



Petroleum Experts

Release Notes

Version 2019.1.0

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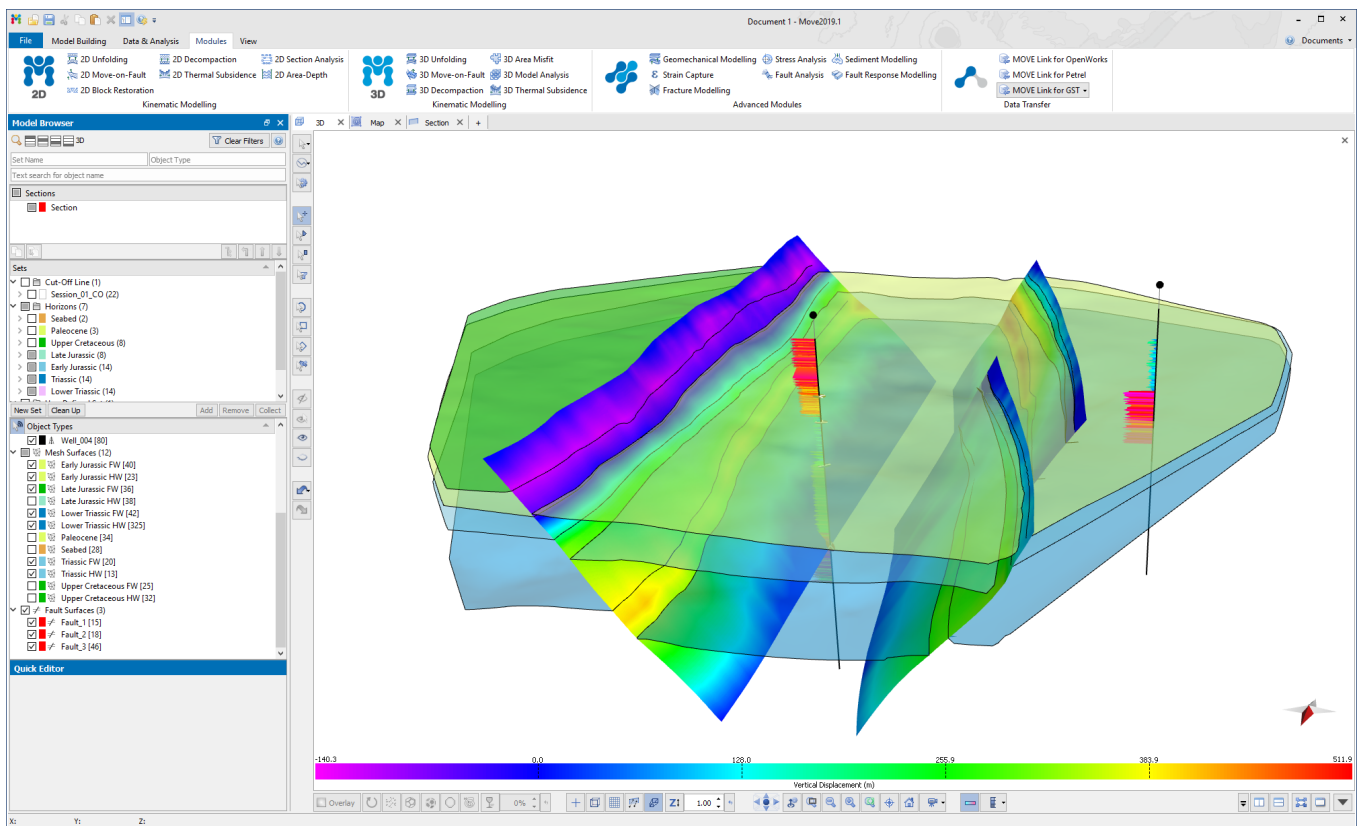
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MOVE2019.1.0 RELEASE OVERVIEW

The new MOVE 2019.1 release follows the previous 2018.2 release of MOVE and includes substantial new features, as well as improvements to the existing functionality and usability. This section provides an overview of the new features, enhancements, and performance improvements to all current modules and tools. It is followed by a more detailed breakdown of the changes to Move Core, the Move Modules, the Move Knowledge Base, and not least the introduction of a new MOVE Application Programming Interface (API).

Please review the additional sections below for details of some important changes. These include "System Requirements Changes and Notifications" concerning platform support, "Software Downloads" regarding obtaining download links for the software, "MOVE File Format Changes and Notifications" detailing changes to the MOVE file format, plus "Licensing Changes and Notifications" detailing major changes to the MOVE licensing system.



Move2019.1 Interface with 3D View

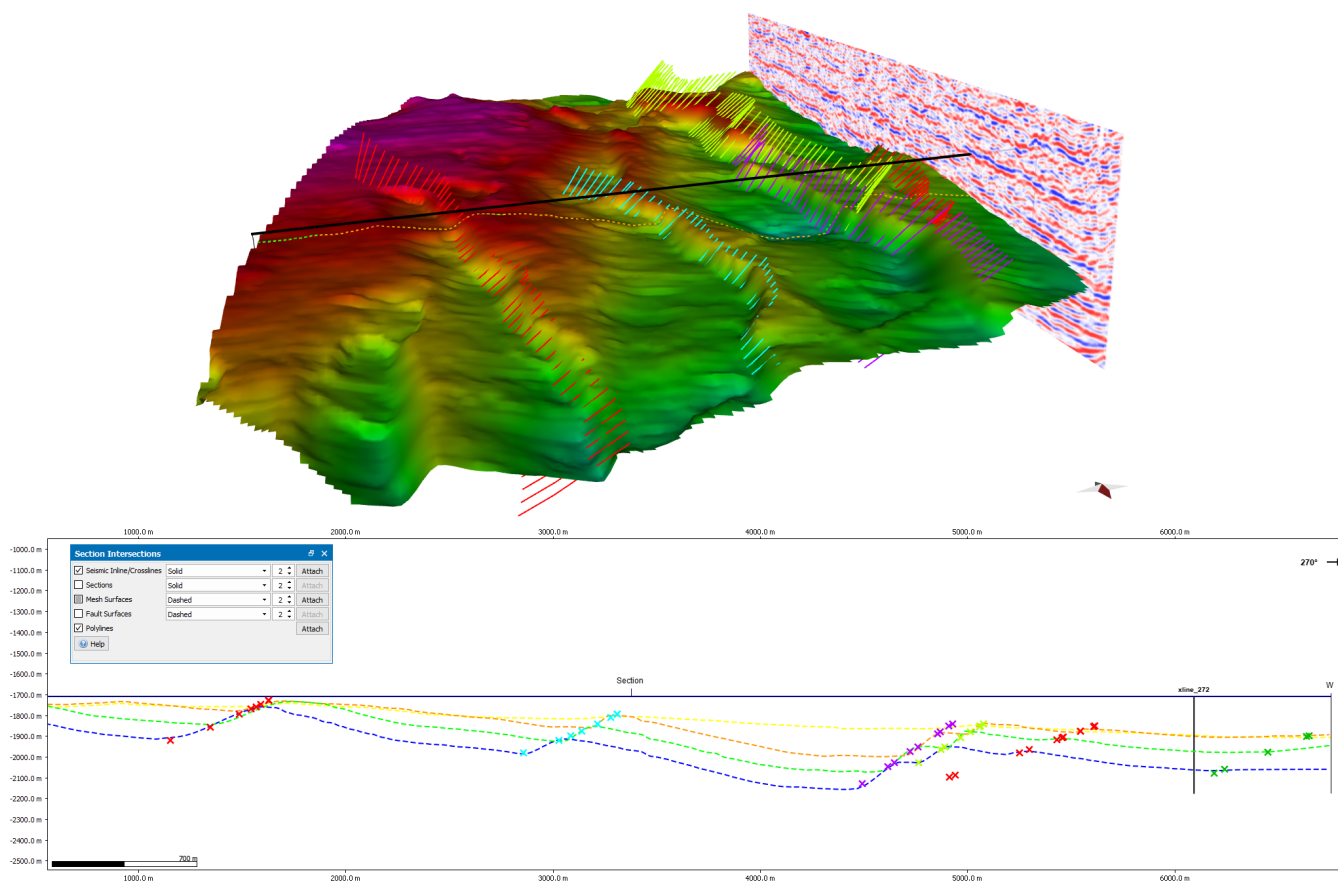
In line with the announcement last year, MOVE 2019 is now a Microsoft Windows-only release which brings MOVE into line with all the other Petroleum Experts IFM, IVM, and IPM suite of products. Note however that MOVE is a 64-bit only product and is not available in 32-bit. The annual release date for the MOVE suite has also been mirrored with the Petroleum Experts release cycle with the major release now targeted towards a September/October time-frame.

Beginning with MOVE 2019, MOVE is licensed solely using the Petroleum Experts HARDLOCK License Manager. Support for FlexNet licensing manager has been removed from the software and licensing system. See the relevant section below for further details.



With the wide adoption of virtualisation and cloud computing, MOVE has been tested successfully in several new environments, not exclusively but including Microsoft Azure, Amazon AWS, and Google Cloud. Additionally, MOVE has been recently tested in the Schlumberger DELFI open cloud-based environment.

MOVE 2019 sees several notable additions to MOVE Core in terms of imports, exports, and data handling. Data imports and integration with other products is an important area and MOVE 2019 includes updates to the MOVE Link for Petrel, GOCAD Voxet import compatibility, and support for a new volumetric data type in the MOVE Link for GST. Visualisation and model selection has been improved in 3D, with improved support for well marker data, plus improvements to Geocellular Volumes cell selection, region support, and horizon extraction. Improvements to model building in 2019 include options to honour original data and maintain existing boundaries in the surface creation and resampling tools. There is a brand new Model Browser Search Bar in MOVE 2019 which, when dealing with large projects, allows the Model Browser to be navigated faster and more efficiently. The Section Intersections Tool has been improved allowing better per-object control and visualisation of intersections in Section View, and the Tidy Horizon to Fault context menu option now allows multiple horizons to be selected and tidied with one click. The 2018.2 release saw the addition of new copy and paste functionality allowing images from the Windows clipboard to be inserted straight into the Views.



