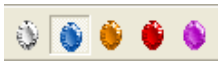
Saphir Guided Session #1

A01 • Initialization

This chapter is an introduction to the basic features of Saphir. It is assumed that you have installed Ecrin workstation or Saphir stand alone to follow this session. The session can be followed in all levels of Saphir except the Saphir reader.

Note: *By default, the plot 'Always show scales' option is on. In this guided session, it has been turned off (in Settings – Plot Aspects - Plots tab).*

The session will use the following files installed in the example directory during the main installation of Saphir or workstation Ecrin: SapGS01.rat, the rate file and SapGS01.pre, the pressure file. The extension to the files is not important here as any ASCII file can be loaded by the application.

If the workstation mode has been installed click on the icon  in the application toolbar  and then new  . If Saphir has been installed as a standalone application, click on new project  directly. This opens in succession two dialogs:

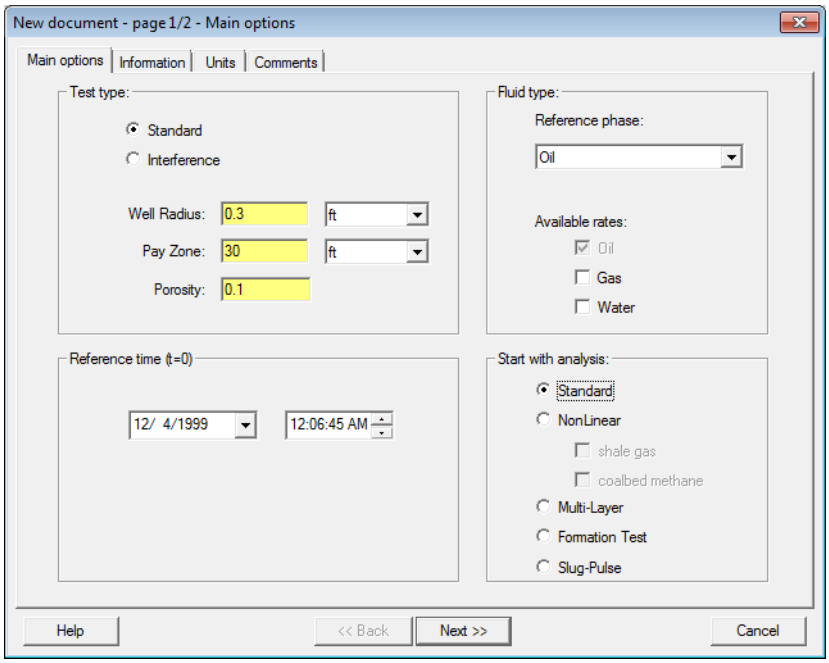


Fig. A01.1 • Initialization dialog 1 of 2

This dialog allows you to choose the test type, reference fluid type, the available fluid rates, net drained thickness, well radius and average porosity. Set the reference time to **Dec 4, 1999 at 00:06:45 hours**. Keep all other parameters as the suggested default.

Click Next >>.

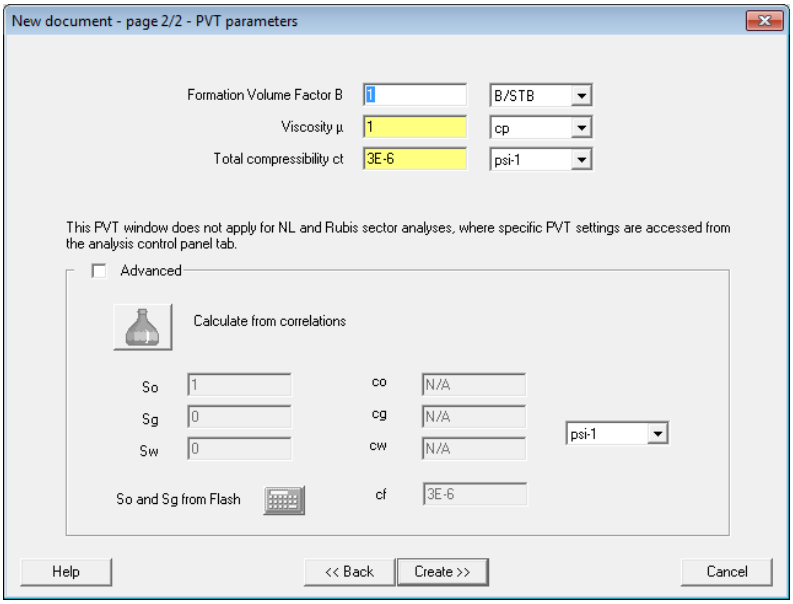


Fig. A01.2 • Initialization dialog 2 of 2

You input the PVT characteristics, the formation volume factor, the fluid viscosity and the system compressibility. Keep all values at their suggested defaults.

Click Create >> to create the new project. The Saphir main screen is displayed.

