Ecrin Update Notes

The Ecrin project is the fourth generation of KAPPA software; it unifies the development of all KAPPA applications, and provides the choice to run them independently or as an integrated workstation.

Diamant Saphir and Topaze are integrated into the Ecrin v4.0 release. Other modules including Emeraude will be integrated in version 4.10.

The present document reviews the new facilities in Ecrin as follows:

A. Generic changes /additions p1
B. Models Saphir / Topaze p12
C. PTA Module (Saphir) p17
D. PA Model (Topaze) p21
E. Data Module (Diamant) p25

A • Generic changes/additions

A.1 • Single application

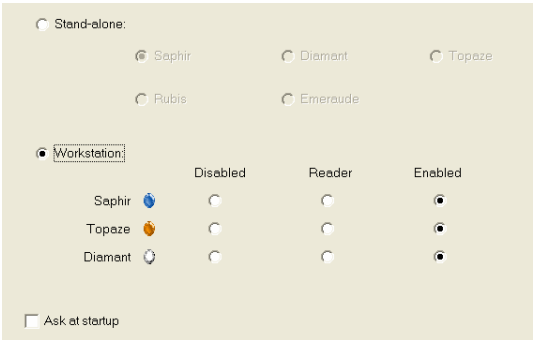
Ecrin is a single application that can open and create documents of different types, namely for v4.0 Saphir documents (ks3), Topaze documents (ktz), and Diamant documents (kdm). The interface adapts itself automatically to the active document. So when a Saphir document is active the control panel is Saphir-like, when it is a Topaze document it is Topaze-like and so on. You can switch between one module and the others easily using the specific Ecrin toolbar shown below. If you run in stand-alone mode (see A.2 below) you will not see that toolbar.

A.2 • Ecrin modes / licenses

When Ecrin is installed the user is offered the choice to run in stand-alone or workstation mode. Stand-alone mode means that you work with a single application, e.g. Saphir, “as before”. In workstation mode, it is possible to work with documents of different types. Each module can be “Enabled” or in “Reader” mode. When enabled (and with the proper license) the module works in full: you can create, edit documents. When in reader mode, a module opens its documents but does not allow any modifications. Note that through the browser you can copy elements from a doc opened in reader mode, and drop into a doc for an enabled module. The mode selection can be viewed/edited in “Settings – Application” , see opposite >



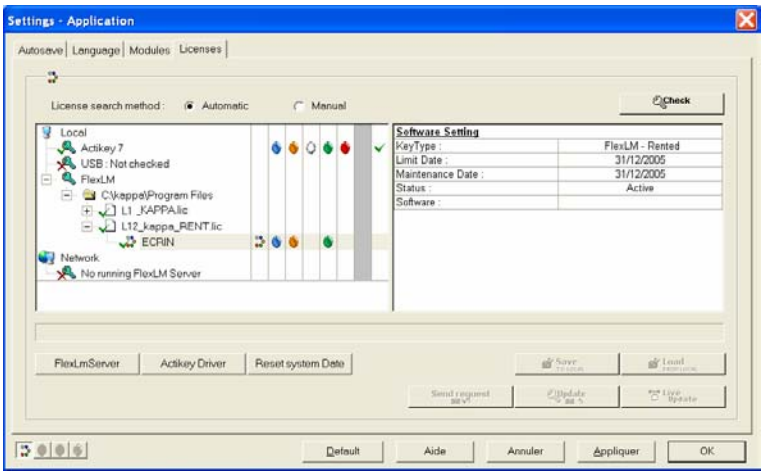
Ecrin toolbar



Module selection

 If no license is found for an enabled module, this module is turned dynamically into reader mode and its stone appears in the Ecrin toolbar with the letter “R” superimposed.

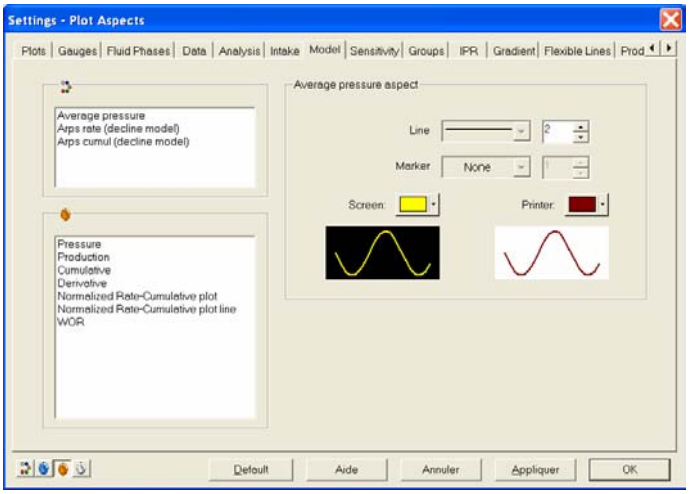
In “Settings-Application” you will find in the last tab the facilities formerly implemented in KeyUtil for license management and maintenance. KeyUtil disappears as a stand alone application in v4.0.



License info in Settings

A.3 • Settings

In All modules a Settings page is found with the same options: Application – Interface – Plot Aspects – PVT – Interpretation – Loading Data – Default Units – Print Setup. In all tab dialogs you will find controls gathered inside boxes with an icon representing either Ecrin, or a particular module. A toolbar at the bottom left lets you view the settings applicable to any given module.



Example of Settings dialogs

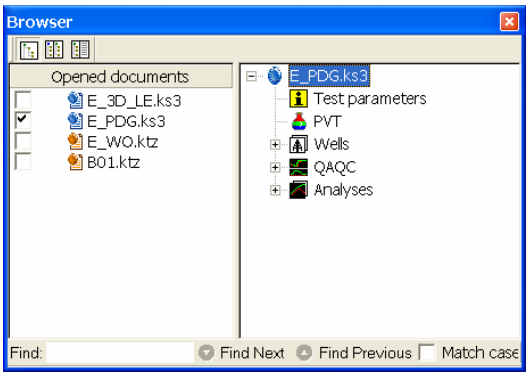
On the above dialog, the current display is set for “Topaze” (see button pushed at the bottom left). Therefore, the controls in view are the ones specific to Topaze as well as the generic ones (always displayed). Note that a control is considered generic as soon as it applies to 2 modules.

A.4 • Data Browser

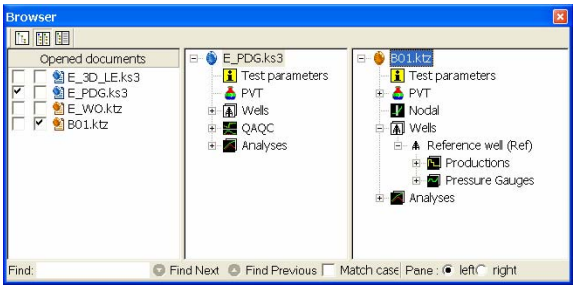
The data browser in Ecrin allows viewing the structure of the opened documents at once. Most importantly, it permits the drag-and-drop of objects between documents of the same, or different kinds.

The browser has 3 possible modes corresponding to the three icons of its toolbar. In order the modes are:

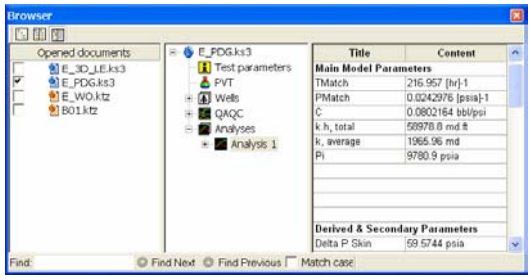
a. One tree pane
b. Two tree panes
c. One tree pane with its info pane.



Mode a



Mode b



Mode c

Drag-and-drop is done in mode b (2-pane). Individual elements such as PVT, 2DMap, gauges, productions, models can be copied – (see exhaustive list below). In addition, a doc-to-doc copy option exists between Saphir and Topaze so you may drag a whole Saphir/Topaze document onto another one (with an identical fluid type). All relevant elements are then copied in sequence, the models generated, etc.
At the bottom of the Ecrin browser is a Find toolbar. When using a 2-document display the toolbar includes check boxes to indicate whether the search is in the right of left pane.



The Ecrin browser includes the following options:

Delete / rename
Wherever applicable, those options are accessed with a right click on a node.

Properties
When enabled, this option calls the appropriate dialog to edit the object properties. Can also be executed with a double-click.

Drag-and-drop
Through this facility you can copy an object from one document to another. The copy can lead to a modification or to an addition. Typically, the rule is that when the target is a unique instance, or if the drop is on the target itself and not on its container, a modification of the target occurs. If you drop on a container for the object type, then an addition takes place. For instance, if you drag a Topaze production onto a Saphir well, this replaces the target well production because Saphir supports only one production per well. On the other hand, if you drag a Saphir production to a Topaze “Productions” folder, a new Production is added.

The following drag-and-drop operations are supported:

Pressure gauges: You need to grab the gauge icon and drop it on another gauge icon, a well icon Reference well a logical container, Other Data in Diamant, Pressure Gauges in Saphir and Topaze for instance.

Note that the term "gauge" is generic here and includes such items as model output, e.g. P(t) at the reference well *under* Model output

Production: You should drop the source production either on another production icon, a well, or a logical production container. Note that if the source is Diamant, you may drag either an individual rate, or an entire production (i.e. oil rate, gas rate, and water rate). In the latter case, all channels are set to a common time reference (union of the existing times or steps) and the target document, if Saphir or Topaze, takes the rates it is configured to work with in the Main Infos dialog.

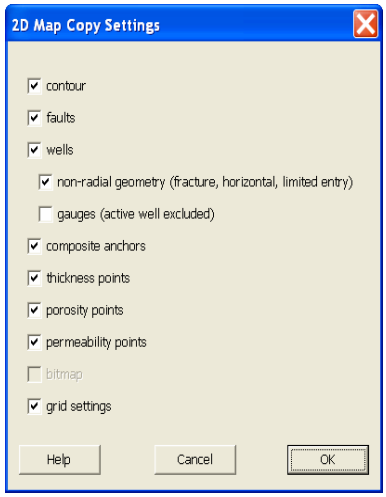
Replace or Append?
When you drop a gauge or a production onto an existing object, you are given the option to replace the existing data or to append the eventual new points. This is used typically when after dropping a gauge from Diamant to Topaze or Saphir the gauge is updated in Diamant. Drag-and-drop with append will simply extend the particular data set in the target module, and update the analysis as required.