New Section Intersections tool for MOVE 2019. Allows for greater control of display of intersections in a Section View.

The Horizons from Template tool is now fully interactive in 2019. Following a project which was based on extremely complicated regional sections from the Gulf of Mexico there are now major improvements to the Auto Polygons and Tidy tools. In 2019 the theme of providing more intelligent workflows and auto-population of tools has been continued with the Thermal Subsidence and Decompaction tools now working in tandem. Additionally, Thermal Subsidence diagrams and data can now be copied to the Windows clipboard. In 2D Depth Conversion there is now improved handling of water velocity and, a new option has been added to the

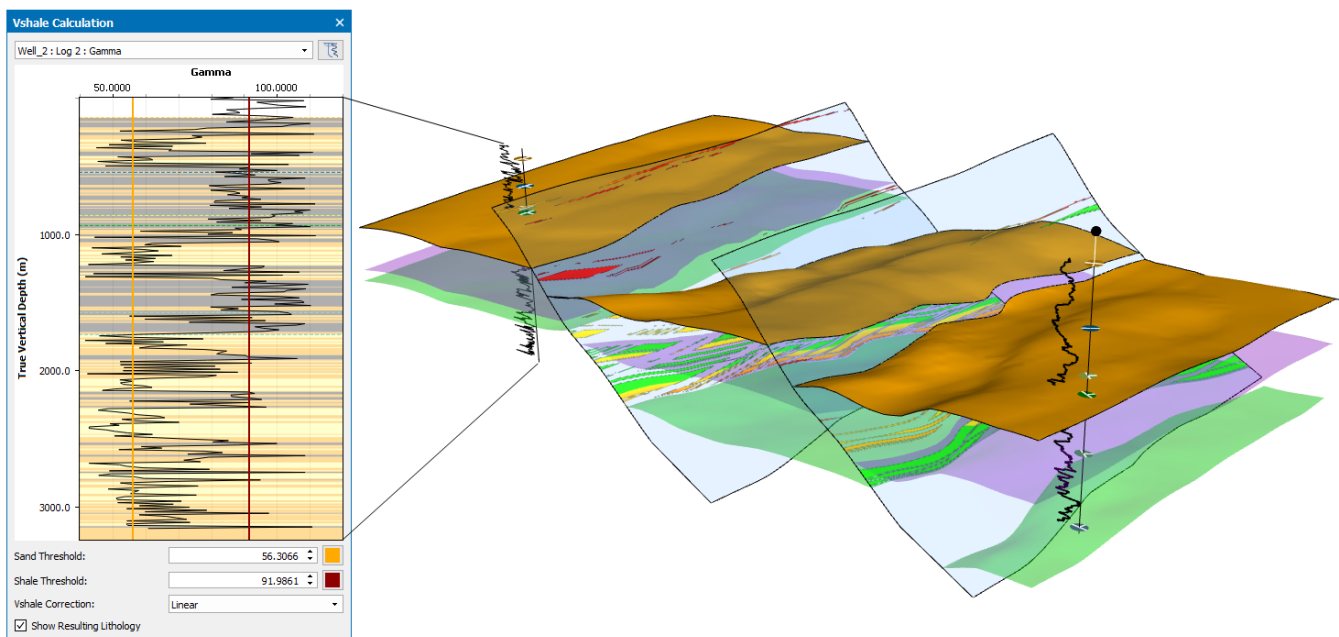


Parameters in MOVE 2019 when using the Database option to allow smoothing of calculated velocities e.g. across faults.

For MOVE 2019, a brand new Application Programming Interface (API) has been developed. The API enables communication with other Petex applications via the RESOLVE software (licenced separately) or communication with third-party applications, such as Excel, using the Petex OpenServer (licenced separately). The API provides a two-way gateway for information between MOVE and external applications. This exciting new development facilitates the creation and implementation of automated workflows, plus the seamless integration of geological modelling with production modelling (including reservoir simulation). Inclusion of structural geology validation in the IPM workflow has been in Petroleum Experts' long term plan for many years. The vision is to use production data and geological principles to validate models being used for production and development. See below for further details.

The MOVE 2019 release sees the re-introduction of the Sediment Modelling advanced MOVE module. The Sediment Modelling module provides an automated 3D turbidity current modelling workflow for simulating turbidite flows onto a (palaeo)bathymetry and outputting turbidite distribution and reservoir quality attributes.

In the Fault Analysis module, intraformational well markers are now taken into consideration when calculating lithologies and seal proxies from Vshale logs, aligned relative to horizon top markers matching cut-off lines in the model. The well log chart on the Wells sheet now visualizes the log lithology as calculated from user-defined Vshale parameters.



In the Fault Analysis, Wells sheet, it is now possible to visualise the log lithology as calculated from user-defined Vshale parameters.

The Move Link for Petrel has been updated with the possibility of switching on or off auto-transfer of objects, allowing more control over the transfer process. A new option has been added in 2019 that allows user to decide if well logs will be transferred, and Pillar Grid faults in Petrel can now be transferred as fault sticks in addition to as surfaces.



MOVE 2019 includes new developments to allow compatibility with Petroleum Experts' Model Catalogue product (licenced separately). Model Catalogue is a version control and model management system.

Client requests for MOVE software enhancements are very important to help us shape our future development strategy. Our annual User Meeting in Edinburgh aims to showcase the latest developments in MOVE, show client presentations outlining MOVE work in industry and discuss client development requests. Users are invited to submit development requests in advance of the meeting – all attendees will have their requests discussed and considered for development. The next Edinburgh User Meeting is the 8th-19th June 2020 - keep the date!

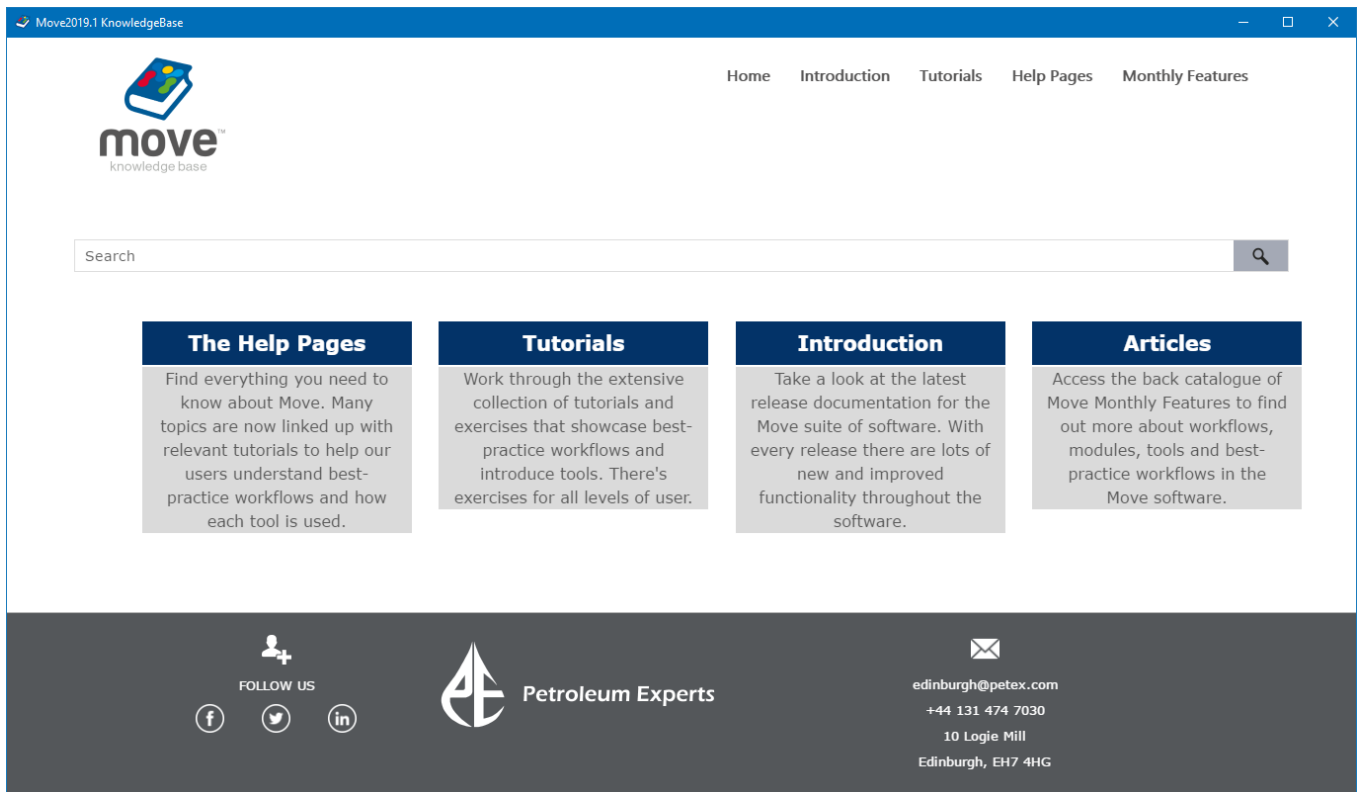
MOVE can now connect to the Petroleum Experts web-site, accessed via the Help & About menu. Users can register on their initial visit, and then, on subsequent visits will be logged in automatically. Users will need a HARDLOCK license number and email to register. From the support section you can access the Petex Web User Area and the Petex Technical Support Area. There you will find technical newsletters, User Meeting updates, presentations and case examples. Users can also now create technical support requests and track any outstanding support requests, as well as search the FAQ database via the Web User Area. Additionally all client reported bugs that are fixed are documented on the Web User Area.



MOVE Knowledge Base

In MOVE 2017 we introduced the first MOVE Knowledge Base. This resource contains all MOVE Help Pages, Tutorials, and the release documentation presented in a single, offline, searchable entity, independent of MOVE. The material is cross-referenced and brings together tutorial workflows with more detailed help topics including algorithm theory and recommendations for tool application and parameter values. The Knowledge Base can be easily updated and made available to our users regularly, therefore it is considered more up-to-date than the application help pages. This allows us to improve our teaching material, which is then independent of the MOVE software release cycle.

