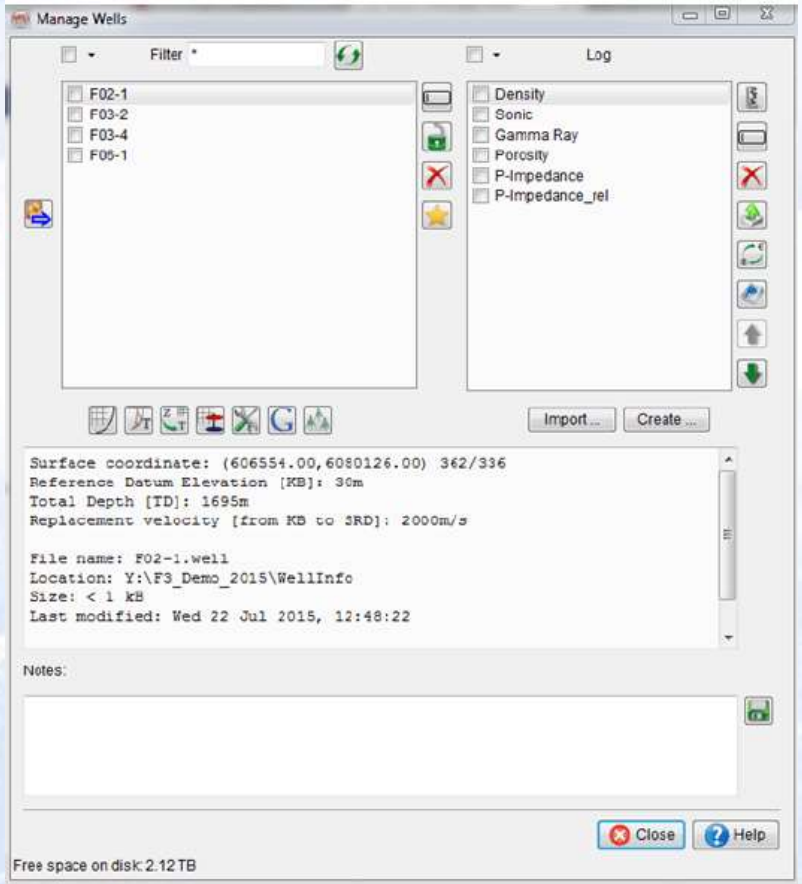
# 4 Survey - 4.5 Manage

4.5.17 Manage Wells

# 4.5.17 Manage Wells

The Well Management window can be open from *Survey* > *Manage* > *Wells...* or from the icon.



The available wells imported in the project are listed on the left. Wells can be renamed, locked, removed or set as default with the buttons in the centre of the window:

Renames the selected well

Toggles the well to be read only(locked)/editable(unlocked)

Removes the selected well

Sets as a default

The well track, checkshot and time/depth model can be loaded and/or edited using the lower left row of icons:

Well Track Editor

Checkshot Editor

Depth/Time Model editor

The well log tools can be used to remove spikes, to smooth and to clip the logs for the loaded wells.

Well log tools

Markers can be imported and managed from the following icon:

Markers editor

Wells can also be exported to be seen on Google Earth using the G icon. It is also possible to either import or create Multiple single wells from the icon .

When selecting a well on the left list, the loaded logs for this given well are listed on the right hand side. They can be renamed, removed and exported with the buttons on the right of the log list. The unit of measure of the logs can be checked or changed if needed (this does not affect the log values). The logs themselves can be moved up/down within the list. For removal and export, multiple logs can be selected.

- Renames the selected log(s)
- Removes the selected log(s)
- Exports the selected log(s)
- View/Edit unit of measure for the selected log(s)
- Edit Well log
- Moves up the selected log in the list
- Moves down the selected log in the list

Logs can be imported from Ascii files, click on *Import*..., or created using mathematical expressions from the well management window, click on *Create*....

Other relevant information is indicated at the bottom of the window.

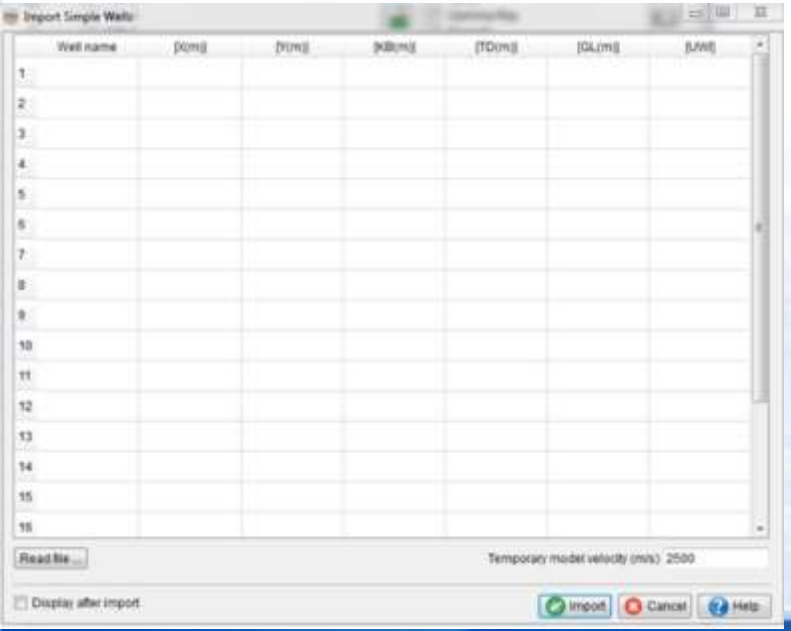
It is recommended to give logs the same name in all the wells. For example, the master density log should be called RHOB in every well. This enables the selection of one set of logs in all wells, ie: for use in the cross-plot tool. Please note that logs names and marker names are case sensitive during multiple selections.

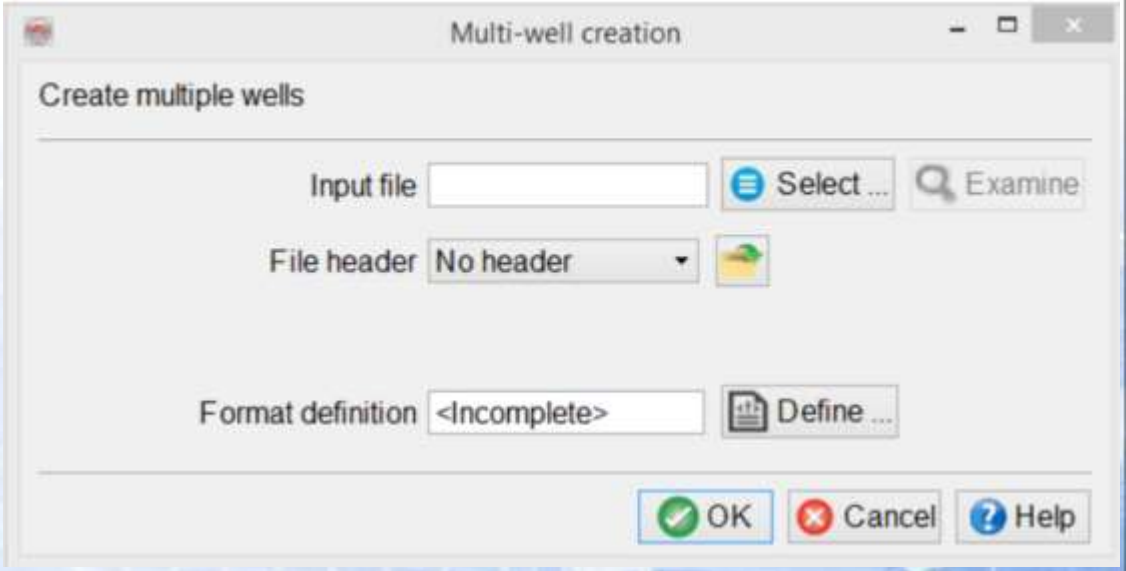
The top Filter is used to filter-out the objects with selected names. For instance, to display all wells that start with letter W use "W*". This works only with text, not numbers or symbols.

