B01 – Guided Interpretation #1

This chapter is an introduction to the basic facilities of Emeraude 2.40 through a two-phase Oil-Gas example. The session is limited to loading and processing a single production period with emphasis on software mechanics rather than interpretation methodology. The original log data has been subject to various manipulations including some mnemonic redefinition.

➢ In the examples this symbol represents an interactive step or action.

Even though this is not always an explicit step of the Guided Session, we recommend that you call the Help button in the various dialogs. All the software reference is on-line, and is accessed contextually.

B01.1 • Creating an Emeraude document

➢ Start Emeraude

The main program window is displayed with a control panel to the left, several toolbars at the top, and an empty area that will subsequently be used for plotting the logs. Every toolbar has a “grip control” (shown with 2 vertical lines) that can be used to drag the toolbar and dock it at a different position, or leave it as a “floating” toolbar inside the plotting area. The original layout of the toolbars will depend on your screen resolution.

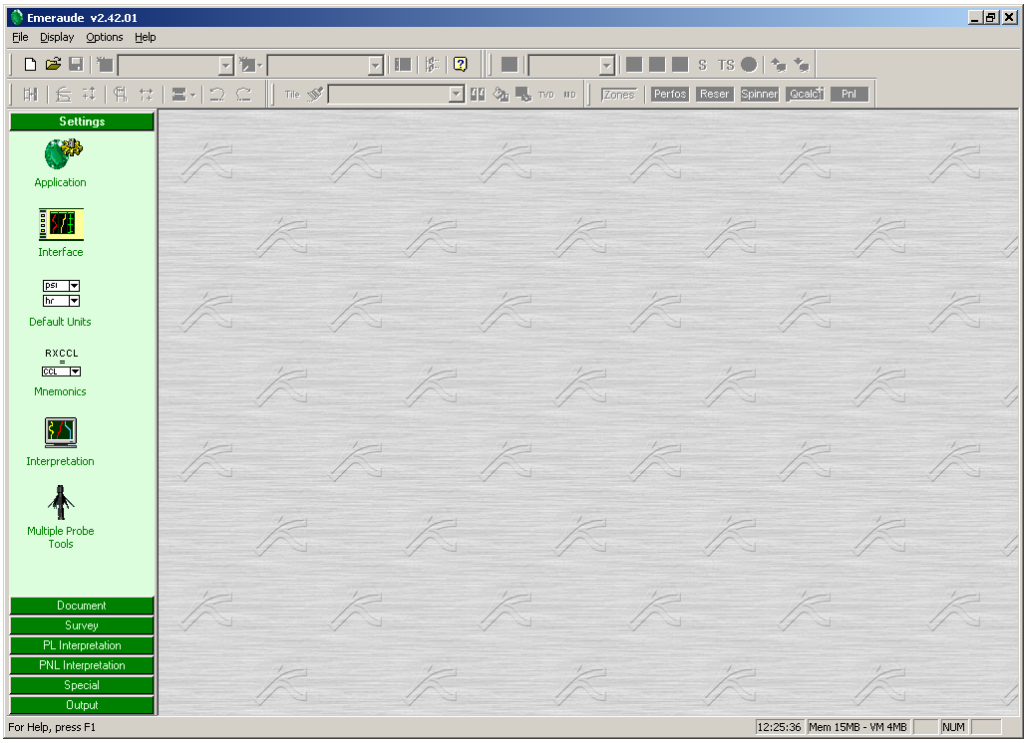


Fig. B01.1 • Settings screen

The control panel contains 7 different “pages” that may be activated by clicking on the corresponding button: **Settings, Document, Survey, PL Interpretation, PNL Interpretation, Special** and **Output**.
When the mouse cursor is moved on top of any toolbar or control panel button, a brief description of the corresponding option appears in a popup window and in the status bar.
Settings is the open page when Emeraude is started. This mode can be used to define permanent user settings in order to customize the following:

- **Application**: Autosave option, path to external user DLL’s (for user editions in the browser).
- **Interface** Color of the control panel buttons, background, default aspect for curves/passes.
- **Default Units**: System of units at program startup and for new documents.
- **Mnemonics**: Edit/create a list of user defined mnemonics.
- **Interpretation**: Define subsets and defaults for PVT, slippage correlations and calibration options. Activate some specific modeling options.
- **Multi Probe Tools** Specify the tool definition and color scale for imaging tool processing.

➢ Create a new document using the **New** icon in the toolbar (or the New option in the File menu).

The **Job Information** dialog is opened, Fig B01.2. This dialog has 3 tabs:

- **Information**: Basic information on the job as it will appear in the report.
- **Comments**: They can be typed in or pasted from the clipboard. They are printed on the first report page.
- **Rate colors**: allows the re-definition of the default rate aspect (colors and pattern).
- **Zone colors**: allows the re-definition of the default zone aspect (colors and pattern).
- **Saturation colors**: allows the re-definition of the default bulk voulumes aspect (colors and pattern).
- **Markers:** Markers can be defined in this dialog with their legends.

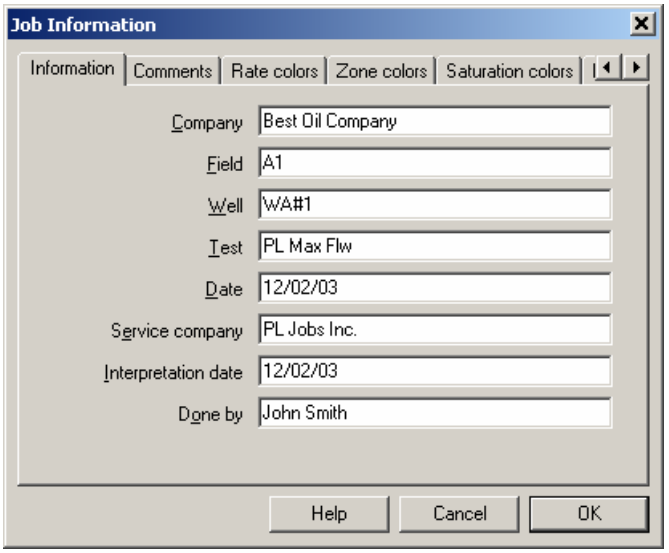


Fig. B01.2 • Job Information dialog

➢ Enter the required information and validate with **OK**.

B01.2 • Emeraude Document mode

After creating a new interpretation file the Document page is opened, Fig. B01.3. From top to bottom, the icons in the Document mode are:

- **Information**: accesses the initialization dialog with the Information and Comments pages.
- **Doc Units**: displays and edit the system of units to be used in the active document.
- **Load Well Data**: loads general well logs e.g. open-hole gamma ray, deviation survey, caliper, etc.
- **Well Details**: accesses a series of tables where the following information can be typed in manually: Deviation (or TVD), Internal diameter (steps), Roughness, Perfos, and Reservoir Zones.

If a deviation survey or a TVD curve is available, they should be loaded using the Load Well Data option. The "Well Details " option is really for manual input.

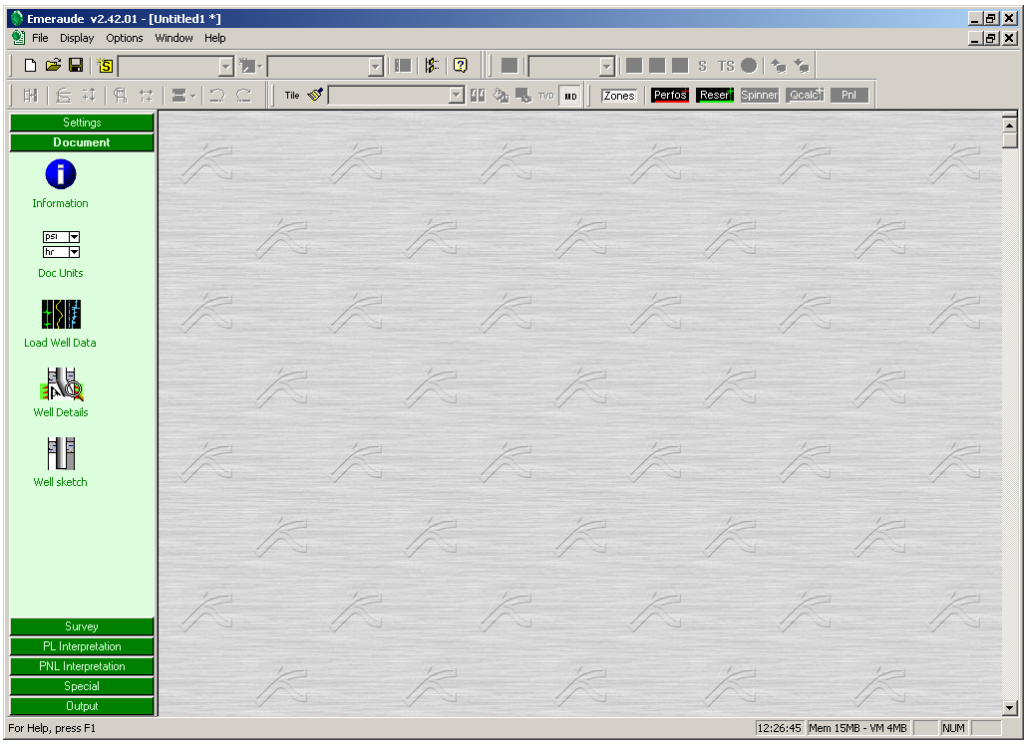


Fig. B01.3 • Document page

As a rule, unless there is general well data to be loaded from files, it is always advisable to start with the load of survey data, using the Load dialog of the Survey panel. This ensures in particular that the automatic depth range used for plotting will be the logged interval. In this example, we do not have an open-hole gamma-ray, the well is vertical, and the only information that has to be defined is the I.D. and the roughness. This information will not be needed until we compute rates, so we can move to the Survey mode directly and return to the Document mode later.

The first option in the document page is “Information” and corresponds to the information dialog called at the document creation. The second option, “Doc Units”, allows the user to adjust the unit system for the current document (when creating a new document the assigned unit system is the default one defined in the Settings page).

- Click the option “Doc Units”.

The Doc Unit dialog is displayed (Fig B01.4). The user may select or define the system of units, either at installation level (will apply to all new documents) or at document level (applies to the active document only). There are 3 preset systems: SI, Oil field, and Hydro-geology. One can also customize a system and store it, or load an existing system. The system of units can be changed at any time during the interpretation process.

- Click the contextual help if you wish to have more information on Units handling.
- Validate with **OK**.

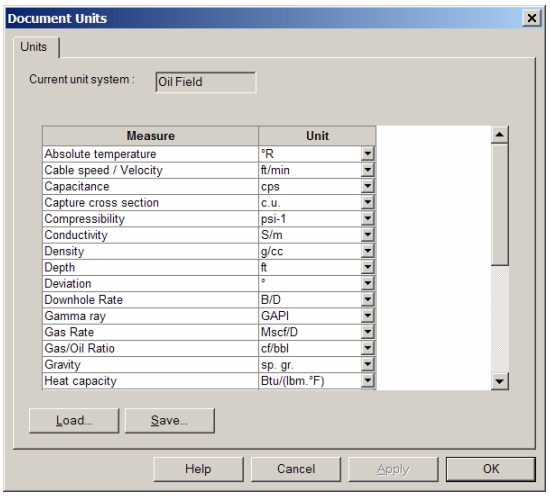


Fig. B01.4 • Doc Units dialog

B01.3 • Data hierarchy in an Emeraude document

Emeraude uses a hierarchical representation of the data as opposed to a flat structure.

First in the hierarchy is the Document, i.e. data whose definition is unique and will be used in the different surveys and interpretations. In the document, common information is stored as the **General Well Data**. Typically the General Well Data will include (some of) the following: open-hole Gamma-Ray, T.V.D. or deviation log, zoned I.D. or caliper log, perforations, etc.
At the same level as the General Well Data level is the Survey, i.e. a set of data/information pertaining to a particular well condition. Several surveys may be stored in the same document. The main Survey data is the actual Log data, consisting of passes (Up and Down, and possibly Stations). Each pass contains a series of measurements. Finally, survey data provides the basis for one or several Interpretations. Multiple interpretations can be, for instance, due to the existence of several tools of the same kind (e.g. in-line and full bore flow meters).
The data hierarchy is mirrored by the 3 control panel modes: Document - Survey - Interpretation. As will be illustrated further, the data browser can be used at any point in the session to get a hierarchical view similar to that on Fig. B01.5.