For 2018.2 and 2019, the Knowledge Base has improved cross-referencing of tutorials and help topics, and has added a new menu to the top bar. The new menu (Monthly Features) allows users to access the back catalogue of MOVE Features that form part of our newsletter and that is made available to registered users.



Opening window of the MOVE Knowledge Base – a platform on which the MOVE help pages, tutorials and monthly features have been integrated.

New tutorials have been added for 2018.2 and 2019 covering new functionality including Elliptical Fault Flow, Sediment Modelling, Geologically Constrained Model Building Techniques and MOVE integration through Visual Workflows using RESOLVE. These tutorials are based on real datasets and provide users with detailed step-by-step instruction on the best practice workflows recommended by our structural geologists. Tutorials have also been updated with additional exercises on Uncertainty Modelling in Fault Analysis, improved 3D Model Building using the new Surface with Boundaries tool and new 3D Model Conditioning techniques. All 38 tutorials can be accessed directly from the Knowledge Base and from the software download link, sent to the designated technical contact for maintained clients.

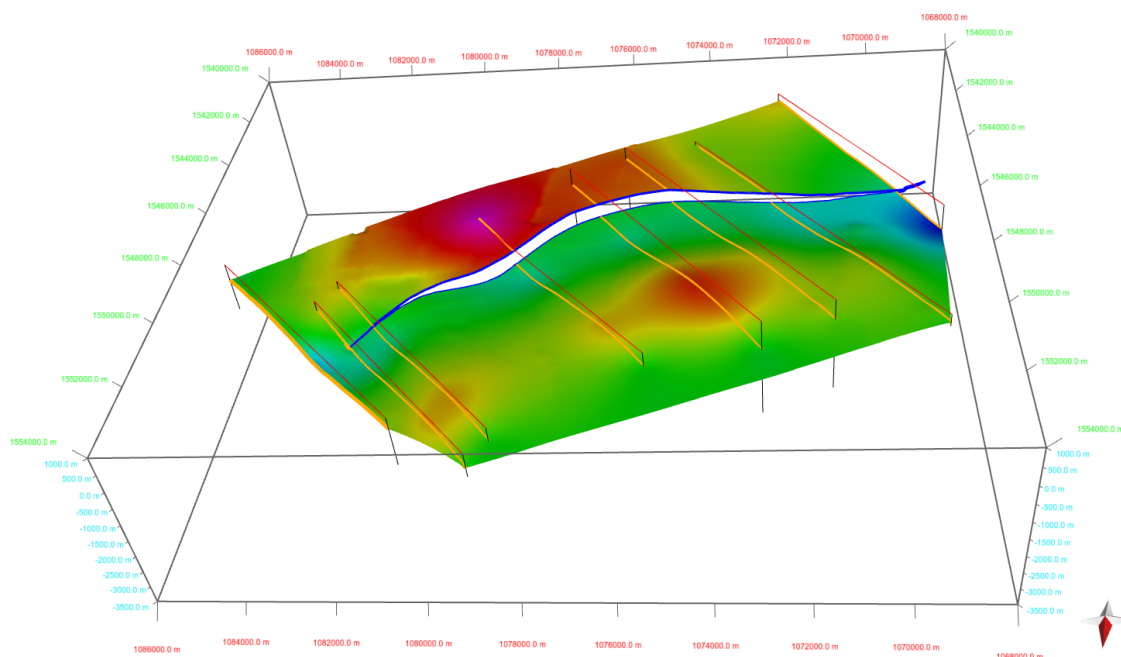


MOVE Core

The MOVE file format has been updated to version 2.6. Older versions of MOVE will no longer be able to open files saved by Move 2019.1 - see the relevant section below.

The GIS vector data (including Shapefiles) live stage connection allows users to work with Shapefiles within MOVE, whilst simultaneously editing the data in other applications such as those belonging to the Esri ArcGIS platform. The 2018.2 release saw support for additional point, multi-point, and multi-polygon Shapefile formats. The 2019 update includes improved handling of Shapefiles with extended ASCII characters, as well as the support of polygons with holes.

In the Create Surface tool there is a new option when using Ordinary Kriging, allowing all input data points to be honoured when creating a surface. The Surface with Boundaries tool allows the user to create kriged surfaces with a user-defined outer boundary. Various constraints, such as inner holes, additional fault boundary surfaces and dip data can be applied to create more complex surface geometries. Also, an isolated fault can be used to tear and reshape a horizon surface locally. In MOVE 2019, using Surface with Boundaries when Control Points for Kriging is selected has been modified to allow the honouring of input data points if desired, similar to the new Create Surface tool functionality. In Create Surface, Fault sticks can now be generated for pillar grids transferred from Petrel.



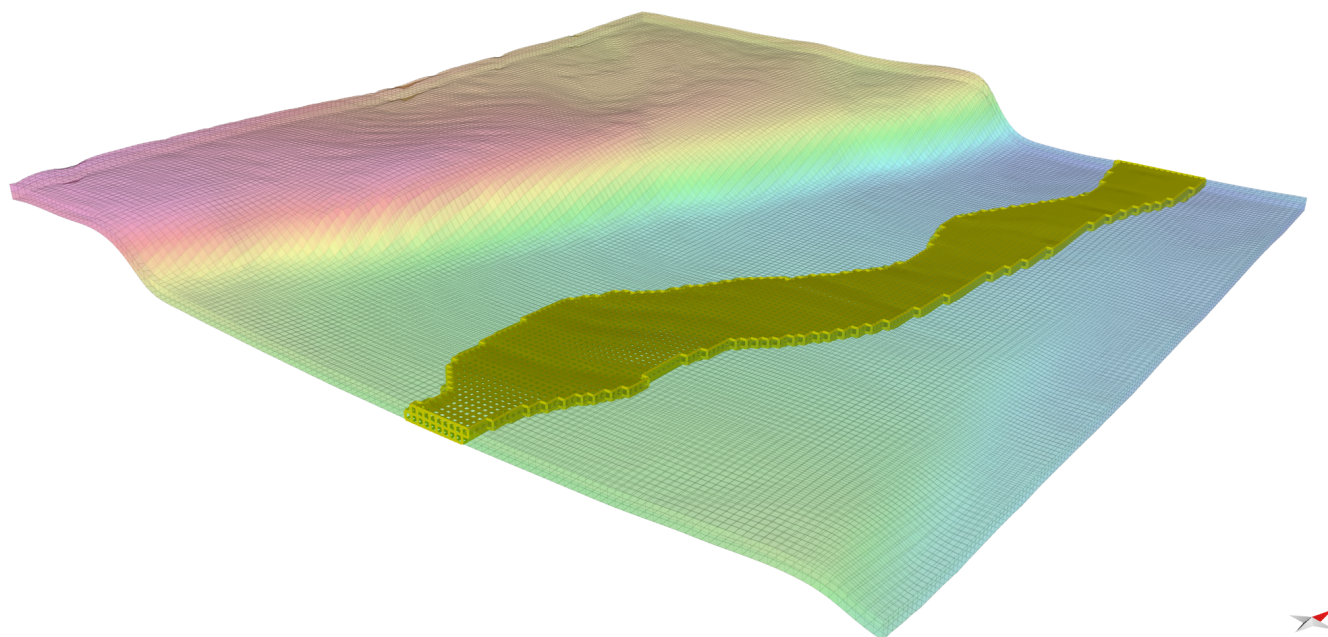
The Create Surface and the Surface with Boundaries tools now allow fully honouring input data points.

A new Edge Collapse method has been added to the rational reduction option in the Resampling tool. This new option allows rational reduction resampling on more complex surfaces while optionally maintaining boundaries. Maintaining boundaries is important for preserving boundary or area calculations post sampling, as well as ensuring, in GIS usage situations, that data borders are maintained when downloading and subsequently uploading data to a database, e. g. ArcGIS or via the MOVE Link to GST.

Imports and integration with other products is an important area and MOVE 2019 includes a new GOCAD Voxet import. Additionally, for the GOCAD importer, there is improved loading of Tsurf files containing 'PATOM' lines. In MOVE 2019 we have added the ability to import multiple 3D seismic files part of a single cube into MOVE for analysis as a single cube. This can be used to load 3D seismic from USGS NAMSS database.



Visualisation and model selection has been improved in 3D, with improved selection and support for well marker data. There are improvements to Geocellular Volumes regarding picking cells and part-selection of the model. The Cell Attribute Analyser has also been improved, and the ability to create Regions from GeoCellular Volumes has been added. In 2019, Faults, in addition to Horizons, can now be extracted from GeoCellular volumes using the Extract Surfaces/Faults from GeoCellular Volume option. A new option to generate points at cell centres for selected or visible cells has been added. It is now possible to create a new Region using the current cell selection.



The new Cell Selection option in MOVE 2019 allowing individual cells to be selected in a GeoCellular volume.

There is brand new Model Browser Search Bar in MOVE 2019 which, when dealing with large projects, allows the Model Browser to be navigated faster and more efficiently. You can search the tree using a combination of one or more of Object Name, Set Name, Object Type. The functionality is connected to the keyboard short-cuts where the Tab key will take you straight to the selection of the Object identified by the search, allowing quick selection/modification/deletion or quick access to any functionality available in the context menu.

The Section Intersections tool has been improved allowing better per-object control and visualisation of 3D intersections in the Section View. This functionality is accessed via a new Section Intersections Tool in the View Tab. The line style and line thickness can be adjusted per object type, and you can choose which 3D object types are shown as 2D intersections. Additional control can be applied using the Model Browser, where individual Objects, Object Types, or Sets can be checked on/off using the tree-view. Previously either all or none of the 3D data was intersected with the Section.

The new Tidy Horizon to Fault context menu option in the 3D View now allows multiple horizons to be selected. In the Attribute Analyser the ability to delete selected attributes using the delete key has been added.