Test parameters: Can be copied between Saphir and Topaze. Drop on the document icon or the Test parameters icon.

PVT: From any module to any module.

Model: Between Saphir and Topaze. By dragging a Model description node onto another one or onto an analysis node, e.g. Analysis 1 , you replace the target model. You can also drop inside an Analyses node (i.e. the container,) and the new model will be added.

2D-map: Between Saphir, Topaze, and Diamant. You need to drop the 2Dmap on the target 2Dmap icon 2Dmap. A dialog will typically popup so that you can specify which components to copy or not >

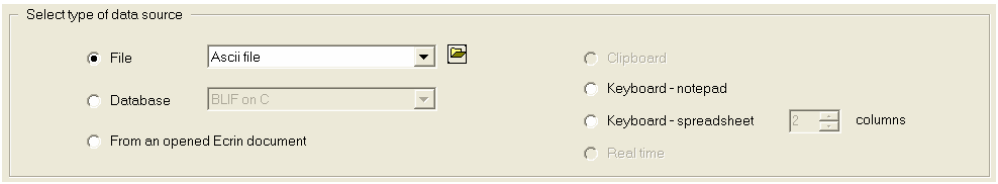


Document: Between Saphir and Topaze, the "doc-to-doc" copy is enabled when the PVT Fluid Types are identical. Executing this action copies (and replaces if needed) the wells, gauges, productions, models etc.

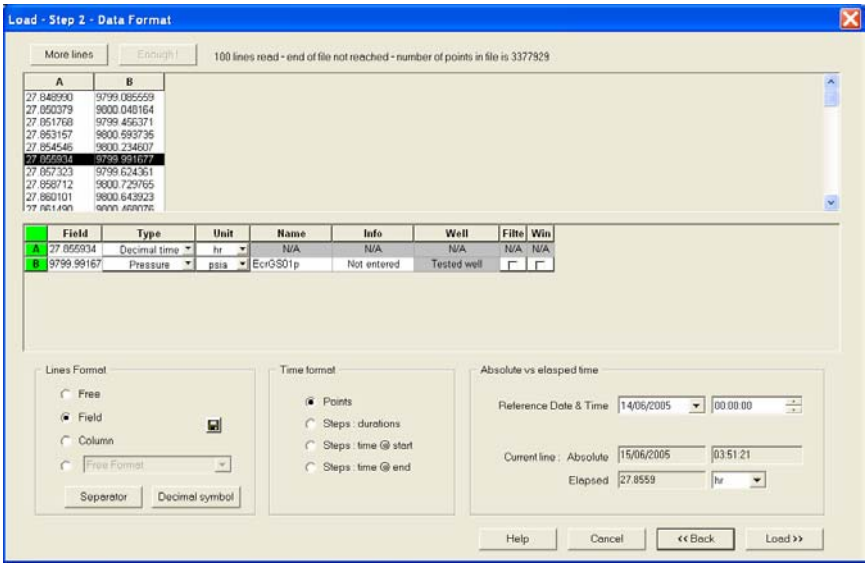
Note that a double-click on a document icon (in the opened document list) makes that document active and closes the browser.

A.5 • Loading

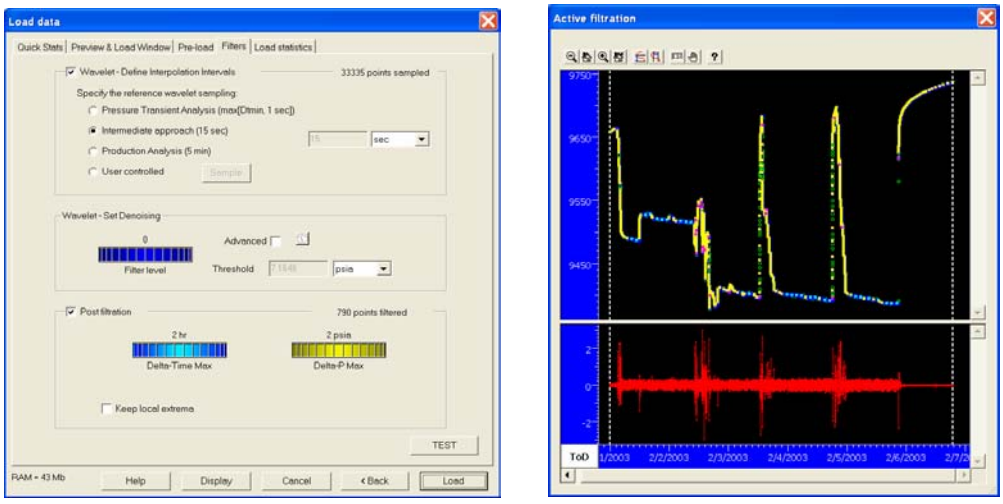
The Load is unified among the modules and is an evolution of the Load option of Diamant 1.10. The data sources include the same file formats as in generation 3, clipboard, keyboard, but also databases (Oracle, SQL, and generic ODBC). In Diamant Master one can load data from other sources, including PI by OSISoft. Wavelet filtration at load time is available in all cases, except when loading multiphase productions in Saphir and Topaze.



Data source selection



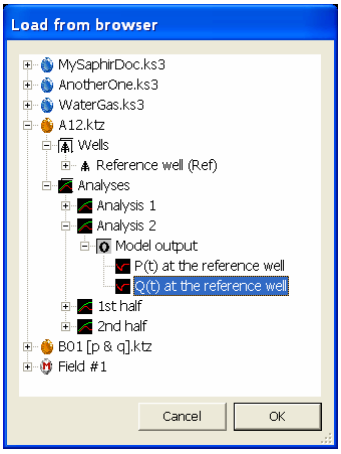
Format definition



Wavelets at load time

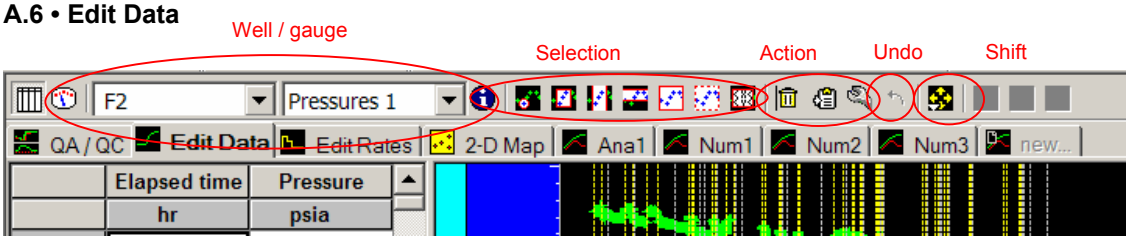
Other additional features of the Load in Ecrin v4.0 are:

- The ability to load multiple channels in one go in the QAQC module of Saphir, e.g. Temperature and Pressure for the same gauge. The created channels are linked automatically so that a subsequent time shift on will affect the other.
- The possibility to Load from the browser directly. In the Load dialog if you select this option a dialog lets you scan through the list of opened documents, and displays only the branches containing candidate channels >
- The definition of a “ribbon” for outlier removal based on the data trend (rather than the former rectangular window). In this case, the outlier removal algorithm is run on the points of the preview, and a min/max limit is defined by shifting the result by a fixed (user entered) value.

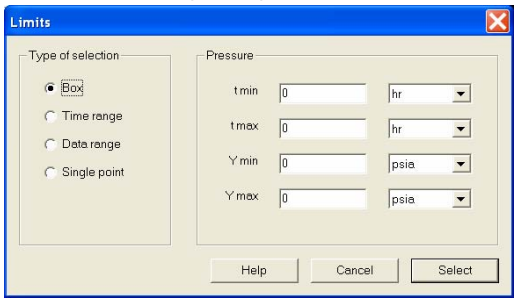


- In the wavelets, it is possible to define a minimum duration for gaps so that the software ignores them completely.

A.6 • Edit Data



- Standardized between Saphir Topaze and Diamant
- New toolbar/interaction : selection (point – box – time – value – all window – all – manual) + Action (delete – clipboard – process) logic
- Comprehensive manual selection option using dialog below



- Saphir and Diamant inherit interactive shifts - not present before (Time, Time + Value). Also a manual shift option is offered with dynamic shift *and* factors, similar to that present in QAQC before.
- Well / Gauge selection: loaded data are assigned to a particular well, unlike in Saphir 3.20 where gauges were all stored at document level. In Edit one can switch between wells, and for each well, between gauges.
- Undo button: the only way this can happen is through a duplication of the data before edition. So there can be a cost associated with this option when dealing with very large data sets. The record trail is erased when exiting the edit tab. You can set the number of “Undo per gauge” in Settings – Interpretation – Misc” tab.

- In Saphir Edit Data, when the pick for selecting a time range is done within the rate window, the selection is based on group limits. An extension of this option is available in Topaze, where the actual time of the rate values represent the limits.

A.7 • Edit step / Saphir Edit rates



- Standardized between Saphir Topaze and Diamant.
- New toolbar/interaction: Selection + Action logic.
- Well / Gauge selection: The production of nearby wells can be edited in Edit Rates whereas before only simple grid editing in the Well property dialog.
- Simplify can be driven with a Delta Q but also a Delta t value. You may now also specify the threshold rate as a percentage.
- For Saphir, in the Display Settings you may now decide to show additional grid columns with Cumulative for the groups.

Time selection: this button usually works by click-and-drag. However if you click once on a flow period, this option selects this flow period alone. Also, the selected range will be affected by the window in which you click, pressure or rate:

- If you select in the rate pane, the selection is snapped to the flow period boundary.
- If you select in the pressure pane, it is driven by the data times.

