functionality and usability from ***MOVE 2022***. This section describes a series of new features, enhancements, and performance improvements, which include changes to the ***MOVE*** core application, ***MOVE*** modules, ***MOVE*** Knowledge Base, as well as the 2024 additions to the ***MOVE*** Application Programming Interface (API) and ***MOVE Engine***, which was introduced in ***MOVE 2022***.

Integrated modelling is achieved using either the existing API, or the ***MOVE Engine RESOLVE*** Data Object (RDO), which provides a gateway for communication between ***MOVE*** and external applications. Modelling tasks in ***MOVE*** can be automated and extended to include additional calculations and analysis in ***RESOLVE*** and additional external applications. The ***MOVE Engine*** RDO works directly from ***RESOLVE*** and accesses ***MOVE***'s calculations and algorithms without opening the ***MOVE*** graphical user interface, allowing even faster automated modelling.

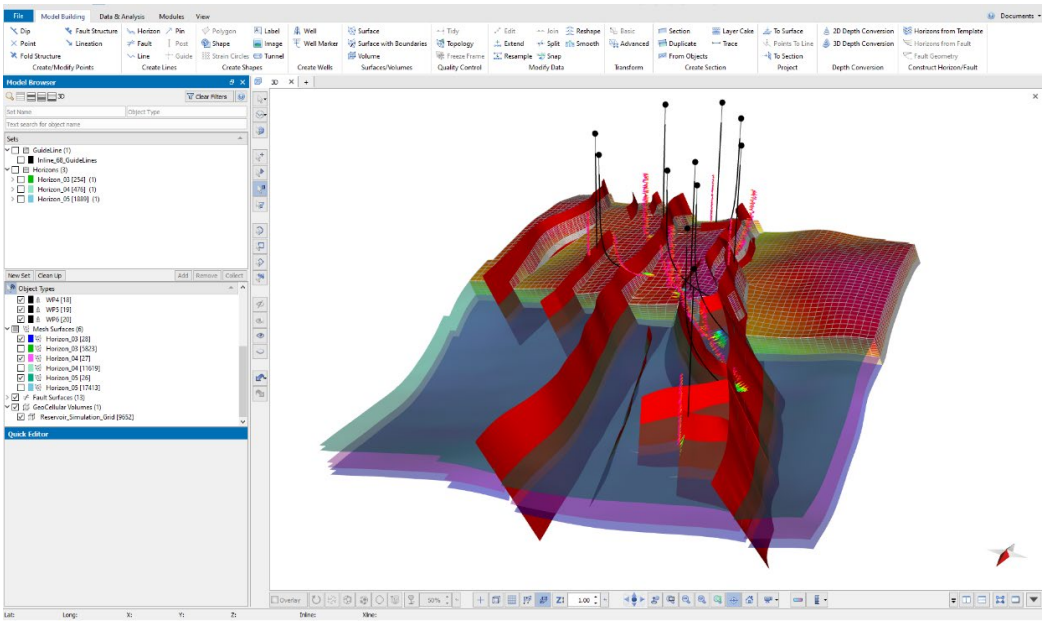

Figure 1: MOVE 2024 interface with 3D View.

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Introduction of new MOVE Sessions

MOVE 2022 introduced functionality to save and easily return to a Fault Analysis modelling scenarios through Sessions. All parameters and settings that have been defined to achieve a desired modelling result – as well as all objects collected in the tool (horizons, faults, wells etc) – are saved as part of a Session.

In ***MOVE 2022***, Sessions were limited to the Fault Analysis module. For ***MOVE 2024*** we have expanded on this functionality, with Sessions now being available in the 2D Move-on-Fault and Horizons from Fault tools.

Sessions are saved as a file that is part of the ***MOVE*** file structure meaning modelling results can be quickly and easily recreated after closing and re-opening ***MOVE***. This also means that modelling results – including the parameters and objects used to achieve a modelling objective – can be quickly and easily transferred to colleagues. For example, if a 2D Kinematic forward modelling scenario is found which fits available data, all the parameters and objects used to achieve this result can be saved in a Session. Loading a previously saved Session automatically populates the object collection boxes and parameters in the tool.

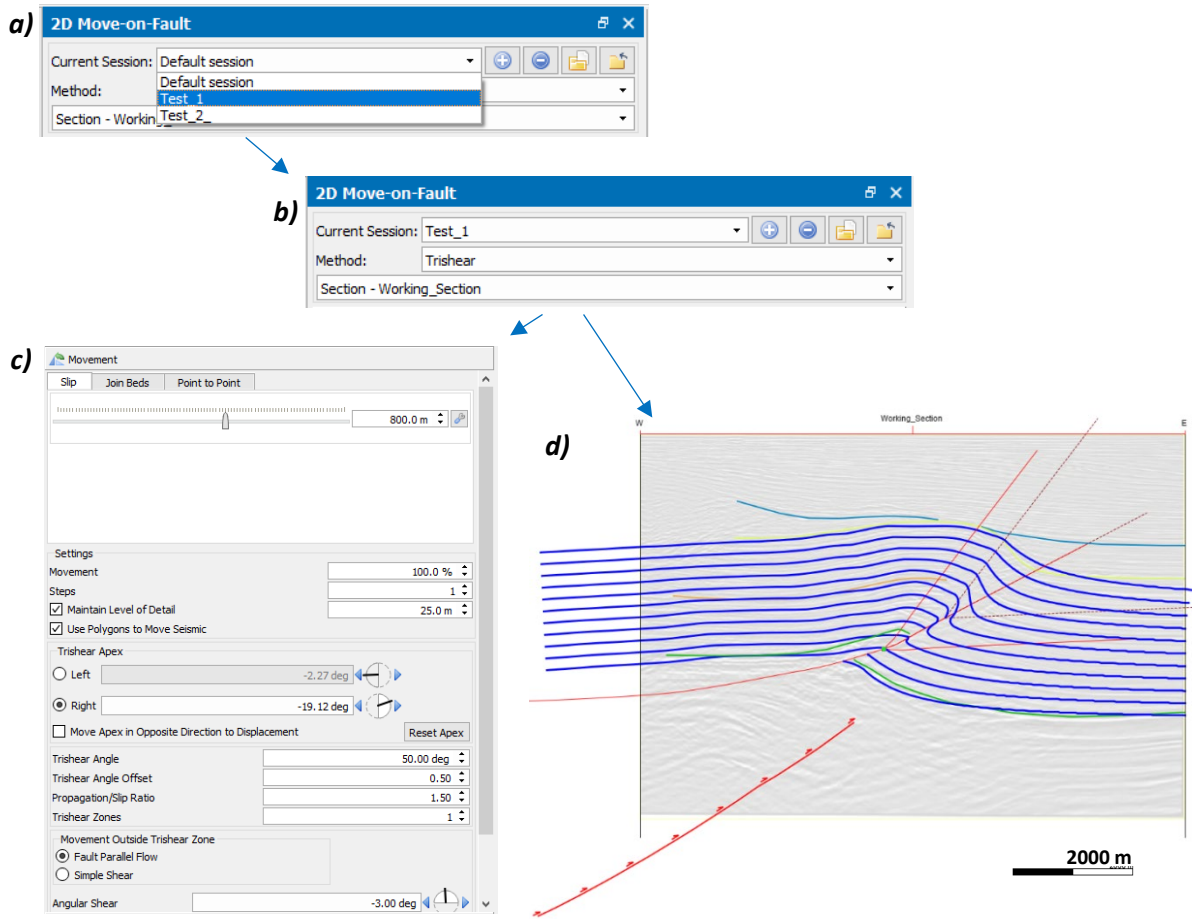

Figure 2: MOVE Sessions in 2D Move-on-Fault. Switching between saved Sessions (a, b) automatically populates all parameters (c) and auto-updates the preview (d).

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Sessions mean that modelling processes are more easily repeatable and auditable. In addition, the ability to create and access Sessions via the ***MOVE*** API and the ***MOVE Engine RESOLVE*** Data Object means that automating modelling processes and saving the results of automated workflows is more streamlined.

Sessions are currently supported in the Fault Analysis, 2D Move-on-Fault, and Horizons from Fault tools.

Integrated modelling & API

MOVE 2024 builds further on the Application Programming Interface (API) that was first introduced in ***MOVE 2019***.

Resource system modelling (including petroleum production, minerals/mining, carbon capture & storage etc) incorporates many domains and specialities. The multi-disciplinary nature of such systems risks isolation of modelling and imposition of artificial boundary conditions. This risks the model deviating from the reality and therefore not being representative and predictive. Integrated modelling is the practice of using technology to remove artificially imposed boundaries using automated and efficient communication between modelling software tools. This enables automatic review of a model in one domain against models and data from other disciplines, ensuring assumptions are consistent in all components of an integrated model. For geological modelling, integrated modelling streamlines the validation process with any available dynamic production data and allows for efficient updates to the reservoir model as understanding evolves.

Integrated modelling is achieved using the ***MOVE*** API, which provides a two-way gateway for communication between ***MOVE*** and external applications. Modelling tasks in ***MOVE*** can now be automated. Doing so:

- Increases efficiency.
- Removes subjectivity.
- Makes analyses documented and repeatable.
- Encapsulates knowledge.