The 2018.2 release saw the addition of new copy and paste functionality allowing images from the Windows clipboard to be inserted straight into the Views.



In the MOVE Core, the 3D PDF export now exports in PRC format. This PRC format is useful for embedding the 3D content into compatible authoring packages. PRC can be used as a 3D file type for storage and interchange. Such 3D binary files can be interchanged with other PRC compatible applications.

As a general notable update for 2019, extensive development has been done to rework MOVE file loading and saving speed and reliability and recovery, as well as to increase the speed and reliability of Copy/Paste functionality between Views and Documents.

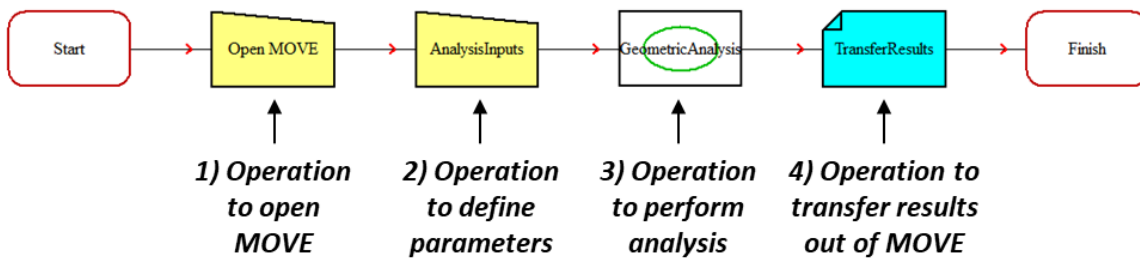


Application Programming Interface (API)

For MOVE 2019, a brand new Application Programming Interface (API) has been developed. The API enables communication with other Petex and 3rd party applications (such as Excel) via the RESOLVE software (licenced separately) or using the Petex OpenServer (licenced separately). The API provides a two-way gateway for information between MOVE and external applications. This exciting new development and API facilitates the creation and use of automated workflows, plus the integration of geological modelling with production modelling (including reservoir simulation). Inclusion of structural geology validation in the IPM workflow has been Petroleum Experts' long term plan for many years. The vision is to use production data and geological principles to validate models being used for predictions and development plans.

1. Creation of automated workflows

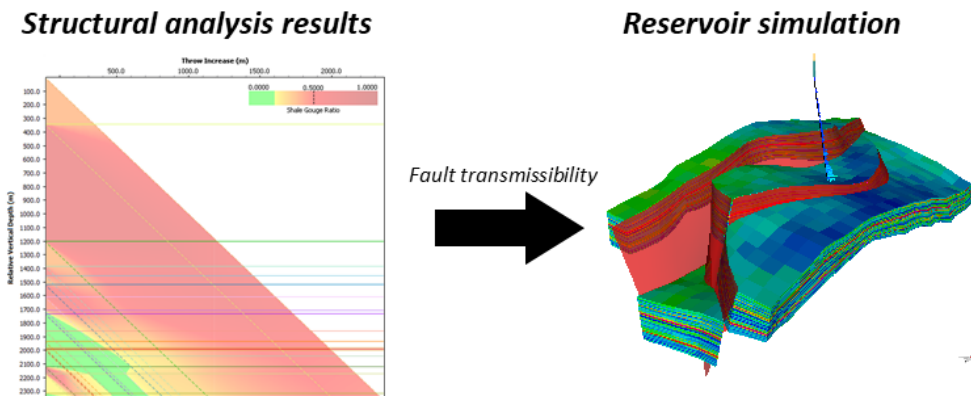
The API allows tools in MOVE to be controlled and workflows orchestrated by third party applications. The results of the analyses can then be returned through the API. A series of logical steps can be defined computationally, using RESOLVE or Excel for example, which control the flow of information within, as well as in and out of, MOVE. Operations and workflows can be automated and standardised to increase efficiency, reduce subjectivity, and minimise operator bias. Once established, workflows can be shared within an organisation to allow others to benefit from the knowledge and expertise of structural specialists.



Example of a Visual Workflow within RESOLVE

2. Integration of geological and production modelling

Once the results of an operation in MOVE are returned to an external application via the API, the results can be accessed and used by other packages. One result of this is integration of structural geological modelling and production modelling. Integration provides a link between static geological models/data (e.g. fault and horizon interpretations) and dynamic production models/data (e.g. reservoir pressure data and fluid compositions). Geoscientists now have access to any dynamic data that are available and can use the additional data to validate geological models and concepts.



Results of structural analysis performed within MOVE can now be seamlessly integrated into external applications (e.g. Reservoir simulators) via the API.



Model Catalogue Updates

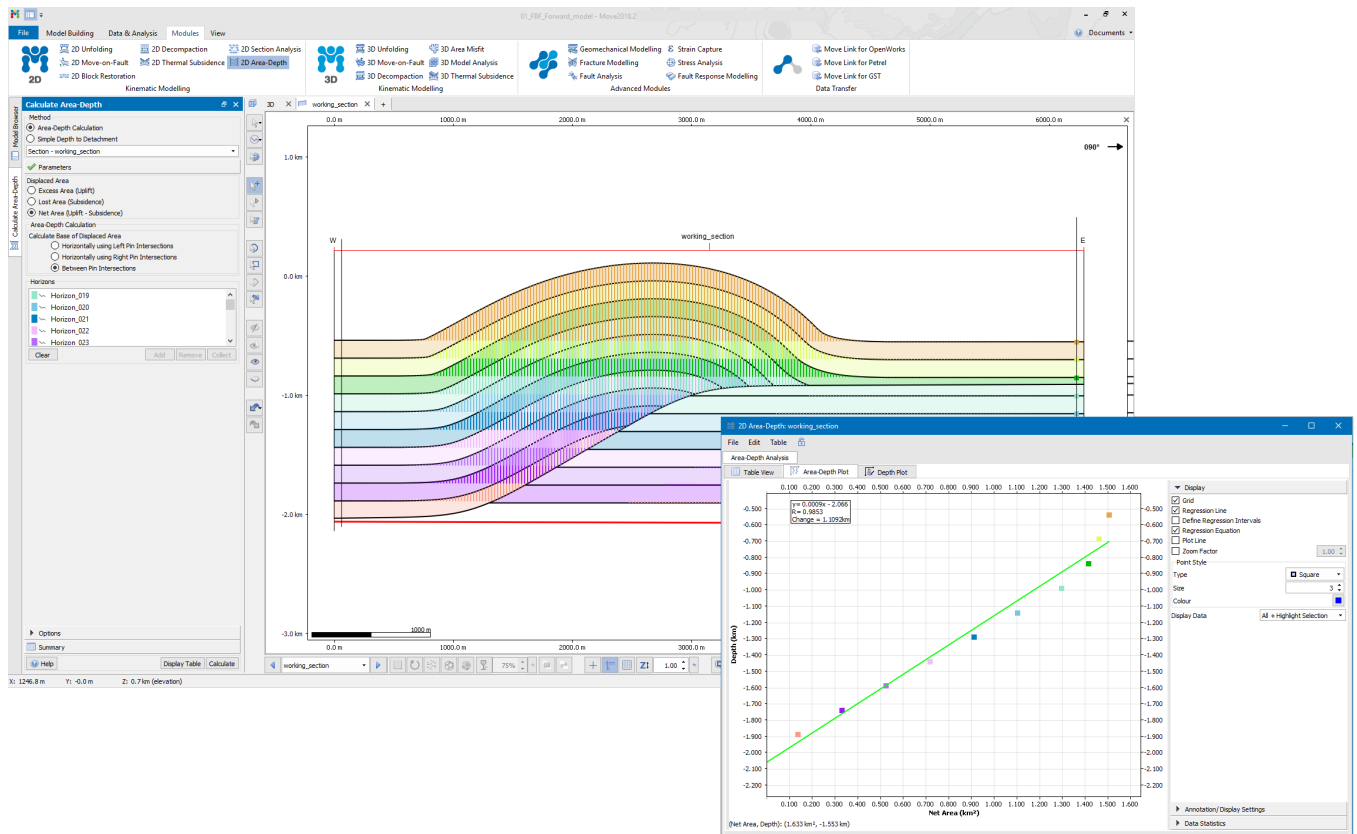
MOVE 2019 includes new developments to allow compatibility with Petex's Model Catalogue product (licenced separately).

Model Catalogue is a version control and model management system. This new development provides significant improvements for multiple users that are working on a single MOVE file. 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.



Kinematic Updates

In 2018.2 we added a new tool, 2D Area Depth, to the 2D Kinematic Modelling Module for Area Depth Strain analysis. The 2D Area-Depth tool provides a set of non-kinematic techniques used to predict detachment depth and to test a section for area balance and internal consistency. Along with calculation of detachment depth, the 2D Area-Depth tool can quantify layer parallel strain, as well as shortening due to folding and/or faulting. The Area Depth plots calculated provide useful insights into the structural evolution of the region of interest such as the depth of an upper detachment or the boundary between growth and pre-growth stratigraphy.

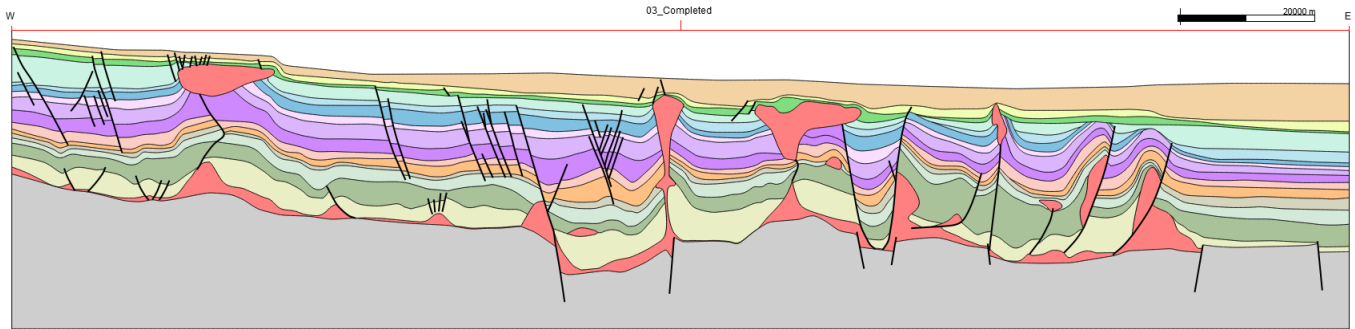


2D Area-Depth tool example, with Area-Depth Plot displayed.