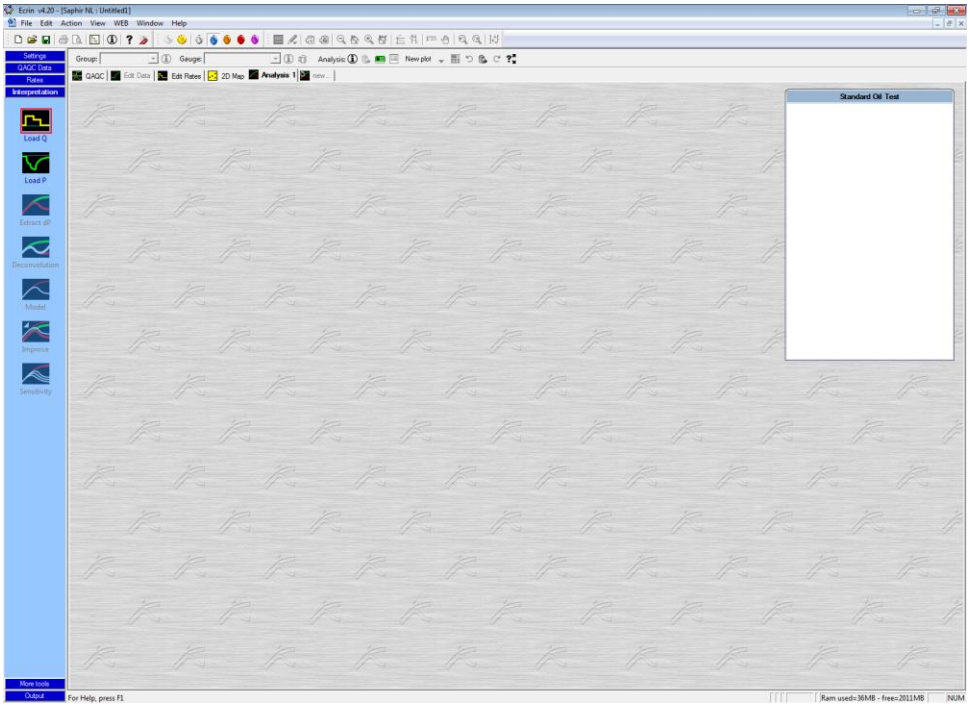


Fig. A01.3 • Saphir main screen

The main screen is opened with the 'Interpretation' page active. This page (or panel) contains seven icons and by clicking consecutively on the icons from top to bottom, executing the dialogs and instructions, you will follow exactly the default path of the basic workflow used in pressure transient analysis.

B01 • Loading data

B01.1 • Loading rates

Click  . This will initialize the load sequence which is usually a sequence of two dialogs. Specify an ASCII file in the 'Define data source' dialog and click on  to browse to the file SapGS01.rat in the Example directory. A preview of the file will be shown in the dialog as illustrated in Figure B01.1.

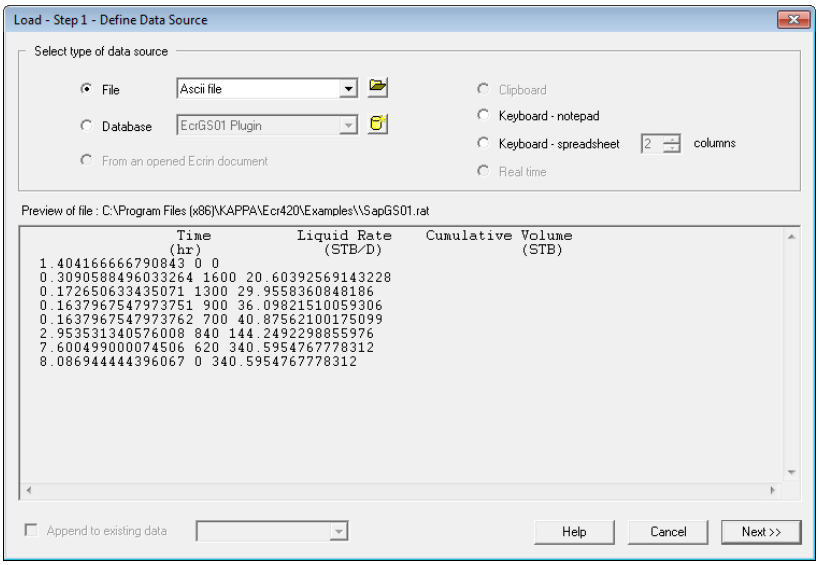


Fig. B01.1 • Load step 1 – Define data source

Click  to go to the Data Format dialog. Saphir has recognized the file as valid and has automatically assigned the first column as 'Decimal Time' and the second as 'Oil Rate'. This is known as 'free format'. The units are correct so no need to change the formatting proposed by Saphir. See Figure B01.2.

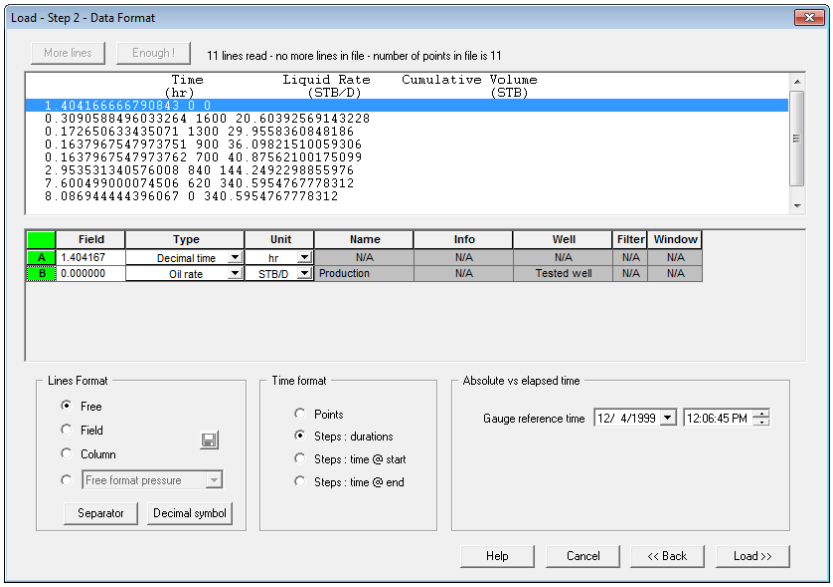


Fig. B01.2 • Load step 2 – Data Format

Click on Load >> to load the flow rate file. A history plot with the loaded flowrate file in steps is displayed. Double click in the title bar of the plot to maximize it and display the scales.