Additionally, by integrating ***MOVE*** with ***RESOLVE***, users gain access to a broad range of new modelling tools and connections to a large network of software packages (Petex and third party). As an example, tools such as the optimised search and sensitivity modelling tools in ***RESOLVE*** can be combined with structural analysis in ***MOVE*** to perform modelling tasks that were previously not possible. ***RESOLVE****'s* connection to many other programs, such as reservoir simulators (e.g. ***REVEAL***), provides a mechanism to automatically connect structural modelling with dynamic modelling.

Several practical examples have been developed to demonstrate how automation and integration of ***MOVE*** adds value to current modelling practices, including:

- Integrated analysis of propagation folding, including automated fault prediction and identification of optimal Trishear parameters.
- Fault and top seal calculator that determines the limiting factor on hydrocarbon column height accounting for fluid properties and using MICP lab data, as well as harnessing ***MOVE***'s fault seal calculations.
- Automatic modification of faulted geometry and fault-rock properties in a simulation grid and comparison with production data.
- Dynamic assessment of critical failure criteria during injection of CO_2 (outlined overleaf).

Workflow automation and integration using ***MOVE***'s API connection provide the flexibility to create workflows tailored to the needs of the user.

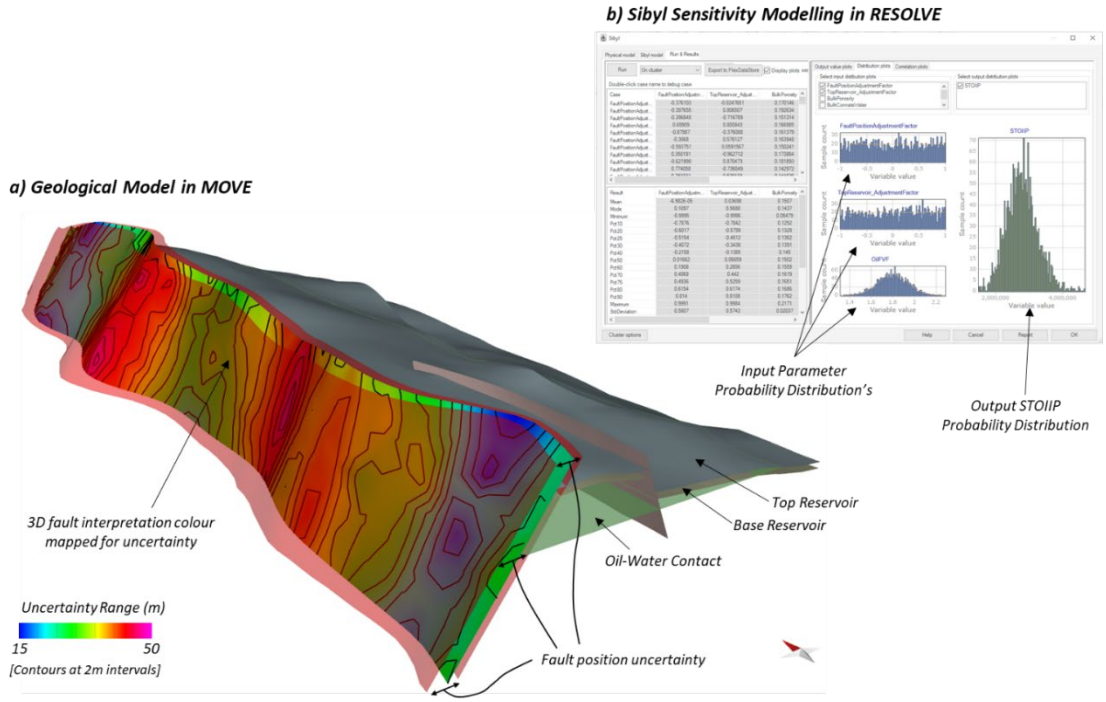

Figure 3: Assessment of how uncertainty in the interpretation of structural features impacts volumetric calculations. Uncertainty ranges are quantified (a) and the impact of the uncertainty on volumetric estimates is explored using the Sibyl sensitivity analysis tool in RESOLVE (b).

MOVE 2024 facilitates the connection of an even larger array of ***MOVE*** tools and operations through the API than in previous versions. The Attribute Calculator and Select Cells tool can now be accessed via the ***MOVE*** API. Many context menu options have also been exposed in this release through the use of specific commands (***OpenServer***) and operations (***RESOLVE***), such as Merge Lines and Merge Meshes.

The loading of ASCII and ASCII Well Data can now be automated through the ***MOVE*** API in ***MOVE 2024***. This adds a wide range of new possible workflows where newly acquired data

can be incorporated efficiently into models and the model updated or flagged for update. Additionally, ***REVEAL*** Point Cloud files can be loaded using the ***MOVE*** API. This increase the integration between ***MOV***E and ***REVEAL*** allowing static and dynamic analyses to be integrated reducing uncertainty and increasing accuracy.

Dynamic Stress Attributes Visual Workflow and REVEAL connection

During the development of ***IPM 13.5***, our geology and reservoir engineering teams worked closely to develop a novel approach to understanding how the stability of faults and fractures changes as fluids are extracted or injected into the subsurface.

This approach has been encapsulated in a ***RESOLVE*** visual workflow that is available to clients upon request.

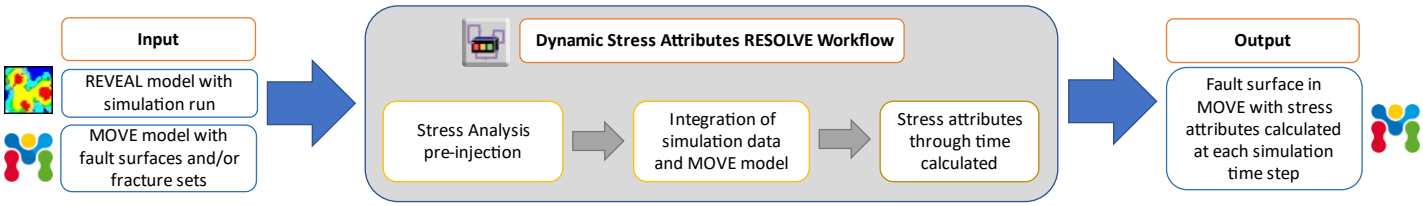

Figure 4: Diagram showing the high-level workflow used to model changes in the stress state of faults and fractures during injection or production of fluids.

The developed ***RESOLVE*** visual workflow is used to link, in real-time, dynamic reservoir simulation with structural modelling tools (***REVEAL*** and ***MOVE***), allowing the response of complex structures to dynamic stress conditions to be analysed. Changes in pore pressure and stress through time related to production or injection are simulated in ***REVEAL***. The results for each time-step are then used as inputs for the calculation of slip tendency and slip stability of fractures and faults in ***MOVE***. By integrating these analyses, typically performed by different disciplines, the failure of faults and fractures can be modelled in parallel with production/injection simulations.

The ***RESOLVE*** workflow relies on new native functionality in both ***REVEAL*** and ***MOVE***. A new file format (***REVEAL*** Point Cloud, *.pc) has been developed which allows the efficient transfer of simulation results from ***REVEAL*** to ***MOVE***. In this format, data are transferred as points, with each point corresponding to the centre of a cell in the 3D reservoir grid. *.pc files are exported from ***REVEAL*** using an ***OpenServer*** command. As part of this command, the attributes to be exported are defined. *.pc files can be manually loaded into ***MOVE*** using the new ***REVEAL*** Point Cloud importer. To allow a greater number of integrated workflows using ***REVEAL*** and ***MOVE***, there is also an operation in ***RESOLVE*** to automate the loading of *.pc files in to ***MOVE***.

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The RESOLVE Data Object (RDO), MOVE Engine

Introduced in ***MOVE 2022, IPM 13***, the ***MOVE*** Engine **RESOLVE** Data Object allows users to connect to ***MOVE*** models and perform specific optimised tasks through ***RESOLVE*** without opening the main ***MOVE*** software application.

Because ***MOVE***'s graphical interface is not opened when using the ***MOVE*** Engine, a number of significant computing requirements are removed, such as graphical rendering, allowing tasks performed by the ***MOVE*** Engine to be greatly optimised for both speed and resource usage.

For the first iteration of the ***MOVE*** Engine, in ***MOVE 2022, IPM 13***, the functionality included:

- Loading and extracting ***MOVE*** model object information, excluding Object Attributes.
- Performing Fault Analysis seal proxy calculations. A parameters file could be saved from ***MOVE*** to specify the required settings.
- Basic 3D rendering of ***MOVE*** model objects within ***RESOLVE*** to perform visual checks.

For ***MOVE 2024, IPM 13.5***, the ***MOVE*** *Engine* additionally includes:

- 2D Move-on-Fault operations, allowing 2D Kinematic modelling to performed in a fraction of the time.
- The ability to use the new ***MOVE*** Sessions in conjunction with the ***MOVE*** Engine for both Fault Analysis and 2D Move-on-Fault.