The Horizons from Template tool is now fully interactive in MOVE 2019. When modelling horizons using the Horizons from Template tool, horizon thickness can be modified easily by clicking and dragging the polylines interactively in the Section View. This interactive behaviour has also been incorporated into the Create Lines tools allowing users to digitize horizons based on the stratigraphy in real time.



After a project dealing with complicated regional sections from the Gulf of Mexico, major developments and improvements were introduced to the Auto Polygons and Tidy tools for MOVE 2018.2. Thanks to these improvements, the Auto Polygons tool now has a success rate of >99% and can handle structurally complex geometries such as those in the figure below. The Tidy tool has been enhanced to give better visual feedback of potential issues and improved automatic correction of problems. Duplicate faults are now clearly highlighted and the default values within the toolbox changed to better reflect a wider range of section extents. A shortcut has also been added, Alt+T (Tidy Selected) to speed up the Tidy workflow.



Complex cross section adapted from Bouroullec et. al. (2017). All polygons displayed in the section were successfully created using the Auto Polygons tool in MOVE 2018.2.

The time required to perform most restoration workflows was reduced in 2018 through the inclusion of more auto-population functionality in the 2D Move-on-Fault toolbox. When a fault is collected into the toolbox, the software will automatically identify the youngest stratigraphic horizon that is offset by the fault, and set up the Join Beds collection boxes with the appropriate hanging and footwall line segments. For sections containing multiple faults, this means the users can simply specify the Active Fault and click Apply, reducing the number of mouse clicks and saving lots of time. In 2019 the theme of providing more intelligent workflows and auto-population of tools has been continued, with the Thermal Subsidence tool and Decompaction tool workflows now synchronised. A new context menu option for the Thermal Subsidence diagram called 'Copy Data' has been added. This allows the Total Subsidence and Burial History curves to be copied to the clipboard as a table for pasting into external packages like Excel. There is a new option, Use Complete Section, in the 2D Decompaction toolbox, and when this option is enabled both the 2D Move-on-Fault toolbox and the 2D Decompaction toolbox will be automatically updated during a workflow.

In 2D Depth Conversion, a new option has been added to the Parameters when using the Database option to allow smoothing of the calculated velocities. This gives improved results when using large velocity changes between horizons in faulted sections. When converting between depth and time using the Equation method it is now possible to set a fixed velocity for objects above the top horizon. This is used to quickly set a constant water velocity for sub-marine environments. A new option has been added that allows the maximum seismic velocity to be defined. This is used when working with deep seismic images to avoid unrealistic seismic velocities in the lower part of the seismic section.

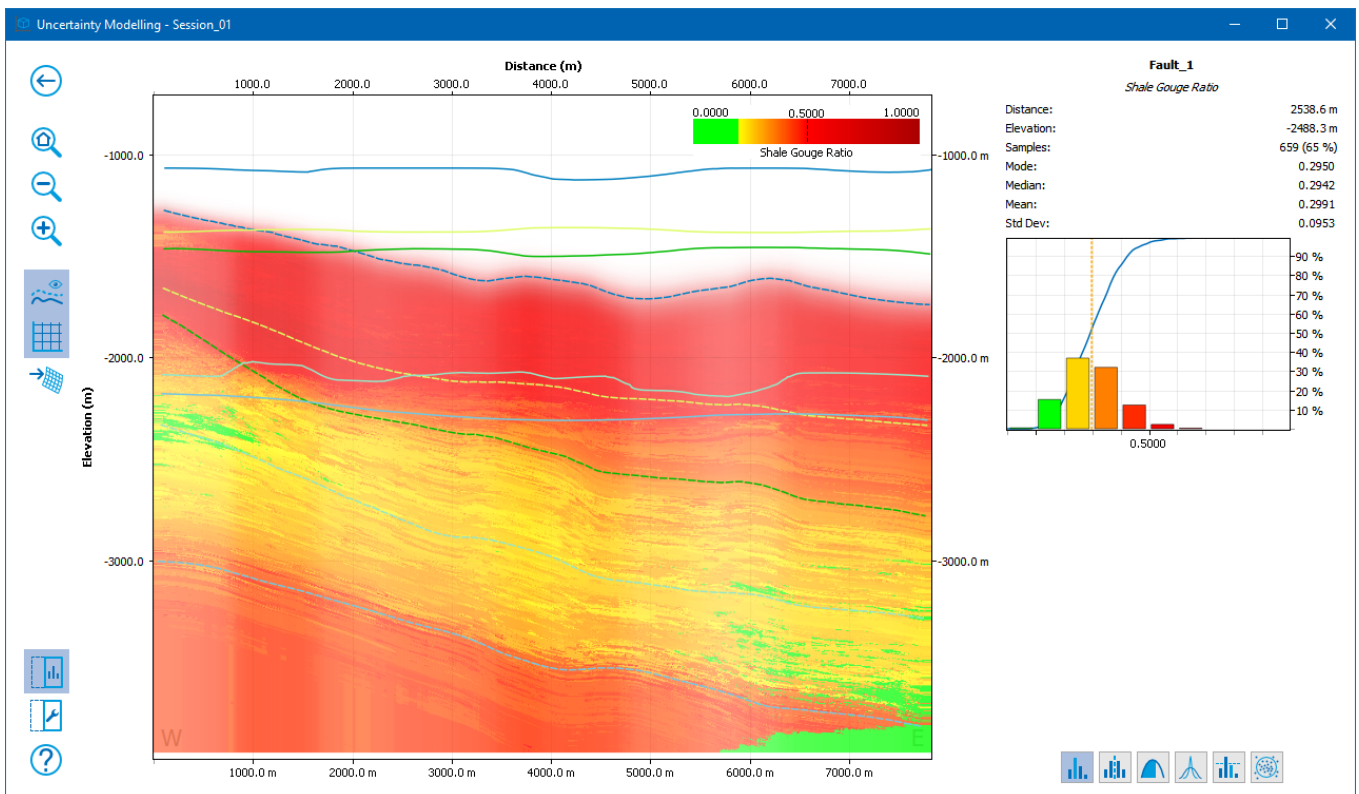


Fault Analysis

Fault Analysis has been expanded to include Uncertainty Modelling for 2018. From the 2018.2 release, intraformational well markers are now taken into consideration when calculating lithologies and seal proxies from Vshale logs, aligned relative to horizon top markers matching cut-off lines in the model. The well log chart on the Wells sheet now visualizes the log lithology as calculated from user-defined Vshale parameters.

The Fault Analysis Uncertainty Modelling tool allows users to run a Monte Carlo simulation that models deviations in fault cut-off position and Vshale log values. Using these simulations, the impact of data resolution can be investigated and the uncertainty of fault juxtaposition and seal proxies to be quantified. A strike projection of the modelled fault can be visualized and colour mapped for the mean, mode or percentile (e.g. P10, P50, P90) result. These values can be saved to the fault in 3D. A graphical display of any point or region on a fault gives each possible result and its likelihood, or the probability of a result.

Uncertainty Modelling quantifies the likelihood of a fault acting as a conduit or barrier to across fault fluid flow. This can add confidence to prospect generation and trap evaluation and reduce financial risk.



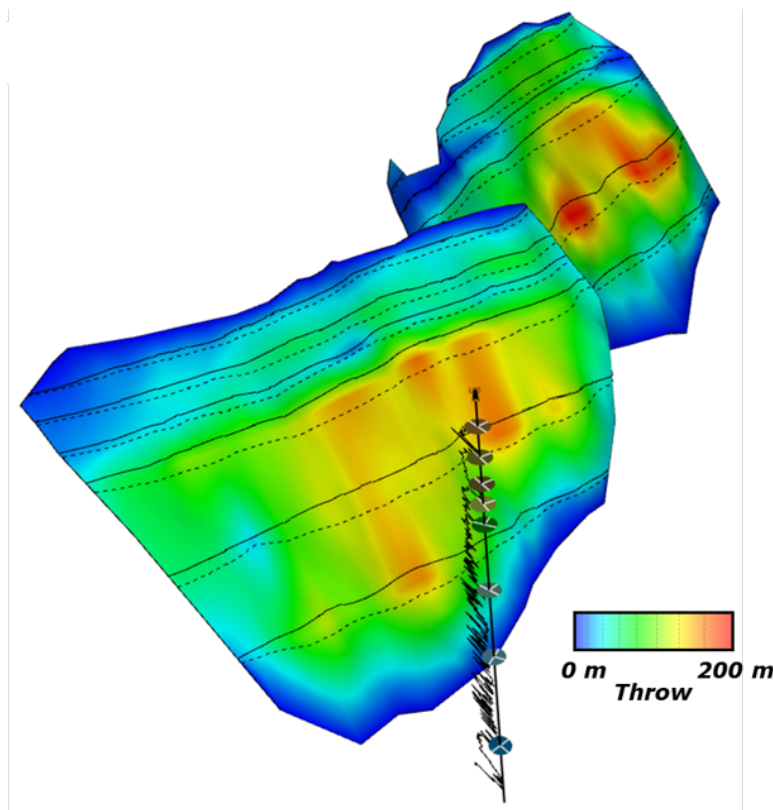
Strike projection of a fault surface colour mapped for the mode values of SGR based on 1,000 iterations in the Uncertainty Modelling tool. The graph on the right of the window shows the possible results and the probability of occurrence of each.