There is actually only one action that can use time limits that are different from flow period boundaries, the "Set shut-in" – described in section C. Other actions will reset the limits, eg if you select based on the pressure times and then do a Merge, the full duration of all periods even partially selected will be considered.

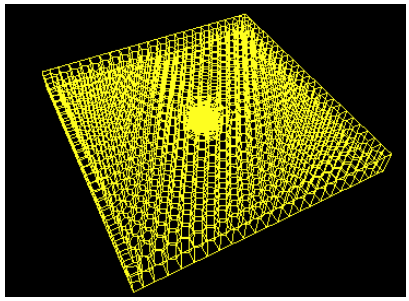
Move options: The option to move a rate limit (to cursor position or the closest pressure point) can work in click-and-drag or click-and-point modes. The first mode is the default; the second mode is active if you press Ctrl before selecting the option.

A.8 • 3D display

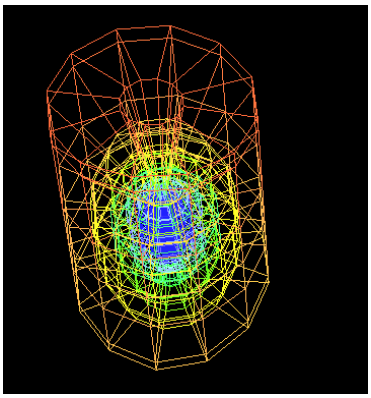
The former 2D/3D geometry plot has been extended to work in full 3D mode. The plot now includes the following 3 distinct modes: = 2D; = Pseudo 3D (Z is a result); = 3D

In the 3D mode the grid alone is displayed (in yellow) by default. If values have been stored during the generation (pressure or saturations), they can be displayed as surface, wire-frames, or points –see examples on next page.

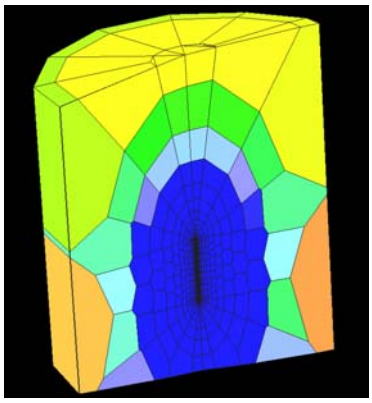
All the options affecting the display can be found in the Settings button. This dialog is now floating and lets you access other facilities (zoom, etc) when it is opened.



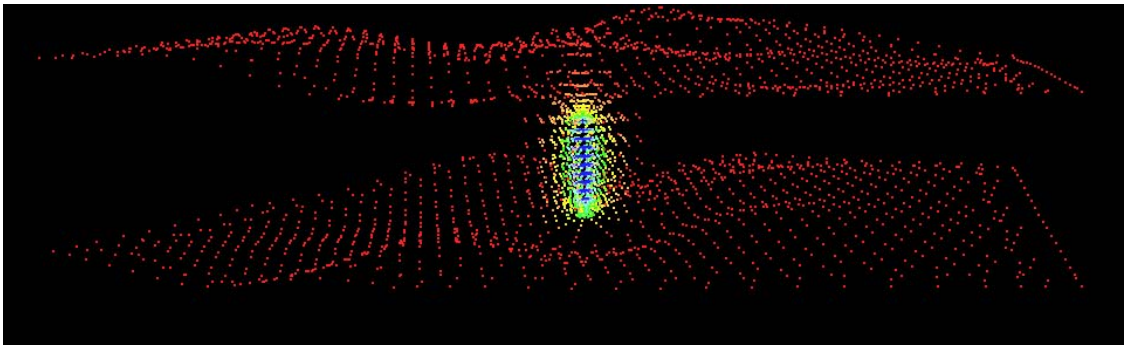
3D grid alone



wire frame



Surface (with cross-section)



Points

New options in the toolbar are:



Gain on Z (minus or plus)



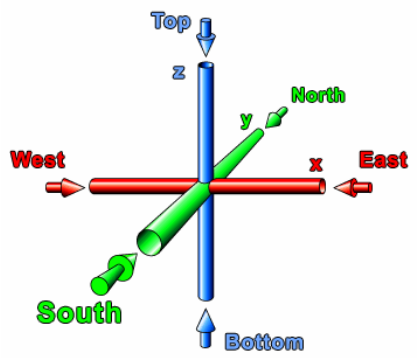
Zoom: Out, Reset, In, Make default



Pre-defined orientations

A sub-menu is offered giving access to the pre-defined viewpoints defined opposite.

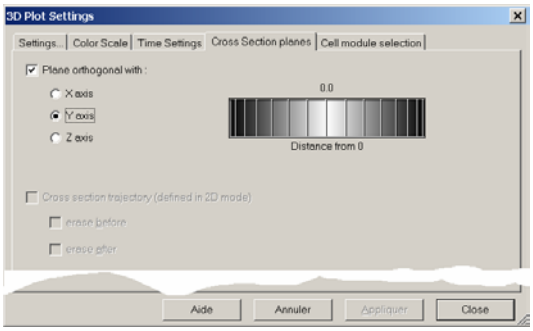
There is also a manual mode where a dialog with the bitmap opposite appears and you can simply click on the desired viewpoint.



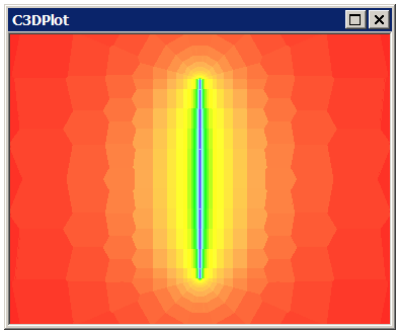
Cross-section planes

In the Display Settings option  a new tab is available for “Cross section planes”. You can enable a plane cutting the grid and perpendicular to a main axis. Then the plane can be moved. Recall that this can be used in conjunction with the pre-defined orientations. You can also define a cross section plane.

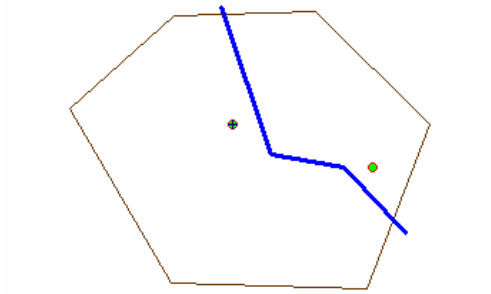
Planes orthogonal to the main axes can be activated and moved directly from this dialog and the effect is immediate. For the 2Dmap cross-section, you need to switch the display to 2D and then to select the option “Create a 3D cross-section” – or the associated icon in the plot toolbar:  You then draw a trajectory as you draw a fault; you can include any number of segments. When the mouse is close to a well the well turns to green to indicate that if you click then, the section will cut exactly through the well. When the display is back to 3D you can Enable the cross section and hide the cells before and/or after.



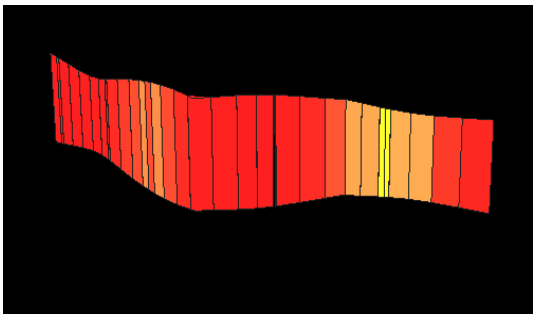
Cross section dialog



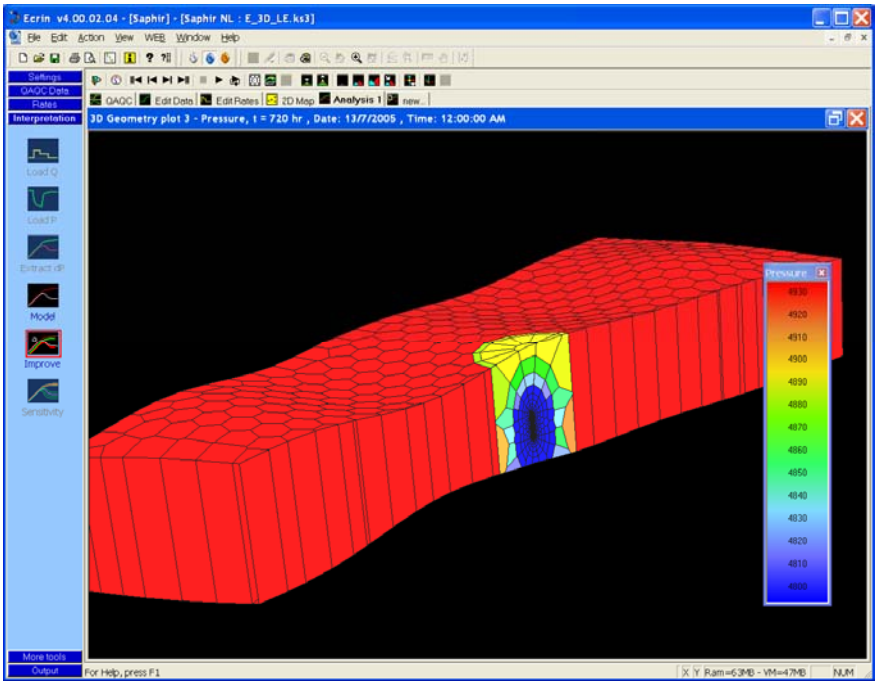
Orthogonal plane



Cross section defined



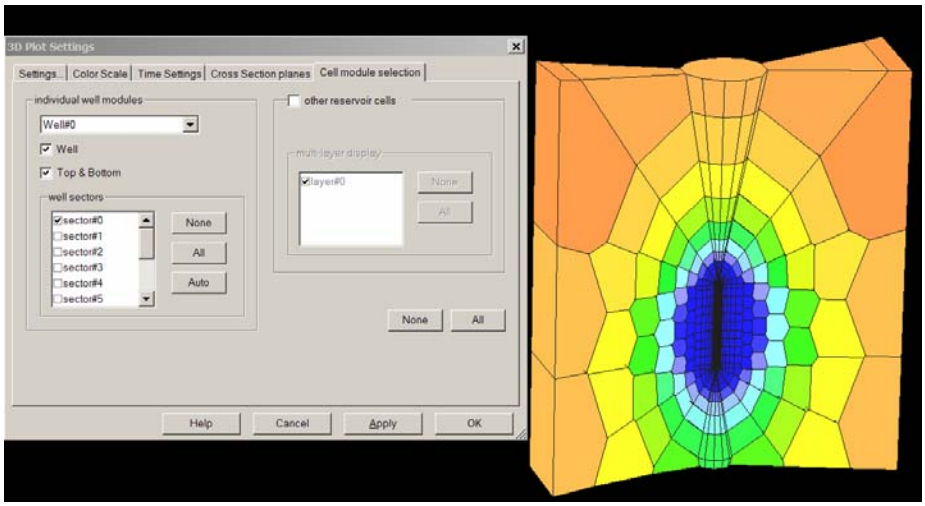
Cross section activated – Erase before and after