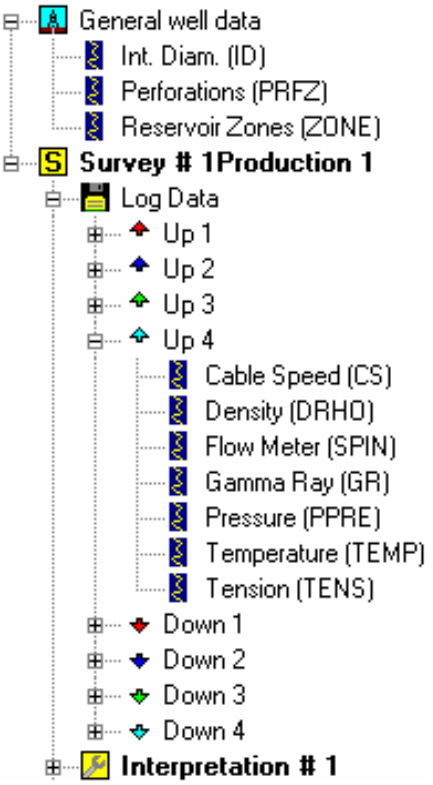


Fig.B01.5 Document data hierarchy

B01.4 • Emeraude Survey mode

➢ Click on the Survey button of the control panel. Options in the survey page are:

- **Infos / New**: Edit properties of the active survey or create the first survey for the active document.
- **Load**: Load Up/Down data in the active survey
- **Load stations**: Load stationary data in the active survey
- **Tool info**: Enter/review characteristics of the tools used in the active survey
- **Stretch**: Interactive depth stretch definition for all the passes in the survey
- **Zone Stretch**: Interactive stretch definition on a selected zone only.
- **Spinner Reversal**: Interactive definition of reversal depth for unsigned spinners

➢ Click on the **Infos**/New button. A new survey is automatically created named “Survey # 1” by default. Note: To create a new survey after one exists, use the icon in front of the survey drop list of the main toolbar.

➢ Change the survey names (Fig B01.6): Name = **Production #1**; Short name = **P1**. Confirm with **OK**.

Note: The use of the short name will be illustrated later in the session. Typically this should start with a letter indicating the period type followed by the index in the given type.

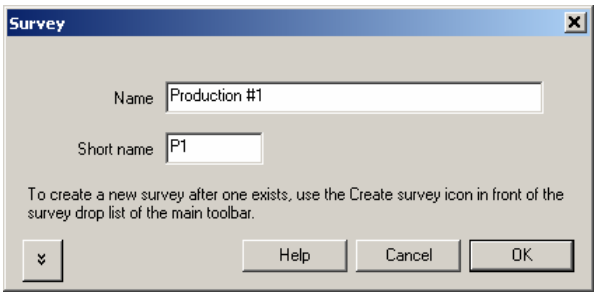


Fig. B01.6 • Survey Infos

B01.5 • Loading data

In the survey page the Load button is now enabled, Fig. B01.7. Emeraude can load data in LIS, LAS, or Ascii format. The load option automatically recognizes the file format and decodes it as appropriate. When anything in the file is not recognized the inconsistency is pointed out and the user if prompted to correct it. In this session the survey data consists of 8 passes, 4 up and 4 down. They are physically stored in Log Ascii Standard (LAS) files and the file names indicate their type and index: B01d1.las, B01d2.las, B01d3.las, B01d4.las, B01u1.las, B01u2.las, B01u3.las, B01u4.las.

- Click on **Load**, the Load dialog is displayed.
- Select **Add**... and in the subsequent “open file” dialog, select the 8 files: B01*.las.

Note: you can select all files at once with the “Ctrl” key pressed or one after the other, clicking on “Add...” every time a new file is selected. When all files are selected the Load dialog looks as shown on Fig. B01.8.

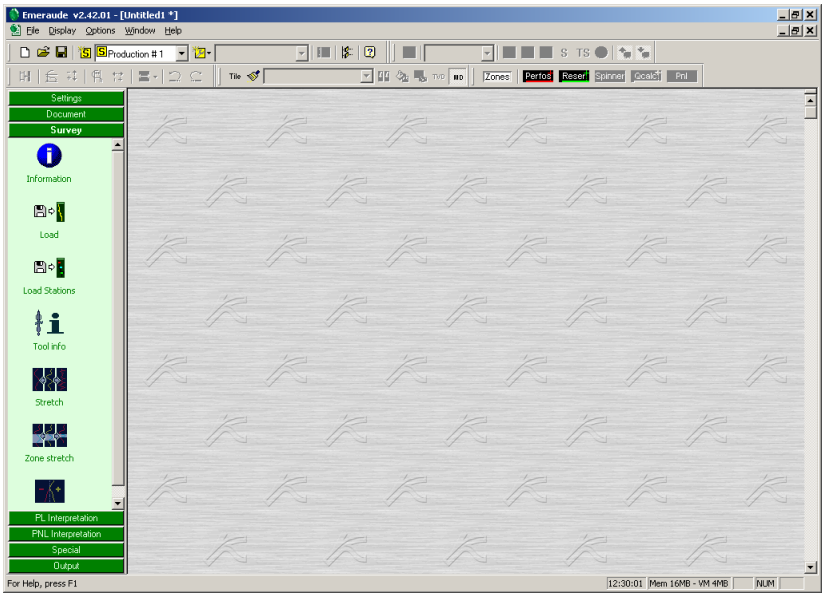


Fig. B01.7 • Survey mode after creation of the survey “Production #1”

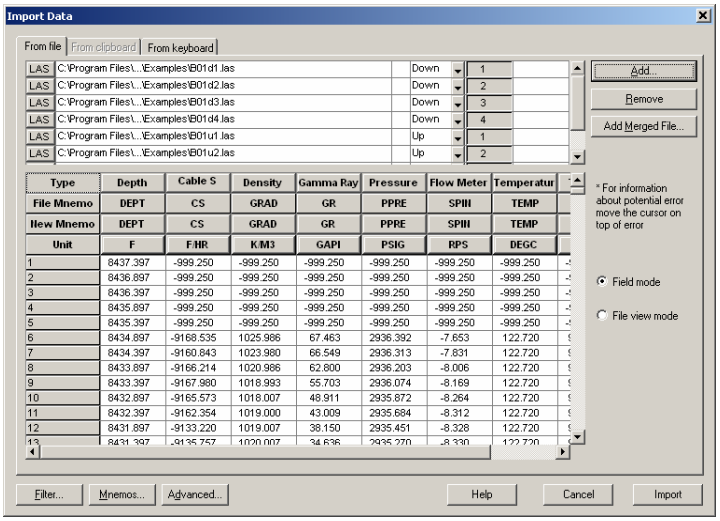


Fig. B01.8 • Load dialog after file selection

The top part of the dialog shows the list of logical files. A logical file corresponds to one pass. There can be only one logical file per Ascii or LAS file, but a LIS file will typically contain several logical files, normally all the files of a given survey or job.

For each file, the following information/controls are given:

- **File type**: indicated in the line header button.
- **Pass type**: Up or Down as read in the file. If the information is not present in the file or not read properly, clicking on the type accesses a drop list where the selection can be changed.
- **Index in type**: A click on the value accesses a control with up and down arrows to increase/decrease the value. It is also possible to type in the new value directly. By default, Emeraude uses alphabetical order.

When two passes have the same type and number, "! Error" appears on the corresponding lines. This indication disappears as soon as the conflict is resolved. A "!" may also appear on any given line to indicate that something in the file is incorrect. By moving the cursor on top of the error, the user is informed on the potential source of error.

The lower part of the dialog shows the formatting of the currently selected file. Each column in the display corresponds to a particular field in the file and has 4 header buttons, from top to bottom:

- **Type**: this is the measure type, e.g. Pressure, Temperature, etc.
- **File Mnemonic**: measure mnemonic found in the file.
- **New Mnemonic**: allows the user to change the mnemonic.
- **Unit**: unit of the data in the file.

Clicking on any of these buttons (except the File Mnemonic) accesses a pop-up menu that can be used when the necessary information for a given curve is not present in the file. The second guided interpretation will show in detail how to use these options. In the current example, there is no conflict or incorrect information so the load can be done at once.

➢ Click on Import to execute the load.

➢ When the Load has completed select File, Save as, enter EX1 and Save, Fig. B01.9

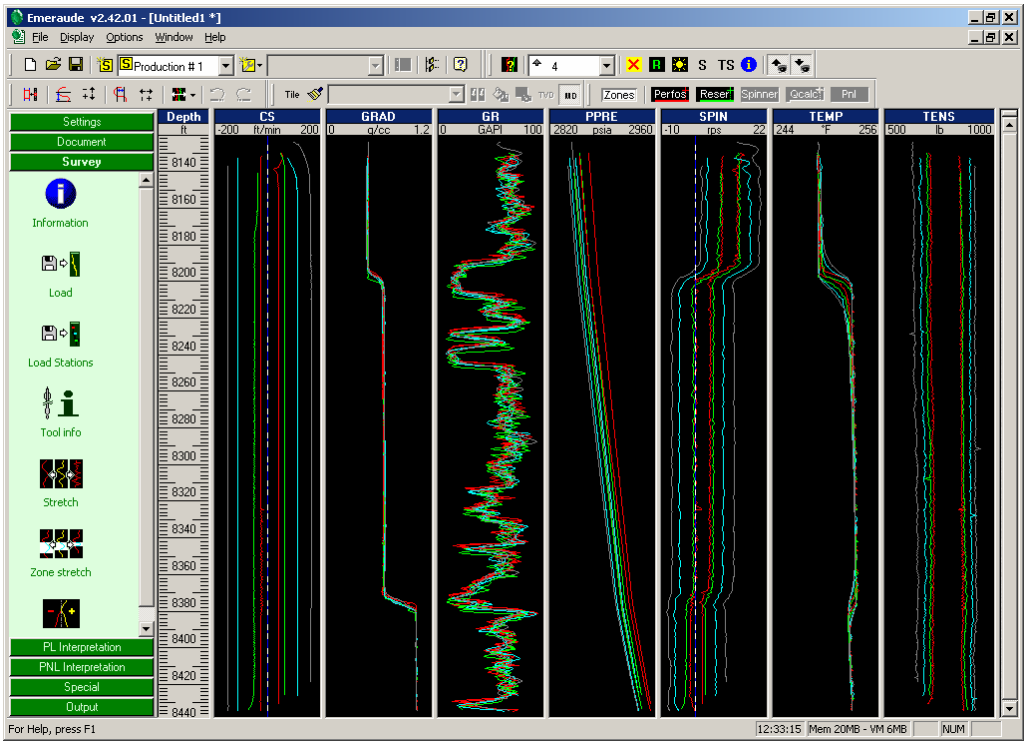


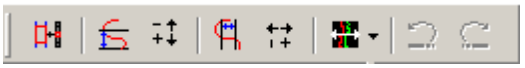
Fig. B01.9 • Main screen after loading

B01.6 • Creating and manipulating plots

The eight passes have been loaded in the “Production #1” survey. Emeraude automatically creates a plot for each channel type and each mnemonic found in the up and down passes. These plots are also scaled automatically to the entire logged interval and show all the acquired curves. In this example, there are 7 automatic plots: Cable Speed (CS), Density (GRAD), Gamma Ray (GR), Pressure (PPRE), Flow Meter (SPIN), Temperature (TEMP), Tension (TENS). All channels in a particular pass are plotted with a unique aspect corresponding to the index of the pass in the type (red=1, blue=2, etc).
The application defaults can be changed in the Display option of the settings panel.

Scaling plots

Scale options can be accessed though the **scale toolbar**:



From left to right the options are:

- **Set depth limits**: changes the depth or scrolling window range manually.
- **Zoom on depth**: redefines the scrolling window range by click and drag: after selecting this option click in any plot for the top limit, drag down to the desired bottom limit, release the mouse button.
- **Dynamic depth zoom**: the scale changes dynamically with the mouse displacements
- **Zoom on measure**: same as zoom on depth, but the zoom is now on the measure.
- **Dynamic measure zoom**: the scale changes dynamically with the mouse displacements.
- **Get access to Zoom options**: the user can choose to zoom on all, on active or on the same type of measure (user views only).