A valid ***MOVE*** core license is required to run the ***MOVE*** Engine ***RESOLVE*** Data Object. Any Fault Analysis operations require a ***MOVE*** Fault Analysis license, and 2D Move-on-Fault operations require a 2D Kinematic Modelling license.

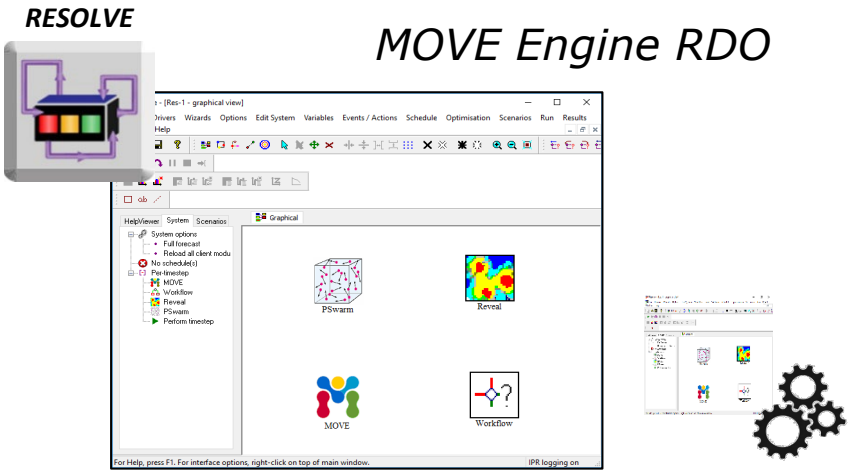

Figure 5: Workflow in RESOLVE using the Move Engine RDO.

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Kinematic Modelling in MOVE 2024

MOVE 2024 incorporates several improvements in the 2D Kinematic Modelling and 3D Kinematic Modelling modules.

2D Move-on-Fault and Horizons from Fault MOVE Sessions

Following the popular addition of the Sessions functionally to the Fault Analysis module for ***MOVE 2022***, this functionality is being extended to other tools in ***MOVE 2024***, starting with the 2D Move-on-Fault and Horizons from Fault tools.

It is now possible to save all of the objects and parameters used in the calculation of fault-related deformation in the 2D Move-on-Fault and Horizons from Fault tools, using the Sessions functionality. Sessions can be created at any time while the tools are open and will save all the variables used in the analysis including:

- Objects collected into the Active Fault and Objects to Be Moved.
- Parameters in the Active Fault, Movement, Sedimentation and Erosion sheets.
- Values defined in the Options sheet.

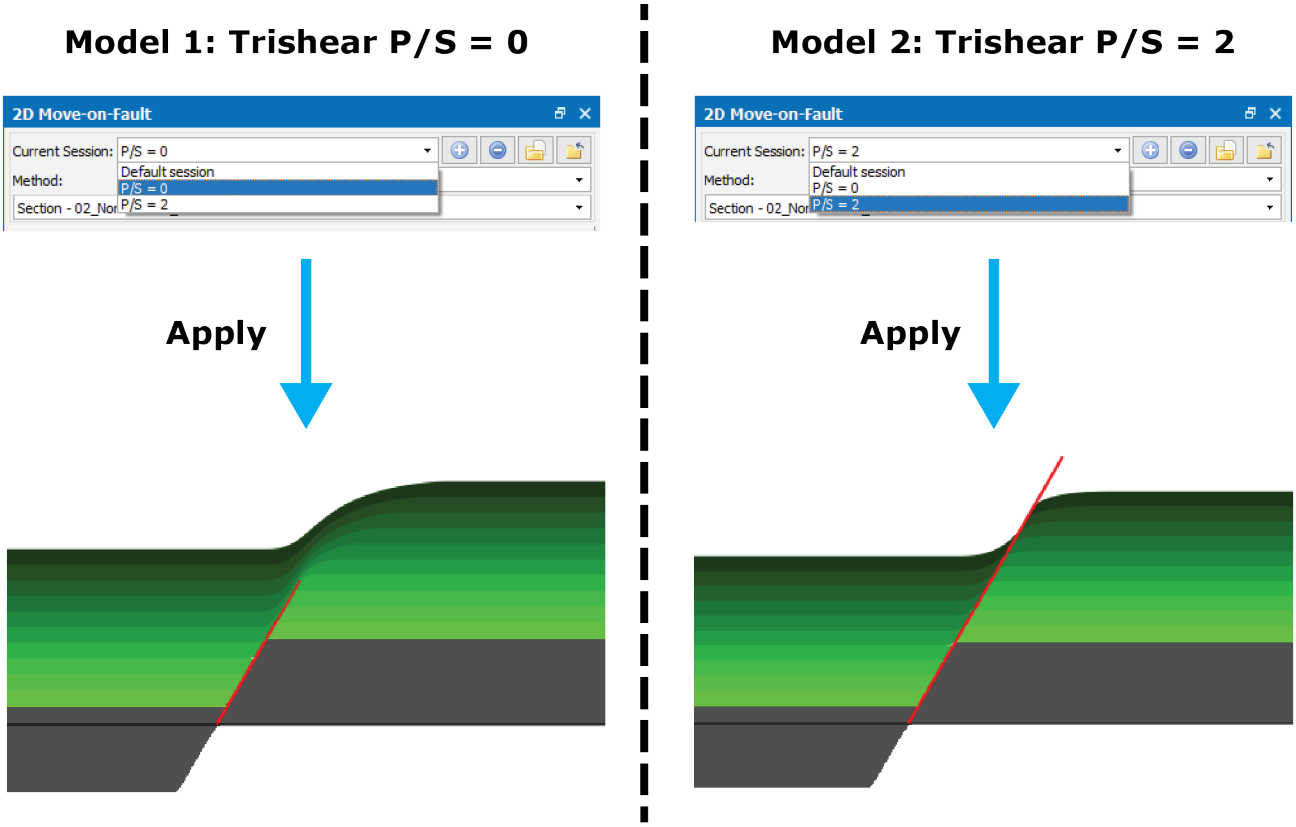

Figure 6: An extensional trishear forward model run using two different sessions. The only parameter changed between the models is the P/S ratio.

Upon reopening a project and section within which Sessions have been saved, the user can simply open the 2D Move-on-Fault or Horizons from Fault tool and choose a previously saved Session from the drop-down list. The toolbox will then be populated with the data and variables previously defined. This functionality allows multiple scenarios to be tested and compared easily and efficiently during 2D forward modelling and restoration workflows. This is especially useful when using algorithms which have many input variables, e. g. Trishear. If desired, Movement, Sedimentation, Erosion and Options can be refined on one section and then used as a starting point for forward modelling deformation on the same fault on another section.

Horizon/Fault Angle Compatibility check in 2D Section Analysis

An option to perform a horizon/ fault angle compatibility check has been added to the 2D Section Analysis tool. This check involves measuring corresponding angles at the hanging wall – fault intersection and footwall – fault intersection. If the difference between the calculated corresponding angles is greater than a user defined tolerance (for which the default is 10°), the hanging wall/ fault intersection will be highlighted with a red circle on the section.

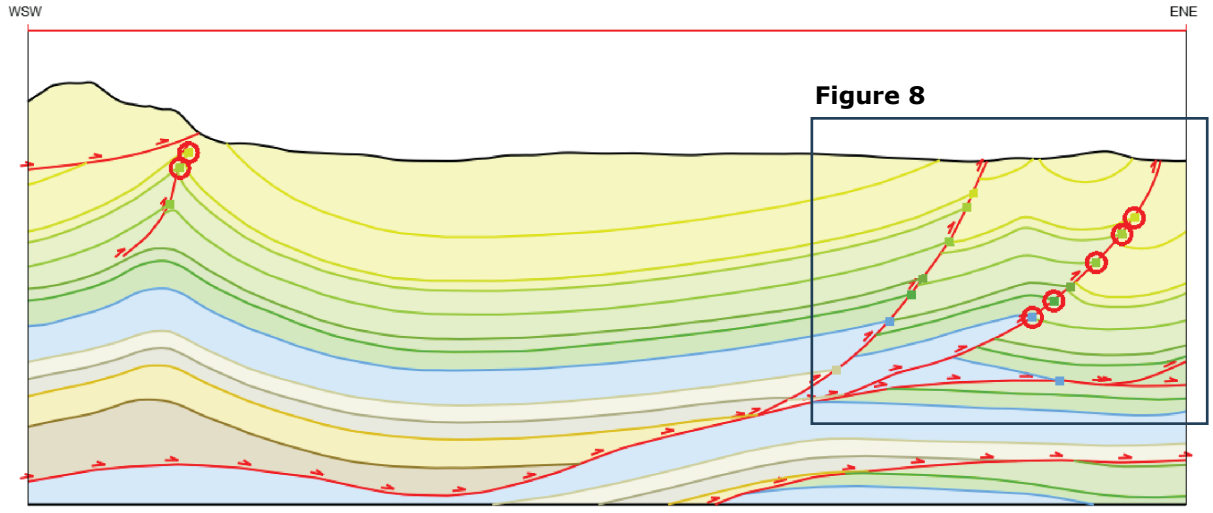

Figure 7: A 2D section in MOVE after performing a horizon/ fault angle compatibility check. The failed tests are highlighted with red circles. The location of Figure 8 is shown.