Additional developments to Fault Analysis allow:

- Seal proxy colour maps to be customised.
- Seal proxies to be filtered by horizon displacement area.
- Fault Triangle diagrams to be calculated from well logs without stratigraphic markers.
- Charts allow guide lines to be created and optionally converted to mesh surfaces in the model.
- The well log chart on the Wells sheet now visualizes the log lithology as calculated from user-defined Vshale parameters.



- In Uncertainty Modelling it is now possible to visualize the probabilities of combined lithological juxtaposition scenarios.
- Uncertainty Modelling now offers the option to transfer scenario percentiles P10, P50 and P90 to the fault in a single operation.
- Uncertainty Modelling now offers the option to transfer the probabilities of all lithological juxtaposition scenarios to the fault in a single operation.
- Intraformational well markers are now taken into consideration when calculating lithologies and seal proxies from Vshale logs, aligned relative to horizon top markers matching cut-off lines in the model.
- Fault Scaling and Fault Growth plots are now calculated from data projected onto individual fault planes, rather than a single combined plane.
- Uncertainty Modelling now offers the ability to simulate variations in parameters to Probabilistic SSF and Hydrocarbon Column Height.
- The Fault Growth chart now visualizes a range of likely growth activity based on lateral sampling.
- Added ability to adjust displacement reference frame for throw calculation.
- Fault Triangle now allows arbitrary well markers to be created by dragging guidelines from the well log charts' horizontal axes.

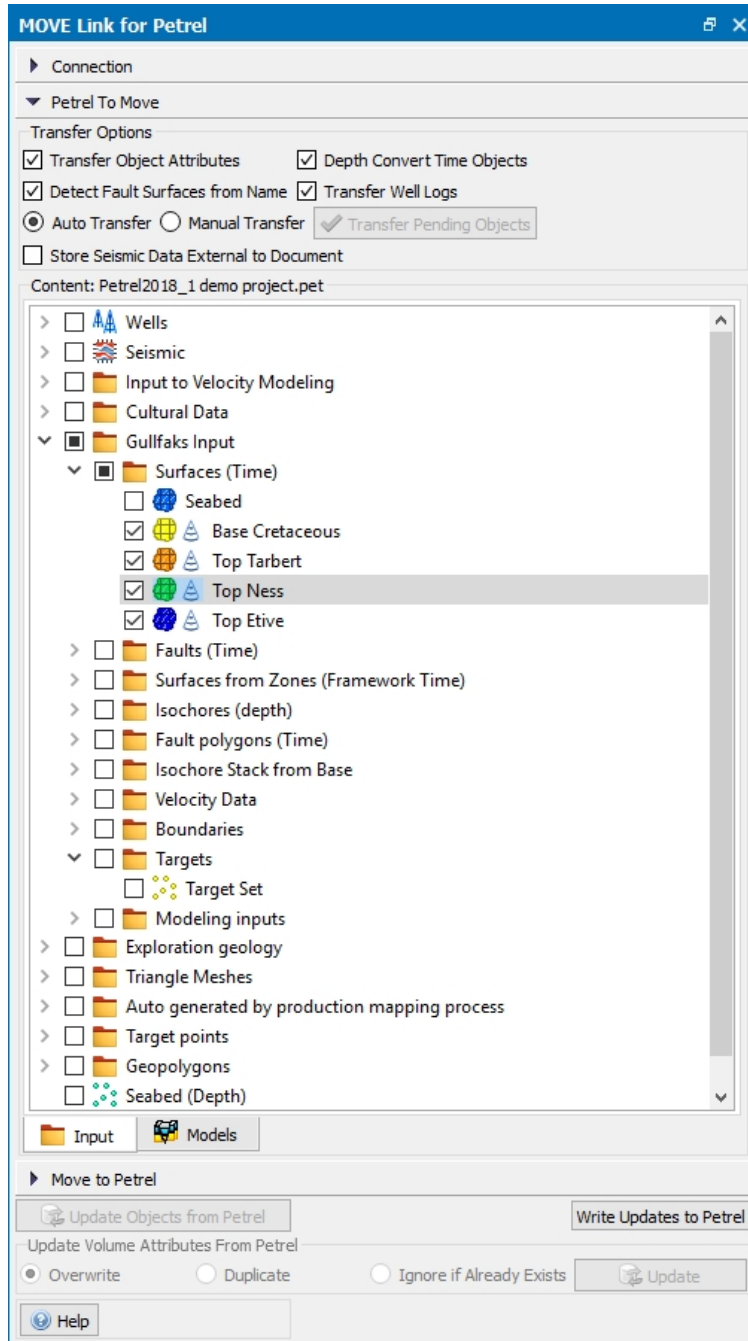


Faults colour mapped for throw with associated horizon cut-off lines displayed in black on the fault surfaces; generated using the Fault Analysis module.



MOVE Link for Petrel

For 2019 the MOVE Link for Petrel Plug-in has also been updated to be compatible with Petrel 2019. After feedback from our User Meeting the MOVE Link for Petrel has been updated with a new option to switch on or off auto-transfer of objects, allowing more control over the transfer process. The Manual Transfer option allows the user to select which objects are to be transferred from Petrel To MOVE before committing to the transfer. The 2019 version adds the ability to transfer Pillar Grid faults as fault sticks, and additionally an option has been added to exclude Well Logs from transfer, reducing loading time.



MOVE Link for Petrel in MOVE 2019.1 with new transfer well logs option.



Other General Improvements

Improvements have been made to the handling of data and the control of object and attribute visibility. A new context menu option has been added to the Sections Browser in the Model Browser to support the display of cross-sections. This option will allow the user more control over the display where there is a large number of cross-sections in the model. The Quick Editor for wells and fractures now includes options to control the display of marker data and the percentage of fractures displayed, respectively. Selection speeds have been improved when working with wells with many well logs.

To improve the handling of large files, two new options have been added to Preferences to control whether objects are visualized when a MOVE project is opened, or new data is imported into an existing MOVE document. These options will allow the data to be imported but will automatically render the objects invisible until the user wishes to show them by controlling object visibility from the Model Browser. This speeds up rendering times when working in a 3D View with a large number of objects. In 2018.2 reading time for MOVE files with larger GeoCellular Volumes has been improved on multi-processor machines.

New options have been added to the Quick Access tools to make it quicker to Close the document, Close All documents or Save the current document. Usability has also been improved with the introduction of a new shortcut, Ctrl + D, to duplicate a cross-section. Due to this the Resample shortcut has been changed to Ctrl + R.

The support for Closed Lines and Polygons with internal holes has been enhanced to allow situations where a multi-line is converted to a polygon. If parts of a line form an internal boundary then this boundary is preserved in the polygon. Where polygons with an internal hole are converted to mesh surfaces, the new mesh surface will have an internal hole.



Summary of Main Release Highlights

MOVE General, Company, System, Licensing and Deployment Changes

- MOVE 2019 is a Windows-only release, with 2019.1.0 supporting Windows 7 SP1 to Windows 10 1903.
- The annual release date for MOVE will now be in the September-October time-frame.
- Updated support is provided for virtual and cloud environments including Microsoft, Amazon, Google, plus Schlumberger DELFI.
- Beginning with MOVE 2019, MOVE is licensed solely using the Petroleum Experts HARDLOCK License Manager.
- MOVE 2019 includes a new API for either RESOLVE (licensed separately) or OPENSERVER (licensed separately).
- MOVE 2019 includes new developments to allow compatibility with Petex's Model Catalogue product (licensed separately).
- Re-introduction of the MOVE Sediment Modelling advanced module.
- MOVE Link for GST: support for GST 3 and GST Block Models within MOVE.
- MOVE 2019 links directly to the Petroleum Experts client Web User Area and the Technical Support Area.
- Development requests will be discussed at Edinburgh Annual User Meeting - keep the date 8th-19th June 2020.
- A full-time Structural Geologist is now in our Houston office providing Consultancy and Technical Support.

MOVE Knowledge Base

- The Knowledge Base is now installed by default by the main MOVE installer.
- Improved cross-referencing of tutorials and help.
- Addition of the back-catalogue for the MOVE Monthly Feature articles.
- Ability to search on a word-level rather than a topic level.

MOVE Core

- The MOVE file format has changed to MOVE 2019 format (version 2.6).
- Improved handling of Shapefiles with extended ASCII characters. Support of polygons with holes.
- Create Surface Tool - new option in Ordinary Kriging allowing for all existing input data points to be honoured.
- Surface with Boundaries Tool - Ordinary Kriging allowing for all existing input data points to be honoured.
- Resampling Tool - new improved Edge Collapse method added to optionally maintaining borders.
- Import multiple 3D seismic files which represent a single cube into MOVE as a single cube.
- Improvements to Geocellular Volumes regarding picking cells and part-selection of the model.
- Faults in addition to Horizons can now be extracted from GeoCellular volumes.
- New Model Browser Search Bar in MOVE 2019, using Object Name, Set Name, Object Type.
- Section Intersections Tool improvements allowing better per-object control and visualisation.
- MOVE file loading and saving have improved speed and reliability and recovery, including Copy/Paste functionality.
- PDF export now exports in PRC format.

Kinematic Modelling

- New 2D Area-Depth tool to quantify layer parallel strain and shortening due to folding and/or faulting.
- Horizons from Template tool is now fully interactive.
- Major improvements to Auto Polygons and Tidy.



- Auto-population for 2D Move-on-Fault toolboxes.
- Auto-population of Thermal Subsidence tool and Decompaction workflow now synced.
- Thermal Subsidence tool - Total Subsidence and Burial History curves and data can now be copied to the clipboard.
- New option Use Complete Section in the 2D Decompaction toolbox syncing with 2D Move-on-Fault.
- 2D Depth Conversion - option when using the Database option to allow smoothing of the calculated velocities.
- 2D Depth Conversion - when using an equation it is now possible to calculate depth relative to the sea floor.
- 2D Depth Conversion, maximum seismic velocity can now be defined.

Stress Analysis

- Shear and normal stress attributes are now created as attributes.

Fracture Modelling

- Property calculation is now multi-threaded, improving performance when using large GeoCellular volumes

MOVE Link for Petrel

- Compatible with Petrel 2019.
- Ability to transfer pillar grid faults as fault sticks.