- **Undo last scale operation**
- **Redo last scale operation**

Clicking the right mouse button with the cursor in any plot accesses a pop-up menu, Fig. B01.10. In the Horizontal scale dialog the horizontal range of the particular plot can be entered directly. This pop-up also contains a “Log title” option where the plot headers can be modified. When the cursor is moved onto the plots it changes to a crosshair over the full plot area. The position (depth, value) of the cursor is shown in the message bar at the bottom of the window. The cursor appearance can be modified in the Display menu, Cursor.

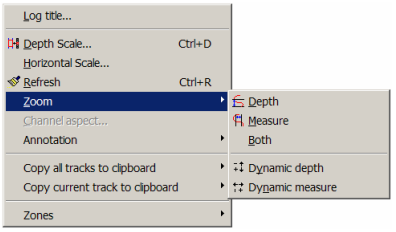


Fig. B01.10

By default Emeraude shows the total data range. Click with the right-hand mouse button in any plot to access the above popup menu and select Depth Scale (Fig.B01.11).

➢ In the depth scale dialog, set the size of the display window to 100 ft.

One can scroll the log using the scroll bar on the right of the plots. By default the scroll is complete: all channels scroll together. For less powerful machines, one can use the fast scroll option (accessible in the Display menu, Scroll option). In this mode, only the depth scale and the zones visualisation (described later) are scrolled continuously. The other channels are only updated when the scroll is over, i.e. the mouse button is released.

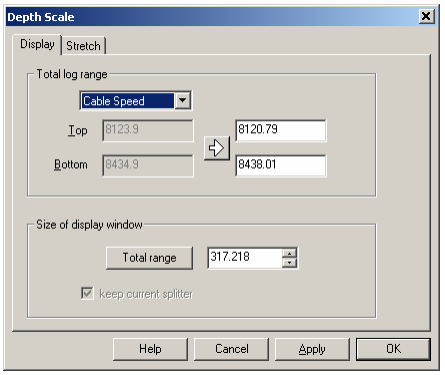


Fig. B01.11

At the top of the scroll bar is a thin rectangle, the splitter handle: one can slide this handle down to split vertically the display window in two parts. Each part can be scrolled independently, allowing two separate regions of the log to be viewed at the same time. The splitter is removed by dragging the splitter handle to the top or bottom of the scroll bar. Up to 16 splits can be made simultaneously.



Display toolbar



Dragging its title bar above the plotting area can hide a plot. A hidden plot appears in the drop list of the Display toolbar and can be retrieved later from this drop list. The **Tile** option optimizes the use of the full window width, dividing the available space equally between the displayed plots. Only the depth scale and the zone visualisation plot (described later) keep their size. The Brush icon is used to refresh the screen if needed (only when symbols are used)

The bucket icon is used to fill areas between curves (user views only) and the last icon in the toolbar is the screen capture facility in Emeraude.

- Hide the plots for Pressure, Temperature, and Tension, by dragging their title bars above the plotting area
- Again by dragging the title bars, change the position of the remaining plots as shown below
- Use the Tile option to use all the available space
- With the splitter handle, split the log in two equal parts
- With the splitter controls, scroll the upper and lower logs to the desired position (Fig. B01.12)

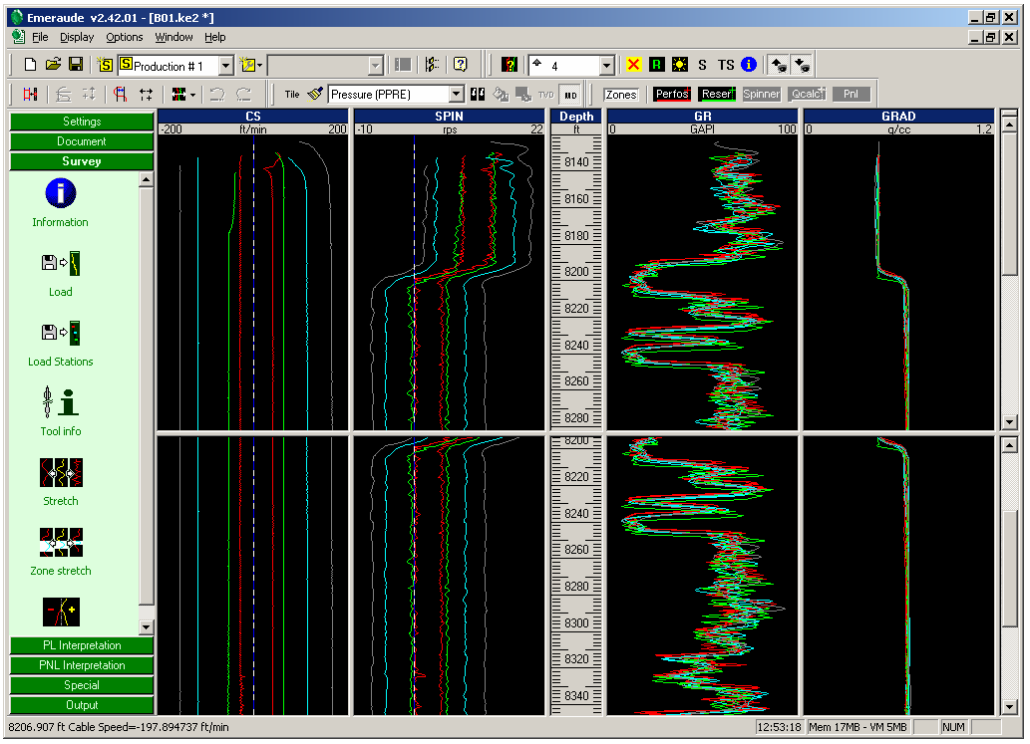


Fig. B01.12 • Main screen after hiding / moving plots and splitting

B01.7 • Using the Data Browser

In addition to the Scale and Display toolbars, the main screen contains the Main toolbar. From left to right options are: New, Open, Save, Create a new survey, Survey list, Create a new interpretation, Interpretation list, the Data browser, and Help.



The survey and interpretation lists are used to view/change the active survey/interpretation. At this stage, the Interpretation list is empty and the survey list contains only “Production #1”.

➢ Click on the browser icon to open the browser dialog.

The dialog is divided into two areas. On the left is a hierarchical tree view of the data in the file (Fig. B01.13). A node in the tree stating with a “+” can be unfolded with a click on the “+” (or double-click on the icon).

➢ Open the **Production #1** icon.

A node labeled Log data contains all passes. This node in turn unfolds to show the individual pass nodes, which contain the individual channels, or curves. Inside the survey icon also appears a Data Store icon. The data store is used to store copies of existing channels for data manipulation, averaging, etc. The right side of the browser contains 5 tabs: List, Infos, Grid, Plot, Plot vs Time, used when the selected node in the tree is a channel.

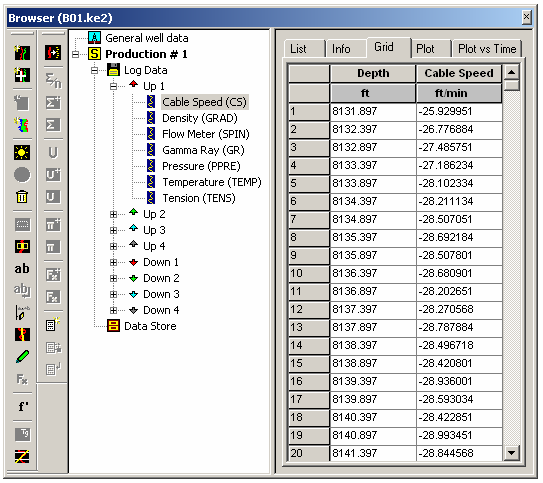


Fig. B01.13 • Browser tree

In addition to providing a clear view of the data structure, the browser gives access to most of the Emeraude editing options. Options are selected in the browser toolbar or alternatively with a right mouse button click in the browser dialog. A quick description of the browser toolbar options can be obtained by moving the mouse successively on top of each button (without clicking). You may also access the specific help on the browser by clicking the “F1” key when the browser dialog is active.

➢ **Close** the browser, either by clicking on the browser icon of the main toolbar or by using the x icon at the top right of the browser dialog.

B01.8 • Depth matching



After loading the log data, operations such as Depth shifting can be applied to a whole pass. These operations are accessed through the pass toolbar. From left to right: **Nearest curve, Active pass, Hide, Reference, Highlight, Shift, Infos, Tool Shift**, **Show/Hide all Up/Down passes**.
As with all other Emeraude toolbars, you can get a quick description of the options by moving the mouse cursor on top of the desired option. We do not have a separate reference gamma ray for this session and we will assume that the depth of the Down 1 gamma ray is correct.

- Remove the splitter by grabbing it and dragging it to the top or bottom of the display area.
- Set the display range as total range: right click in a log, “Depth scale” then press “Total range” and “OK”. You should see the whole log on the screen.
- Click in the pass drop list and activate Down 1
- Select it as the **reference** R. All the channels of this pass are now plotted in white.
- Activate the pass up 1 and **Highlight** the pass, with .
- Select the **Shift** icon of the toolbar S and, in the Gamma Ray plot, click and drag the channel to try out the shift option. Note: a double click in the Gamma Ray Header will maximize the track to make it easier to do the depth shift. Double clicking again in the track header will return the screen to the status before.
- Remove the highlight
- Then repeat for any other curve as required.

Pass activation can also be made with the **Nearest curve** option
- Click on this option
- Click on, or close to, a channel of the pass you want to identify
- Use highlight to verify that the correct pass has been activated

The pass will automatically be activated.

Plots can be temporarily set to full page by double-clicking on the header:
- Double-click on the header of the gamma-ray plot to bring it full-page.
- Double-click on the header again to return to the previous screen layout.

You can click on the Pass Infos icon to view, for any pass, the value of the shift after depth matching.

B01.9 • Tool info

- Click on the **Tool info** button (Fig B01.14)

In the tool information dialog, characteristics of the tool string used in the survey are entered. A tool is defined for each mnemonic of type pressure, temperature, flowmeter, density, or capacitance. If a mnemonic is present in several surveys, it is assumed that the same tool was used.
Emeraude accepts other input measurements (any phase holdup, velocity, or rate) for which the tool characteristics are not entered. This is because the measure in this case is a direct physical property

involved in the rate calculation. The default tool O.D. is correct in this case. The density section is used to characterize the type of density tool used. For a gradio, a drop list indicates the correction that Emeraude will apply. For instance, in this case the density channel is not corrected for deviation so we select:

- Apply deviation correction: / **cos(deviation)**

The default choice of correction is based on the mnemonic but should always be checked. In this example the well is vertical so this will not have any influence on the calculations.

- Change the spinner O.D. to **3.5 in** and validate with **OK**.

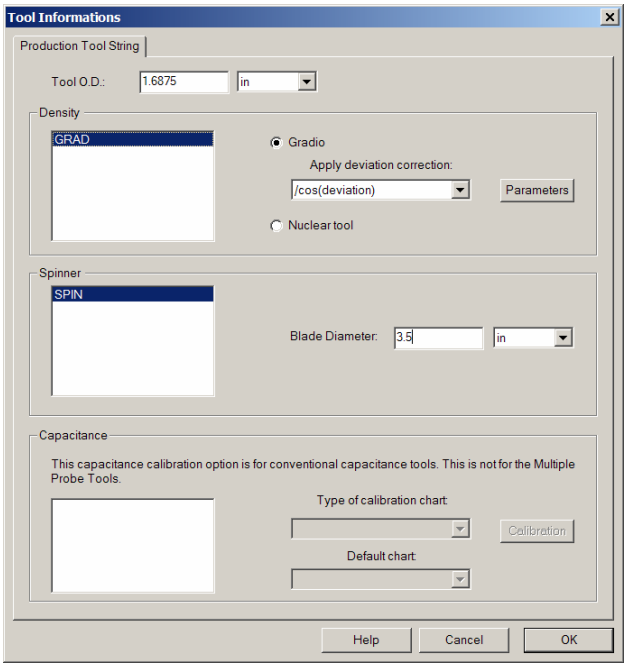


Fig. B01.14 • Tool info dialog (after input)

In this example we do not need to consider stretch or spinner reversal

- Restore all the views (except the one for the Tension) by selecting them from the hidden plot list. Note that if you press the icon, next to the Hidden plot list, a dialog appears where you can select and restore several tracks at once.
- Setup your screen as on Fig. B01.15 on the next page.