Limited entry well and thickness field;
cross-section through the well shows the local 3D grid

Cell modules display

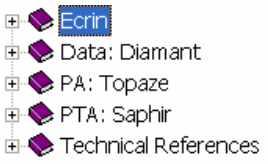
In the Display Settings option a tab is available for “Cell module section”. All grids are grouped by modules. You can selectively display any module of the grids. All subsequent display operations such as showing pressure values, clipping etc, will apply to the modules in display only.



Cell module selection

A.9 • Revised on-line help

The Ecrin on-line help is built using the modular structure shown opposite. In the “Ecrin” book are all the generic items. The Data, PA, PTA books describe options specific to the corresponding modules.

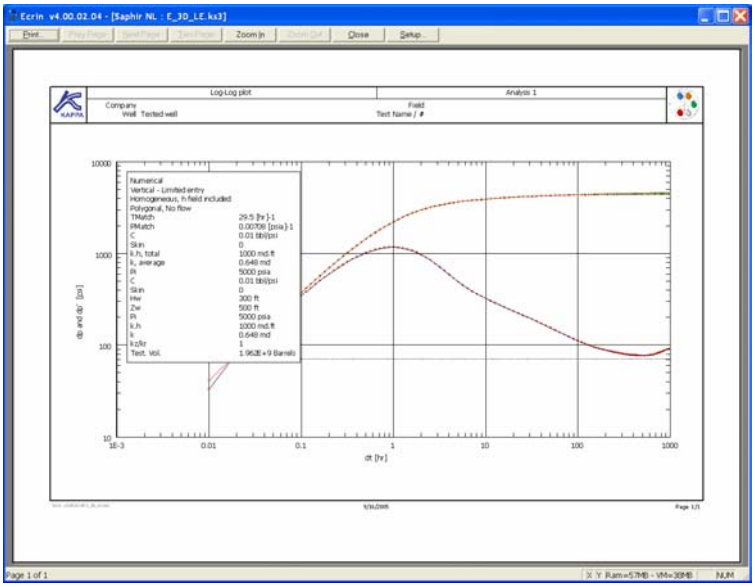


Among the additions made in v4.0 the module specific books contain a new section called “How to?” providing a quick reference for some complex procedures, or giving an answer to some Frequently Asked Questions. Those sections are meant to grow with the subsequent Ecrin upragdes.

A.10 • Other generic changes

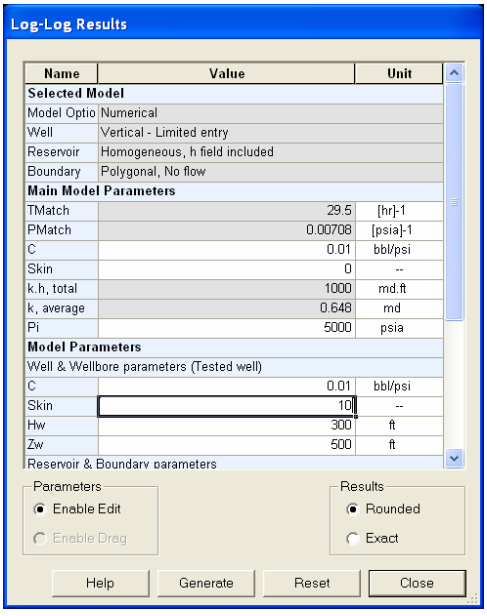
Results in plots

In Saphir (loglog, semilog, history plots) and Topaze (history, loglog, and Blasingame plots) it is possible to overlay the results directly on the plot – see next page. This option is called in the toolbar with the icon .
On printouts the result box is only visible in landscape mode. Note that the font size of the results is editable in “Print setup – Fonts – Results”.



Changing model parameters from the Results dialog

In the Saphir loglog plot or the Topaze history plot, the values in the Results dialog may be edited directly and the model response re-generated. After the new values are typed in, you can either “Generate” or “Reset” the original parameter values.



Calculated volumes in Numerical with composite zones

When using a numerical model with composite zones, tested volumes can be obtained by taking into account or not the composite regions. In other words results can be obtained for the actual M’s and D’s or assuming that they are equal to 1. In Saphir you can display both results together.

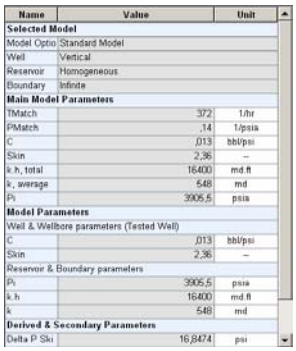
Modify Lines with Vertex

In plots with straight lines there may be two options for interactive modification: “Mouse” and “Vertex”. The “Mouse” method is the usual one; it follows the mouse movements by translating the line when the mouse moves up/down, and rotating the line when moving left/right. With the “Vertex” method, two vertices are drawn at the extremity of the lines. If you click with the mouse on a vertex and move, you drag the vertex. If you click and drag away from the vertices you translate the line.

Standardized Table aspects

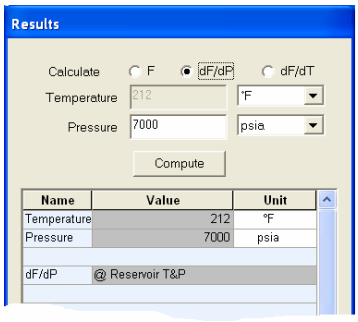
All tabular results are standardized on the model shown opposite >
3 distinct cell types are considered:
- grey = read only
- blue = title
- white= editable value or active unit list/control

The default colors for the 3 types can be modified in “Settings – Interface – Main”



PVT Flash with partial derivatives

The PVT Flash option, accessible in the PVT Main dialog with the  icon, may now display either the PVT values, or their partial derivative w.r.t. pressure, or temperature.
The switch is operated by the three radio buttons following the “Calculate” legend at the top of the dialog.



B • Models Saphir/Topaze

B.1 • General

Sharing

The model catalog and the model option interface are common to Saphir and Topaze. In particular, all the new numerical options of version 4.0 as well as the multilayer model (analytical and numerical) are available in Topaze. *The only exception is the multi-status, not supported by Topaze.*

New storage options

In the model dialog you may set the storage to none. Also for the changing wellbore storage the Fair model has been added.

Permeability fields

In the 2DMap, among the options used to define value fields you will now find permeability. With a permeability field the model parameters will include a “k/k_field” value, by default set to 1. In case of drag and Improve this parameter will be affected.

X-Y anisotropy: numerical and analytical

In both cases a new option in the reservoir. For analytical models this option is not offered with circular geometries, linear composite, wells other than vertical and leaky fault. The X-Y option is accessed in the Model dialog with a new checkbox labeled “horizontal anisotropy”. A new parameter kx/ky is added and can be included in the nonlinear regression.

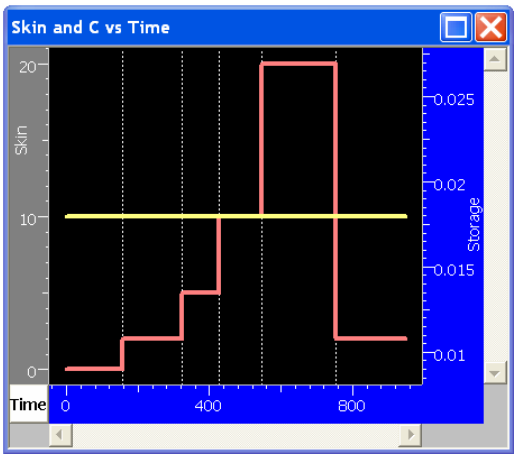
Multiwell: history extrapolation

An explicit option exists in the “Settings – Interpretation – Misc” tab, for handling the extension of the “other wells” history. Namely, one can decide to shut-in the wells at the end of their history or else to extrapolate the last value.



Interface

Options, checkboxes, etc have been grouped whenever possible for clarity.

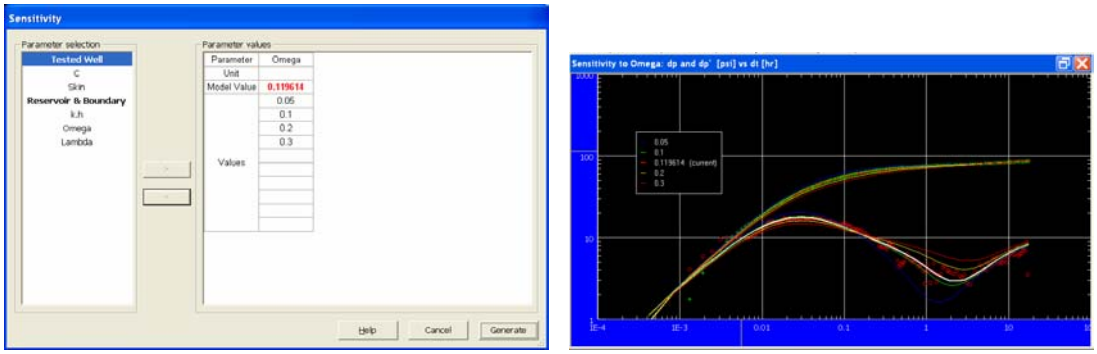


Plot of C & Skin versus time

When the selected model is a changing well model (Saphir) or time-dependent skin model (Saphir & Topaze) a plot can be created that shows storage and skin vs. time. Creation through the “New Plot” option of the main screen toolbar.