Software Components delivered in Move2019.1.0

- MOVE modules and third-party software links:
 - 2D Kinematic Modelling.
 - 3D Kinematic Modelling.
 - Geomechanical Modelling.
 - Fault Analysis.
 - Fracture Modelling.
 - Fault Response Modelling.
 - Stress Analysis.
 - Sediment Modelling.
 - Move Link for Petrel, OpenWorks, GST.
- Move Link for Petrel software (Petrel installers).
- Petroleum Experts Limited License Manager.

Software Downloads - Important Information

New releases of the MOVE software are distributed via email notification with a download link when a new or updated release becomes available.

Maintained customers can request a download link to the latest release of MOVE software at any time by sending an email request to edinburgh@petex.com.

System Requirements Changes and Notifications - Important Information

Move2019.1.0 is a 64-bit only release on Microsoft Windows.

Move2019.1.0 latest tested and supported version - Windows 10.0.18362 1903 (May 2019 Update).
Move2019.1.0 is also compatible with Windows 7 SP1, Windows 8, and Windows 8.1. MOVE is not supported on Windows XP, or Windows Vista.

Please note the following important platform changes:

- MOVE support on Linux is now discontinued; MOVE 2018.2 was the last release supporting Linux.
- MOVE support on Windows 7, and Windows 8 will be discontinued in one year's time.
- MOVE support on OS X was discontinued previously; MOVE 2017.1 was the last MOVE OS X release.

MOVE Registry and Temporary Files entries - Important Information (Windows Only)

Beginning with MOVE 2018.2.1, the storage locations for the MOVE application has changed. In summary:

- Information stored in registry "HKEY_CURRENT_USER\Software\MVE\Move2018" is now in "HKEY_CURRENT_USER\Software\Petroleum Experts\Move2019"
- Information stored in directory "%USERPROFILE%\AppData\Roaming\Move2018.x.x" now in "%USERPROFILE%\AppData\Roaming\Petroleum Experts\Move2019"
- Information stored in directory "%USERPROFILE%\AppData\Local\MVE\Move2018" now in "%USERPROFILE%\AppData\Local\Petroleum Experts\Move2019"



- Information stored in directory "%TEMP% or %TMP% now in %TEMP%\Petroleum Experts\Move2019"
- Information stored in directory "%CSIDL_COMMON_APPDATA%" now in "%CSIDL_COMMON_APPDATA%\Petroleum Experts\Move2019"



MOVE File Format Changes and Notifications - Important Information

Beginning with MOVE 2018.2, the .move file format has changed. In summary:

- Older versions of the software (including MOVE 2018.2 and previous MOVE versions) will NOT be able to read any ".move" files produced from a newer version, e.g. MOVE 2019.1.
- Newer versions of MOVE, e.g. 2019.1, will still be able to read older versions of ".move" files (including files saved from MOVE 2018.2 or any previous MOVE versions).
- Please bear this in mind when either testing a new version of MOVE in an environment where older versions of MOVE still exist, or if utilising multiple versions of the MOVE software.

Licensing Changes and Notifications - Important Information on HARDLOCK License Manager

Beginning with MOVE 2019, MOVE is licensed solely using the Petroleum Experts HARDLOCK License Manager. Support for FlexNet licensing manager has been removed from the software and licensing system. In summary:

- MOVE 2019 requires a HARDLOCK license and will not work with previous FlexNet License Manager installations.
- The MOVE 2019 installer installs a Windows Service (Petroleum Expert Licensing) that allows MOVE to communicate with the HARDLOCK License Manager, or a BITLOCK Licensing Dongle.
- Temporary license codes will be sent to clients that wish to use MOVE 2019 from October until December 2019.
- From December 2019 onwards (yearly code renewals), HARDLOCK codes will be forwarded to all MOVE maintained clients.
- Any questions or details can be discussed; please contact edinburgh@petex.com.
- Please read the separate supporting documentation on HARDLOCK License Manager.

Move2019.1.0 Software and Supporting Documentation

The following software is provided with Move2019.1.0

Move2019.1.0 Software Installers for Move and Knowledge Base

Move2019.1.0/Windows64

Installers for Windows (64-bit)

License Manager Software

Petroleum Experts Ltd. License Manager (HARDLOCK) is available as separate download.

Move Link for Petrel Software Installers

MoveLinkforPetrel/Petrel 2017

MSI and PIP Installers for Petrel 2017

MoveLinkforPetrel/Petrel 2018

MSI and PIP Installers for Petrel 2018

MoveLinkforPetrel/Petrel 2019

MSI and PIP Installers for Petrel 2019



Move2019.1.0 Release Documentation

The following documents, Tutorials, and Knowledge Base are provided with Move2019.1.0. The Knowledge Base resource contains all the MOVE Help Pages, Tutorials, and the release documentation presented in a single, offline, searchable entity, independent of MOVE.

- Move2019.1.0 Release Notes PDF.
- Move2019.1.0 Installation Guide PDF.
- Move2019.1.0 Tutorials.
- Move2019.1.0 Tutorial Data Files.
- Move2019.1.0 Knowledge Base.



MOVE2019.1.0 NEW FUNCTIONALITY

File Format, Imports, Exports, Help

Move Files

- It is no longer recommended to save MOVE archive files (*.movz files) within the main *.movd folder. By default archive files are now created in the same directory as the MOVE file.
- MOVE files are now compatible with Petroleum Experts project storage system, Model Catalogue, which allows MOVE project management and version control.
- The Move file format has changed. Older versions of Move will no longer be able to open files saved by Move 2019.1. See release notes for more information.

Application, Model Browser, Quick Editor

Editors

- Using the cell selection option in the quick tools it is now possible to select cells in GeoCellular volumes. Functionality is the same as that of triangle selection with mesh surfaces.

General UI

- MOVE now shows processing progress in the windows task bar.

Licensing

- Beginning with MOVE 2019, MOVE is licensed solely using the Petroleum Experts HARDLOCK License Manager. Support for FlexNet licensing manager has been removed from the software and licensing system. MOVE 2019 requires a HARDLOCK license and will not work with previous FlexNet License Manager installations. The MOVE 2019 installer installs a Windows Service (PETEXPXLS) that allows MOVE to communicate with the HARDLOCK License Manager, or a BITLOCK Licensing dongle. Temporary license codes will be sent to clients that wish to use MOVE 2019 from October until December 2019. From December 2019 onwards (yearly code renewals), HARDLOCK codes will be forwarded to all MOVE maintained clients. Please contact edinburgh@petex.com
- MOVE can now connect to the Petroleum Experts web-site. Users can register once on the initial visit, and then on subsequent visits will be logged in automatically. Users will need a HARDLOCK license number to register. From the support section you can now access the Petex Web User Area and the Petex Technical Support Area. Here you will find technical newsletters, User Meeting updates and presentations, case examples. Users can also now create technical support requests and track any outstanding support requests, as well as search the FAQ database.

Model Browser

- Wells in sections which do not have a 'parent' well are now displayed in a separate branch in the Model Browser: 2D Wells. This ensures that the Wells branch in the Model Browser only contains wells which are not in a section. This makes the selection of wells for projection onto sections much simpler.
- A new Model Browser Search Bar has been added to the Model Browser allowing users to search and filter the Model Browser to display specific sets, object types and object names.



Quick Editor

- New option to display or hide attribute unit labels.
- Quick Editor: it is possible to prepend or append text to the names of multiple objects.

Model Building

2D Decompaction

- Added the option Use Complete Section to the 2D Decompaction toolbox. When this option is enabled both the 2D Move-on-Fault toolbox and the 2D Decompaction toolbox will be automatically updated and remain in sync during a backstripping workflow.

2D Depth Conversion

- When converting between depth and time using the Equation method it is now possible to set a fixed velocity for objects above the top horizon. This is used to quickly set a constant water velocity for submarine environments.
- A new option has been added that allows the maximum seismic velocity to be defined. This is used when working with deep seismic images to avoid unrealistic seismic velocities in the lower part of the image.
- A new option has been added to the Parameters when using the Database option to allow smoothing of the calculated velocities. This gives improved results when using large velocity changes between horizons in faulted sections.

Create Dip

- When setting new dip positions using the mouse, in addition to clicking the Create Dip button, the dip can now be created by pressing the 'Enter' key.

Create Polygon

- Polygons with internal boundaries, holes, are now supported

Create Surface

- Faults in addition to Horizons can be extracted from GeoCellular volumes using the Extract Surfaces/ Faults from GeoCellular Volume option.
- A new option has been added to Ordinary Kriging allowing for all existing data points to be honoured when creating a surface.
- It is now possible to extract faults from a GeoCellular volume. Fault sticks can now be extracted from pillar grids transferred from Petrel.

Create Volume

- When creating Geocellular volumes in MOVE, the horizon information is now added to the volume.

Edit Surfaces

- Tidy Horizon to Fault context menu option now allows multiple horizons to be selected.



Object Attribute Analyser

- The Object Attributes analyser can now be opened when no objects are selected in the active view. Opening it when the active view is a section will display all objects in the section, opening it when the active view is a 3D view will display the whole model in the table.

Resample

- Improvements to surface resampling: both Rational Reduction and Edge Collapse methods are now available to handle more complex surface geometries.
- New Edge Collapse method added to rational reduction option in the Resampling tool. Allows rational reduction resampling on complex surfaces while maintaining borders.

Surface with Boundaries

- There is a new option available in Control Points for Kriging, to honour the z elevation of all of the input data points when creating a surface.

Data and Analysis Panel

Attribute Analyser

- Selected attribute values can now be deleted from the attribute analyser by pressing the delete key.
- A new attribute has been added to the Cell Attributes analyser called volume; this records the geometric volume of each cell.

Document Properties

- A new option in the Document properties menu, the Connections tab, provides a summary of all external file connections being accessed by the MOVE project.

GeoVol Display

- It is now possible to create points at cell centres for selected or visible cells.
- It is now possible to create a new Region using the current cell selection.
- When creating points at cell centres the colour map is maintained.