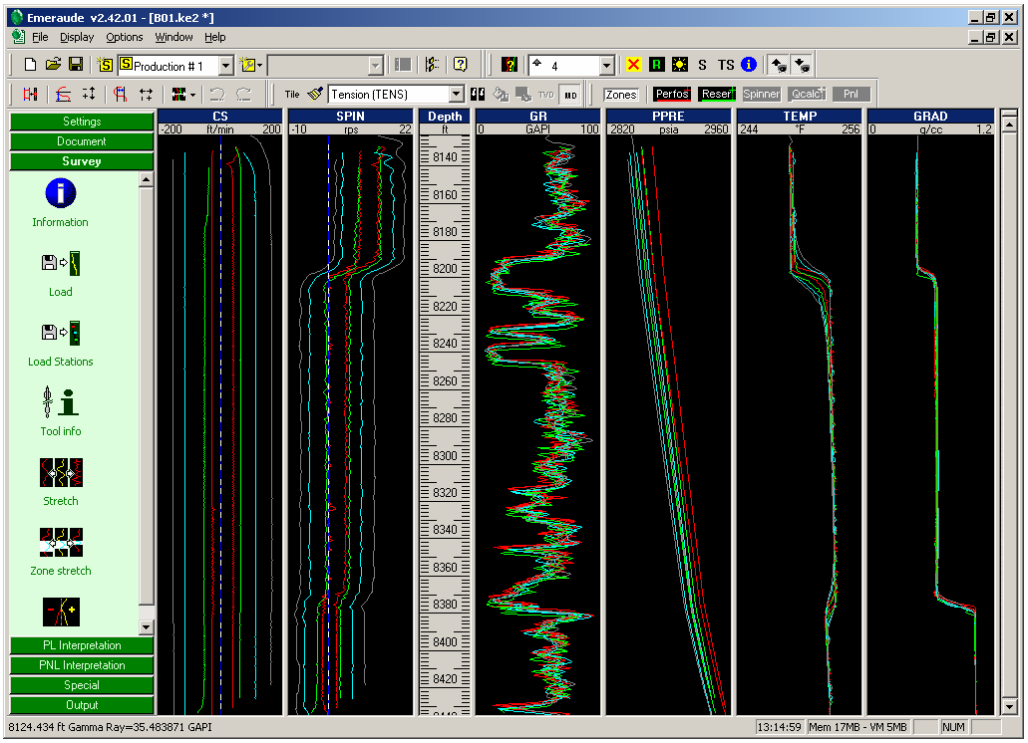


Fig. B01.15 • Views restored

B01.10 • Creating an Interpretation

- Click on the **PL Interpretation** button of the control panel.

The options in this mode are:

- **Infos/New**: edits properties of the active interpretation or creates the first interpretationfor the active survey.
- **Calibrate**: spinner calibration
- **V apparent**: generates an apparent velocity channel
- **PVT**: Input PVT parameters by phase.
- **Zone rates**: Zonal rate calculations
- **Log**: generates schematic of zonal results or complete (continuous) rate logs

In Emeraude, an interpretation is built on user defined reference channels of temperature, pressure, and any measurement that the calculation can match: density, capacitance, phase holdups, phase velocity, or rate and temperature. Reference channels will be typically either a straight copy of an already existing channel, or the result of averaging channels from several passes. Deciding which channels needs averaging, possible editing, filtering, etc will require looking in detail at the various plots, sometimes to create and compare several averages. These manipulations are beyond the scope of the first guided session and will be illustrated, to some extent, in the Guided interpretation #2. A user view of the reference and match channels is automatically created once the user has defined the appropriate reference channels.

➢ Click on the first button labeled **Infos/New.**

This option is primarily used to edit the active interpretation properties. It also automatically creates a first interpretation when none exists. Beware that to create a new interpretation after one exists, you need to use the icon in front of the interpretation drop list of the main toolbar. When an interpretation is created the only required entry is a name and a short name.

Some components may be copied directly from existing interpretations (if any in the session). Note that such copy operations can also be executed at any time inside the data browser.

➢ Validate with **OK.**

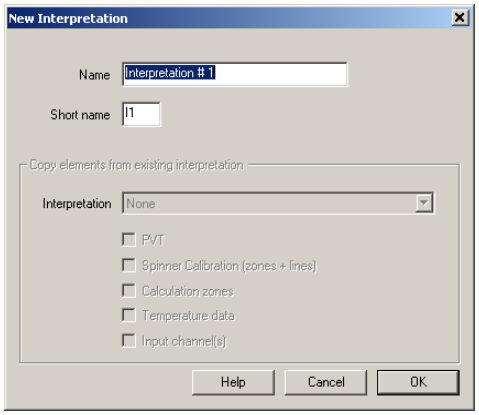


Fig. B01.16 • New interpretation

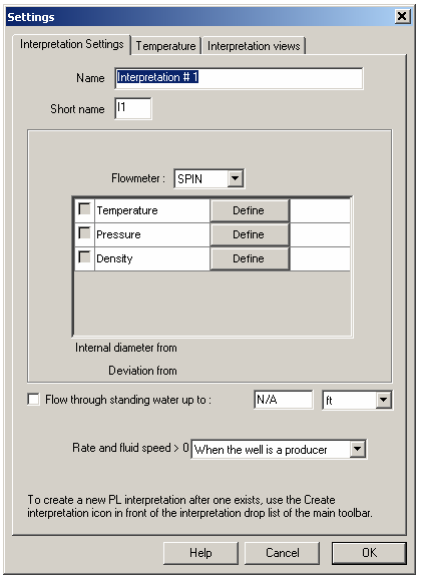


Fig. B01.17 • Interpretation settings

A second dialog appears, Fig B01.17. The "Flowmeter" drop list is used to select which spinner data to use in the interpretation if there are several (this is not the case here).

Before defining the reference channels we will save a screen capture for use later in the guided session. By starting the interpretation even without any defined channels the following is done:

➢ Click **OK** without defining any reference channels.
➢ Tile the plots if necessary
➢ Click on the button , store current screen.

Figure B01.18 illustrates the dialog where the user can define the current snapshot of the screen as "Original data"

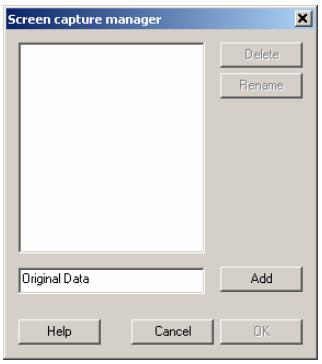


Fig. B01.18

➢ Click **Add** and the current screen is stored for future reference.
➢ Click on **Info/New** button and proceed to define the reference channels.

- Click on the **Define** button next to **Temperature**. This opens a dialog listing all the temperature passes in the current survey.
- Select **Temperature in pass down 1** and validate with **OK**, Fig B01.19. The check box on the Temperature line is now checked and the mnemonic displayed.
- Click on the **Define** button next to **Pressure**.
- This time select **All** and **OK**. Emeraude creates a lateral average of the selected channels inside the interpretation (Hodges - Lehman averaging).

- For **Density** select the **Down 1** channel and validate with **OK**.

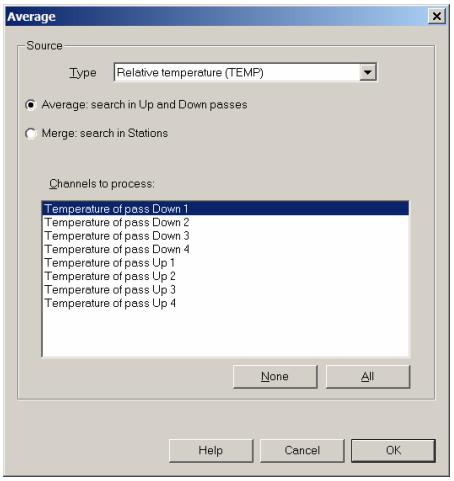


Fig. B01.19 • Reference channel definition / Average dialog

There are two more tabs in the Interpretation settings dialog Fig. B01.17: Temperature and Interpretation views: The temperature option will be discussed in Guided Session #6. The interpretation view allows selecting if the user views of the reference and match (QA/QC) channels are automatically created.

- Exit the dialog with **OK**, and **Save**.
- Open the **browser** using the browser icon on the main toolbar
- Check the content of the interpretation node

Reference pressure, temperature, densities (and capacitance) did not need to be defined at this point. More complex processing may be required than that offered by the "Define" dialog above. Additional facilities are available in the data browser and are described in Guided interpretation #2.

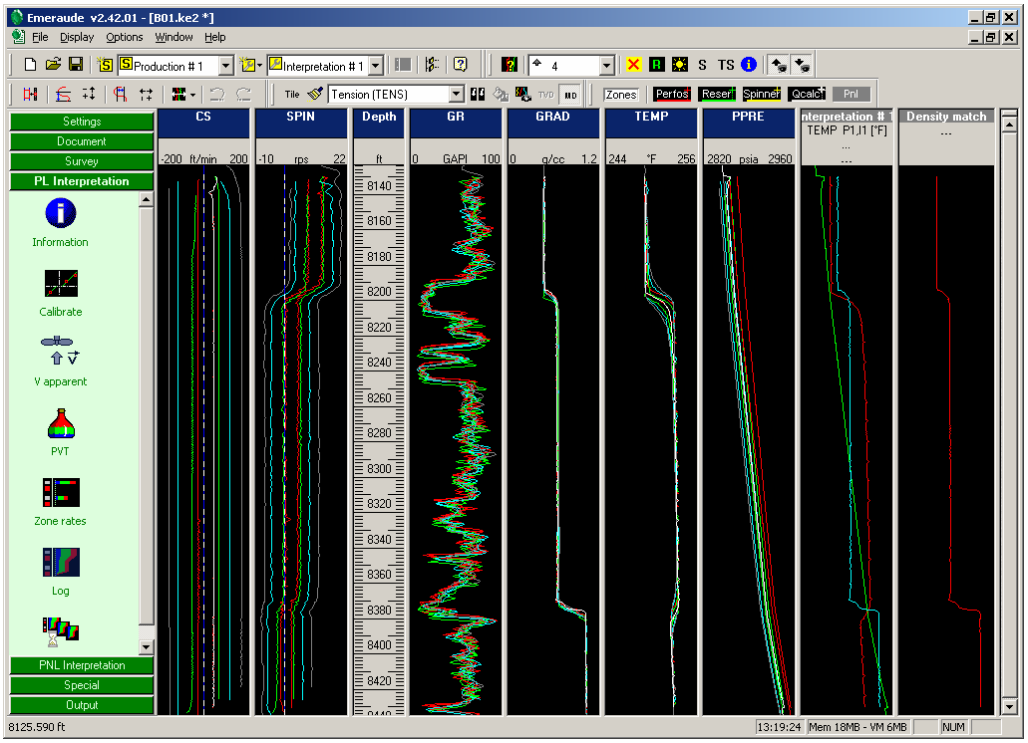


Fig. B01.20

Fig. B01.20 illustrates the screen after the definition of the reference channels. The rightmost track, called “Density match” view will be used to overlay the measured and simulated density resulting from the diagnostic at a later stage of the interpretation.

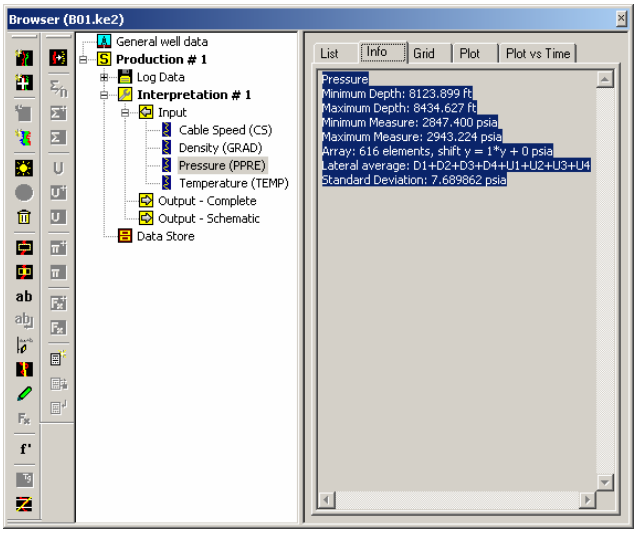


Fig. B01.21

A record of the way each of the reference input channel has been built is kept under the info page of the data browser (Fig. B01.21). This info is recorded for any “created average or merged channel from list” processing.