In some scenarios, it is expected that across a fault plane, the intersection angle of a horizon will be the same. This simple test can be used to identify potential issues with a 2D interpretation prior to performing more advanced analysis. By identifying such issues early in a structural geological analysis workflow, they can be fixed to avoid extensive time-consuming analysis being carried out on a geologically inconsistent interpretation.

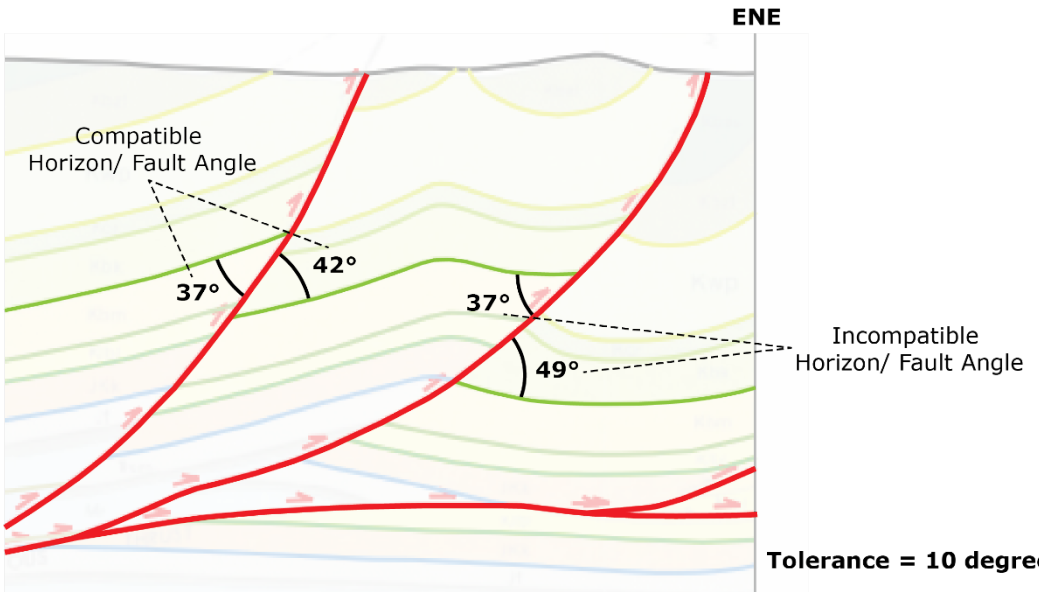

Figure 8: A diagram showing two examples of the horizon/fault angle compatibility check.

Other Kinematic Modelling improvements

The 3D Depth Conversion has been improved in ***MOVE 2024*** with support for velocity cubes now available. Both average velocity and calculated velocity cubes can be used to convert data between the time and depth domains, or vice versa. Additionally, velocity cubes can be created by the 3D Depth Conversion tool, allowing velocity models to be easily integrated with other software.

Velocity cubes must be in 3D Regular Grid format to be used in the conversion between time and depth domains. 3D Regular Grids can be created from seismic cubes, if required, using a context menu option.

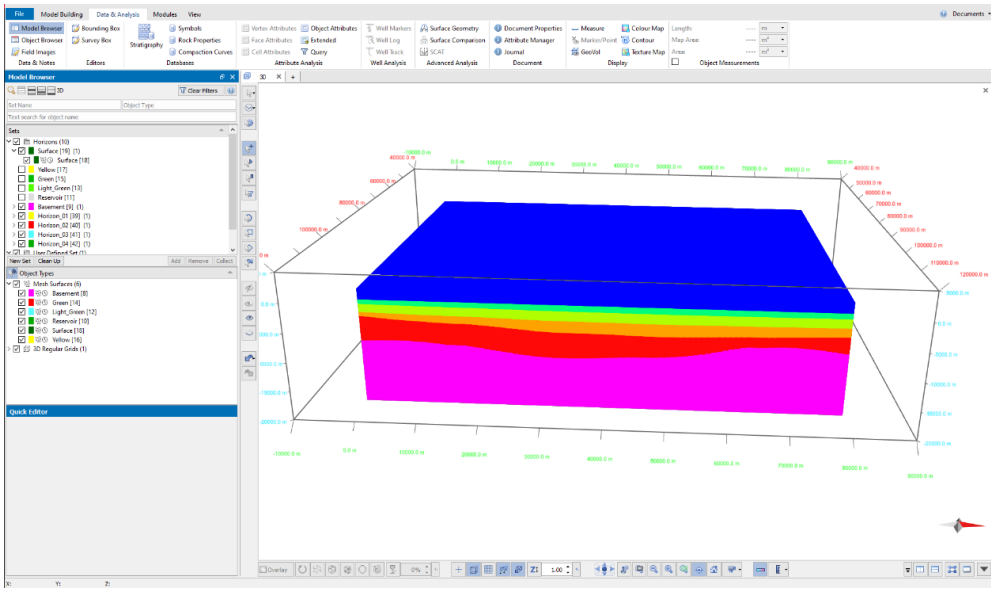

Figure 9: 3D View in MOVE showing a velocity cube created from the 3D Depth Conversion tool.

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Model Building and Data & Analysis in MOVE 2024

In ***MOVE 2024*** Model Building and Data & Analysis have seen significant improvements. The addition of ***MOVE*** Sessions to Horizons from Fault makes this interactive tool even faster to use, and helps documenting the parameters used for constrained construction. In the Horizons from Template tool, the added ability to handle Overturned Bedding readings expands the range of geological configurations to which rapid horizon creation can be applied.

In Data & Analysis, multiple source inputs in the Query tool and colour mapping of projected planes in the Stereonet Plot are some of the latest additions to the capabilities of the versatile ***MOVE*** model interrogation.

Horizons From Fault Sessions

It is now possible to save all of the objects and parameters used in the quick prediction of deformed horizons and quick fault editing in the Horizons from Fault tool, using the Sessions functionality.

Sessions can be created at any time while the tool is open and will save all the variables used in the analysis including:

- The object collected into the Fault sheet.
- Parameters in the Movement sheet.
- Values defined in the Options sheet.

Support for Overturned Bedding readings in Horizons From Template – Kink Band method

The Horizons from Template – Kink Band method has been improved, allowing the use of Overturned Bedding readings in horizon constructions from dip data. This greatly increases the range of scenarios for which the tool can be used to produce geologically valid interpretations from point orientation data, particularly when working in highly complex compressional setting such as the Andes, Pyrenees, or any other mountain belt.

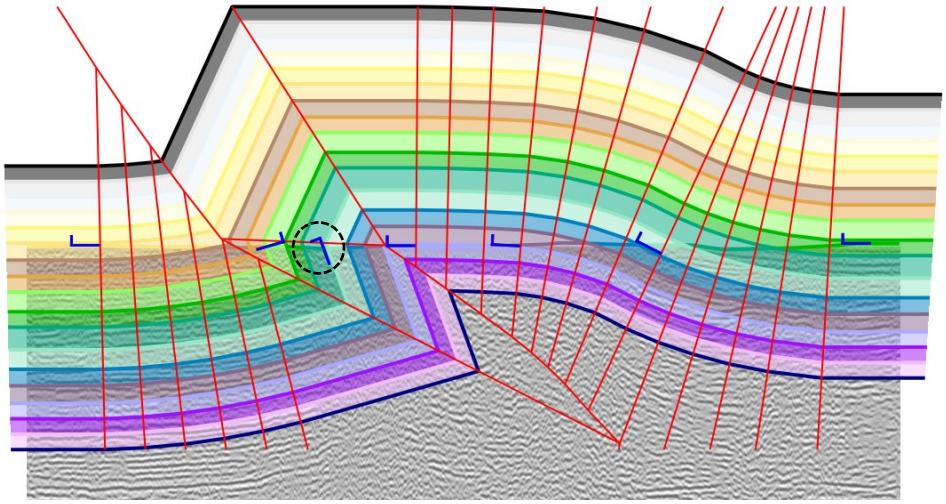

Figure 10: A horizon interpretation constructed using the Horizons from Template tool. An Overturned Bedding reading is highlighted.

Prior to constructing horizons using Overturned Bedding readings, input data must be sorted. Two different methods are available for this sorting. These are toggled between using a new option in the Horizons from Template toolbox called “All Dips Are at Similar Elevations”. The tool will automatically enable this option if the elevation range of the input data is less than 500 m. However, this can be overridden by the user if desired.

The choice of sorting method is crucial for correctly constructing horizon geometries using Overturned Bedding readings. When one or more overturned dip is present, the fold can be decomposed into three parts: the backlimb, the overturned part, and the forelimb. The option "All Dips Are at Similar Elevations" should be disabled if any overturned dips are encountered out of sequence across the section (e.g. Figure 9a). Otherwise, the option "All Dips Are at Similar Elevations" should be enabled.

Enabling "Show Bisector" and "Show Lines Perpendicular to Dips" in the Options sheet can help the user to understand how the input data is used in the horizon construction. The inclusion of these two different sorting methods allows the new functionality to be applied to a wider variety of modelling situations.