B.2 – Sensitivity

When a model is generated you can use this option to get additional loglog plots (Saphir) / history plots (Topaze) representing the sensitivity to any desired parameter. In the sensitivity dialog, you select the parameters, click on the “>” and enter the range of values. Ecrin generates as many models are requested and builds the corresponding loglog plots.



Saphir: sensitivity to ω on a double-porosity example

The behavior of the sensitivity options is as follows:

- If you create a sensitivity plot and get back to the sensitivity dialog you will find the input values, arranged in increasing order. You may then modify one or several values and click generate: only the modified values will be generated again, the other ones remain unchanged.
- If one deletes an existing column in the sensitivity dialog and validate: the corresponding plot is erased.
- If one deletes an existing sensitivity plot: the corresponding column in the sensitivity dialog is erased, and the parameter values are lost.
- Model generation, test design, improve: ALL sensitivity plots/values are lost.
- Topaze specifics [1]: If a forecast has been made the following sensitivity plot(s) will also be performed on the forecast part of the rate/pressure history.
- Topaze specifics [2]: the results page is available in the sensitivity plot toolbar. Results provided are the STHIIP/STHIP of the model for each sensitivity value.

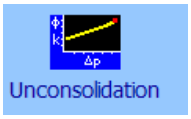
B.3 • New Numerical Well models: limited entry with and w/o fracture, horizontal well

When creating a well in the 2Dmap you may now choose from 3 geometries: Vertical, Fracture, Horizontal well. The three options correspond to 3 new icons of the 2Dmap toolbar:  (in order). In addition a new “limited entry” checkbox appears in the well properties dialog.

The possible combinations are: Vertical well + limited entry; fractured well + limited entry; horizontal well.

All the relevant parameters can be defined in the Model dialog. For the horizontal and limited entry cases, vertical anisotropy can be considered, like with analytical models. The limited entry and horizontal geometries require specific 3D grid, which can be seen using the real 3D display in 4.0.

B.4 • Saphir NL: unconsolidated formations



When creating a single phase Numerical analysis, a new button appears in the panel in place of the Kr button. This is used to define the behavior of permeability and porosity with pressure.

In unconsolidated formations, the porosity and permeability depend on the internal stress of the formation. Under the assumption of no isostatic overburden pressure the stress is directly related to the pressure difference. So under those conditions, the behavior can be modeled by defining the permeability and porosity as follows:

$$\phi(x,y,z,p\ ) = f_p(p - p_{ref}) \times \phi_{ref}(x,y,z)$$
$$k(x,y,z,p\ ) = f_k(p - p_{ref}) \times k_{ref}(x,y,z)$$

In Saphir NL the functions *fp* and *fk* are defined by:

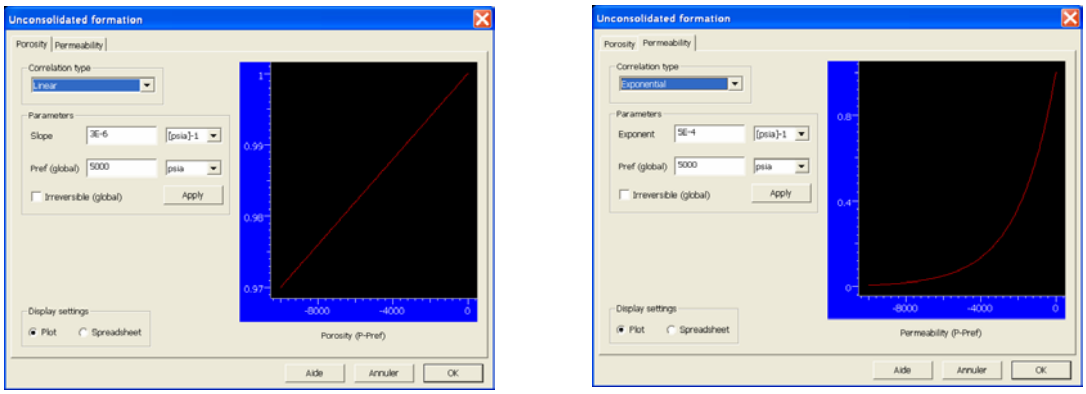
Porosity function f_p

- Linear function : $f_p(p - p_{ref}) = 1 + slope \times (p - p_{ref})$
- User table

In the first case, the default value for the slope in the formation compressibility

Permeability function f_k

- Linear function: $f_k\left(p-p_{ref}\right)=1+slope\times\left(p-p_{ref}\right)$
- Exponential: $f_k\left(p-p_{ref}\right)=\exp\left[b\times\left(p-p_{ref}\right)\right]$
- Power of Phi: $f_k\left(p-p_{ref}\right)=\left[\frac{\phi(p)}{\phi_{ref}}\right]^n$
- User table



Unconsolidated option dialogs

Note that all the above equations are applied at cell level.

The unconsolidated option is currently restricted to single phase fluid flow in the reservoir. All other options of the Saphir numerical model are available. When using this option in conjunction with non-Darcy, the β factor is assumed constant i.e. the relation between the formation properties and the pressure is not extended to β.

With a finite conductivity fracture, the function “fp” also affects the fracture conductivity.

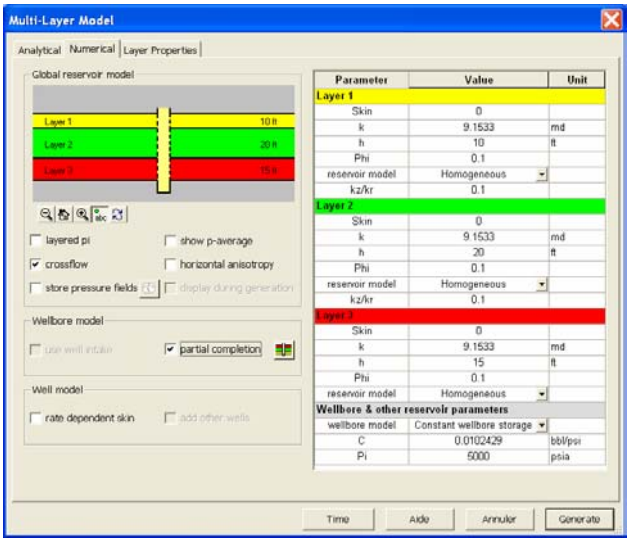
Hysteresis vs. Irreversibility

During a drawdown the decrease of fluid pressure will result in compaction of the porous reservoir rock. If pressure is then allowed to increase, “de-compaction” of the porous reservoir rock will occur and permeability will gradually rise again but it will not however, return to its previous state before the drawdown.

In Saphir 4.0, we limit ourselves to the consideration of reversible or irreversible processes. In the latter case, once a reduction in permeability occurs, the cell keeps the last known value, even when there is a subsequent pressure increase.

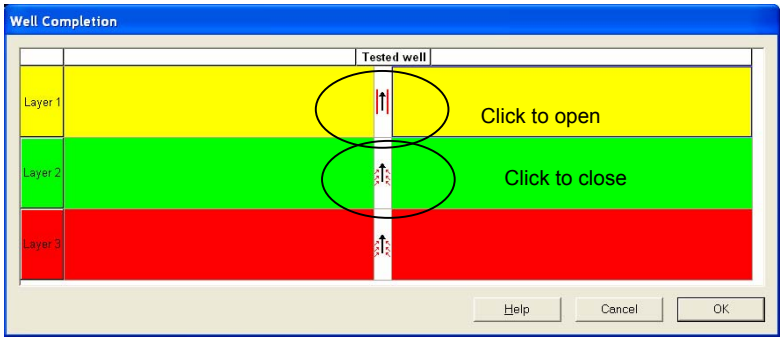
In the Model dialog a new checkbox is present “Unconsolidated formation” to account for the relations defined.

B.5 • Numerical multi-layer (PTA and PA)



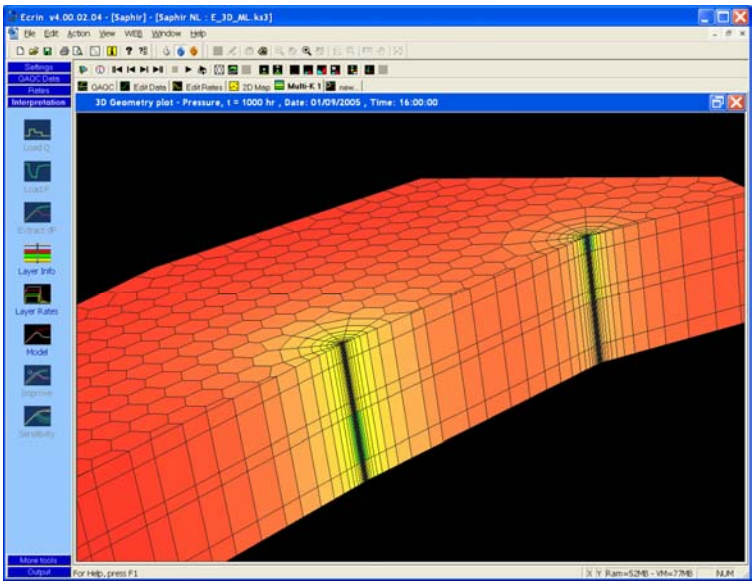
In the Model dialog (of a multi-layer analysis) a “Numerical” tab is included. In this tab the specific options not found in the analytical model are:

- Crossflow - if included a kz/kr appears in zone “i” representing the crossflow between layer “i” and layer “i+1” below. This value defines a multiplier for the transmissivity in the z direction between the two layers.
- Partial completion: for each layer defines whether the well is opened in that layer or not. Shows a schematic where you can interactively click to change the conditions.