- Since we have now selected the reference channels for Temperature, Pressure, and Density we will hide the tracks for the raw measurements. Hide also the Gamma Ray, and setup your screen as on Fig. B01.22.

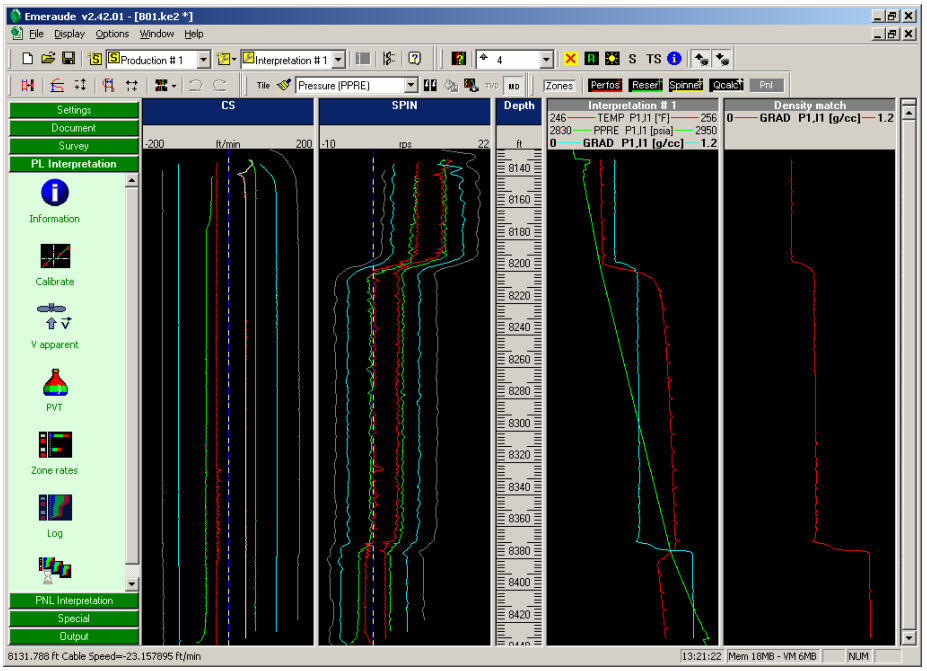


Fig. B01.22 Layout for interpretation

B01.12 • Entering the general well data

At the beginning of the session the general well information was not entered. To make an interpretation it is now necessary to enter this information (ID, deviation, etc) as it will be required in the calculations.

- In the control panel, select the **Document** page, click on **Well Details**, and activate the **Internal Diameter** tab. Make sure the input mode in on "Int.Diam." (as opposed to Caliper) and enter: **8000 <Tab> 6.184** (Fig B01.23).
- Activate the **Roughness** tab and enter **8000 <Tab> 6e-4**.
- Select the **Perfos** tab. Enter **8190 <Tab> 8200**, **< Tab**> to go to the second line, then **8365 <Tab> 8375**

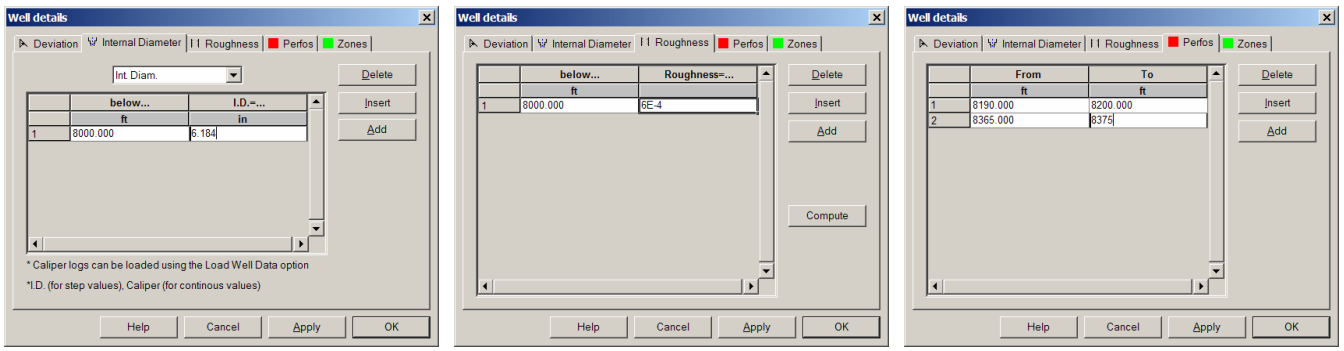


Fig. B01.23 • I.D. / Roughness / Perfos

- Validate with **OK**

A new plot named “ID” is created and displayed, as well as a track labeled “Z” with the perfos indicated using red markers.

- Hide the ID plot by dragging its title bar outside the plotting area.
- To enlarge the Z track position the mouse above the right border of the Z view, click and drag the right border to the right.
- Move the view to the left of the Depth track, and Tile the plots: Fig. B01.24.

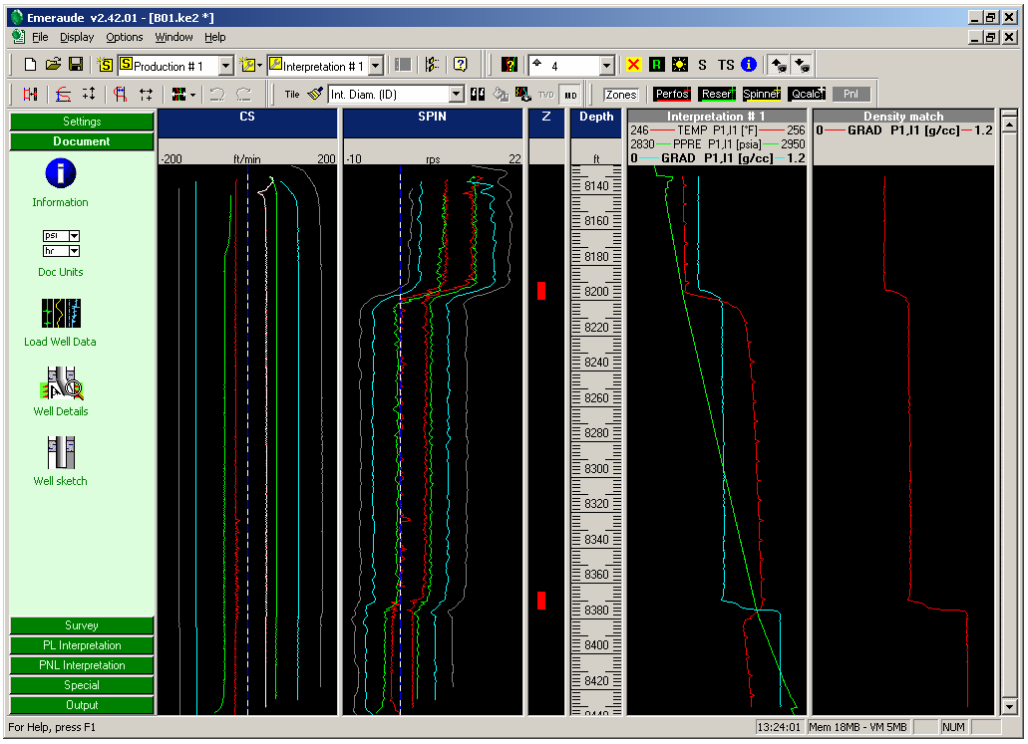


Fig. B01.24 • General Well data entered

A note on Reservoir Zones:

Reservoir zones present in the “Well Details” dialog are distinct from the perforated interval and they areused to materialize the actual reservoir(s). The reservoir zones are displayed with green markers by default and are only used in SIP analysis. For all other purposes they are for visual illustration.The aspect of all zones (perfos, reservoir, etc) can be modified in the Document – Information option (Zone colors tab)

B01.13 • Spinner calibration and V apparent calculation

➢ Return to the **PL Interpretation** panel

If you try to select **Calibrate**, which is the second option of the panel, Emeraude will indicate that calibration zones should first be created using the "Zones toolbar":



This toolbar gathers the following options: Tabular Zones edition, Interactive Perfos, Interactive Reservoir zone, Interactive Spinner calibration zone, Interactive rate (Q) calculation zone, interactive Pnl crossplot zone.

Interactive creation is done zone-by-zone, clicking for the first limit, then dragging and releasing for the second limit. Spinner calibration zones should be selected where the spinner and cable speed responses are reasonably stable. The calibration zones will be shown as yellow markers on the Z plot. Once created, they can be edited manually using the first icon of the Zones toolbar, or interactively in the Z track. On this track a single click make a zone active; a subsequent "Del" deletes it, or the zone can be resized by grabbing and dragging handles appearing at each extremity.

➢ Click on the Spinner (calibration zone) icon of the Zones toolbar repeatedly to define 3 calibration zones, above between and below the 2 reservoir zones. For example, the calibration zones could be **8140-8160** ft, **8280-8320** ft and **8390-8420** ft.

If you would like to view/edit your input, select the 

icon, Fig B01.25

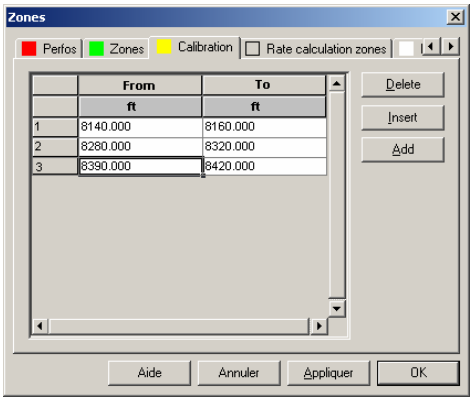


Fig. B01.25 • View/edit the calibration zones

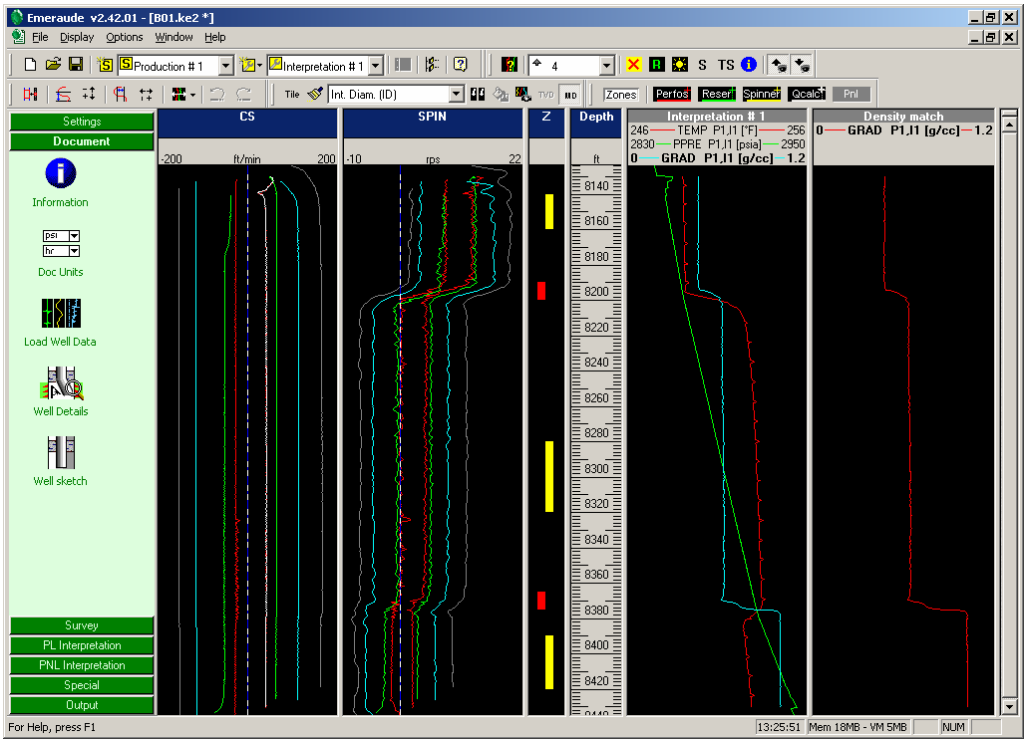


Fig B01.26 • Calibration zones defined

- Click on the **Calibrate** icon.