A click on the time button Time in the time scale will change the scale to real time (ToD) as defined with the reference date and time at startup. Minimize the plot.

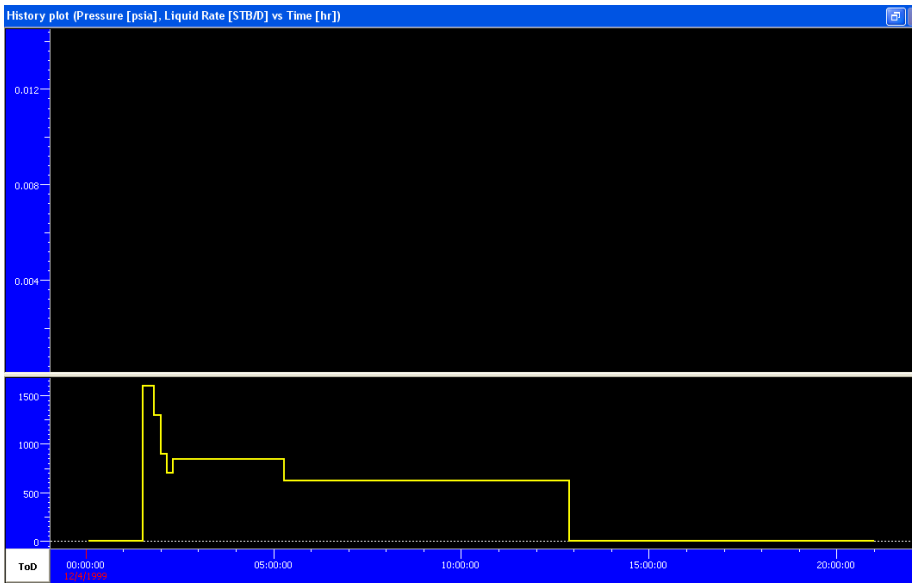


Fig. B01.3 • Loaded flowrates

B01.2 • Loading pressure

Click on the icon  . This will initialize the pressure load process. Specify an ASCII file in the 'Define data source' dialog and click on  to browse to the file SapGS01.pre in the Example directory. A preview of the file will be shown in the dialog as illustrated in Figure B01.4.

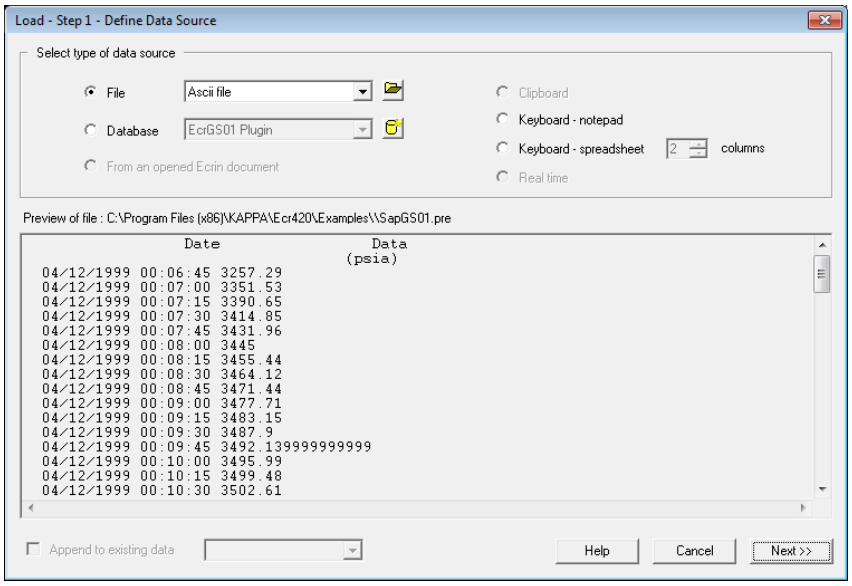


Fig. B01.4 • Load pressure Step 1 – Define data source

Click Next >> to go to the Data Format dialog. Saphir has automatically recognized the file as valid, but the automatic interpretation of the format is not correct, the first column contains the date, the second column contains the real time (ToD) and the third column is listing the pressure. Thus you need to manually specify the format.

Select the **Field** option in the Lines Format section. A spreadsheet like display is shown containing the data separated in three columns. Under the header Type you can define the various field types by choosing from the droplists. The type of the first field is Date **(DD/MM/YYY)**, the second is **ToD - Auto** and the lasts field is the value, **Pressure**. The pressure file is in **Points** mode.