# 4.5.17.1 Simple Multi-Well Creation

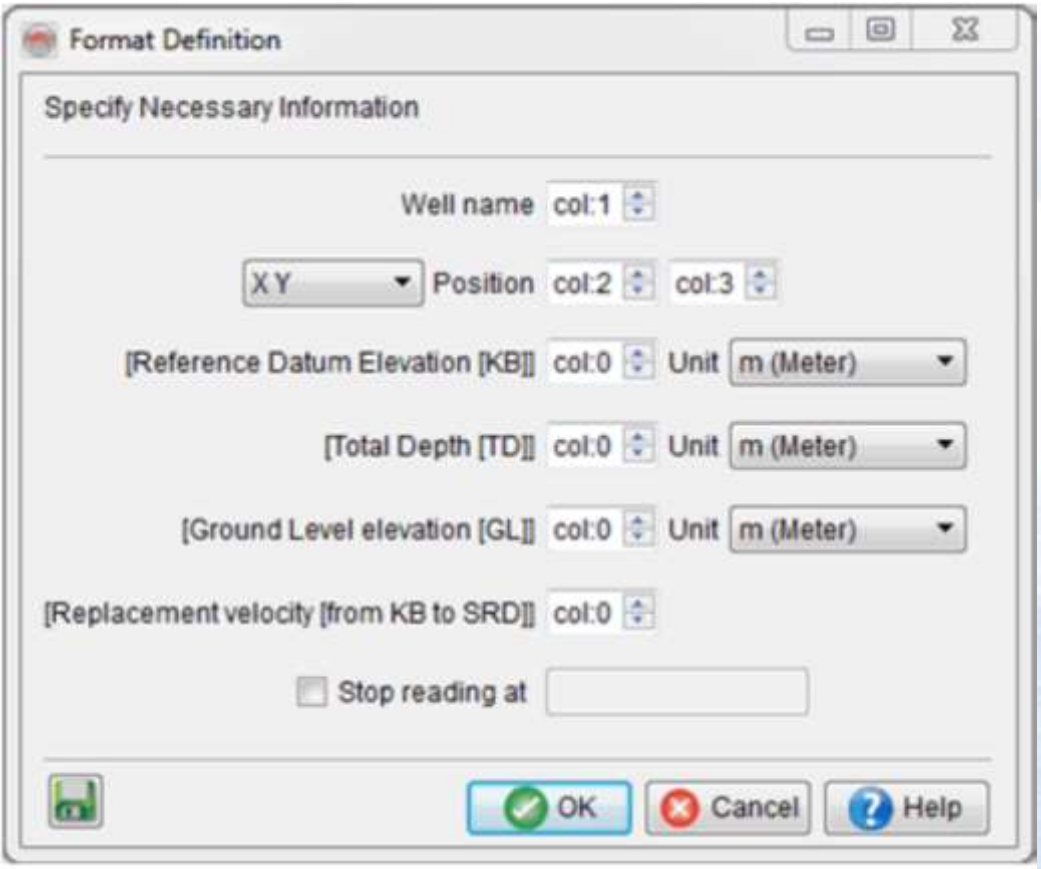
Multi-wells can be imported or edited through the *Import > Well* menu. This window contains editable fields. The new wells can be created by either importing them or entering directly the values and names. The *Read file* button can be used to import an ASCII file containing all well information.

Select the input file (as shown below) and provide the appropriate format definition settings. To provide the format definition, the selected input file can be examined by pressing the *Examine* button. If the file contains the header lines, those lines can be eliminated by providing the file header information.



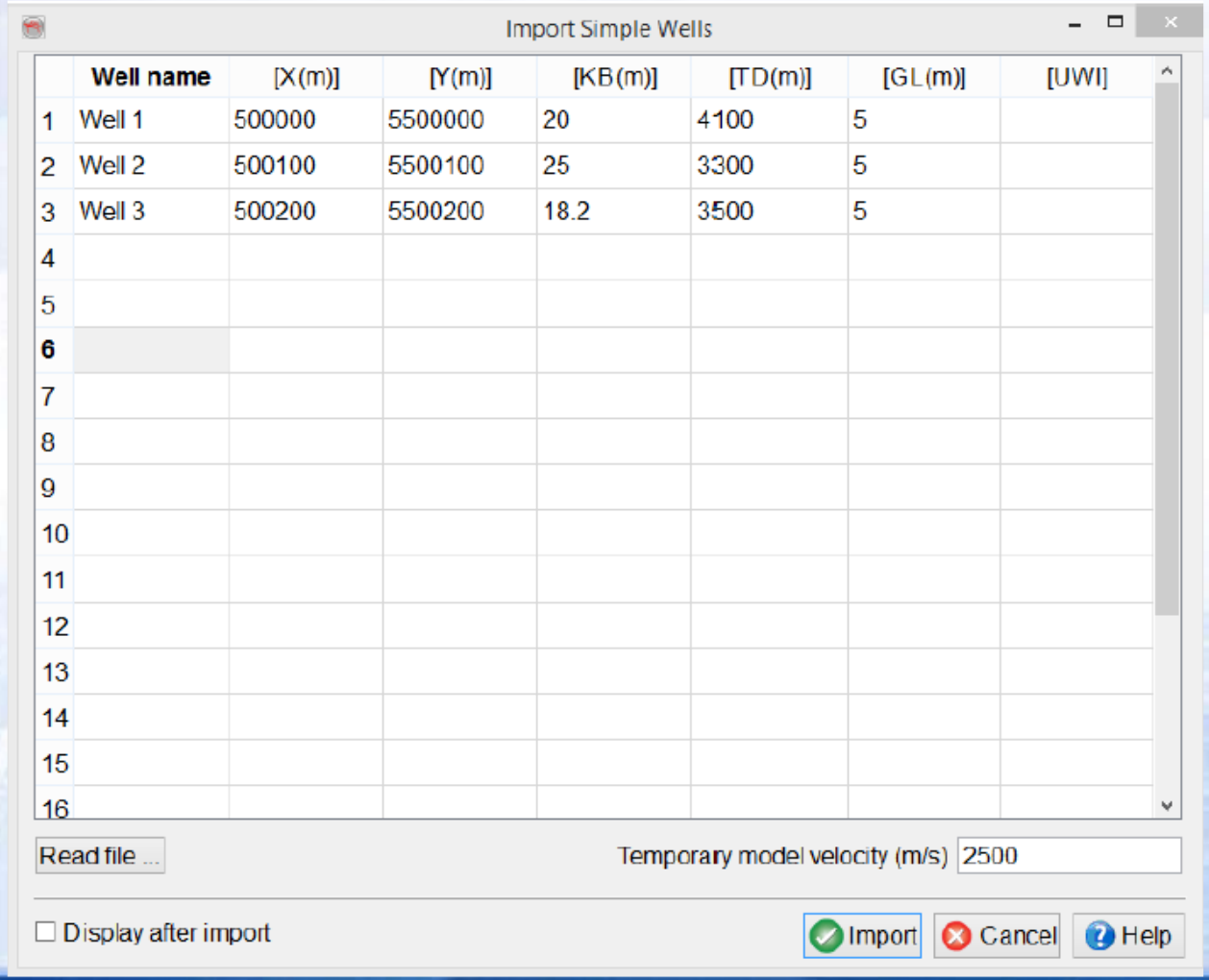



The file format definition is provided by pressing the '*Define*' button. In the format definition window, the default 'col:0' values can be modified according the the input file. When the correct file format is defined, the wells can be imported by pressing 'OK' button in the multi-wells creation window. By default the wells are loaded with a constant velocity. The velocity data or the time-depth model can be provided while importing the Time-depth model.