The calibration plot is displayed (Fig B01.27). Right click in the plot window and a scale and zoom dialog is available. The active zone is highlighted in red. To activate a different zone, you may click on the vertical schematic showing the 3 zones, or use the up / down arrows above. The slopes and intercepts can be modified manually or copied from one zone to another. The two buttons at the top labeled **Actions for all zones** and **Actions for active zone** give additional options.

- In the **Actions for all zones** button select: **Set all positive slopes to average**
- In the **Actions for all zones** button select: **Set all negative slopes to average**.
- Click on the **Threshold** + button. A drop list to the right gives access to the possible no flow zones. In this case there is only zone 3.
- Select **Copy** and the positive intercept value is copied as the tool threshold. Validate with **OK**
- Do the same for the negative threshold (**Threshold** -)

For each line, an arrow pointing down shows the apparent velocity value for the positive line, taking into account the positive threshold. Similarly, a line pointing up shows the value of apparent velocity for the negative line. On zone 3, these two arrows coincide at 0 as we have just defined the thresholds as the intercepts. This is not the case for zone 2. A difference in those values could be due to a centralization problem and may well have to remain. If we believe that the error is irrelevant we can unify all intercepts/slopes.

- Make **zone 2** active
- In **Actions for active zone** select **recompute zone with tool threshold**.

The program re-calculates the calibration for this zone, by imposing the distance between the two intercepts equal to the sum of the thresholds, hence giving a coherent rate value for both negative and positive lines: the two “arrows” now coincide for this zone as well.

➢ Validate the calibration with **OK**.

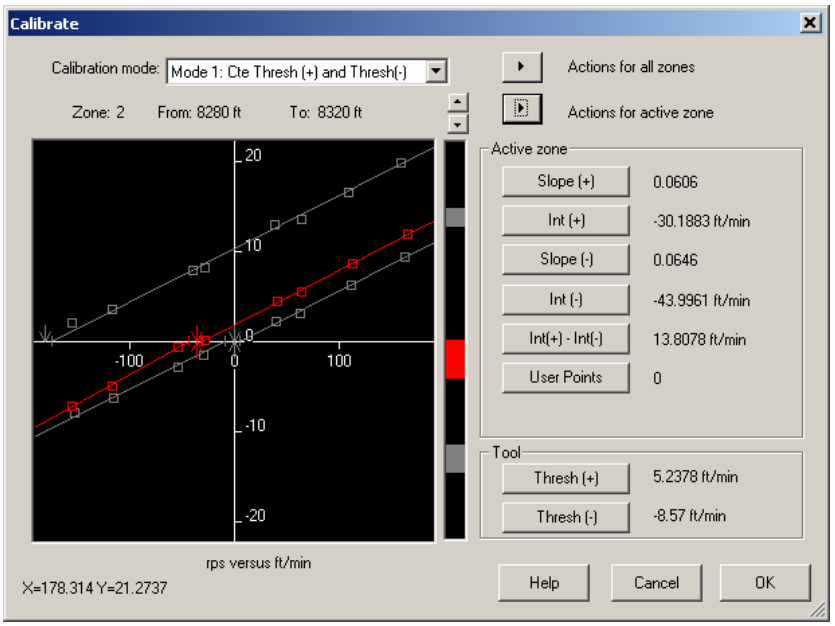


Fig. B01.27 • Final Calibration

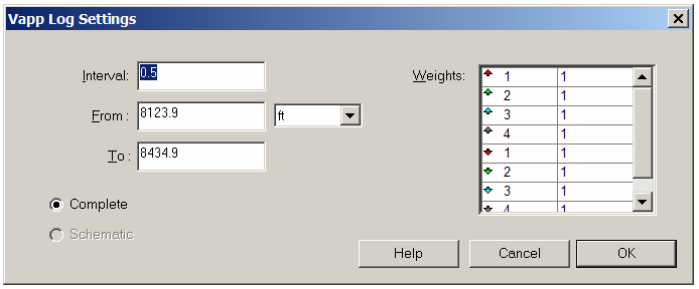


Fig. B01.28 • Apparent velocity calculation

When the calibration is accepted, Emeraude automatically calls the **V apparent** option. This is called V apparent because it only corresponds to the speed of the fluid seen from the spinner location in the wellbore. This is different from the average fluid velocity.

In this dialog the interval for the generation as well as the depth increment can be set. At each depth, the default is to compute a V apparent channel resulting from an average of the calculation for each spinner pass. This default can be changed by assigning different weights (possibly 0) to different passes. You can edit and change the weight value if you wish.

➢ Leave or reset all weights to 1 and validate with **OK**.

A velocity match view is added to the interpretation, showing the VAPP channel just added inside the interpretation, you can hide the Cable speed and Flowmeter views, Fig B01.29 next page.

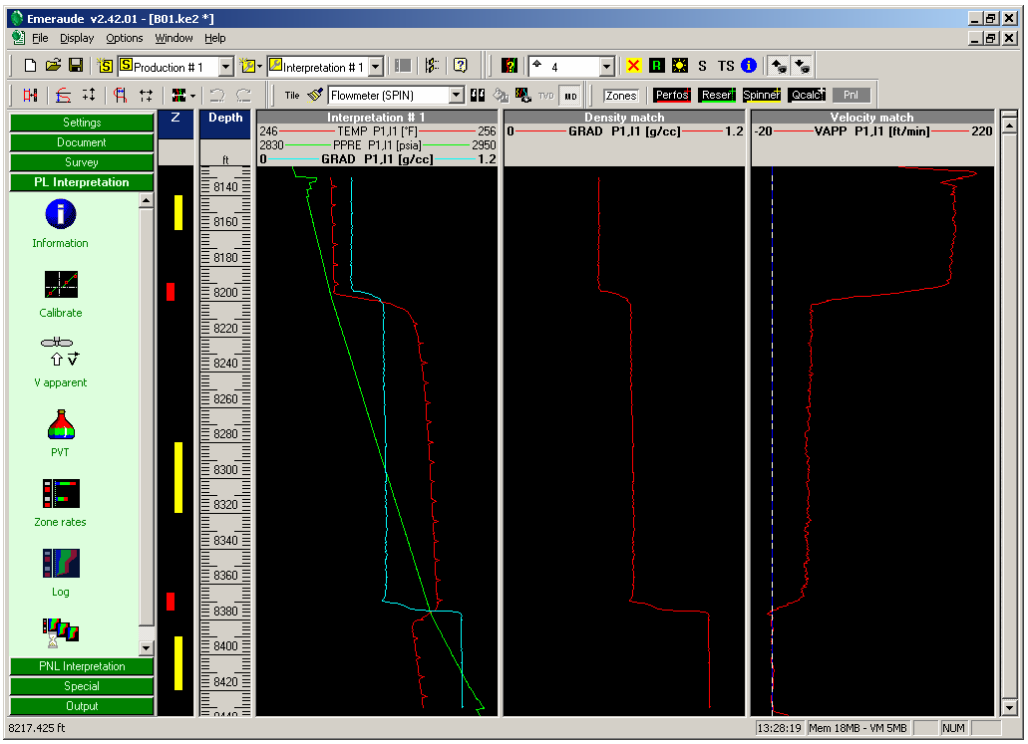


Fig. B01.29 • Apparent velocity calculated

B01.14 • Entering PVT information

Before starting the rate calculation process, Emeraude needs a PVT model

➢ Click on the PVT icon: the main PVT dialog pops up (Fig. B01.30 left).

Default fluid type consists of **Saturated Oil (bubble point fluid)** with no water. Although there is no water production at surface, it is evident from the density log that there is standing water in the bottom of the well so we will check the **Water** box. The temperature is the default one for viewing the correlations. Note that if user data have been entered, the display will switch to the temperature of the first constraint point. The pressure range and increment are used to display the correlations in a table. Some reservoir parameters may be also required depending on the fluid type, e.g. the solution GOR for a bubble point fluid.

➢ Enter the following **GOR = 1100 cf/bbl**.

When the PVT model is created or changed, each phase present should be defined from left to right, using the corresponding toolbar. For each phase dialog, input data are entered and correlations are selected in the first page; each additional page is assigned a property. The list of correlations as well as the default correlation can be changed permanently with the **Interpretation** option of the **Settings** panel.

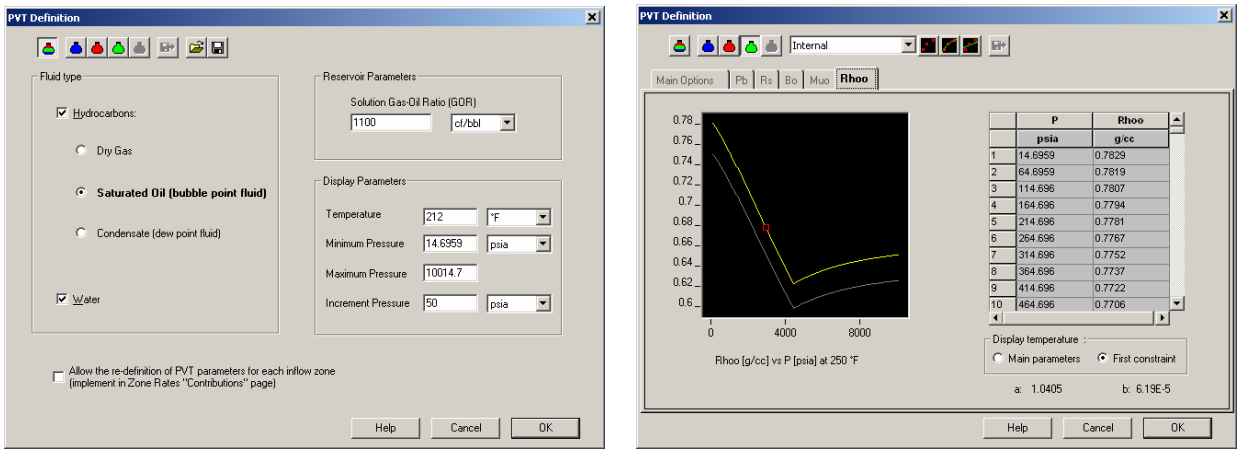


Fig. B01.30 • PVT

Each correlation can be viewed and matched to fit defined **Constraints** (Fig. B01.30 right). The **Constraints** icon opens a grid where measurements of the property for a set of (T, P) values can be entered. The **Match Constraints** icon runs a non-linear regression on the constraints; the original correlation shows in blue and the fitted one appears in yellow. The **Reset Constraints** icon returns to the original correlation.

Most correlations give a PVT property as a function of T and P. PVT plots show the property as a function of P, at a given T. If case correlation is constrained, the display T can be set to the main display temperature or to the temperature of the first constraint. This temperature value has no influence on the calculations, it only affects the display.

To change scales on a PVT plot, the user can make a right click anywhere in the plot area and a popup menu with scaling options is displayed.

- Edit the water properties with and enter: **Salinity 80000 ppm**.
- Edit the gas properties with and enter: **Specific gravity=0.7 • %N2=0 • %CO2=0 • %H2S=0**
- Edit the oil properties with and enter **Gravity=39.7 API**
- Apply the following constraint to the oil density: **T=250°F, P=2865 psia, Rhoo=0.68**
- Validate the PVT and return to the main screen.

B01.15 • Zone Rates

Rates will be computed on defined zones as well as continuously on the entire log interval.

➢ Click on the **Zone rates** icon

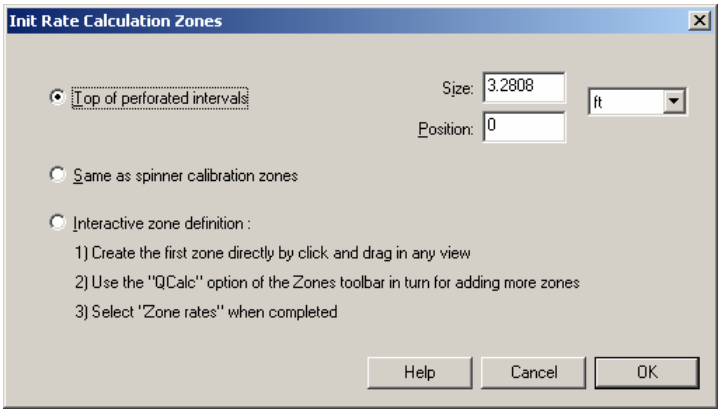


Fig. B01.31 • Init rate calculation zones dialog

The first time this icon is pressed (or if all existing calculation zones have been deleted) a dialog appears with the default parameters for creating the zones. The zones can either match the spinner calibration zones or be located above all the perfos (plus one zone below the last perfo). The user can also choose to interactively create the zones using the mouse with click and drag. The initialization based on the perfs defines a position above the perfs (default 0) and size (default 1 m).