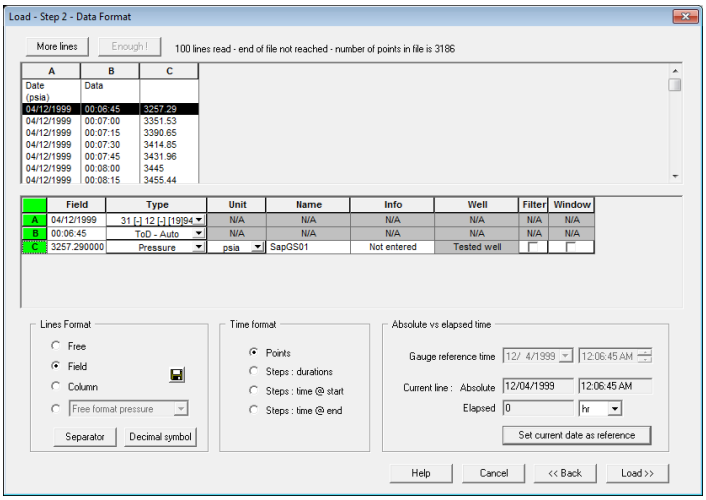


Fig. B01.5 • Load pressure Step 2 – Data format

Click on Load >> to load the pressure file. The history plot contains now both the flowrate and the pressure file. Figure B01.6.

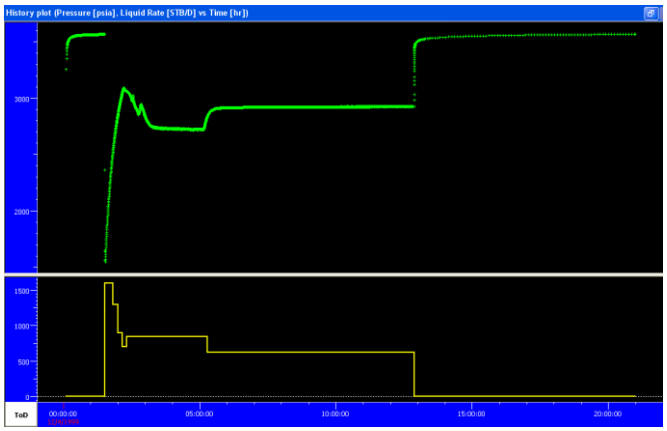


Fig. B01.6 • History plot

The pressure shows that the test is a simple DST, starting with some static pressure followed by a slug as the fluid rises in the well. Then finally flowing at surface, followed by two drawdowns on different choke sizes and a final buildup. The buildup is subject to the pressure transient analysis in this session.

C01 • Extracting delta P

The next natural step is to extract the buildup pressure to the loglog plot, compute the Bourdet derivative to be displayed together with the delta P to aid the interpreter to choose the model that may finally match the data and yield the results.

Click on the icon  . The first dialog is to choose the period to be extracted, in this case 'build-up #1'. The second dialog is to set the derivative smoothing, the filtrations (points/log cycle) and the starting pressure (P at dt=0, often also called Pwf), the default value of the pressure has been chosen by Saphir as the nearest pressure point to the change in flowrate (when the flowrate goes to zero for the buildup). Stay with the default values and click OK.

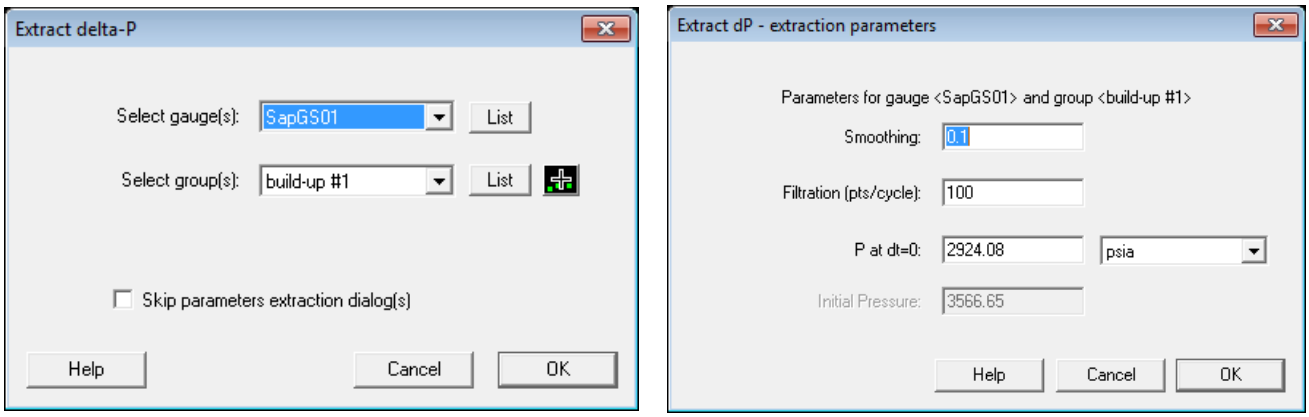


Fig. C01.1 • Extract dialogs

Now the Saphir screen contains two new plots; the loglog and the semilog plot. Figure C01.2.