In v4.0 numerical n-layer the well can either be vertical or fractured. Unlike the analytical model, the numerical n-layer can be used in a multiwell environment. A cross-section in a reservoir with 2 wells each partially completed is shown next as an illustration.

Note that a single 2D X-Y grid is used for all the layers, which means that the contour, faults, etc. are the same in all layers. If X-Y anisotropy is introduced there is therefore a unique kx/ky value.
Finally because each layer is considered in 2D only (no vertical grid refinement in layers), the partial completion option should be used with caution.



5 layers with crossflow, 2 wells partially completed

C • PTA module (Saphir)

C.1 • Control panel changes

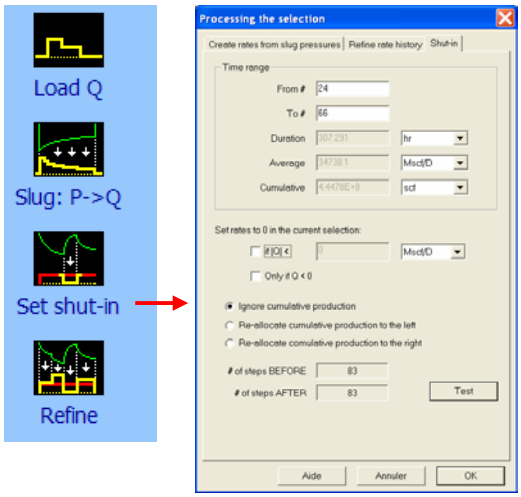
The Saphir control panel now has the pages: Settings – QAQC Data (formerly QAQC) – Rates (formerly Edit Rates) – Interpretation – More tools (formerly Interpretation 2) – Output.

C.2 • Edit rates

In Edit Rates, some options have been moved to the control panel and a new option added >

Set shut-in

After a selection is made you can use this option to force the enclosed rates to 0, possibly with additional conditions (if they are below a certain threshold or negative and below the threshold). The production thus removed can be re-allocated before or after. Recall that the range for this option can be defined based on the times of the pressure data, or the rate data.



Set shut-in

Next / Previous BU 

This is a new option of the Edit Rates toolbar materialized by the two icons above. They allow moving to the next/previous build-up with a scale reset each time to focus on the build-up. This is especially useful to check/change the start times.

Refine rates

The refine rates option has been modified to leave build-ups unchanged. Also, in the Refine dialog, you may now edit the cumulative volume for the refined period.

C.3 • Improved Tides correction

A new correction is implemented based on the method presented in SPE84376. The basic idea is to use a cubic spline to represent the corrected pressure signal and to integrate the determination of the spline nodes with the determination of the tide shift and gain. This is tailored for the application to a particular build-up, and the steps are as follows:

(1) Make sure you loaded the seabed response and made any required cleanup to the data

(2) In Edit rates make sure the start and end time of the candidate build-up are set with accuracy

(3) In the Tides QAQC dialog:

- Select the gauge to be corrected in the "Active" drop list; Select the seabed in the "Signal drop-list"
- Use the "Set to rate(s) limits" button and click inside the candidate build-up. When you validate with OK you will see two vertical dotted lines on the Tides plot indicating the time range for the selection
- Click on to launch the regression that will calculate the spline and also the time shift and amplitude
- Create new gauge

C.4 • Oil single phase m(p)

A new fluid type is available labelled "Oil – single phase m(p)". When it is used the pressure is replaced with a pseudo pressure defined as:

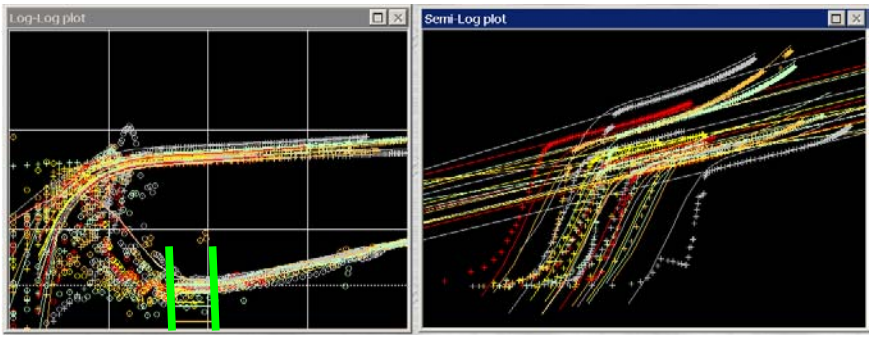
$$m_n(p) = (B_o\mu_o)_{ref} \int_0^P \frac{dP}{B_o\mu_o}$$

The integration of the viscosity and formation volume factor in the pseudo pressure permits a consistent analysis over a period of time where the pressure varies significantly (and thus the PVT properties) *provided that one considers times where the pressures are above the bubble point*. Typically a series of build-ups over a long history, each one being at pressure levels above the bubble point, will give consistent kh's. Note that using the pseudo pressure alone does not address the variation of compressibility with pressure. For the time being there is no option equivalent to the gas "Material balance" option available.

C.5 • Other additions

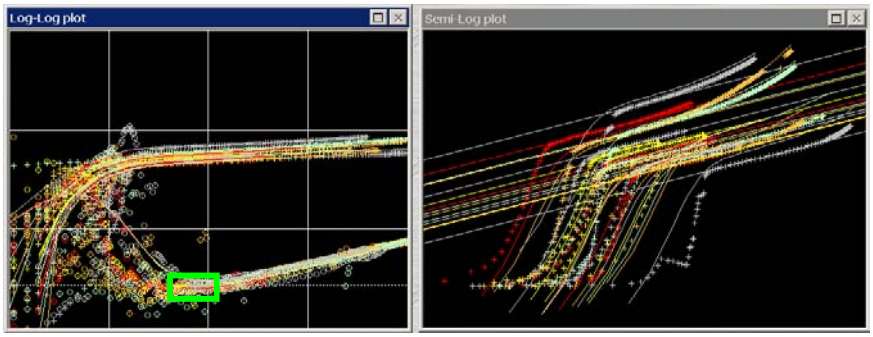
- Gauge statistics in Gauge infos
- Results: "Complete" checkbox: In the Main Results dialog there is now a "Complete" checkbox. Activating this option causes Saphir to display all relevant results: the input parameters, PVT, model, etc. The point is to have everything in one place to quickly review a file.
- In the Extract dP dialog an explicit "List" button is now available. Also, when extracting All periods of a given type, you can set a minimum duration.
- In QAQC and multiple well situation, if the rate plot is made visible (option of the toolbar) the rate histories from ALL the wells can be displayed simultaneously using the "Show hidden gauge" option
- In Edit rates: show incremental and cumulative production for each flow group
- With an existing model, if you make changes in the 2DMap a warning icon will be displayed in the 2D (3D) Geometry plot on the main screen, to indicate that the current 2DMap is different from the one used to generate the response.

- Multiple Build-up IARF processing with Y range definition and nonlinear regression: When you extract several build-ups together right click on the loglog for instance, and select “Line” - “Multiple versus time”, there are now two distinct options: “All” and “Select range”. “All” proceeds like in v3.20: you define a time range with 2 clicks and for all periods a least square is made on the selected range.



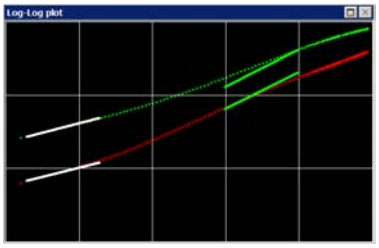
Multiple Line – All

With “Select range” you define a box by click-and-drag and Saphir runs first a least square, keeps only the line with an IARF level inside the box, then runs a non-linear regression with a single slope value.

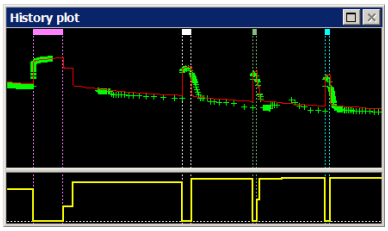


Multiple line – Select Range

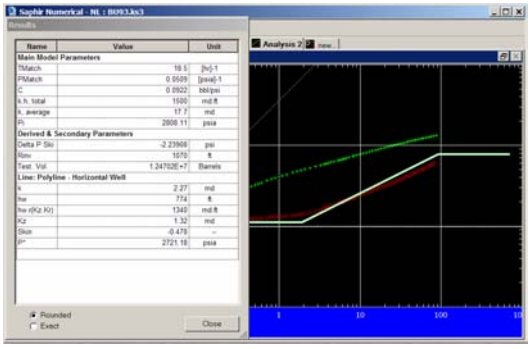
- Specialized lines for fracture linear and bi-linear flow. They are now represented by 2 lines (one for dP the other for dP’) as was already done in the Pick options.



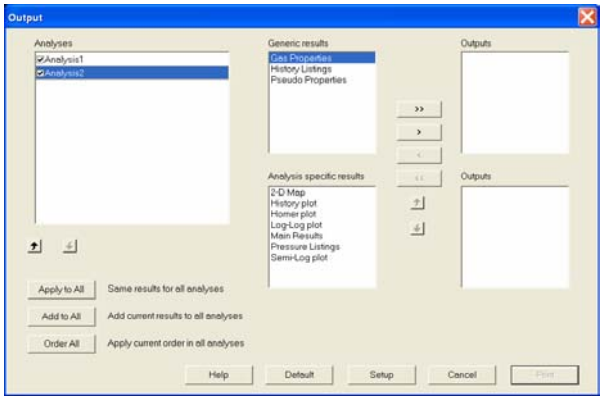
- “Top only” = new option to visualizing the analysis groups on the history plot – In “Settings-Plot Aspects- Groups



- “PolyLine” horizontal well: In the “Specialized lines” menu of the loglog plot. The creation is done with a series of clicks like for instance for a fault in 2Dmap. There are 3 different segments created = early radial, linear, last radial. A Modify option highlights the nodes that can be dragged to move the levels.