➢ Select **"Same as spinner calibration zones"** and click **OK**.

In the Z view, gray markers will be added to represent the newly created rate calculation zones. In the Z track, a zone can be activated by a single click and its limits changed by dragging its top and bottom handles. An activated zone can be deleted by pressing the ***Del*** *key. When calculation zones exist, the "Qcalc" option of the Zones toolbar can be used to define new zones interactively, in a similar way as for the spinner calibration zones.*

As will be seen later, Emeraude automatically creates one inflow zone between each 2 consecutive calculation zones. By default in this case, the inflow zones are identical to the perforation zones, but they can be resized as needed, to adapt/correct the shape of the schematic logs.

Except when selecting the Interactive zone creation, the Zone rates option is called automatically. The first page is defined by the Init tab. (Fig. B01.32) This option requires the selection of an initial flow model and associated flow correlation. In this case, the PVT model was defined as Oil-Gas and Water. Since only two measurements are available (density and VAPP) Emeraude suggests a model that does away with one unknown: the Water-Hydrocarbons model, a Liquid-Liquid model accounting for gas only up to the amount given by the PVT, and considering no slippage between the gas and oil. This model would be adequate if we were only flowing water and oil downhole, but on the contrary, we can infer from the density channel, the well

deviation and surface productions, that that there is water in the sump only, and that the flowing fluids are oil and gas. We will therefore change the model to Liquid-Gas.

➢ Select **Liquid-Gas** and **Dukler**.

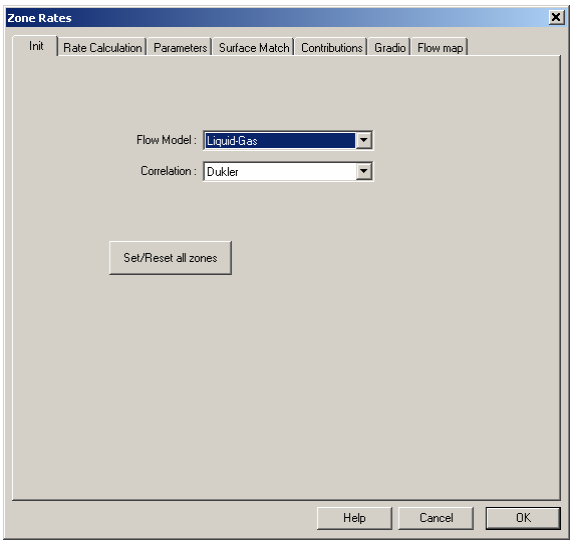


Fig. B01.32 • Zone Rate Init

At the top of the dialog, click on **Rate Calculation** tab (Fig. B01.33).

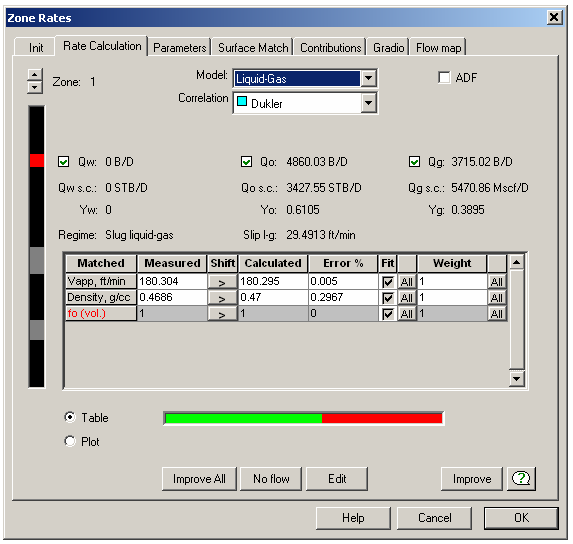


Fig. B01.33 • Rate calculation dialog

The values displayed in the dialog correspond to a given calculation zone. Similar to the spinner calibration dialog, a small schematic shows the active zone and can be used to change the zone under investigation.
For Liquid-Gas flow, a model is basically the conjunction of 2 main components: a flow regime map and a slippage (or holdup) correlation for each regime. For any couple of rate values (gas and liquid rates), the flow model can be used to predict the flow regime, the slippage value and thus the phase holdups. Given the

holdup, and knowing individual densities from the PVT model the mixture density is calculated. Knowing the transfer function of the density tool used (possibly involving frictions and deviation) it is possible to compute the theoretical value that the density tool should read, assuming this flow model. Similarly, it is possible to compute an expected value of apparent velocity and practically this is done by estimating the value of a correction factor, Vpcf=Vm/Vapp.
To summarize, for any assumption of the rates at a given depth, and any flow correlation, we can calculate the simulated apparent velocity, and the simulated density. Emeraude can then run a non-linear regression in order to match measured and simulated values. The displayed values of rates result from this calculation. The bottom table indicates the measured and simulated values.

Note the green checks in front of the Qw, Qo, and Qg buttons, they mean that all three rates were variables. Only 2 measurements were however available and Emeraude had to consider a third information for closure. This third value is listed in red in the table, and is “fo (vol.)”, the volumetric oil fraction in the liquid phase. The current value of 1 is a default and means that there is no water; this corresponds to our assumption.

Clicking on the «Plot» button at the bottom left, shows a graphical display of the correlations, and the error, Fig B01.34:

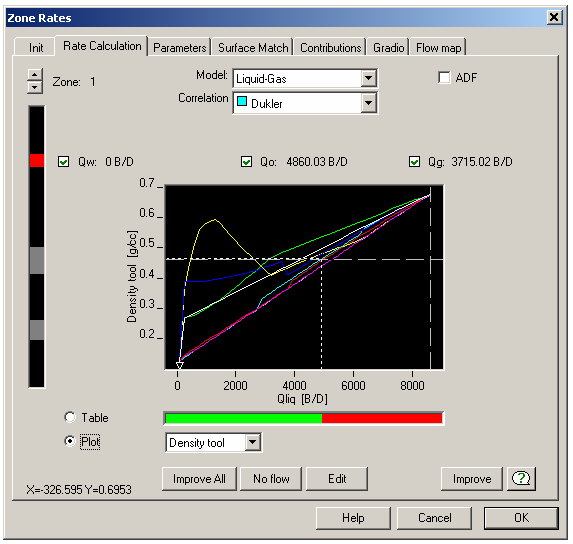


Fig. B01.34 • Rate calculation dialog: plot mode

The plot shows the density tool response versus possible values of Qliq (here Qo) and Qg for the current value of the total rate. On the plot, the current value of total rate is displayed with a vertical dashed line. Allowable values on the Xaxis go between 0 and Qt and represent the oil rate. The difference between Qt and Qo represents Qg. On the Y-axis (density tool response) a horizontal dashed line shows the measured density (this is an average value of the density channel across the zone). Colored curves show the simulated density tool response for various correlations. The current solution is indicated by a vertical dotted line and the simulated density tool response with a horizontal dotted line. In this case on the plot the simulated and measured density tool responses are equal shown respectively by the dotted and dashed horizontal lines.

➢ Click on the Flow map tab.

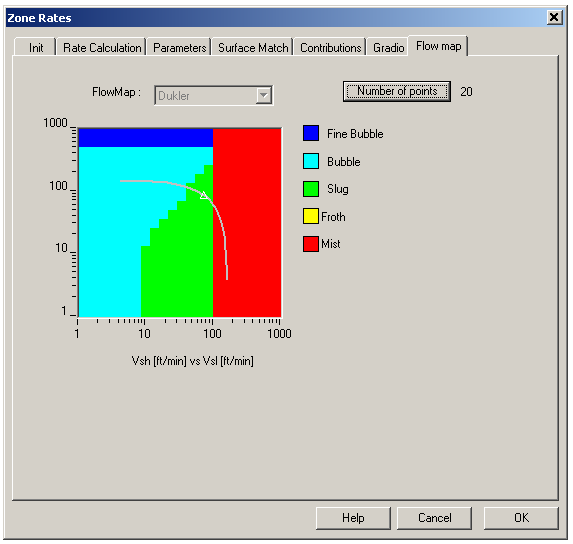


Fig. B01.35 • Flow map

The flowmap is presented in terms of superficial velocities Vsh and Vsl. Superficial velocities are defined as the rates divided by the cross section. “h” refers to “heavy” i.e. liquid phase here; “l” refers to “light” i.e. gas here. The gray line on the flow map is for Vsh + Vsl = Vm and the white triangle shows the current solution. The resolution of the flow map may be improved by changing the number of points.

All input parameters, other than those used in the matching can be viewed in the Parameters page. When the density tool is not a nuclear tool, the Gradio page lists all the gradient components.

Until this stage, we have disregarded the surface conditions.

➢ Select the “Surface Match” tab Fig B01.36
➢ Enter the surface rate values as **Surface oil = 2700 STB/D; Surface gas = 4500 MSCF/D**
➢ Return to the “Rate Calculation” tab, and if the Plot is not currently displayed, select this mode. Make sure also that you are looking the top zone, Fig B01.37.

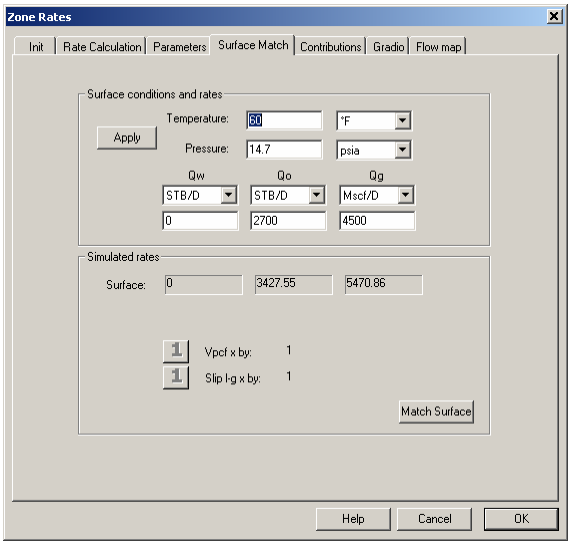


Fig. B01.36 • Surface production entered

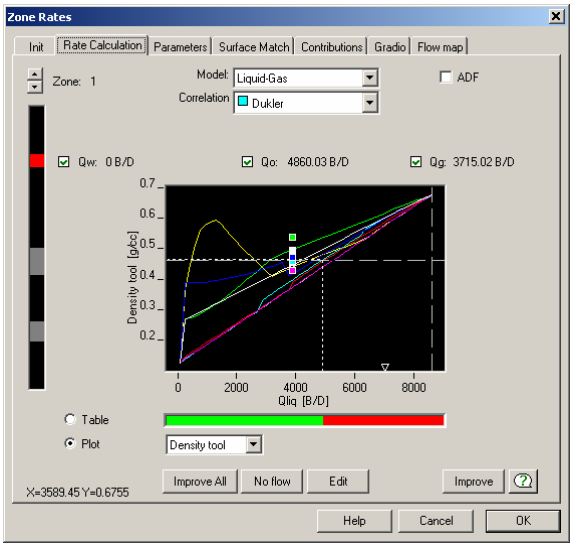


Fig. B01.37 • Top zone; Plot mode

On the plot are symbols representing the surface conditions. On the X-axis a white triangle shows the value of downhole total rate as computed from the surface rates (and the PVT model). Colored squares indicate, for each flow correlation, the density tool response the correlation would predict if the downhole rates were those corresponding to surface conditions. Hence, on the plot:

- Qt does not match the Qt from surface conditions (vertical dashed line does not match the white triangle)
- Qo/Qg do not match the surface conditions (rectangles are not aligned with the dotted white line)

The difference between the simulated and measured surface rates may come from an inaccuracy in either the data or the models used for the simulation. The second guided session will illustrate how the data quality can be assessed using a shut-in survey. In this session there is no further information and the assumption is made that the surface data is correct and the accuracy of the model is questioned. Two variables can be used to modify both the slippage correlation and the model predicting the correction factor Vpcf. These are the Vpcf multiplier and the Vslip multiplier. These are initially equal to 1 (i.e. no change to the models).

- Activate the “Surface Match” tab
- Select the **Match Surface** button.