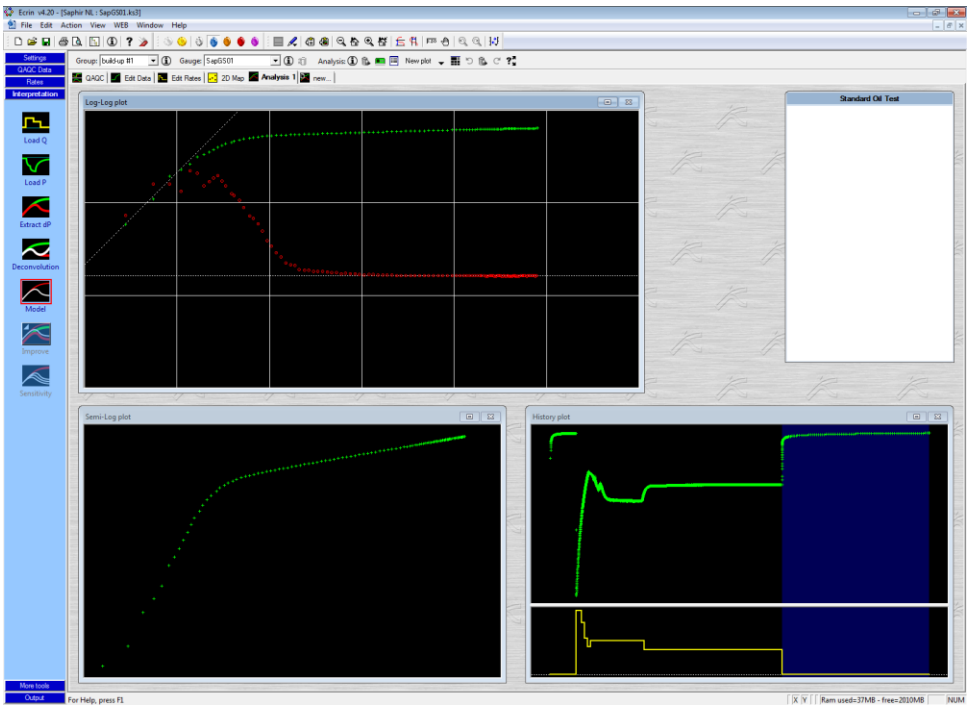


Fig. C01.2 • After extract

The extraction process can also be done automatically, i. e. without the intervention of the two dialogs in Figure C01.1. In that case it is always the last extractable period in the history that is extracted.

To invoke automatic extraction you hold down the shift key while clicking on the icon  . The red flash on the icon indicates that the extraction is in automatic mode.

At the extraction Saphir makes an automatic match. Stabilization is sought in the derivative, as well as a unit slope straight line at early time in both the derivative and the delta P. This corresponds to the two most common flow regimes seen in pressure transient analysis, namely infinite acting radial flow and wellbore storage. If Saphir can find these regimes it will make the match by setting the white horizontal dotted line on the stabilization of the derivative and the unit slope white dotted line on the early time data as seen in Figure C01.2. The lines are connected and can be moved to any other position by you (click and drag with mouse) in the event that the automatic match is not satisfactory.

D01 • Modeling

Once the match is satisfactory the process changes to diagnostic mode. The diagnostic phase includes the search for all flow regimes that may be present in the response of the extracted period. This allows the interpreter to choose the most appropriate model that includes all the flow regimes identified. Then the next natural process is to run the model and obtain the match which again will yield the results.

The response of this extracted flow period is straight forward with a long period of infinite acting radial flow and a small amount of wellbore storage to start with. Small wellbore storage was expected as this is a DST with downhole shut-in.

The most appropriate model to use in this analysis would be a model that takes this into account, hence the use of the homogeneous model with wellbore storage and skin in an infinite system.

Click on the Model icon  . This will open the Model dialog where the combination of wellbore, well, reservoir and boundary models may be selected. The default model parameters are displayed in the dialog and you can modify them manually. The default values of C (wellbore storage coefficient) and kh (permeability thickness product) are deduced from the original automatic match made by Saphir. Keep the default values as seen in Figure D01.1.

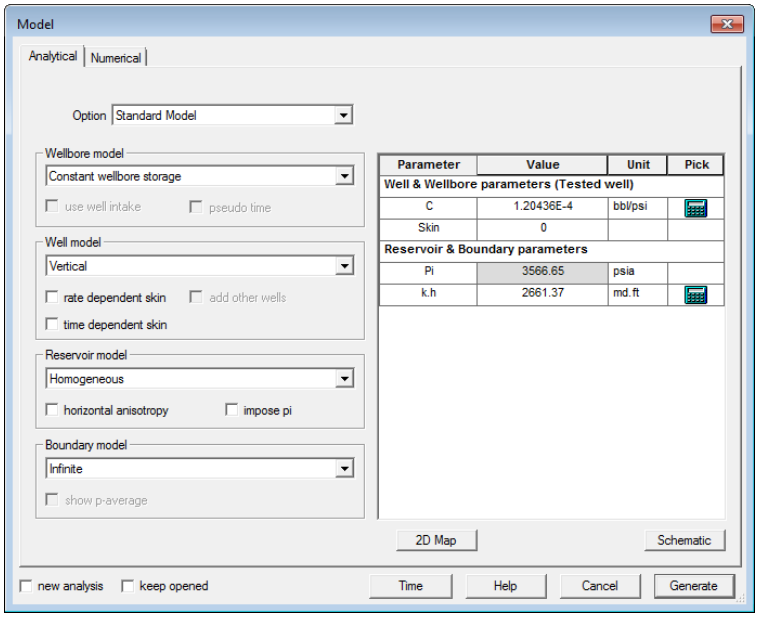


Fig. D01.1. • Model dialog

Click on Generate. The model is generated and immediately it can be seen that there is an important mismatch between the model and the data, see Figure D01.2 left. This mismatch is caused by not having used the correct skin. By calling the Model dialog (Figure D01.1) again (and a few times) and manually changing the skin a good match will be obtained as seen in Figure D01.2 right. There is still a small problem with the match, the wellbore storage coefficient is not exactly right but this problem will be dealt with in the next section.