Specialized horizontal well polyline

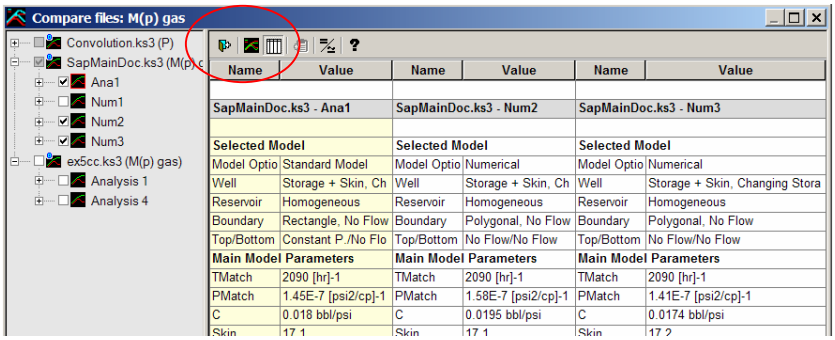


Multiple analysis report in one go

- Multiple analysis report: this option lets you print in one go the report for several analyses. The dialog lest you define the content, and it distinguishes between the generic and the specific results.
- Pseudo Skin calculations: they are using the model for all configurations: limited entry, horizontal well, or fractured well. In previous versions approximate equations were used except for the limited entry well. More explicit legends are also used in results.

Pseudo-Skin Components		
input parameters		
Well model	Vertical - Limited entry	
kz/kr	1	--
hw	300	ft
Zw	500	ft
computation result		
Geometrical Skin	20.8	--
Damage Skin	-2.12	--

- Compare files: tabular view in complement to the former loglog plot comparison. Note that you may activate the grid column and then press “Ctrl+C” or “Ctrl+Ins” to copy the content to the clipboard.



- Compare files: aspect control: driven by the aspect used in multiple analyses
- It is now possible to create a Multilayer analysis in an Interference file.
- Skin, model results: in the main result a geometrical skin is reported when relevant. The ratio of the Delta P due to Skin with the total Delta P for the current group is reported as “Delta P Ratio (Total Skin)”

D • PA module (Topaze)

D.1 • Multiphase rate loading

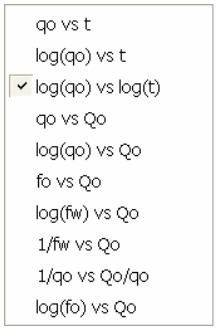
When the fluid type is set to Oil, you may now specify in the "Main Infos" dialog that you will load water and gas rates too. The Load and Edit options have been modified as in Saphir for this case. When multiphase rates are available they will allow a number of additional processes:

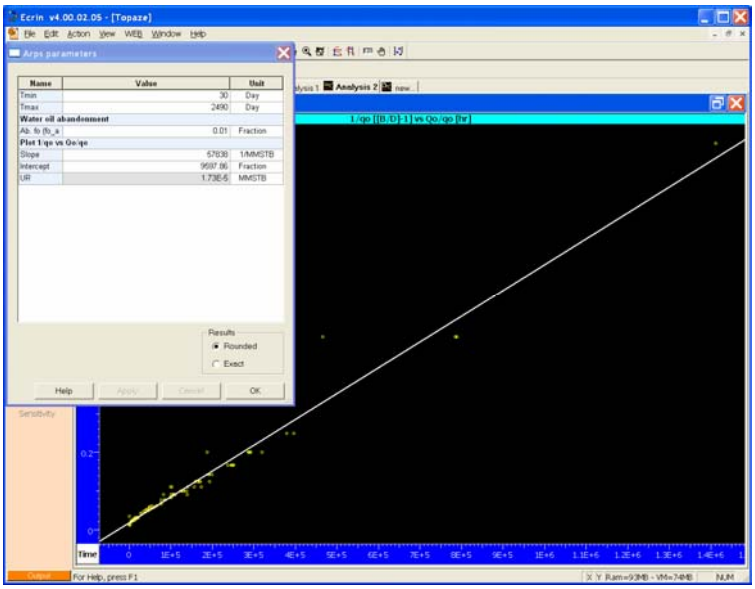
- Intake correction using the actual rates, rather than fixed GOR and WOR
- Arps water-oil analyses, see D.2
- WOR model prediction, see D.4

D.2 • Arps Water-Oil

When you load both oil and water rates, new presentations are available in Arps, as shown opposite. The first 4 are the usual single phase presentations; they share the same underlying decline curve and will produce the same results as in single phase. For all the additional presentations, a specific line exists that will provide an estimate of ultimate oil recovery. *Note that all the relations are empirical and it is recommended to look at all of them to get a range for the answer.*

When you call a given presentation the first time, a line is calculated automatically. You may then modify, or re-calculate this line as usual.

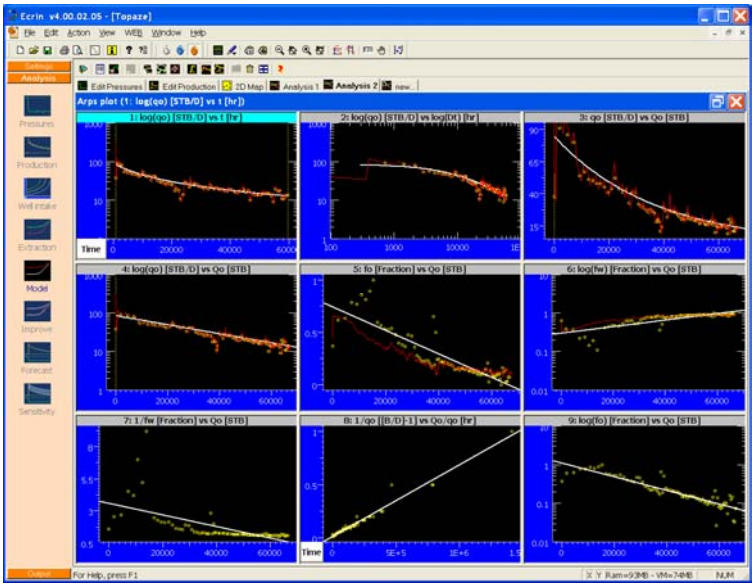




1/qo vs Qo/qo analysis

D.3 • Arps multiscale

The wheels are gone from the Arps plot; the access to the interactive Modify, or Set parameters option is facilitated; a new selection using a "lasso" is implemented. Most importantly you may now display several scales simultaneously within the same plot. In the popup menu are two new options to "Add" or "Remove" plot. A plot is activated with a single click and the usual options to set scale, modify parameters, modify on the screen etc apply to the active plot. A "Tile" option is given that sets the plot sizes uniformly.



Arps multiscale display

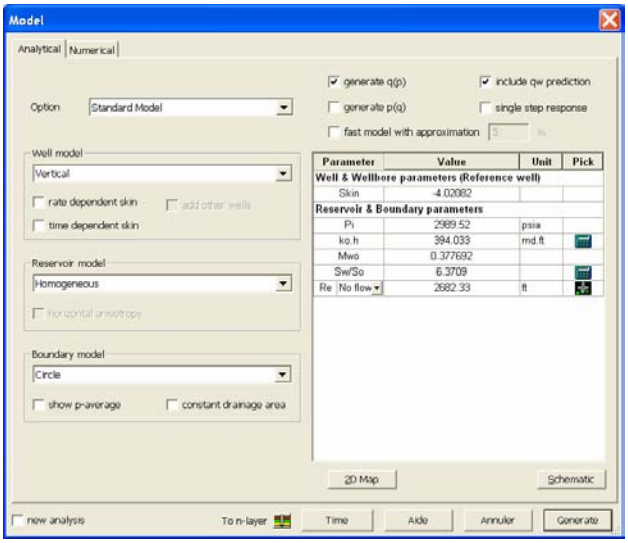
Note that in the new Arps options the Results option and the Set Parameters options are merged. You get a table where you can directly edit the relevant values.

D.4 • Water prediction in model

In their 2002 SPE77569 paper, Bondar and Blasingame showed that an assumption of pseudo steady state for an oil and water system made independently produced a WOR model that could match observed data adequately.

Based on this observation, a new model option is added when oil and water rates are loaded, which will predict both oil rate was water oil ratio. The additional model inputs are a saturation and mobility ratios.

The regression can improve the new parameters by considering an additional residual on the WOR.



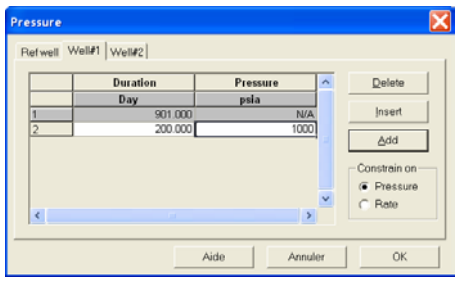
The next plot shows an example. In the top pane the measured WOR is added as well as the simulated equivalent.



Water-oil model

D.5 • Multiwell forecast with pressure imposed at the other wells

When running a forecast and entering the future part of the well history, a tab is present for each well. With analytical models only rate control is possible but with the numerical model you may constrain on pressure.

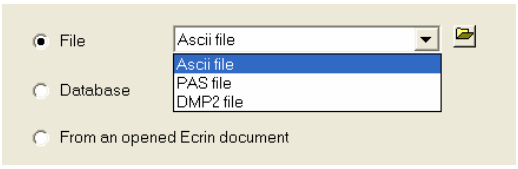


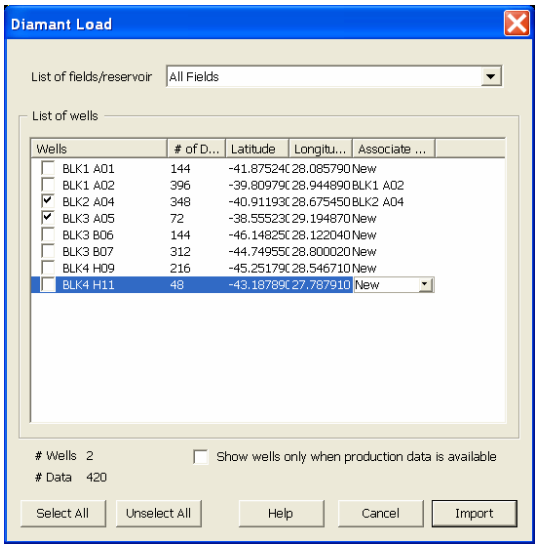
For those wells, Topaze will use the loaded production up to the start of the forecast, and then will switch to a control on pressure, simulating the rates. When you display the “other wells history plots” you will have the possibility to see the model rates for those other wells. Note that you may load the measured pressure at the other wells (use the “Pressures” button of the Analysis panel while in “Edit Pressures” and you will find a drop list to select the target well in the Load dialog). If such data is present, you can display it in the particular well history plot. In all situations the pressure is a bottom-hole flowing pressure.