The simple multi-well file can now be imported and displayed after creation:

创建multi-well文件后导入和展示

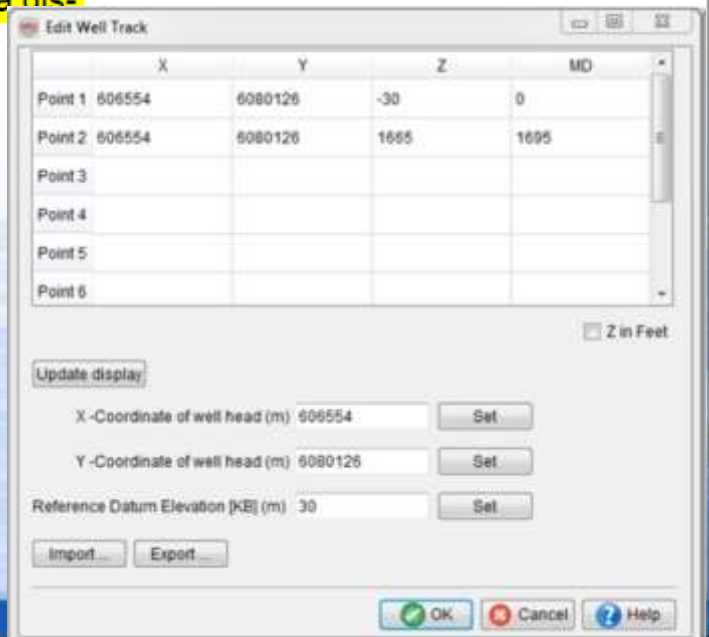


# 4.5.17.2 Well Track Editor 井轨迹的编辑器

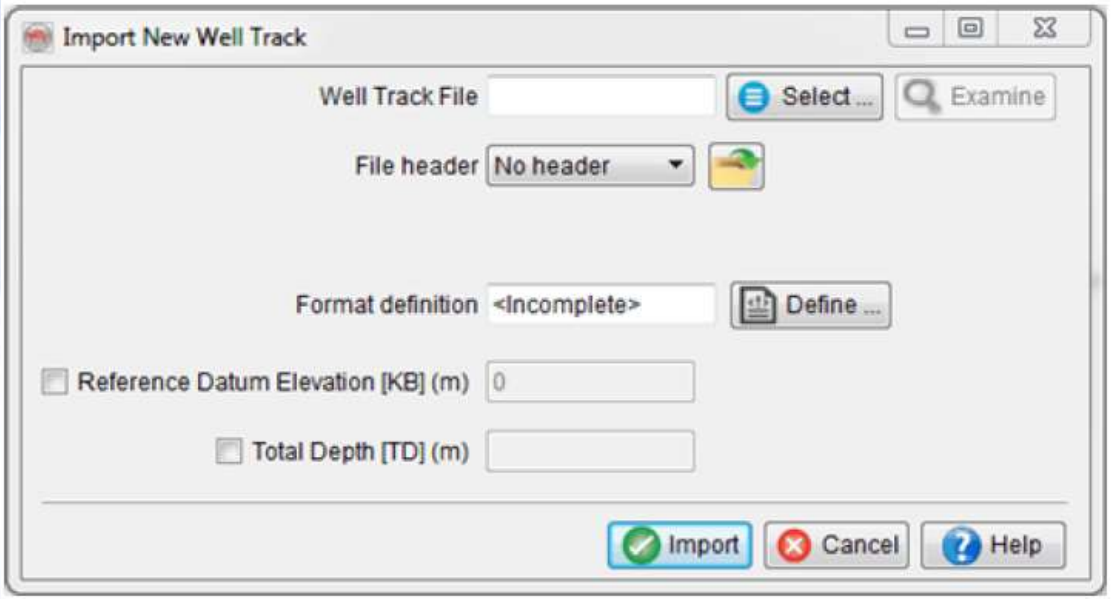
This table shows the import relation between the X and Y coordinates (first two columns), the TVDSS depths (Z, third column) and measured depths in the fourth column. This table is fully editable: Double-click on a cell to edit it, type a new number and press enter or select another cell. Please note that other values will be recomputed to reflect the changes.

The "*Update display*" button allows to update the displayed well track in the scene based on the modified table content. Optionally a whole new track file can be read from a file to replace the existing data, like during track import.

During edition the depths can be displayed in feet. Please note that this flag will be kept in the survey defaults and will apply in other windows. However it is only a display setting and the data on disk will not be affected.



The following window appears after having clicking on "*Read new*". The import settings are fully similar to that of the import step.




Read New 读入新的井轨迹数据

# 4.5.17.3 Checkshot and Time-Depth Models

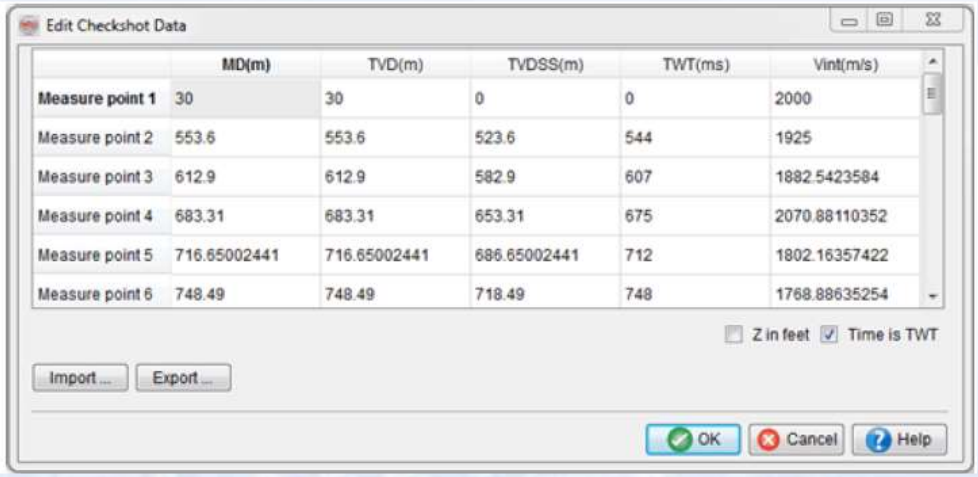
Wells in OpendTect can have two different types of Time/Depth models:

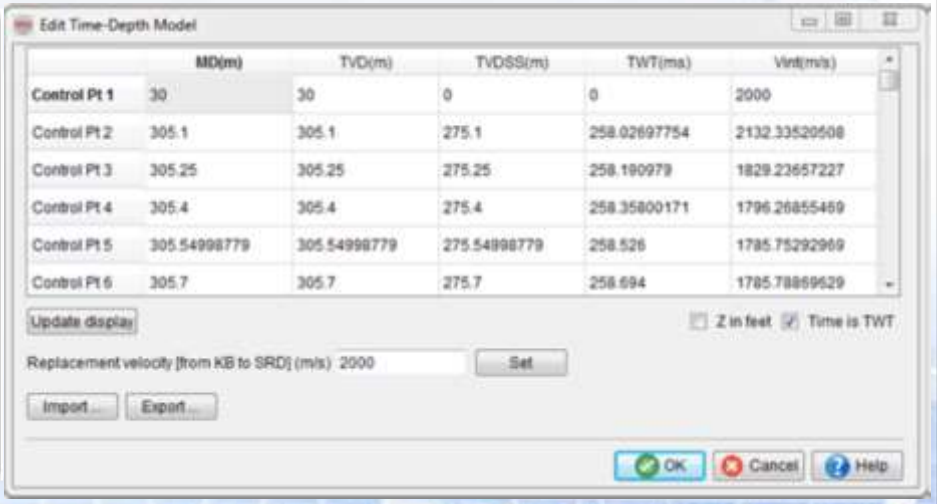
1. An optional checkshot model, often the first available time/depth model or a measured checkshot survey.
2. The Time/Depth model, that is always the active time/depth model for the well, used for data extraction and visualization.