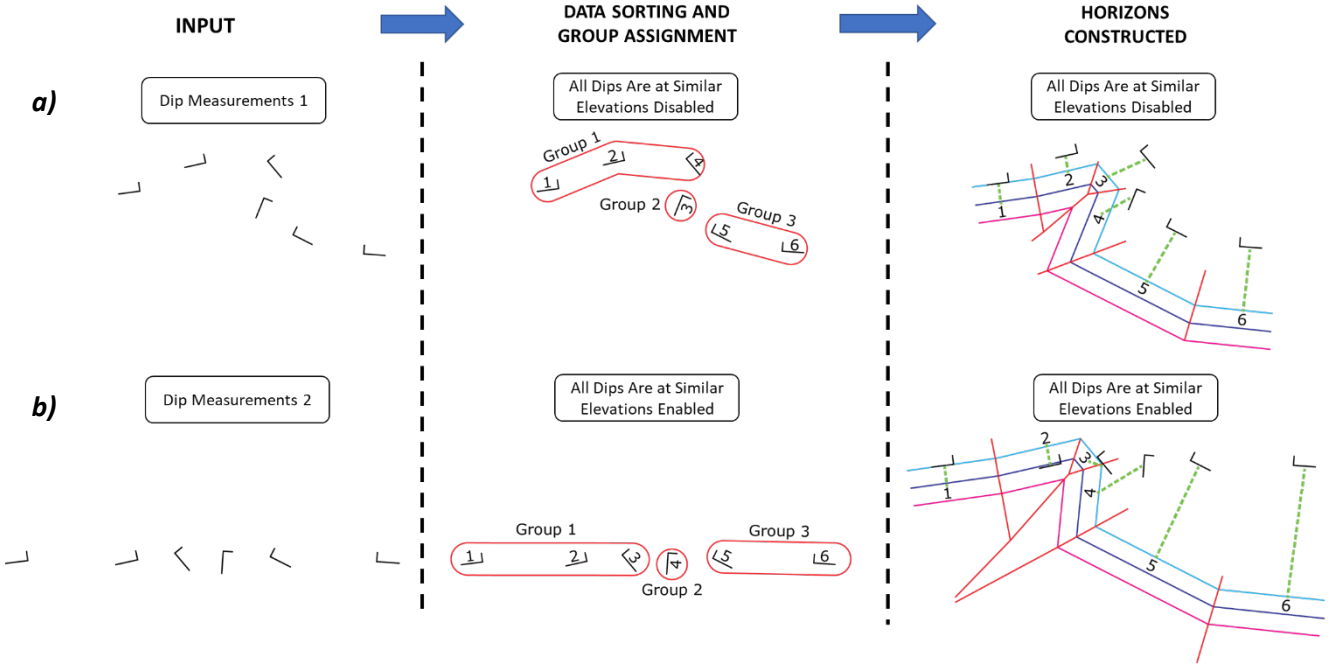

Figure 11: The two different Overturned Bedding sorting methods applied to two different datasets. a) Dip Measurements 1 are recorded across a range of elevations. b) Data in Dip Measurements 2 have been recorded at similar elevations.

Improvements in the Query tool

The Query tool has been improved to support a greater range of queries and data. These are listed below:

- While the tool is open, Query results are now stored and can be recalled, allowing quick comparisons between queries.
- Multiple source objects can now be defined when performing Spatial Queries.
- Support has been added for multipart polylines and polygons, such as those commonly loaded from ShapeFiles.
- Face and Cell selection query modes now work in Map view.
- When performing spatial queries using Closest to Vertex, Directly Above, Directly Below and In Direction, setting the search distance to zero is now the same as setting the search distance to extend beyond the maximum possible distance for the source data.

Colour map planes in Stereonet plot

Planes defined from orientation data can now be colour mapped on Stereonets. This allows for trends in data to be more easily identified and communicated.

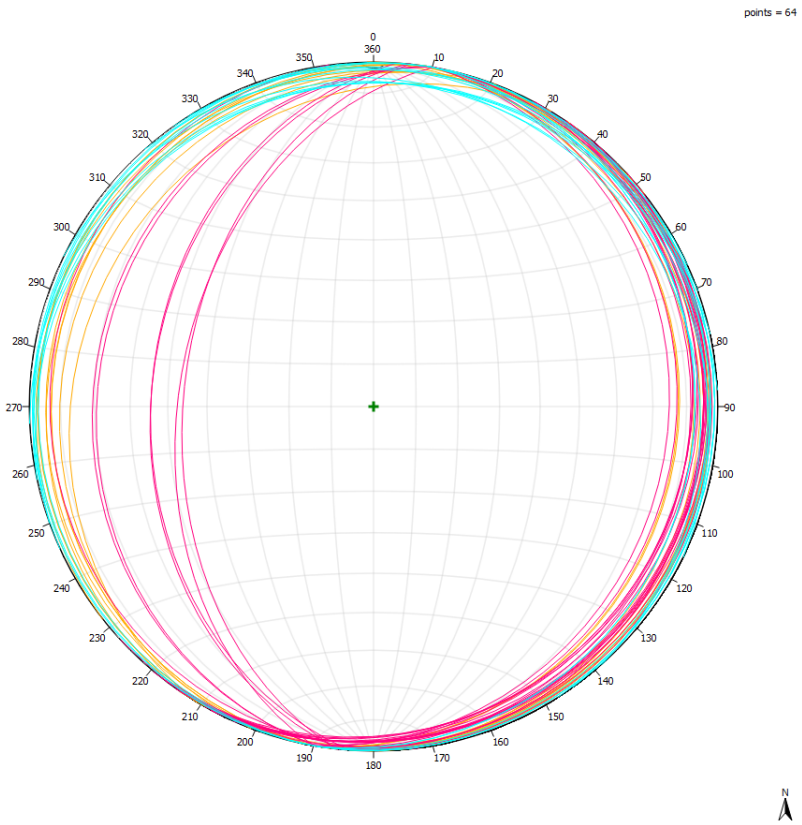

Figure 12: A Stereonet produced in MOVE 2024. Orientation data are plotted as planes and colour mapped for horizon assignment.

Other improvements

Surface creation improvements

Several small but significant improvements have been made to the surface creation capability of ***MOVE***.

Closed polylines collected into the Surface tool when using the Create Surface from Points/Well Markers method can now be used as outer and inner boundaries by enabling the "Constrain Mesh to Lines" option.

The Adaptive Sampling algorithm in the Resample tool has been updated and now allows for outer and inner boundaries to be preserved. In cases where boundaries are rounded by the resampling, these options can be enabled to preserve the exact boundary.

Volume creation improvements

GeoCellular volumes created using the Create Volume from Faults and Horizons method added in ***MOVE 2022*** now have additional useful attributes that aid loading geological models into numerical reservoir simulators, such as Petex's REVEAL software. Specifically non-neighbour connection (nnc), fluid in place regions (FIPNUM), and horizon assignment (ROCKNUM) will all have attributes created which can then be easily exported.

A new tutorial, Tutorial 11: Volume Creation, is included with ***MOVE 2024*** which provides user with a step-by-step guide on how to create GeoCellular volumes in ***MOVE*** using the Create Volume from Faults and Horizons method added in ***MOVE 2022.***

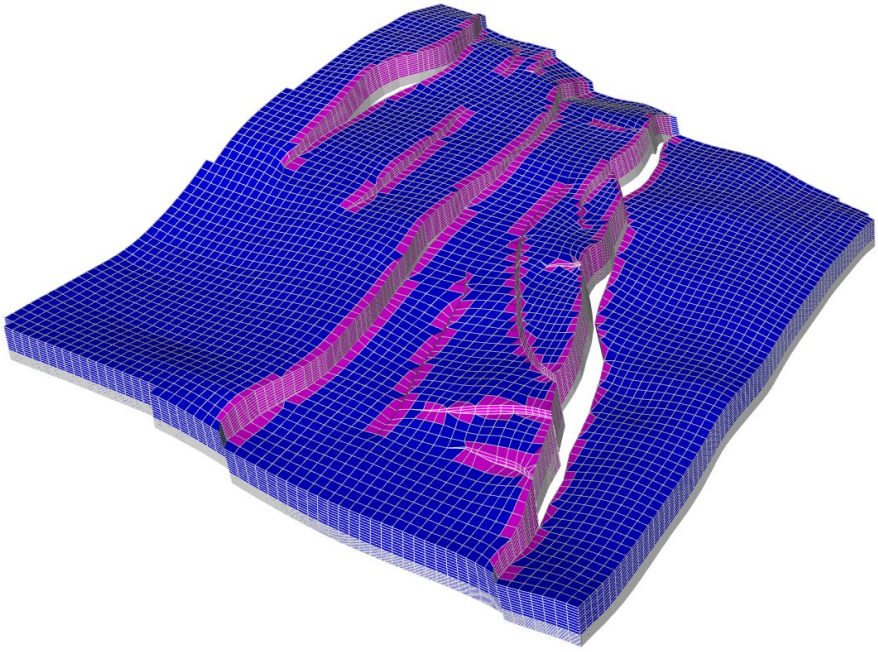

Figure 13: A GeoCellular volume in MOVE 2024 colour mapped for non-neighbour connections (nnc). Pink indicates cells with a nnc (1) whilst blue indicates those without an nnc (0).