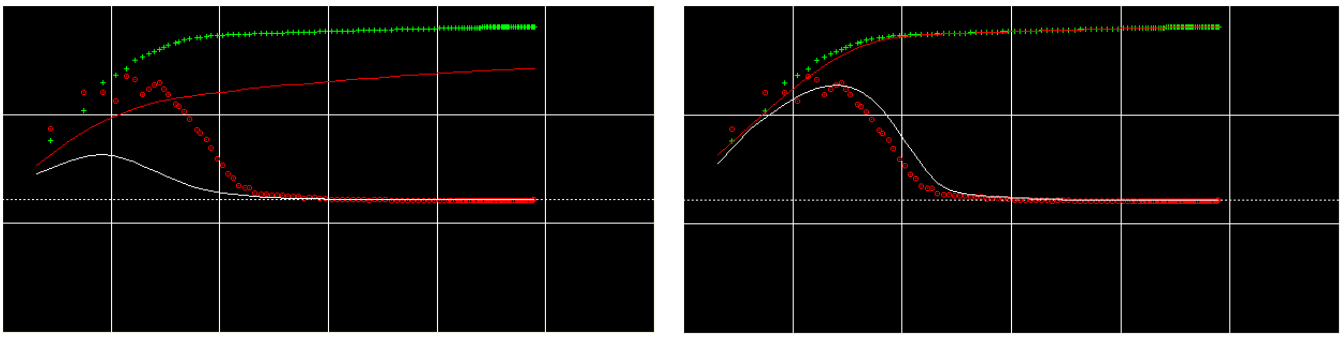


Fig. D01.2 • Loglog matches

It is also possible to run an automatic model.

If you hold down the shift key and click on  (the red flash indicates automatic mode) the homogeneous model with wellbore storage and skin in an infinite system will be run without the dialog in Figure D01.1. The skin will be estimated and the match as indicated in Figure D01.2 right would have been immediate. It is also possible in the Settings page (panel) to have Saphir make the automatic skin calculation the first time the model dialog is called.

E01 • Improving

Click on the improve  icon. This will allow you to run a non linear regression to improve the match between the model and data. Uncheck the permeability k and run the regression on the wellbore storage constant C and the skin. Click 

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The result after regression is shown in Figure D01.3.

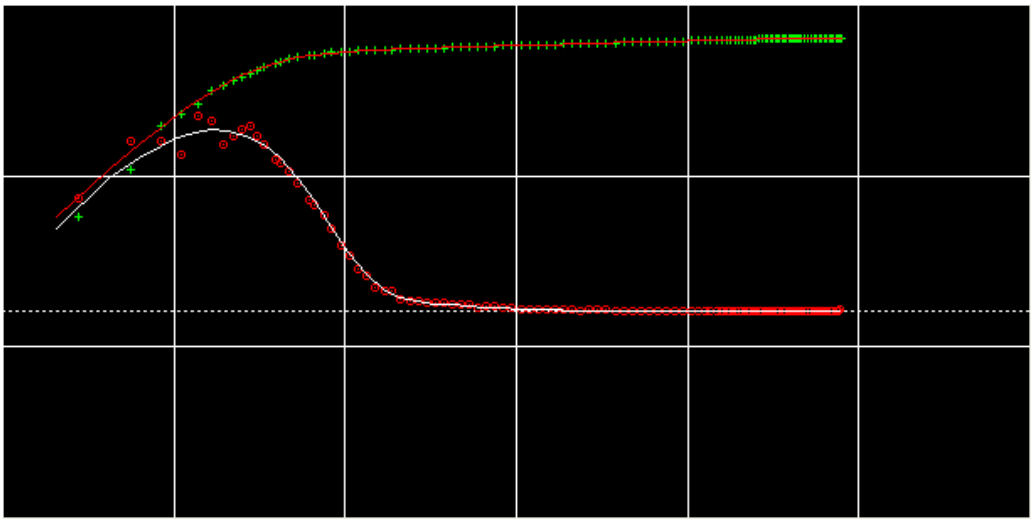


Fig. D01.3 • Match after regression

The Saphir screen now shows the model match on all the plots. Figure D01.4.

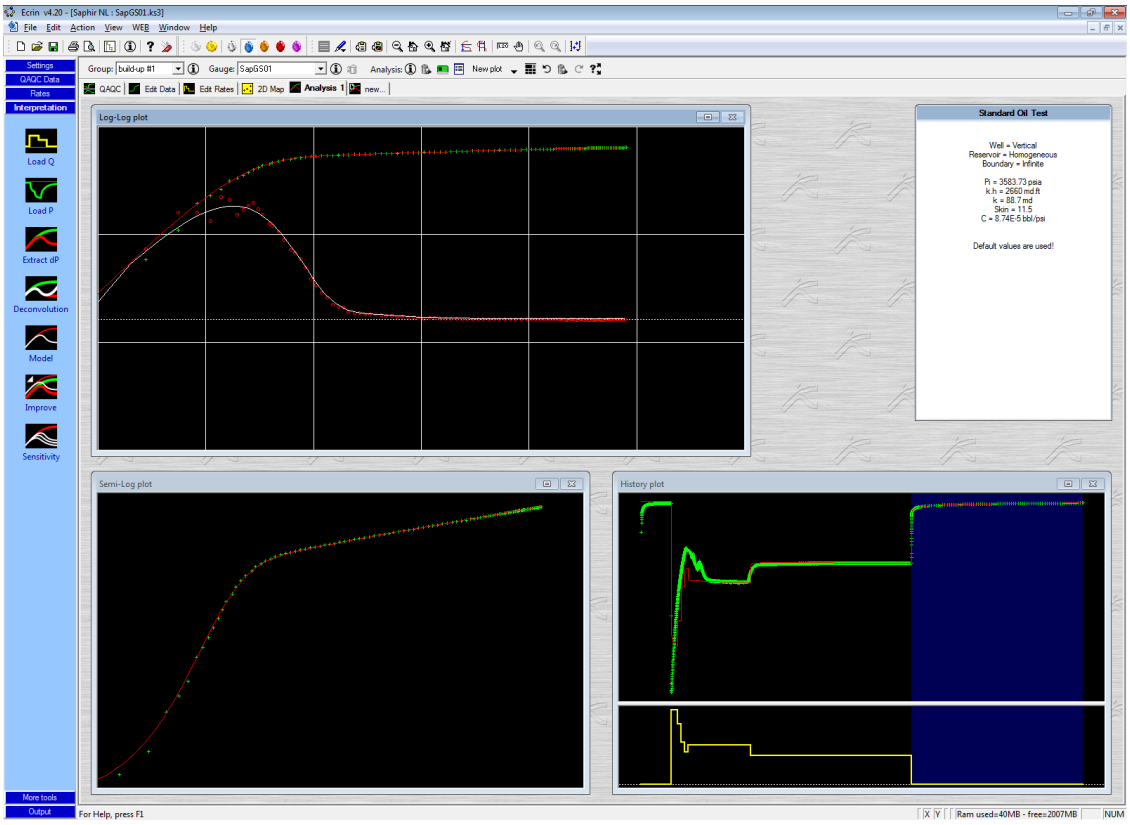
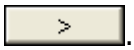