D.6 • Other additions

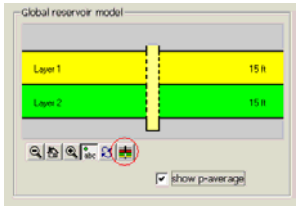
- Topaze inherits the last Saphir numerical additions: 2Dmap per analysis and all the new models as well as numerical fractured well, limited entry etc (see Section B).
- Analytical gas material balance (in Q(P) with multi-step history)
- Analytical multi-well solution
- Simulation in steps when the measured data is in steps
- Simulation beyond Tmax
- Sensitivity, as in PTA but with comparison on history plots
- Fast model access and logic changed: now activated – and not simply accessible- when more than xxx points.
- In Model and Forecast, it is now possible to set the output times to days, weeks, or months. This is available in the “Time” dialog.

- In Arps, the Tmin can be edited to redefine the time from which the decline curve model applies independently of the extract limits. The Tmin and the Tmax can be dragged directly on the screen (if not in Modify mode).
- Load of DMP2 files: this is accessible through the standard load dialog, after selecting “DMP2” in the source file formats. Depending on the context, one or several well productions may be loaded.





- On the Loglog plot, when Ctrl is pressed only the horizontal match line can be moved - eg Re is constant. Conversely, if Shift is pressed, only the unit slope line can be moved –eg kh is constant.
- When simulating q(p), where the input rates are 0, the simulated rates are forced to 0 as well. This avoids “loosing” the cumulative.
- In the Arps plot, the selection of the points for regression is not done by successive time intervals anymore but by using a lasso to define the desired groups of points. You can select as many groups as needed and/or draw any arbitrary shape to include/exclude points.
- At the bottom of the Model dialog is an icon to access the multi-layer model . In Topaze the multilayer condition is not treated as a separate Analysis. This means that you will not find the two additional panel buttons included in a Saphir multilayer analysis, namely:
  - Layer info: in Topaze the same dialog is accessed from the Topaze model dialog
  - Layer rates: No equivalence in Topaze. The main use for this input in Saphir is the regression and doing a multi-layer improve in Topaze is not realistic. The prime objective of the Topaze multilayer option is to allow the copy of a Saphir model (already tuned) to Topaze.



- The option to pick Pi when doing an extraction can be set to work on the extraction interval rather than the whole pressure range. In the Pick dialog the new option is activated with a checkbox at the bottom left.



- Abandonment on normalized Rate-Cumulative plot has been added and the results include a recovery. There is a specific plot option accessible through the plot popup labeled “View / Edit P Ab” to modify the abandonment pressure.
- Topaze now includes a Word report like Saphir. A template is provided with the installation.
- In the Extraction dialog it is now possible to specify a rate threshold ratio with respect to the rate range. Any point with a rate below that value is ignored. This option is especially useful in the case of permanent downhole rate monitoring.

- On the History plot, rate/cumulative pane, you may now zoom interactively on the two Y scales independently. This is achieved with the "Vertical scale setting" option . You can set the interactive zoom on Y to affect only the active scale or all the scales.

E • Data module (Diamant)

E.1 • Diamant Master

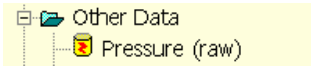
Diamant Master has a number of functions not present in Diamant Workstation:

- The ability to access data in PI servers
- The ability to create a mirror in BLIF format of any data source
  This is a must when dealing with large amounts of data and a data server with slow access. *BLIF stands for "Binary Large Index Files". This is a KAPPA internal format providing a fast data access in a concise form.*
- The ability to write back a channel to a database
- Also, with files created with a Diamant Master, it is possible to drag-and-drop gauge data using a Diamant Reader. If the file is a Diamant workstation this cannot be accomplished.

The following differences between Diamant Master and Diamant Workstation should be noted

	Master	**Workstation**
File extension	.kdmm	.kdm
Application icon		

The mirror is activated in the Load dialog using the checkbox at the bottom left: 
This option disables the "Filter" the point here being to create a mirror of the raw data. The data source can be anything. The dynamic update flag is set by default. After the load, the channel is materialized by a specific icon inside the browser:



The data for such channels are not loaded into memory. If you activate the Plot or Table modes, Diamant scans instead the associated BLIF file to show a preview, using the default preview sample defined in the application Settings. The sample used for preview is kept in memory for the duration of the session. The sole interest of the mirror is to provide a quick way to re-access the data for instance to reload using filter.

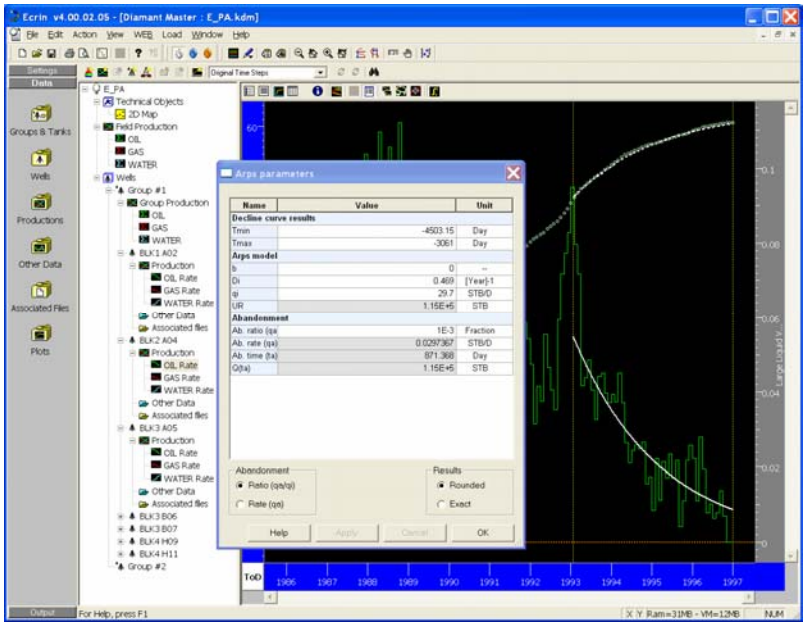
If you right-click on a BLIF mirror, you will have the option to use it as the source of a new channel using "Load".



This option takes you straight to the "Data Format" dialog where you may select Filter.

E.2 • Production Analysis in Diamant

When the active node is a rate and the display mode is set to plot, it is possible to access the typical Arps single-phase analysis. By clicking the "decline curve" icon of the plot toolbar, Diamant will make a first estimate by regression and add the model on the plot. You may then view/edit the parameters, or modify the decline curve on the screen. You can redefine the points used to calculate the decline curve parameters using the lasso. Also, like in Topaze, you can switch the scale to other presentations: q vs t, log(q) vs t, log(q) vs log(t), q vs Q, log(q) vs Q.



Like in Topaze, the Results and Edit Parameter options are merged.

The Tmin from where the model is applied can be modified manually or interactively on the screen.

The Arps analysis in Diamant can be made on a rate node located under a given well, a given group, or the whole field. When performing such an analysis on a container node, if all the node's descendents have a decline curve, you can display the sum of the individuals

The plot printout includes all the usual results for Arps.

E.3 • Other additions

- Edit point as in other modules:
- Edit step as in other modules:
- Unification of all settings with other modules
- Dynamic Diamant Reader

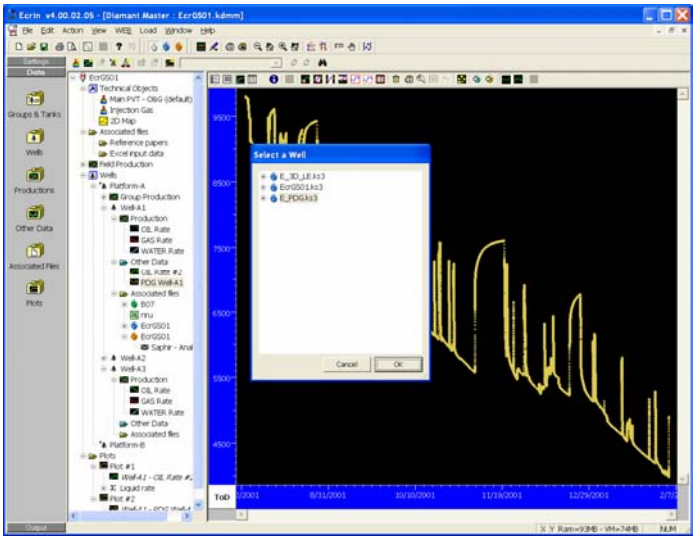
- Find option in the browser toolbar 
  When you select this option the search toolbar is displayed above the status bar:



- The Plots under the “Plots” folder now include a Show/Hide option, so you may customize the plots in display at a given time. To hide a plot you can simply grab its title bar and drag it outside the plotting area, or you can right click on its icon in the tree and select “Show/Hide”. To show a hidden plot, right click on the plot node and select “Show/Hide”. When they are hidden, the plots appear dimmed in the browser



- When a selection is made on a channel and you select the option to transfer only that section to Saphir or Topaze, a “mini browser” is opened where you may now just select a document (and no have to open all its levels). In that case, the gauge is added to the reference well of that document. Replacement occurs if the element only has one instance.



[End of the Update Notes]