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Fault Analysis in MOVE 2024

Addition of new Hydrocarbon Column Height calculation (Yielding et al., 2010)

Following feedback from clients, an additional equation for the calculation of hydrocarbon column height (HCCH) has been added to the Fault Analysis module. The previously implemented Bretan et al. (2003) cross-fault pressure difference equation is a power-law relationship which was based on data that included some single-phase across-fault-pressure-differences (AFPD). The relationship gave increasing values of pressure difference for increasing shale-gouge-ratio (SGR) values. At high values of SGR this could result in values equivalent to column heights in the region of tens of kilometres. Yielding et al (2010) published a revised dataset excluding single-phase samples and linear AFPD relationships which result in more realistic calculated column heights for high values of SGR. In the implementation in ***MOVE***, the HCCH values are capped for SGR values above 0.45. The user can choose to use the existing Bretan et al. (2003) or the newly implemented Yielding et al. (2010) in the Parameters sheet of the Fault Analysis module.

References

Bretan, P., Yielding, G. and Jones, H., 2003. Using calibrated shale gouge ratio to estimate hydrocarbon column heights. AAPG bulletin, 87(3), pp.397-413.

Yielding, G., Bretan, P., and Freeman, B., 2010, Fault seal calibration: a brief review: Geological Society, London, Special Publications, 347(1), p.243-255.

Fault Analysis Sessions connection to RESOLVE, OpenServer and MOVE Engine

Sessions were added to the Fault Analysis module in ***MOVE 2022***, allowing the setup of the toolbox to be saved and easily retrieved for future use. In ***MOVE 2024***, Fault Analysis sessions can now be utilized by the ***MOVE*** Engine RDO. Sessions can be loaded into the ***MOVE*** Engine and then results calculated. Additionally, sessions can be edited in the ***MOVE*** Engine via ***RESOLVE*** visual workflows. These additions make building Fault Analysis visual workflows which utilise the ***MOVE*** Engine easier and more efficient.

Other Highlights in MOVE 2024

Improvements to ASCII and ASCII Well importers allowing automatic population of known column headers

The ASCII Data and ASCII Well Data importers have been improved and now allow column headers to be automatically populated based on information from the loaded file. This is done using a new button which is labelled "Populate Headers From Selected Row". A row must be selected in the Column Specification and Preview table before the new button is clicked. When clicked, the importer will populate the column headers from the entries in the selected row if any match attributes already present in the ***MOVE*** model. This greatly speeds up the time taken to load ASCII Data and ASCII Well Data into ***MOVE***. This is especially true when loading large data sets containing a multitude of different attributes.

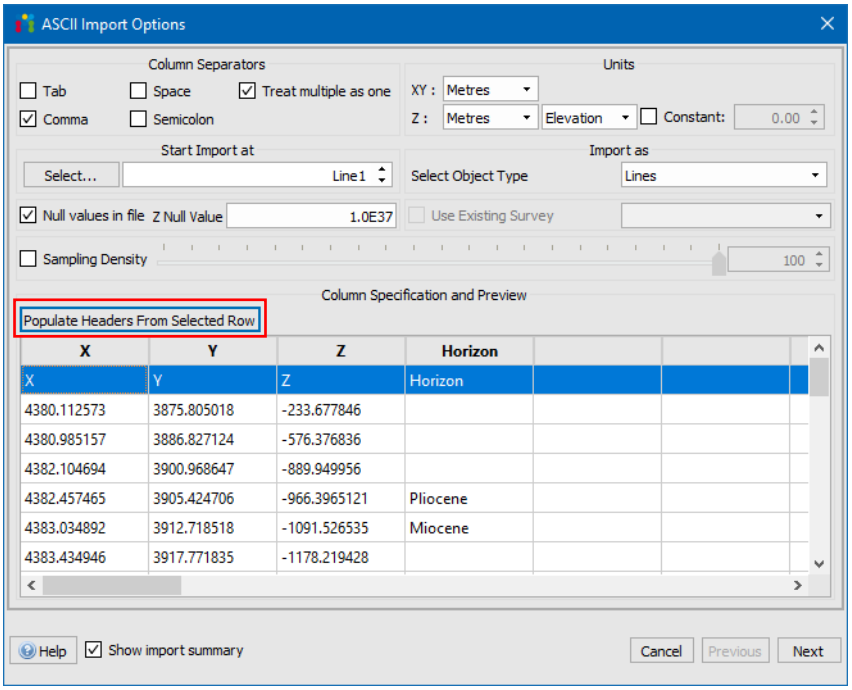

Figure 14: The improved ASCII Data importer. The "Populate Headers From Selected Row" button is highlighted and a row in the Column Specification and Preview table is selected.

More information on how to use this new functionality is included in *Tutorial 3: Loading and Visualizing Well Data*.

New export formats have been added for Grid and Mesh Surfaces

A new Mesh Surface export format is available for ***MOVE 2024*** in the form of the Alias Wavefront OBJ exporter. The Alias Wavefront OBJ file format is a commonly used format for 3D mesh model data and is used by a wide variety of modelling packages. Previously OBJ files could be imported into MOVE but not exported. The principal purpose for OBJ file support in ***MOVE*** is to allow the transfer of 3D models with textures, such as sample or cliff face models that have been produced by photogrammetry, between different modelling packages.

Mesh Surfaces, as well as Grid Surfaces, can now be exported as GeoTIFF files. Any attributes saved on the surface, including elevation, are written to the GeoTIFF. GeoTIFFs can be loaded into a variety of software applications from geological modelling packages to graphics software. Adding the ability to export GeoTIFFs increases the efficiency of a range of common workflows that utilise models created in ***MOVE***.

This export format requires that the surface is sampled using an evenly spaced grid. The data are resampled during the export with grid options available in the export window.

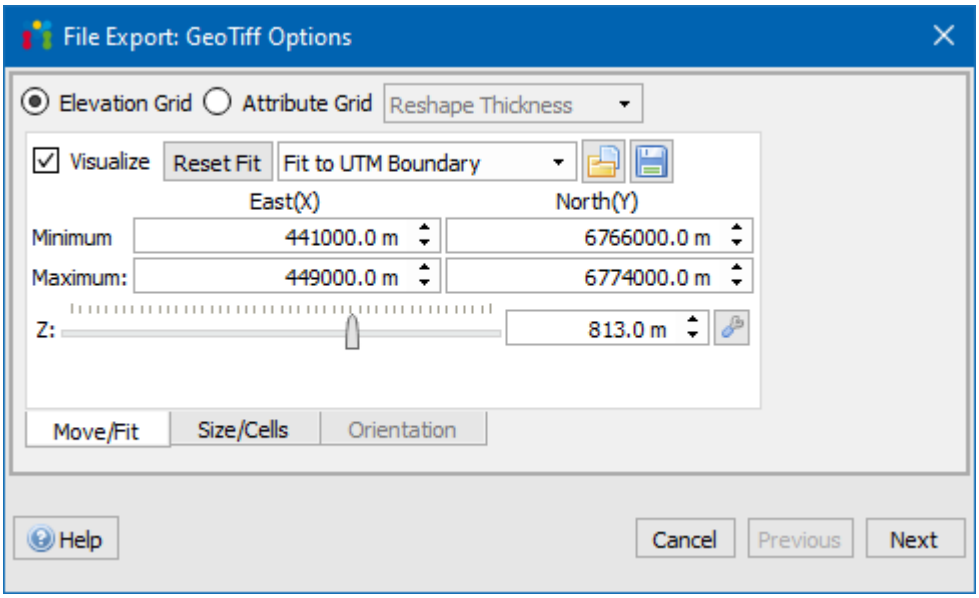

Figure 15: The new GeoTIFF exporter.

MOVE 2024 also adds support for exporting Grid and Mesh Surfaces in ShapeFile format. This allows for increased integration between ***MOVE*** and GIS software packages, such as ArcGIS. Support for tessellation information is not available in ShapeFiles and as such only the point data for surfaces will be included in the export.

Updated rotation speed settings for Autospin

The rotation speed settings for automatically spinning models have been improved in **MOVE 2024**. Auto Spin allows models to be spun around a defined axis at a defined speed. The speed can now be defined as a decimal and the minimum speed has been reduced to 0.01. This allows user to finely tune the rotation settings of a model for presentation purposes and makes the creation of videos showing ***MOVE*** models easier.

Improvements to MOVE Link for Petrel

Several improvements have been made to the ***MOVE*** Link for Petrel in ***MOVE 2024***. Dipmeter data, held in Petrel as PointWellLog data, can now be transferred to ***MOVE*** using the link. When this type of data is transferred to ***MOVE*** it will be created as markers on a well.

The speed of the Petrel link has been dramatically improved by decreasing the number of messages between the two software applications and by reducing the transfer of unnecessary data to ***MOVE***.

GeoCellular volumes created in ***MOVE*** can now be transferred from ***MOVE*** to Petrel. In previous versions of ***MOVE***, volumes could only be transferred from Petrel to ***MOVE***.