Fig. D01.4 • Saphir screen

F01 • Sensitivity

The final step in the workflow is the sensitivity. Click on the Sensitivity icon  . The dialog that follows (Figure F01.1) will allow you to specify the parameters to run the sensitivity on.

In this case the choice is the skin value. Move the Skin from the parameter selection area to the parameter values by selecting it in the left-hand side list and clicking on  . Enter the following sensitivity skin values: 1, 2, 4, 6, 8, 10, 14, 20.

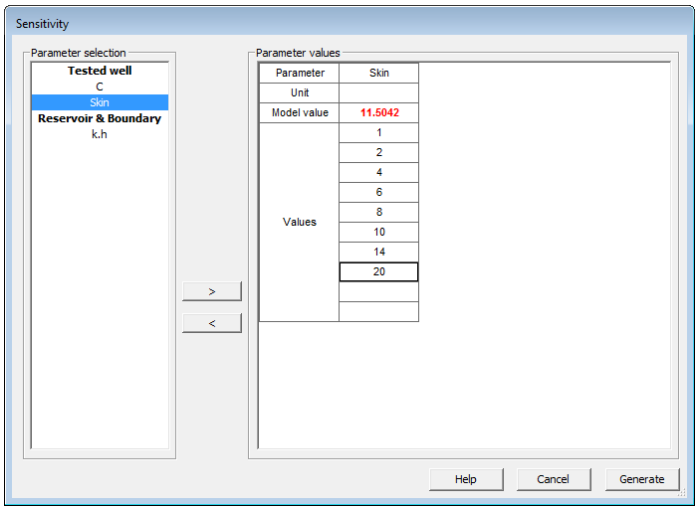
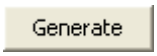


Fig. F01.1 • Sensitivity

Click  and a loglog plot with all the skin models will be created. Figure F01.2.

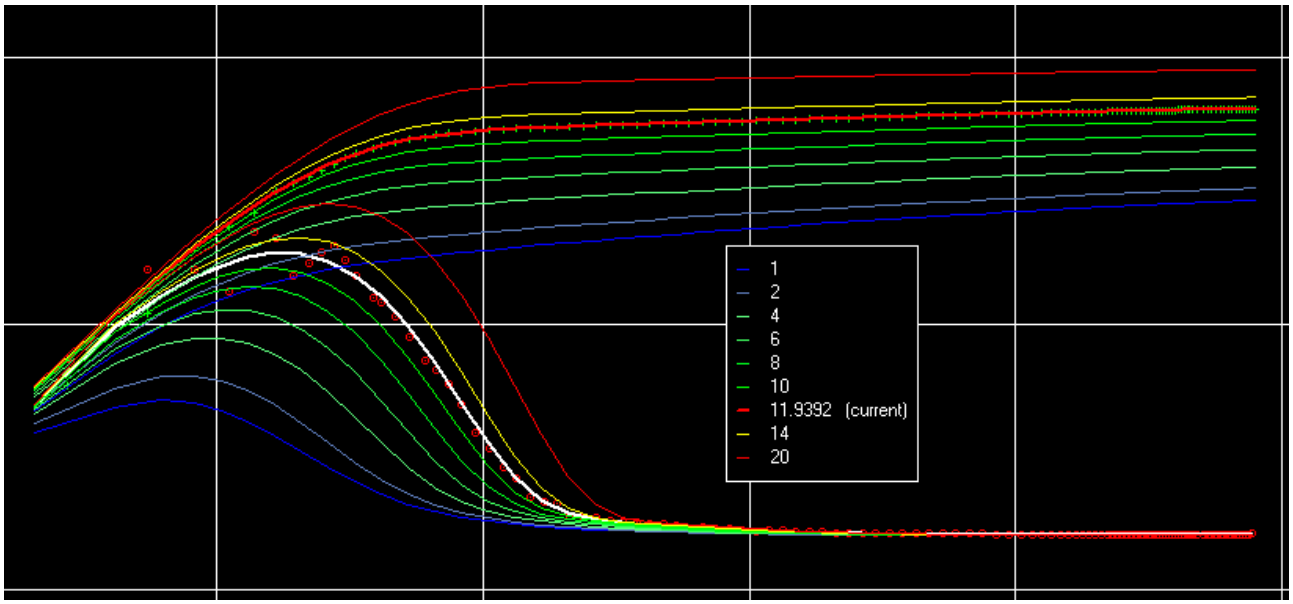


Fig. F01.2 • Skin sensitivity

G01 • Horner plot

The Horner plot is strictly only valid for a buildup following one single constant rate drawdown. However, when you want to use such an analysis method it is possible, and it is just necessary to confirm the previous production time which is calculated within Saphir as the cumulative production divided by the last rate. The access to specialized or flexible plots is through the page (panel) 'More tools' 

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Click on  . This will access the Flexible plot dialog, choose the Horner plot in the drop list (Figure G01.1) and accept the default previous production time.