The main differences in usage are:

- If a Time/Depth model is flagged as being a checkshot model during import, the Time/Depth model will be a copy of the Checkshot model.
- If a Time/Depth model is not flagged as being a checkshot model during import there will be no checkshot model for this well.
- Checkshot models may be used during synthetic-to-seismic ties to constraint the out-put Time/Depth model. On the contrary the time/depth model provides the actual input mapping when starting the well tie.

Both types have a similar editing window. It shows the mapping between measured depths and two-way travel time, respectively in the first and second columns. Depths are displayed either in meters or in feet (toggle at the bottom of the window), and times are always displayed in milliseconds. These tables are fully editable: Double-click on a cell to edit it, type and new number and press enter or select another cell. The "*Update display*" button allows the user to update the displayed well data (track, markers and logs) in the scene to be updated based on the actual table content.



The following window appears after having clicking on "*Import*" in the edit Checkshot or Time-Depth model window. The import settings are fully similar to that the import step.

*Please note that a user can expect to get less imported time-depth pairs, as, in order to maintain a decent search speed in the imported table, the software protects against duplicated time and/or depth values in the input TD table by removing duplicated velocities. There should be no concern about loosing time-depth pairs, as the underlying velocity function is kept, although potentially converted to a more compact form. This compaction greatly improves the performance of most search operations done on the time-depth model. This applies for both OpendTect objects checkshot and time-depth model, but in practice checkshot surveys hardly ever have redundant data points.*

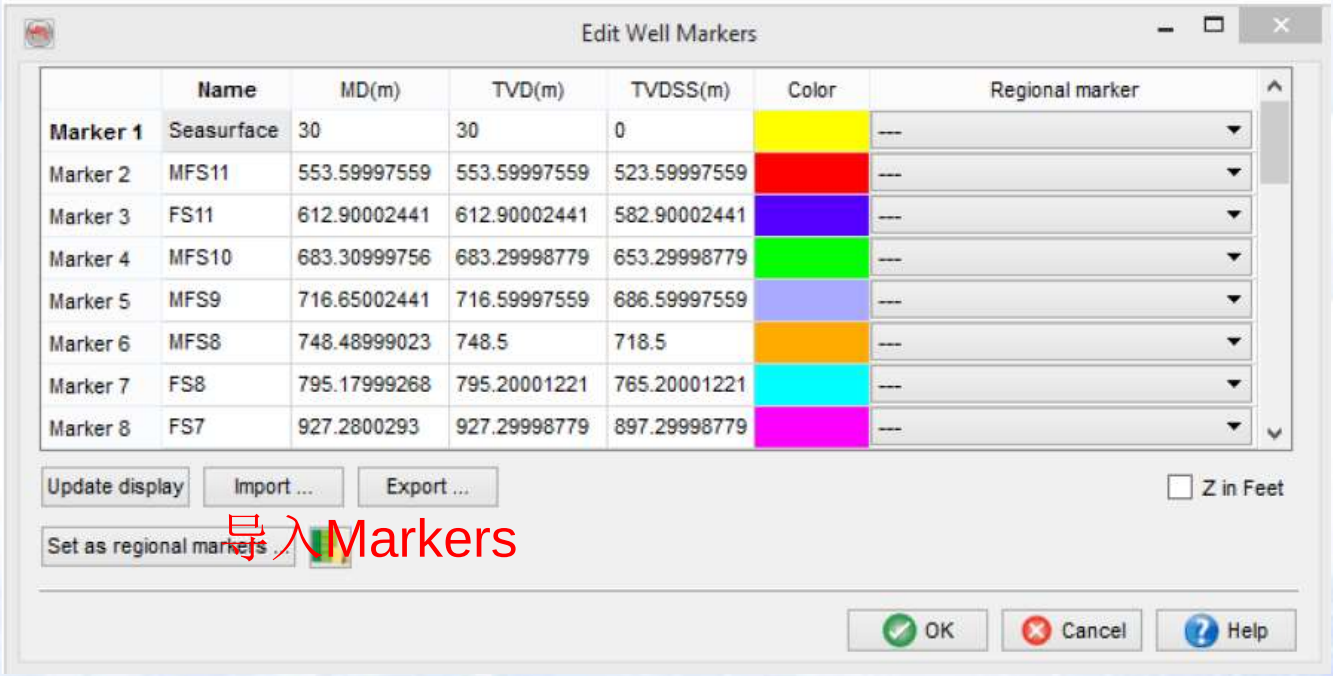
The *Export* button allows to export the table in the same format to an output ASCII file.


导入和导出 时深转换模型

# 4.5.17.4 Manage Markers

手动建立或导入 Geologic markers

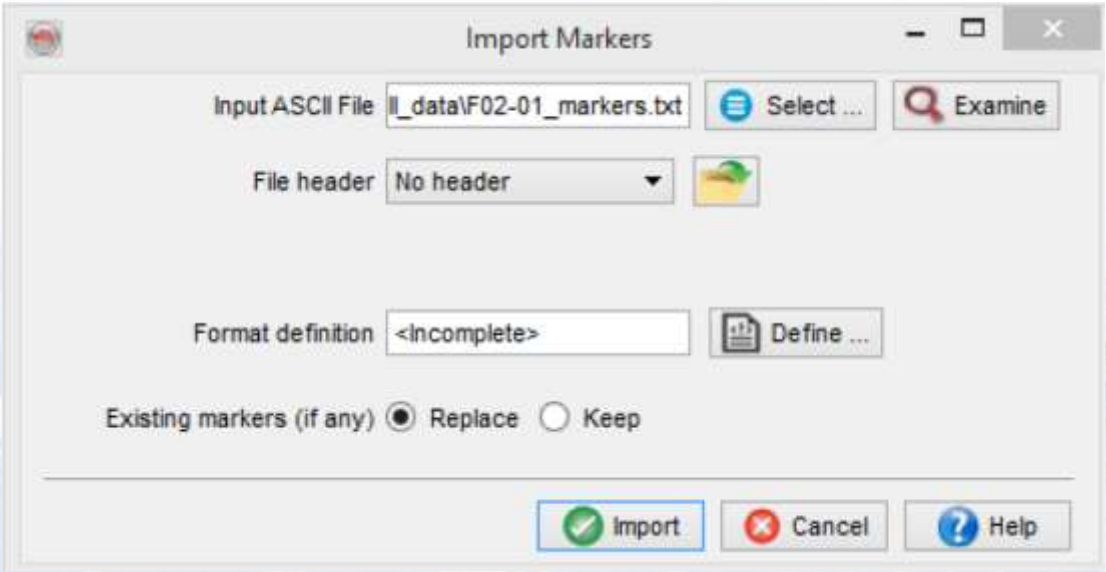
Well markers can be manually provided or imported. They can be exported.