Stratigraphy Table

- A new option has been added to the context menu to allow horizons to be merged into a single horizon. All objects, horizon sets, and well markers are automatically updated.



Well Marker Analysis

- A new Convert option in the context menu for Wells has been added: it is now possible to convert selected well markers / dips into a Dip Data (point) cloud. This can then be used as input for the surface building tools.
- Well markers can now be colour mapped using attribute values.

Modules Panel

3D Decompaction

- The Thermal Subsidence tool now automatically initializes to match the Decompaction tool if opened while the Decompaction tool is active.

Fault Analysis

- Fault Analysis is now accessible from the newly built Application Programming Interface (API), which allows workflow automation and interaction with other PETEX and 3rd party software through RESOLVE and OpenServer.

Fracture Modelling

- Improved performance of attribute calculations e.g. P32, reducing computation time.

Stress Analysis

- In the Mohr diagram, Theta (Θ) is now the angle between the pole of the predicted failure plane and Sigma1 (σ_1). This follows the convention of Fossen (2016) and Allmendinger et al., (2011).

GST Link

- When loading features, any feature that is already in the model cannot be selected to be loaded again.
- Compatibility with Voxet volumes added.
- GST now has means to edit the saved connections so that the combobox does not become cluttered.
- When uploading multiple objects from MOVE to GST, the 'Use NULL for Unmatched' user decision from the previous object is carried forward to the next object.
- MoveLink for GST is now compatible with GST 3.

Petrel Link

- The MOVE Link for Petrel Plug-in is now compatible with Petrel 2019.
- A new option has been added that allows the user to choose if well logs will be transferred from Petrel to MOVE alongside a well.
- Pillar grid faults in Petrel can now be transferred as fault sticks in addition to as surfaces.

Sediment Modelling

- The Sediment Modelling module has been reintroduced for MOVE 2019. Sediment Modelling is a 3D Turbidity Current model workflow for simulating turbidity currents onto a palaeobathymetry and



outputting deposits with detailed sedimentary and stratigraphic attributes.

Thermal Subsidence

- New context menu option for the Thermal Subsidence diagram: 'Copy Data'. This allows the Total Subsidence and Burial History curves and data to be copied to the clipboard as a table for pasting into external packages.

View Panel and Display

3D View

- Improved performance in 3D Views when selecting or deselecting large numbers of wells with dips or markers displayed.
- Improved the display performance when using very large point clouds and Enhanced Symbol Display options.

Map View

- Images can now be resampled in Map View

Section View

- The Section Intersections tool is now available in the View Tab when in Section View. This new tool allows greater control over the way that surface, polyline, section and seismic intersections are shown on a 2D section.

Seismic Import

- It is now possible to load multiple 3D seismic files which represent a single cube, for example data from the USGS NAMSS database, as a single cube. Multiple files should be selected in the correct order in the 3D Seismic import. A single seismic file is then created and loaded into MOVE.

Knowledge Base

Knowledge Base

- The MOVE Knowledge base is now part of the MOVE installer. The single installer now creates two desktop shortcuts. The Knowledge Base previously had its own separate installer.



MOVE2018.2 NEW FUNCTIONALITY

File Format, Imports, Exports, Help

Exports

- PDF export - now has the option to export in PRC (product representation compact) format, for storage and interchange of 3D models.
- Accented characters in GOCAD filenames are now changed to their simple ASCII equivalents.

Imports

- Shapefile import - now able to read the following OGR Geometry types: wkbPointM, wkbLineStringM, wkbPolygonM, wkbMultiPointM, wkbMultiPolygonM, wkbPointZM, wkbLineStringZM, wkbPolygonZM, wkbMultiPointZM, wkbMultiPolygonZM

Move Files

- Loading time for Move files with larger GeoCellular Volumes has been improved on multi-processor machines.
- When dragging and dropping files onto Move the user can now decide to either open the files as separate documents or insert the files into a single document. If the files are dropped on the top bar then they are opened as separate documents. If they are dropped on a 3D View then they are inserted into the current document.

Application, Model Browser, Quick Editor

Shortcuts

- The shortcut "Alt + T" will tidy multiple lines to other lines
- New shortcuts have been added to improve support when multiple files and / or multiple views are open. F6 and Shift-F6 to page through the current open documents. Ctrl-F6 and Shift-Ctrl-F6 to tab through the current open views for the current document.

Copy Paste

- Paste now supports pasting an image copied into the system clipboard into the active Move view.

Model Building

Auto Polygons

- When opening the Tidy Tool from the Autopolygon Tool, the Auto Polygon tool is no longer automatically closed

Create Horizon Line

- If the Use Horizons from Template options is selected (Section view only) and the Construct Horizons from Template tool is open, it is possible to carry out real-time construction from template of horizons



using the stratigraphy.

Create Surface

- Create Top/Mid/Base: lines can now be used to create a new mesh or grid.

Horizons From Fault

- New option to quickly hide the displayed horizons to allow improved viewing of the underlying seismic.

Horizons From Template

- Interactivity has been added to the tool to modify horizon thicknesses during construction.
- The Horizons from Template tool now allows the option to create horizons based on the stratigraphy in real-time as the user is digitizing a line or horizon.

Model Building

- New 3D context menu option "Trim Horizon To Fault" allows horizon fault contacts to be maintained during multiple fault 3D restoration.
- The coefficients used for exponential and gaussian modelling when kriging have been updated for 2018.2.

Object Attribute Analyser

- The Object Attributes Table now displays horizontal length for lines.

Resample

- Output from rational reduction of surfaces now honors the original surface border.

Tidy

- The Section and Map view context menu Tidy option now works with multiple selection with the following rules. 1. Selected horizon lines are tidied to both ends. 2. If horizons and faults are selected (or everything in the section is selected) then only the horizons are tidied. 3. Faults are only tidied if only faults are selected.
- Tidy Tool now automatically updates when changing sections using the section list on the Display toolbar.
- Tidy Tool has new option to detect overlapping and duplicated faults.

Topology

- The 'Remove Duplicate Boundary Vertices' option has been removed. The same functionality can be achieved using the 'Remove Duplicate Vertices' option.



Data and Analysis Panel

GeoVol Display

- Geocellular volumes in Move now always display k values and layer indices with zero as the top / highest layer / cell.
- Performance of the GeoVol Tool has been improved for larger volumes.

SCAT

- Log curves can now be displayed on all depth plots.

Well Log Analysis

- The ability to create data as points is available again.

Modules Panel

2D Area Depth

- In 2018.2 we have added a new tool, 2D Area Depth to the 2D Kinematic Modelling Module for Area Depth Strain analysis.
- The 2D Area-Depth tool provides a set of non-kinematic techniques used for predicting detachment depth and to test a section for area balance and internal consistency.
- Along with calculation of detachment depth, the 2D Area-Depth tool can quantify layer parallel strain, as well as shortening due to folding and/or faulting.

Stress Analysis

- Shear and normal stress values are now created as attributes, when the user creates a the stress overlay as an attribute.

Fault Analysis

- The well log chart on the Wells sheet now visualizes the log lithology as calculated from user-defined Vshale parameters.
- In Uncertainty Modelling it is now possible to visualize the probabilities of combined lithological juxtaposition scenarios.
- Uncertainty Modelling now offers the option to transfer scenario percentiles P10, P50 and P90 to the fault in a single operation.
- Uncertainty Modelling now offers the option to transfer the probabilities of all lithological juxtaposition scenarios to the fault in a single operation.
- Intraformational well markers are now taken into consideration when calculating lithologies and seal proxies from Vshale logs, aligned relative to horizon top markers matching cut-off lines in the model.
- Fault Scaling and Fault Growth plots are now calculated from data projected onto individual fault planes, rather than a single combined plane.
- Uncertainty Modelling now offers the ability to simulate variations in parameters to Probabilistic SSF and Hydrocarbon Column Hight.
- The Fault Growth chart now visualizes a range of likely growth activity based on lateral sampling.
- Added ability to adjust displacement reference frame for throw calculation.
- Fault Triangle now allows arbitrary well markers to be created by dragging guidelines from the well log charts' horizontal axes.



GST Link

- When uploading multiple objects from Move to GST, the "Use NULL for Unmatched" user decision from the previous object is carried forward to the next object.
- Partially locked objects are no longer being reported as violating the partial lock when locked vertices are moved by a very small.

Petrel Link

- The MoveLink for Petrel Plug-in is now compatible with Petrel 2018.
- Move Link for Petrel has been updated with a new Auto transfer option, allowing more control over the transfer process.
- Users can now assign Surfaces as faults determined by name or container name.

View Panel and Display

Section View

- When dip data from different sets are copied between cross-sections, the data will no longer be merged into a single dip data point cloud.

Google Map View

- Point/Dip data are now displayed correctly in Google Map view.

Vertical Toolbar

- The user can use the mouse wheel to adjust the width or use F5 key (when the horizon label area is in focus), to set the width to fit the largest horizon name.



MOVE2019.1 KNOWN ISSUES

File Format, Imports, Exports, Help

Exports

- 3D PDF - If the 3D view is set to Pixel mode and the user exports a 3D PDF, point clouds and well markers will be rendered smaller than expected. Change the View settings to Metric to export correctly.

Modules Panel

Fault Analysis

- Decompaction of branchlines using a Fault History diagram is currently experimental. Consequently, the results may be inconsistent with 3D restoration and decompaction results. It is recommended that faults containing branchlines are restored using the Only Join Beds method.

View Panel and Display

Section View

- Images larger than 20,000 pixels x 20,000 pixels cannot be displayed in Section views. These can be down-sampled on import.

Data and Analysis Panel

Survey Box Editor

- When working in a file with multiple surveys, one of which has been edited, the survey box extents are not restored to custom extents, instead a default box is created from survey coordinates and model bounding box.

Model Building

Horizons From Fault

- Detachment Fold: Syn-tectonic beds may not be fully drawn correctly if the sediment thickness is less than the uplift in each step.



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