Improvements to DXF importing and exporting

Both the import and export of DXF files has been improved. The import now accepts a wider range of files and DXF object types. The importer now has functionality to automatically adjust settings if the import fails, this means that the default settings should work in most cases. The exception being any file which represents a single section and contains only X and Y coordinates. In these cases, the "2D DXF Section" option should be enabled. An additional option has been added to support different character sets in DXF files. Older files, and some third party files, use Latin1 as the default character set. Modern DXF files typically use the Utf8 character set. If on loading layer names and other text containing extended ASCII characters (characters with accents etc.) are not displayed correctly then reload using the alternative option.

Several improvements have been made to the DXF exporter. Text labels can now be exported. Text is exported using the Latin1 character set as this has better support in third party applications. Support for layers has been added, allowing multiple meshes to be saved to a single file. Mesh Surfaces exported as DXF files are now exported as single object, this is an improvement over previous version of MOVE where individual triangles would be exported.

Model Catalogue Updates

MOVE 2024, IPM 13.5 builds on existing compatibility with Petex's ***Model Catalogue*** which is a version control and model management system. A ***MOVE*** model can be loaded into ***Model Catalogue*** and the contents of the model are registered. The most up-to-date version of a model is maintained, and ***Model Catalogue*** notifies a user if the model is being worked on by someone else. Once a user has finished working on the model, any changes are tracked and recorded. Users can leave comments for other users outlining the work that has been completed or the changes that have been made.

PE Limited

Engineering & Geological Software Development

MOVE 2024, IPM 13.5 – Updates & Fixes

As well as the major changes and additions outlined above, please find below is a comprehensive list of updates and improvement to ***MOVE 2024*** organised by the ***MOVE*** interface tabs.

Please note that some of the fixes rolled up in this release were developed in, or back ported, to the ***MOVE 2022*** version as part of our regular updates to the commercial version throughout last year and are marked (*).

General Application Changes

- The Recent File list on the Open page of the File tab now lists recently opened MOVE Archive files (*.movz). (*)
- A keyboard shortcut (Ctrl+B) has been added to return to the Model Browser when another toolbox is active.
- Pressing Ctrl+Alt+D on the keyboard now creates a duplicate sub-section of the current section.
- The document save operation now performs writes to the database in a single batch process, reducing the chance of projects becoming corrupted whilst being saved.
- It is now possible to remove GIS (ShapeFile) connections and Petrel connections via the Document Properties dialog.

User Interface Changes

- Added a new context menu option to the Model Browser, Collapse All, which allows for a folder and any associated sub-folders to be closed simultaneously. (*)
- The Number of Segments in a merged polygon is now listed in Object Properties. (*)
- It is now possible to save out MOVE camera positions to a file and load them into other projects. (*)
- The North hand of the compass rose in 3D view is now also red coloured underneath. (*)
- Significant improvements have been made to the render times for Map Views. (*)
- The Log and Dipmeter tabs of the Well Quick Editor can now be dragged and displayed as separate windows to allow a clearer view of the data. (*)
- Dipmeter data on wells can now be displayed as a log plot in addition to dip symbols. (*)
- Fixed an issue in the Section Intersections tool where intersections would display after changing Section views with the tool no longer active.
- When re-ordering sections in the Section Browser the state of folders (closed or expanded) is now preserved.
- Performance of the 3D Line Edit tool when using Free Mode has been improved by now only displaying manipulators for selected Nodes.
- Fixed an issue where fault structure well markers were not always showing the correct slip sense in section views.
- Improved object selection times when working with models that include a large vertex cloud.
- In Rotation Settings, Auto Spin now accepts decimal speeds, and the minimum rotation speed has been reduced.

- Text Labels containing extended ASCII characters are now displayed correctly in 3D views.
- It is now possible to expand the selection to the complete column when a cell is selected in either a GeoCellular volume or 3D Regular grid. This allows single columns from a volumes to be quickly displayed in the Cell Attributes table.

File format and Import/Export

- The export of the Alias Wavefront OBJ file format is now supported.
- When importing ASCII files, column headings can now automatically be populated from information in a row of the data. Steps on how to do this are included in a variety of the MOVE tutorials, such as Tutorial 3: Loading and Visualising Well Data.
- It is now possible to export GeoCellular volumes in the REVEAL file format by right clicking on them and selecting the relevant option from context menu. (*)
- HTML (hexadecimal) colours in Gocad ASCII files are now supported in the GoCad importer. (*)
- In the Eclipse exporter, an option is now provided to export information to a to a single GRDECL file. (*)
- For OBJ files, material colours (*.mtl) are now displayed when inserted. If "Merge all images and meshes" is enabled, material colour attributes will be created and displayed as a Colour Map. If "Merge all images and meshes" is disabled, an object is created for each material colour. (*)
- MOVE project file names now support extended ASCII characters. (*)
- The ZGY importer now has an option to specify whether data is in time or depth and has an option to select the Z units for depth.
- The KML exporter has been improved to better handle data that spans the international date line.
- An issue has been fixed where in some cases saved seismic images were losing image quality when reloaded due to no colour map being saved.
- When exporting a single object, the object name is now used as the default file name.
- It is now possible to import SEG-Y files whose names contain non-standard ASCII characters.
- Fixed an issue where unit options were not being used correctly for CPS and ZMap exports.
- Imported Wavefront *.obj files with very large X & Y coordinates are now visualized correctly.
- Projection parameter options are no longer erroneously displayed when importing data as Lat/Long into a MOVE project with a defined coordinate system.
- Images exported from the Animation tool now always display the correct section direction.
- Improved support for polar stereographic projections when importing data.
- The vertices of Mesh and Grid Surfaces can now be exported to Shape Files.
- Grid and Mesh Surfaces can now be exported as GeoTiffs.
- An option is now given when exporting ShapeFiles to not sort attributes in alphabetical order, maintaining the original order instead.
- It is now possible to export 3D Regular Grids as ZGY files from the “Export As” context menu option.
- 3D Seismic data can now be exported in the *.zgy file format from the 3D Seismic Quick Editor.
- In exported ShapeFiles, attribute values are now exported with the significant figures that can be represented as 32Bit floats and any remaining values are padded with zeroes - for example the value 1.8 will now be exported as 1.800000000 instead of 1.799999523

Model Building

- The Auto Polygons tool now displays the following message "Unable to create any valid polygons. Only complex polygons detected. Check selected lines using the Tidy tool." if no polygons have been created. (*)
- Converting polygon to mesh where one or more polygon vertices generate near zero degree angles no longer causes MOVE crash. (*)
- Fixed an issue where Well names with extended ASCII characters were not displayed correctly in 3D views. (*)
- Extend Surface in Dip/Strike Directions now has a “Preview” option. If “Preview” is off, no pre-calculations are run, or previews shown while changing parameters. (*)
- A new option has been added to the Surface with Boundaries tool which allows the created surface to honour the boundaries of objects collected into the Surface Extent sheet. (*)
- The Isolated Faults sheet of Surface with Boundaries has been renamed to Faults, and a new method to create surfaces that honour multiple faults has been added. (*)
- In the Horizons from Template tool if the collected data has a single horizon assignment, this is now the default template horizon in Use Stratigraphy mode. (*)
- In the Surface with Boundaries tool, the Honour Points option is now available when the Surface Extents option Use Object Boundaries is enabled. (*)
- Improved the Ordinary Kriging algorithm to remove artefacts created when kriging surfaces from points whose best fit plane is close to being horizontal. (*)
- When projecting dip data onto a section, the projected dip data are now always created as new dip data object. Previously they were added to the parent object. (*)
- Fixed an issue where MOVE could crash in some cases if a line was deleted using the context menu “Delete” option while editing it using the 2D Edit tool within a section. (*)
- In Horizons from Template, it is now possible to detach and resize the stratigraphy tables (as in Horizons from Fault). (*)
- Improved the Horizons from Template Bisector algorithm to reduce errors. (*)
- When creating volumes using the Create Volume From Faults and Horizons method, an attribute (nnc) is now created to indicate if a cell has any non-neighbour connections. This attribute is set to 1 if a cell has non-neighbour connections and to 0 if it does not.
- Fixed an issue in the Add Properties to Volumes from Wells sheet of the Create Volume tool where logs with the same attribute name did not have their datasets merged prior to averaging the values. (*)
- In Create Surface from Points, the Multilevel B-Spline Approximation method has two new options. One to not filter grid cells containing no input data, and another to define the order of polynomial used in the B-Spline Approximation calculation. (*)
- In the Edit Line tool, the Snap Mode is now remembered when the tool is closed.
- Fixed an issue in Project to Section where Along Strike dip projection was failing for dip azimuths in the 4th quadrant (measured clockwise relative to section orientation). (*)
- Improved performance of the Resample tool when working with large surfaces.
- In Horizons from Template, Well Dip Markers can now be used as a starting dip.
- It is now possible to half sample Grids Surfaces using the context menu Resample options.
- Fixed an issue where if changes were made to the grid used to create surfaces, the generated surface would not match the spatial extents of the previewed grid. (*)
- When creating surfaces from points using the Multilevel B-Spline Approximation method, the extent of created surfaces matches that of the points when the option Maintain Horizontal Edge is enabled. (*)

- In the Surface with Boundaries tool, the Partial Sill and Range settings for the kriging calculation will update depending on the input data if the number of Input points is greater than 3 (previously 20). (*)
- Create Surface from Points using Delaunay triangulation now supports triangulation to boundary lines.
- The “Convert 3D Regular Grid to Seismic / Geocellular Volume” options have been changed to “Create Seismic / Geocellular Volume” for 3D Regular Grid. The existing 3D Regular Grid now remains in the model.