导入Markers

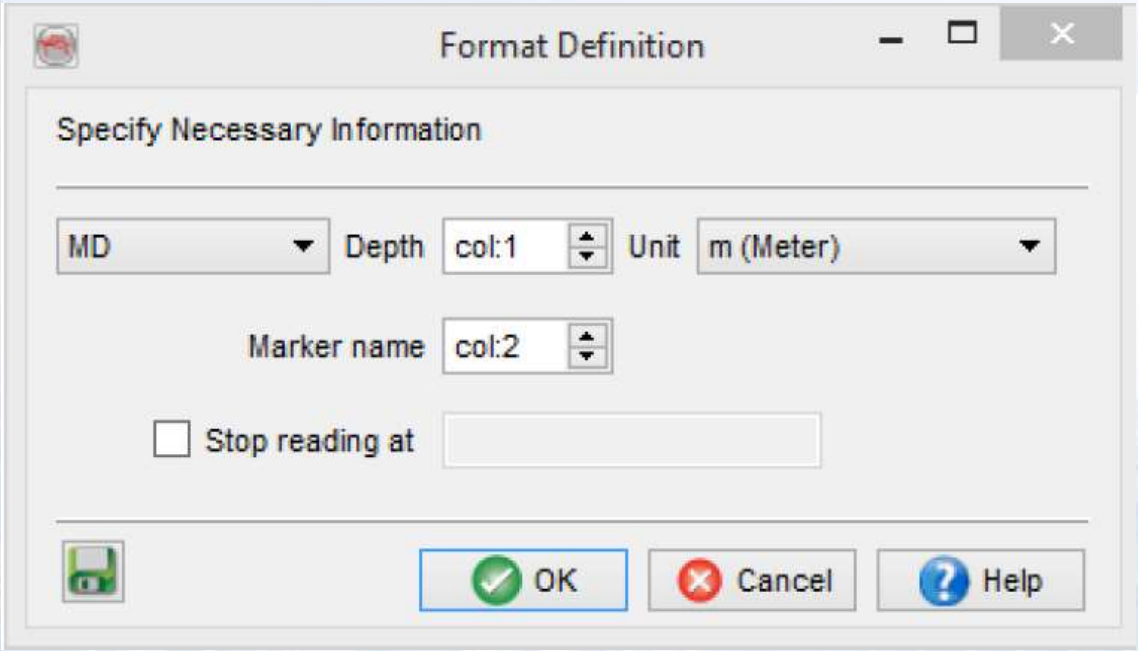
**Edit markers:** Individual markers can to be added or deleted right-clicking the mouse on an existing well marker in the marker table and choosing the appropriate command. To edit the name or value, double click in the appropriate cell. Levels can be set according to the stratigraphic framework, but please note that marker names and color will be updated according to the framework when setting a level to a well marker. The Stratigraphy manager can be access from the  icon.

**Add markers:** Markers can be loaded from a file by clicking the *Import* button. The following window will then be displayed:



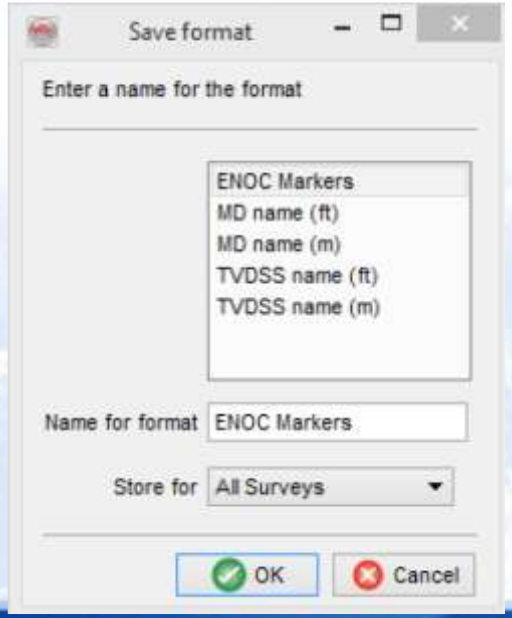
Select the input Ascii file. The main work is to specify the presence of a *file header* and the file *format definition*. The header, if present, can be of fixed length (number of lines), or delimited on its last line by a keyword.

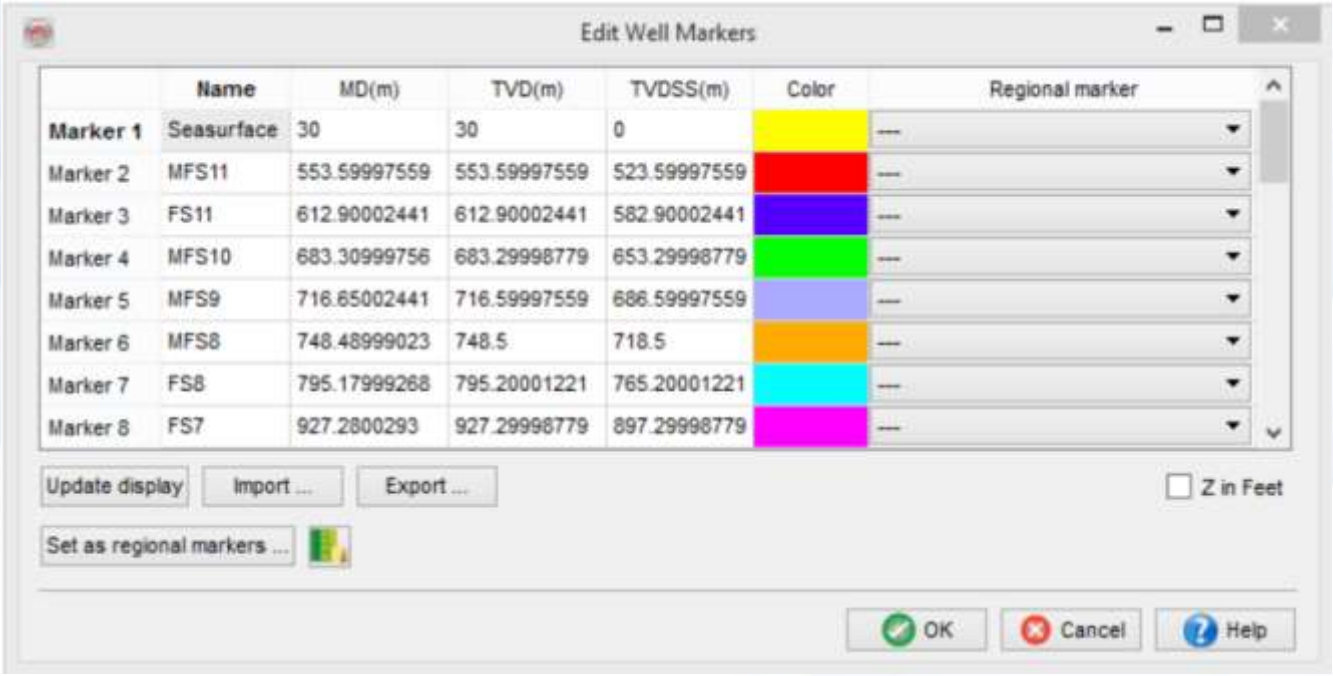
Predefined and saved file formats are available by pressing the Open icon . Otherwise the format must be manually specified. The *Define* button gives access to the format definition window.



You must specify in the format definition window the column numbers of the marker name and depth. Please mind the spaces in the marker names that can break the fixed column format. For that reason it is recommended to have the depth in the first column, and to specify column 2 as the position of marker names. Then all strings found in column 2 and up will be used to form the marker names. Depths can be either measured depths or TVDSS depths. Data loading can be stopped at a specific line by providing the adequate keyword.

It is recommended to save the format definition for a later use and QC, by clicking on the Save icon . In pop-up window, write the name of the format and store it. The format can be stored at different levels (All surveys, Current survey, Current OpendTect user level) depending on the usage. Press *Ok* when done.






**Update display:** After adding and/or editing the markers, they can be refreshed in the main display by clicking on the*Update display* button.