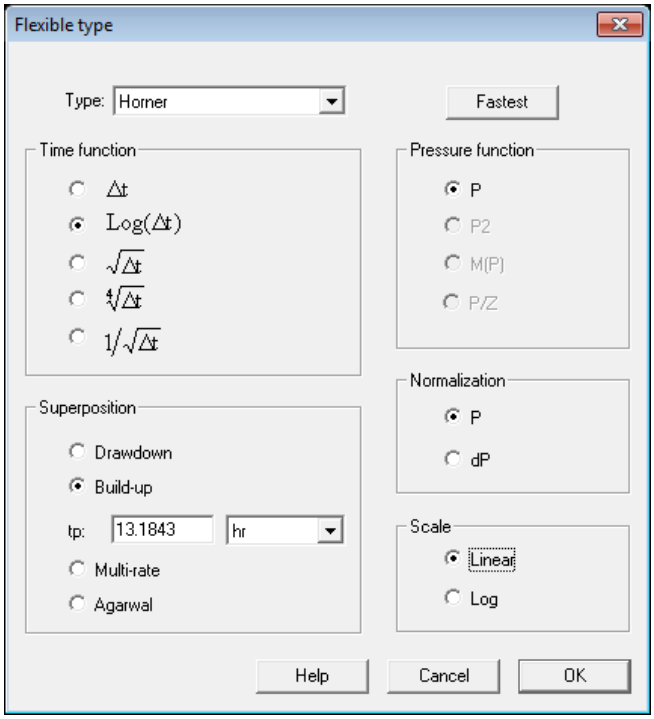

Fig. G01.1 • Flexible plots

Click OK and the Horner plot is displayed. Right click on the plot and select 'Show Derivative' and unselect 'Show Model'.

To regress or draw a semilog straight line on the plot use the button  or the plot popup menu (right click in the plot). Use the regression method and click the beginning and the end of the line, the line will be displayed and the line results are accessible by clicking on the Results icon  . Figure G01.2.

The derivative curve (red markers) can be used as an indication of the best possible straight line by selecting the interval where the derivative is constant.

The method of drawing a straight-line on the semilog plot in the main Saphir screen is identical.

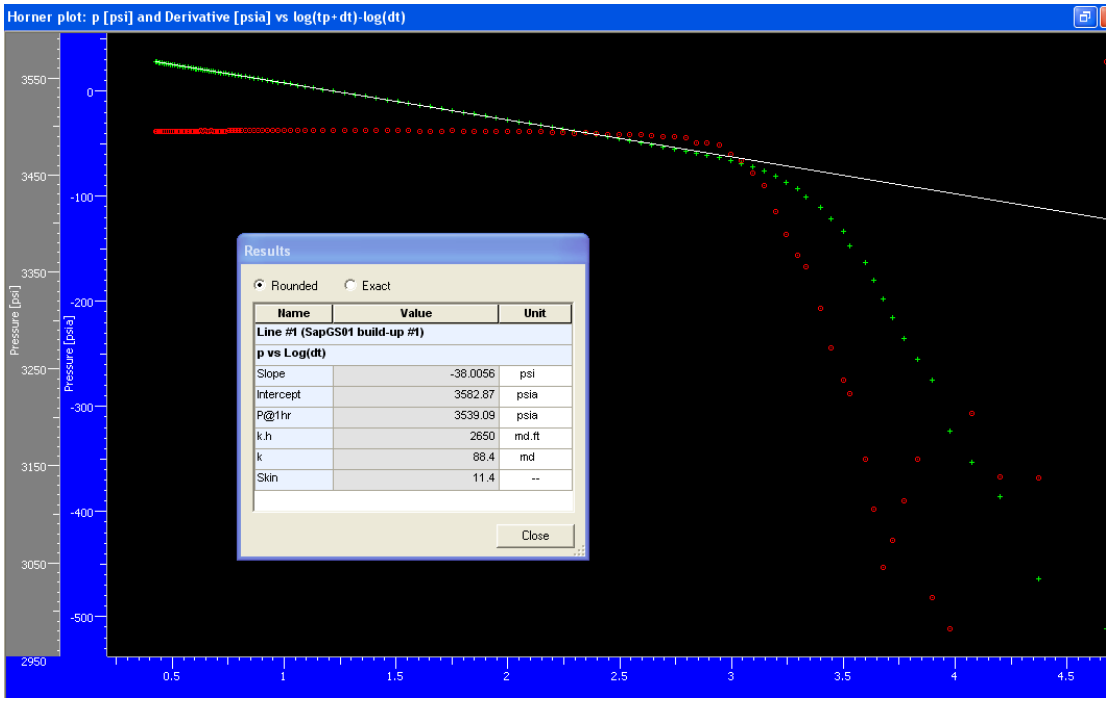

Fig. G01.2 • Horner plot