Data and Analysis

- In the Query tool, Spatial Queries can now be performed using multiple source objects.
- Queries are now saved and can be recalled as long as Query tool remains open.
- Fixed an issue where the Create Vertex Cloud option in the Well Marker Analyser would fail for projected wells if the corresponding section view had not been opened. (*)
- Major improvements in performance and stability have been made when editing the Symbols Table with very large models, (models with 1000+ wells or drill holes and associated well data and well logs). (*)
- When using the Create Vertex Cloud option in the Vertex Atribute Analyser the vertex cloud type selection is now honoured. (*)
- When creating Dips from Well Markers, the Well Name is now added as a Vertex Attribute to the Dips. (*)
- Well logs in the Well Log Analyser are now displayed in alphabetic order. (*)
- Improved handling of data for wells with a large number of markers. (*)
- The Well Log analyzer now displays attributes in alphabetic order after Measured Depth, Dip and Azimuth. (*)
- In Stereonet plots, Projected Planes can now be colour mapped.
- Fixed an issue where the Object Name column was missing in Vertex Attributes when multiple objects were selected. (*)
- When Filter Table Data is active in any of the attribute analysers, an explicit warning is now given to indicate that the loop selection of data in Stereonet, Tangent and Cross-Plot charts is not available. (*)
- In the Query tool, Spatial Queries with merged polylines are now supported.
- Fixed an issue in the Stereonet plot of attribute analysers which prevented only selected data being displayed. (*)
- An issue with the Terzaghi Bias Correction has been fixed, where when working with Well Marker data not all data points were displayed after applying the correction. (*)
- Fixed an issue in attribute analysers where the displayed min/mean/max was not always correct when working with multiple objects. (*)
- Added an option to show a plot line on Cross Plots in attribute analysers. Points can now be hidden on Cross Plots in attribute analysers.
- Fixed an issue where only the first two rows of Well Marker attributes could be populated.

2D and 3D Kinematic Modelling

- Thermal Subsidence tools: added an option that, when enabled, causes the calculated Thermal Subsidence and Burial History curves to have the same value at the end of the Syn-Rift Duration. This allows the curves to be easily compared after this point. (*)

- In 2D Decompaction, the Use Polygons to Calculate Decompaction checkbox is now toggled on by default. (*)
- Faults created using the Fault Geometry tool now start at the start point of the input fault segment. (*)
- Support for average velocity cubes has been added to 3D Depth Conversion. (*)
- 3D Depth conversion: Fixed an issue where 2D Seismic image were not properly converted when using the Velocity Cube method. (*)
- In the Strain Capture tool, Normalized Joint Intensity is now calculated based on finite strain (fe1) values. (*)
- The option to set a maximum seismic velocity is now fully implemented for the Fixed and Equation depth conversion methods. (*)
- In 2D Area Depth: Simple Depth to Detachment, the Excess Area mode now can now handle a single fault and two top horizon lines (hanging wall and footwall) to predict detachment depth. (*)
- Fixed an issue in the 3D Depth Conversion tool where a large lateral variation in average velocity caused 2D seismic images to be depth converted incorrectly. (*)
- The Flexural Isostatic Response option can now be enabled in the 2D Decompaction tool after calculating a Burial History table.
- Improved the calculation of velocity images and cubes in the Depth Conversion tools meaning these objects can be displayed for all methods.
- Horizon/ Fault Angle Compatibility analysis added to 2D Section Analysis, as a quick quality control technique for 2D interpretations.
- In 2D Section Analysis, a new checkbox allows the user to avoid displaying Line Length and Thickness results in the Section View if desired.
- Fixed issue on file saving where changes to some restored images were not recorded.

Fault Analysis

- Lithological data for use in fault seal analyses can now be sourced from a pre-existing gridded Vshale volume. (*)
- The Fault Analysis module now has improved Sessions functionality with the ability to save all of the objects and parameters used in the calculation of fault displacement and seal properties. (*)
- Fixed an issue where Cross Section plots on Fault Triangle and Fault History diagrams had incorrect backgrounds when using discrete colour maps. (*)
- The Yielding et al. (2010) method has been added for Hydrocarbon Column Height calculations and it is now the default method.
- For Hydrocarbon Column Height calculations, burial depth is now referenced to hanging wall to improve prediction (previously it was referenced to footwall). This affects both Yielding and Bretan methods.

MOVE connections to RESOLVE and OpenServer (API)

- New pages have been added to the MOVE Knowledge Base which explain all of the currently available RESOLVE operations and OpenServer commands.
- REVEAL Point Cloud files (RVPOINTCLOUD format) can now be imported into MOVE from RESOLVE and OpenServer (API).

- ASCII data can now be loaded into MOVE using RESOLVE and OpenServer (MOVE.ImportAscii(objectType, file)).
- The RESOLVE operations and OpenServer commands (API) to Cut, Copy and Paste MOVE Objects now work when MOVE is not the active window. This means they now work in both "Test run the workflow" and "Test run one step" mode (RESOLVE). (*)
- The following tools are now exposed to RESOLVE and OpenServer (API). (*)
    - Project To Section.
    - Snap.
    - 2D Thermal Subsidence.
    - 3D Thermal Subsidence.
    - Create Surface.
    - Create Dip.
    - Create Point
    - Create Fold Structure.
    - Create Fault Structure.
    - Create Lineation.
    - Create Well Marker.
    - Create Horizon (From Points).
    - Colour Map.
    - Horizons from Template.
    - Duplicate Section.
    - Strain Capture.
    - Fracture Modelling.
    - Attribute Calculator.
    - Modify Cell in attribute analysers.
    - Select Cells in attribute analysers.
    - Label.
- Creation and editing of Compaction Curves has been exposed to the API (OpenServer / RESOLVE). (*)
- The MOVE operations in RESOLVE are now arranged into folders with the Create/ edit a global function window. (*)
- The Create Points At Cell Centres operation is now exposed to RESOLVE and OpenServer (API). (*)
- Operation added to Select All Shown objects of the open MOVE view from RESOLVE and OpenServer. (*)
- It is now possible to hide and show MOVE objects as desired from RESOLVE and OpenServer (API). (*)
- Columns in data analysis tables can now be sorted using RESOLVE and Openserver (API). (e.g. MOVE.VertexAttributes.TableViewSortColumnAscending(column number). (*)
- An operation has been added to toggle Zoom To Selection from RESOLVE and OpenServer. (*)
- Operations have been added to save and load camera positions from RESOLVE and Openserver (API). (*)
- Operations have been added to Merge Lines and Merge Meshes from RESOLVE and OpenServer (API). (*)
- An issue has been fixed where attribute kriging was not possible from RESOLVE or OpenServer (API). (*)
- The MOVE Engine RDO now supports the use of sessions in the Fault Analysis module.
- The MOVE Engine RDO now supports the use of sessions in 2D-Move-on-Fault tool.

- MOVE sections inserted from RESOLVE or Openserver (API) are now automatically listed in the Section Browser. (*)
- In the Stereonet plot of attribute analysers, Centralise the Mean and Apply Rotation now work from RESOLVE and OpenServer. (*)
- Fixed errors in RESOLVE and OpenServer connections with MOVE Fracture Modelling: some fracture parameters were not updated, sessions could not be loaded and fracture sets could not be renamed. (*)
- ASCII Well Import is now exposed to RESOLVE and OpenServer (MOVE.ImportAsciiWell(importType, file, columnSeparator, multiSeparatorsAsOne, startImportAtLine, xyUnits, zUnits, zConvention, firstLineIsWellPosition, verticalWellDef, wellCurveCalcMethod, populateHeadersFromRow, attributeNames, coordinateSystem))

MOVE Link for Petrel

- The MOVE Link for Petrel in IPM 13.5 is compatible with Petrel 2023, 2022, 2021, and 2020.
- Dramatic speed improvement in communicating Petrel project contents.
- Dipmeter data, held in Petrel as a PointWellLog, can now be transferred to MOVE as well markers.
- When transferring Well logs, the unit of Permeability in MOVE is now the Darcy, whereas previously it was meter squared. (*)
- A new option has been added to the MOVE Link for Petrel that allows users to specify if All, Displayed or No Well Logs and Markers are transferred between Petrel and MOVE. (*)
- It is now possible to transfer 2D Seismic Data from MOVE to Petrel using the MOVE Link for Petrel. (*)

MOVE Link for GST

- The MOVE Link for GST is now compatible with GST 3.9.5 and 3.11.0.
- In the GST database, by default the MOVE system tables will now be in the public schema. MOVE will however use any existing tables in the Everybody_pool schema if the tables are not found in the public schema.

To find out more about the developments, enhancements, and bug fixes in MOVE 2024 please visit the Petex Client Web User Area.