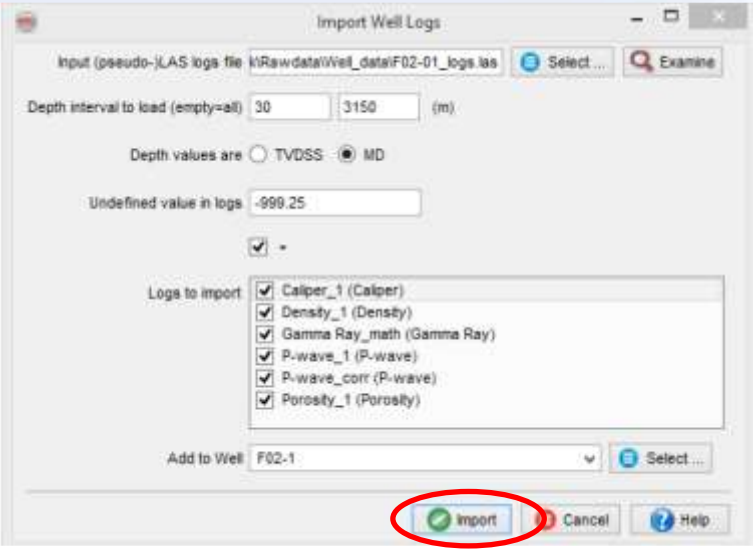
**Export markers:** Finally, the edited markers may be saved to a new file/location by clicking on the *Export* button.

更新显示与输出Markers

# 4.5.17.5 Logs Import

Logs can be imported from the Well Manger window.

测井数据，从Well Manager窗口导入。

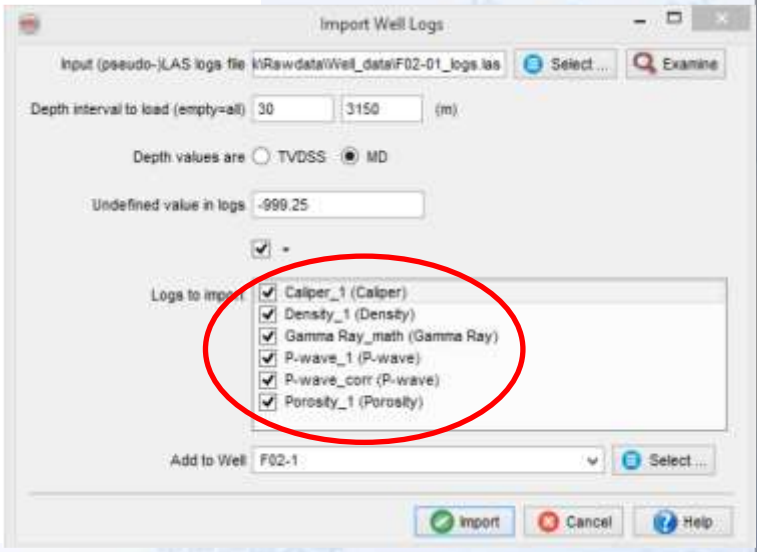



**Import Logs:** The file should be in LAS format, with either MD, or TVDSS. Alternatively, the log files can be pseudo-LAS, meaning LAS (with one line of data per depth value) with the header replaced by a one-line definition: "Depth Gamma Sonic" etc (without quotes). Log names should be separated by blank characters (space or tab). For both LAS and pseudo LAS, the following units can be recognized. The recognition process is case insensitive.

Once the file has been selected all recognized logs will be listed in the *Select logs* section. Only the highlighted logs will be imported. Be careful that two logs do not have the same name. The depth interval can be limited to a subrange. The start depth, stop depth and step written in the LAS files are not used; instead the depths found on the same line as the amplitudes will be used.

In pseudo LAS, units should follow directly behind the log name in parentheses, e.g. Depth(ft) Density(g/cc). Below are examples of text string that will match units:

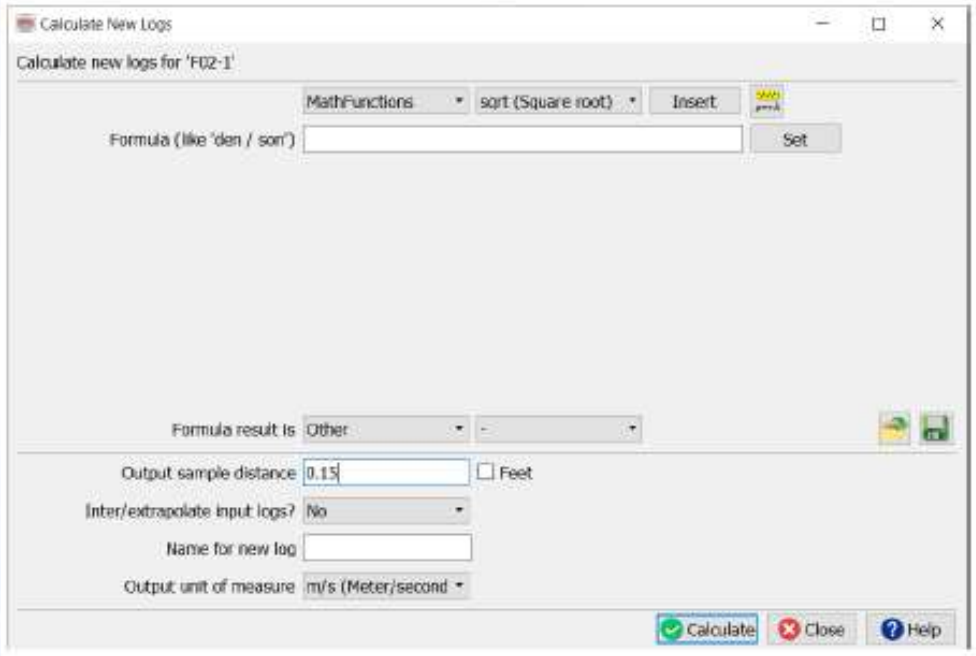
- Time: *s, msec, µsec*
- Distance: *m, feet, f, ft, in*
- Density: *kg/m3, g/cc, g/c*
- Velocity: *m/s, ft/s, f/s, feet/s, km/s*
- Sonic: *s/m, us/ft, µsec/f, us/m, usec/m*
- Acoustic Impedance: *kg/m2s, kg/m2us, g/ft2s*
- Fraction (porosity, water saturation): *%, PU, or blank for unitless*
- Permeability: *k*
- Gamma Ray: *API*
- Electric Potential: *V*
- Resistance: *ohm*
- Compressibility: *1/Pa*
- Temperature: *K, deg.C, deg.F*
- Pressure: *Pa, bar*




LAS文件的内容

# 4.5.17.6 Logs Creation

Logs can be created from log-log computations. Select one or more wells and click on 'Create' in the well management to open the log creation window as shown below:




log-log计算创建录井
选择一个或多个测井，点击Create，打开录井创建窗口，如图。

There is an inbuilt list of functions which can be used for creating new logs.This is supplemented by a Rock physics library containing more advanced resources.