Rates are set to honor the surface values. The Vpcf and Vslip multipliers are then adjusted so that consistency is kept between measured and simulated data. When the value of the multipliers has been obtained Emeraude automatically re-runs a non-linear regression **for all zones** using those values. When the calculation is finished it can be seen that surface conditions are honored and the measurements are coherent for all zones.

- Return to the “Rate calculation” tab. You can check on the plot the effect of the Surface Match, Fig B01.38

- Select the bottom zone and click on **NoFlow** to set the mixture velocity to **0** (this will also automatically set the water holdup to 1)

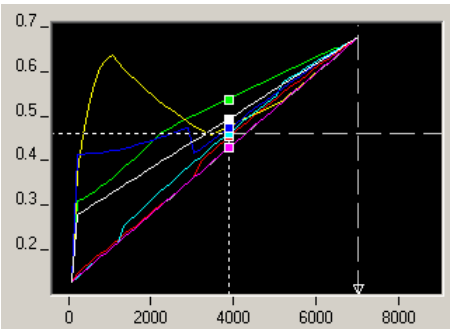


Fig B01.38

- Validate the zone rate calculation with **OK**. The "Log" option of the control panel is called directly, and the dialog in Fig B01.39 appears.

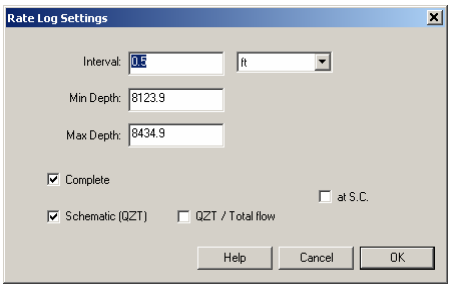


Fig. B01.39 • Log generation

The rate log can either be a schematic or the result of a complete calculation. The latter invokes the non-linear regression scheme described earlier at every depth. This option is described in the next section. The schematic is simply a graphical presentation of the zone rates. Note the option to generate the schematic rate log at standard conditions rather than the default downhole conditions.

- Leave **Schematic** checked and uncheck **Complete**. Do not change the other settings.
- Validate with **OK**.

Emeraude generates 4 new logs in the interpretation: QOZT, QGZT, QOZI, QGZI. "O" stands for oil and "G" for gas. "Z" stands for "zoned". "T" stands for total (or cumulative) and "I" for incremental. Two plots are automatically added to the main screen, one for cumulative rates, and the other for incremental contributions. The simulated density and velocity are added to the match plots.

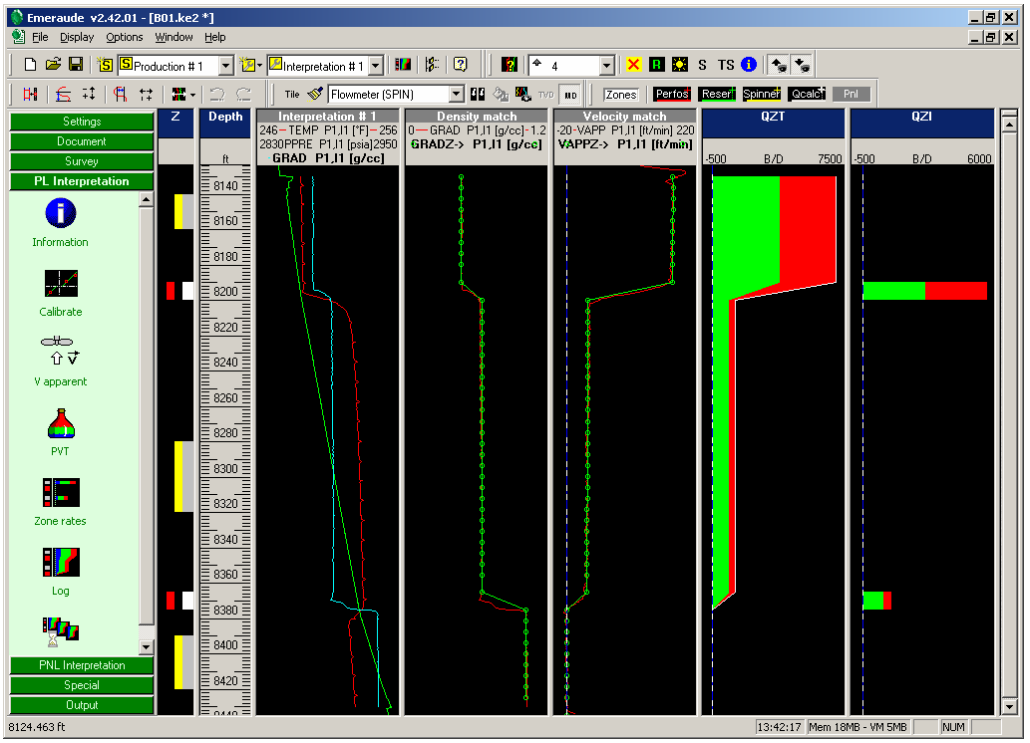


Fig. B01.40 • Schematic calculated

B01.16 • Generating a complete rate log

➢ Return to the Log option and this time select only Complete.

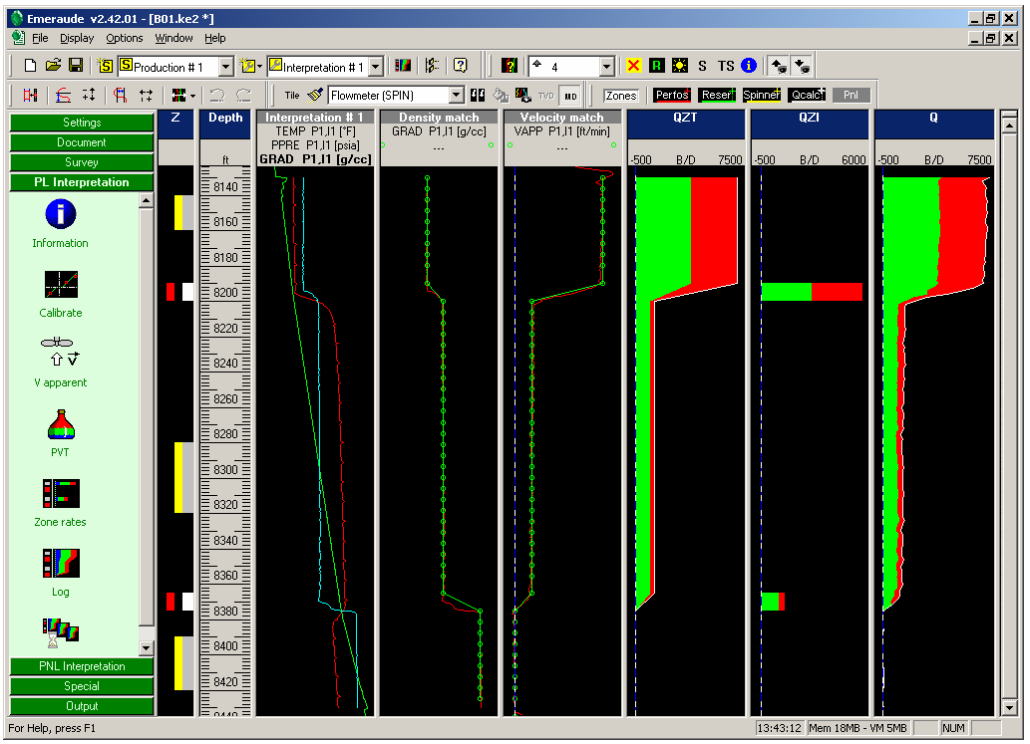


Fig. B01.39 • Complete log calculated

Proceed to capture the current screen by clicking on the button . The screen can be called **Final** for instance. You can now switch between the original data and the final data by clicking on  and choosing the screen capture in the list.

B01.17 • Outputs

➢ Move to the Output page of the control panel.

There are 5 possible types of outputs in Emeraude: Log, Report, Summary table, Export, and MSWord report.

Log

The Log printout shows by default the plots present on the screen when the option is called. The Log output can be checked with the corresponding Preview option. Note that fonts, margins, lines, and the type of output can be changed in the “Setup” option of “Preview”. In the Setup dialog one can also create API layout that can be recalled at any later stage (see the on-line help in the Print Setup dialog). The log output is made by

default to the installed printer drivers. Note that a CGM, or TIFF output can also be generated with the last option of the output panel (*the CGM output option is not part of the standard distribution*).

Report

The report consists of the following pages (depending on the level of the interpretation): Job Information, PVT, Calibration, Incremental zone contributions at S.C.; Incremental zone contributions at reservoir conditions; Cumulative zone contributions (standard and reservoir conditions); Detailed Results (multi-phase interpretation only). Use the Preview option to check the report.

Summary Table

Provides, in tabular format, the zones results. The results can be copied to the clipboard.

Export

Creates an output file (LIS, LAS, or plain ASCII) of the current interpretation contents. Note that export options in the data browser can be used to generate customized report files.

MSWord report

Emeraude is provided with a template Word report, “SampleReport.doc” which reproduces the Emeraude built-in report.

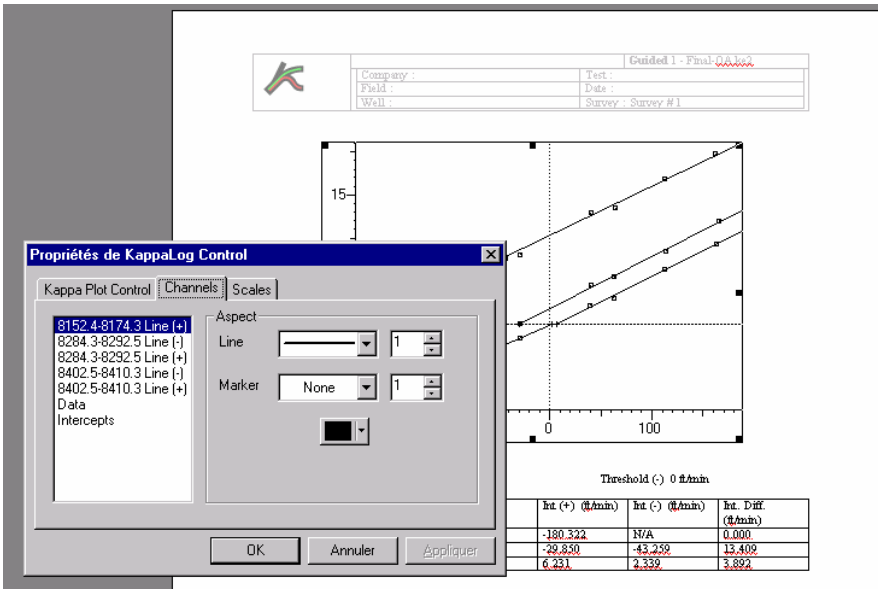
With an open document in Emeraude, open “SampleReport.doc”. At the top of the document, you will see the specific toolbar below:



Assuming that your active Emeraude document shows a completed interpretation, click on the first icon (Reset Emeraude variables): all relevant information will be filled-in, rows will be added in all tables and completed, and a calibration plot will be created on page 3.

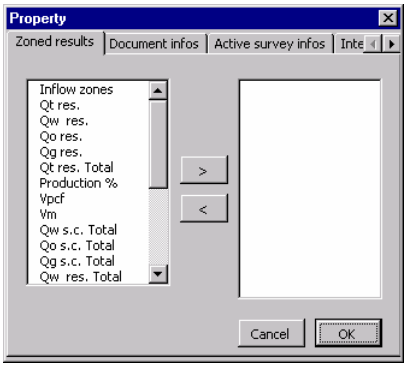
Customizing the result or the template

The results can be fully customized since this is a Word document. Fonts can be changed, colors, table formats, etc. In addition, the calibration plot is an active object of the document. If you double click on this plot a dialog will appear where you can change colors scales, etc (see next page).



The second icon of the Emeraude toolbar inside the Word document gives access to the dialog opposite.

With this dialog you can define entirely the types of results that you want to see in your report.



- Save and Quit Emeraude

This completes Guided Session #1. Kappa software is designed to be highly intuitive and therefore we recommend that you run this session again on your own in order to become more familiar with the options. Try and refer to this documentation only when you are stuck. Running your own simple data set at this stage is also recommended.
We would advise you to get familiar with the facilities demonstrated in this guided session before moving to the Guided Session #2, where you will be trained on adding new mnemonics, handling multiple surveys, multiple interpretations, and comparing shut-in and flowing surveys.