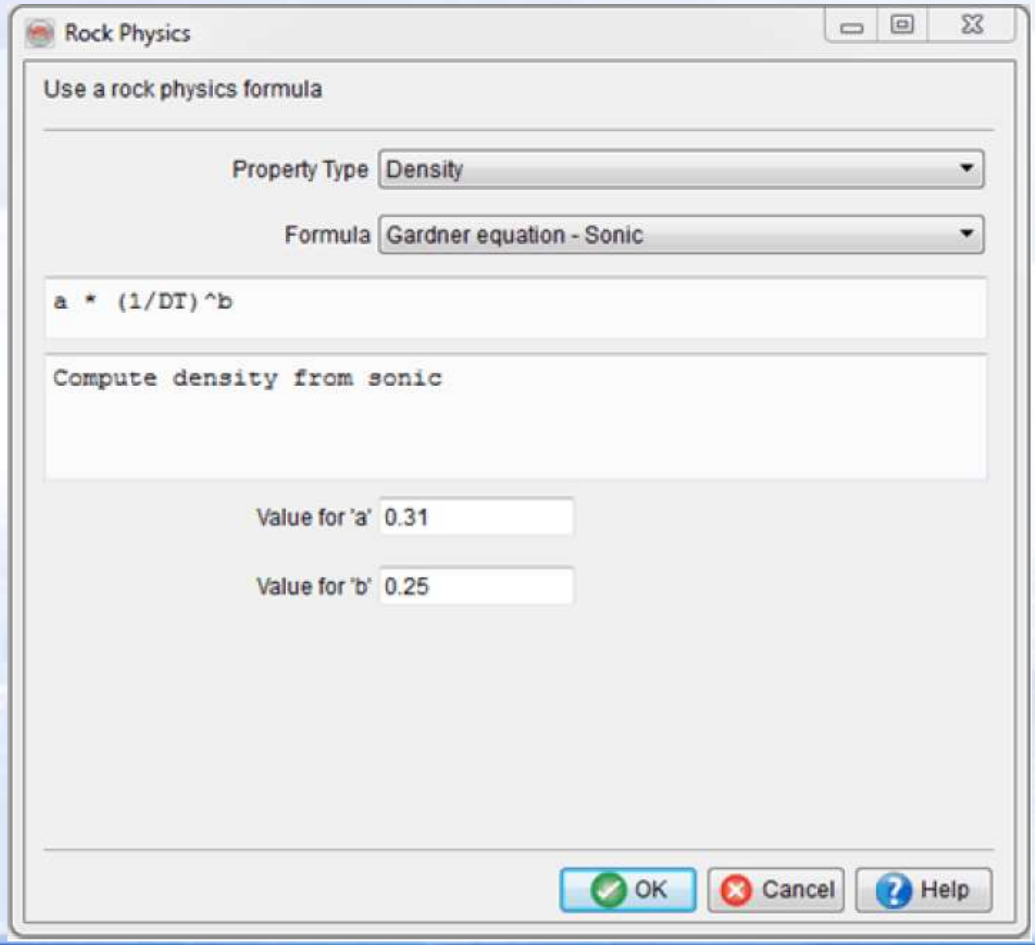
The same syntax as the mathematics attributes should be used, with the following changes:

- The computation is done in the depth domain. No upscaling is performed.
- The various quantities (e.g. density) in the formula are matched with the input logs on which the calculation is being performed. The units of these quantities can also be changed, if needed.
- If "Fill empty sections" is not set for any log then the output will be defined where all logs do exist. Otherwise the input log that must be filled will be interpolated. In the shallow and deep parts the input log will be extrapolated by copying the data from the first and last sample respectively. This interpolation/extrapolation is done prior to computation.
- An automatic assignment of well logs based on the expression names is attempted when pressing "Set".
- The inputs logs have probably different Z ranges. The output Z range will be a regular array defined by the '*Output sample distance*'.

录井的计算，与数学属性的语法一样，也有不同：

# 4.5.17.6.1 Rock Physics Library

A number of in-built advanced rock physics formulas can be selected to create various types of logs from available well log data.




根据录井数据，计算岩石的物理属性参数。

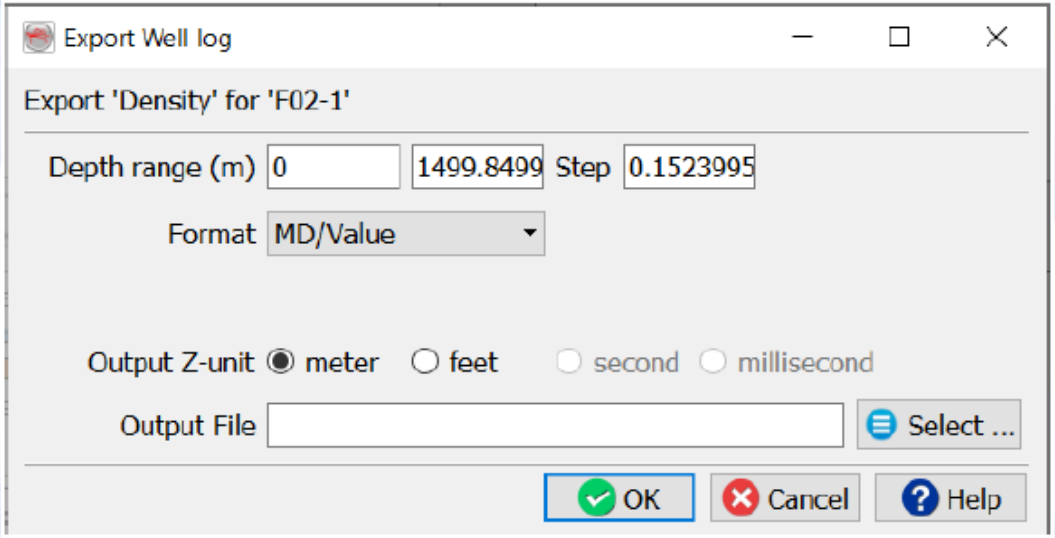
The type of output log quantity is chosen from *Property Type* list (e.g. Density, Velocity and Pressure). Afterwards, a specific formula out of a number of possible alternatives can be chosen to compute the required log quantity. The choice of equation depends on several factors such as the type of available log quantity and the region (e.g. a rock physics equations might work well in Gulf of Mexico but not in North Sea). After this selection has been made, the formula will be displayed along-with a short description below it.

The standard values for variables of the selected formula is also displayed.

It is extremely important to keep in mind that the input log quantities (e.g. Sonic) MUST be converted in to particular units for the formula to work. These units are already selected by default and should NOT be changed. Same applies on the output unit of measure as well.

# 4.5.17.7 Logs Export

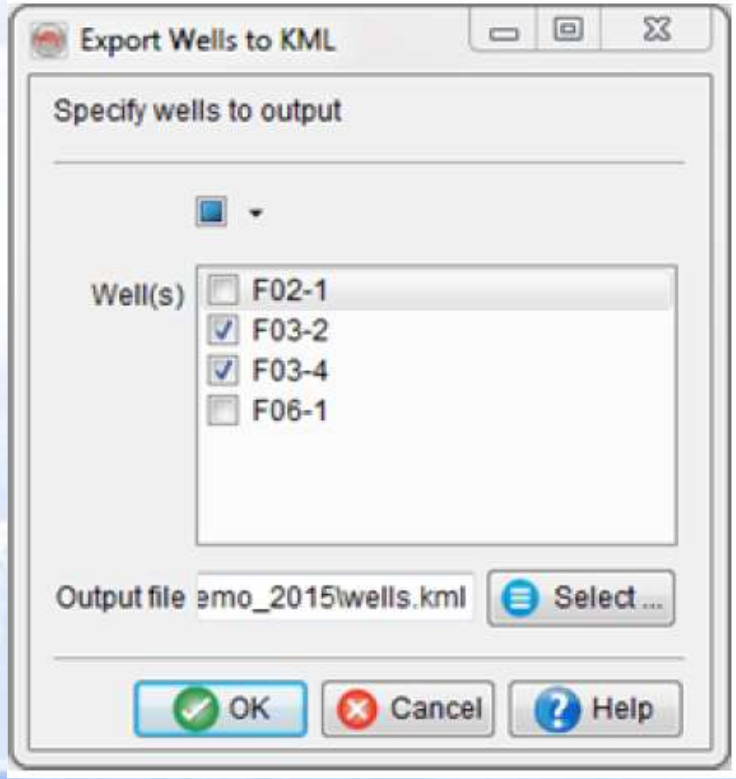
All or a selection of logs can be exported to an output text file. The input well must be selected, then select the logs to be exported, and click on the export icon .




The logs can be exported with respect to MD and TVDSS depths, optionally also with X/Y or Inline/Crossline positions. The depth range and step will specify the regular array on which the input logs will be interpolated prior to the export. The output file will be a column sorted Ascii file.

# 4.5.17.8 Export Well Surface Positions to Google Earth

The well locations (surface coordinates) can be exported in Google earth using the G icon. Select a selection of wells (CTRL-left click to select several wells) to be exported in the popup window, and specify a filename for the kml file to be created. Press Ok, and open this file in GoogleEarth.




测井位置，输出为kml文件

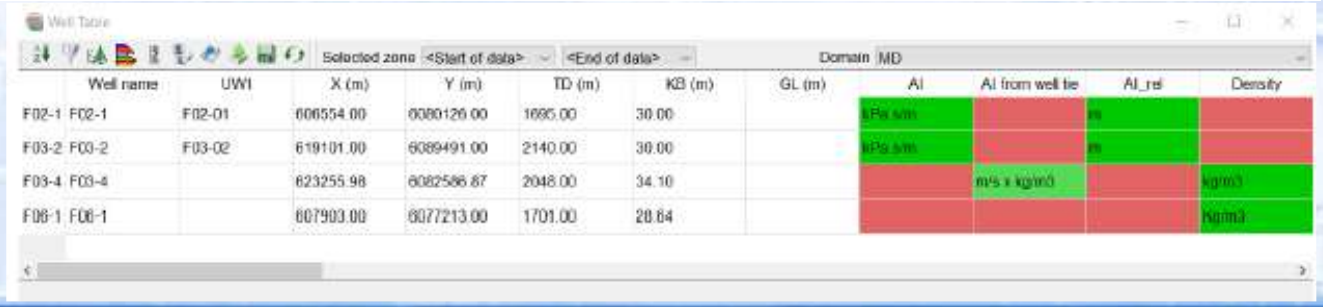
# 4.5.18 Well Data Management

The new Well Data Management table can be accessed from the small drop-down menu on the 'Manage Wells' icon in the Manage Toolbar (right edge of scene).

This opens a spreadsheet containing all the wells imported into the project, along with their info (UWI, X, Y, TD, KB and GL), all the logs and all markers present in these wells.

The wells are along the rows with their details, logs and markers in their corresponding columns. The logs which are present in the particular well have the corresponding cell coloured green, in different shades, depending upon the availability of logs in the selected zone(s) (decided by markers) and those unavailable are highlighted in red. Similarly, available markers have their corresponding cell coloured with the marker colour along with their depth.

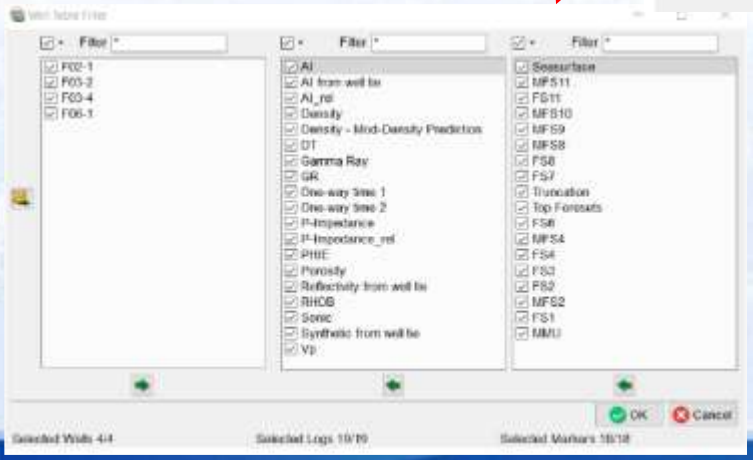
The colour coding for availability of logs follow a four-tier system and goes from deep green to light green. The four tiers are: >75%, (75 - 50)%, (50 – 25)%, and <25%



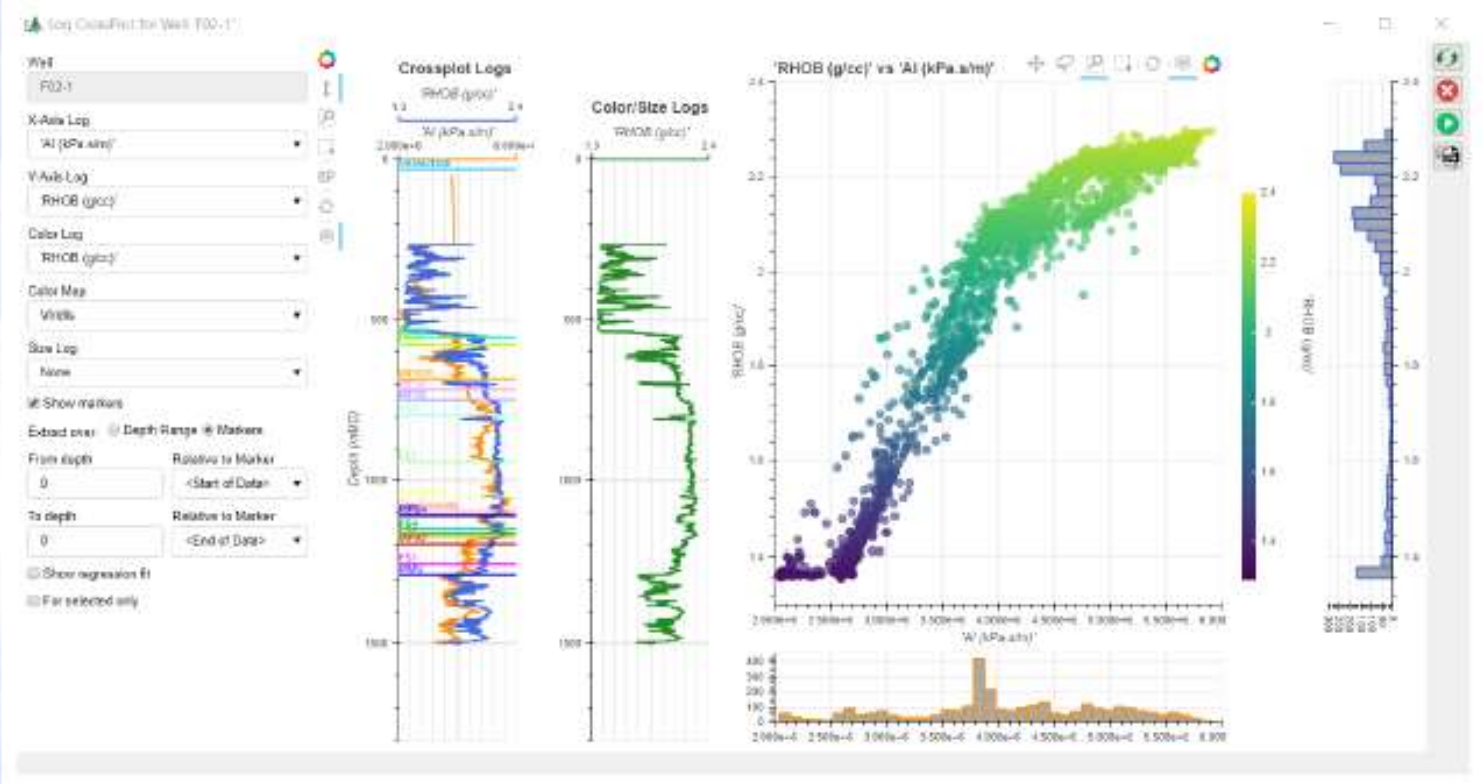
On the top of the Well Data Management table, there is a toolbar which has a number of menus for data management. They are described below in the order they are in, going left to right:

Enable sorting by activating column. Default sorts the wells alphabetically.

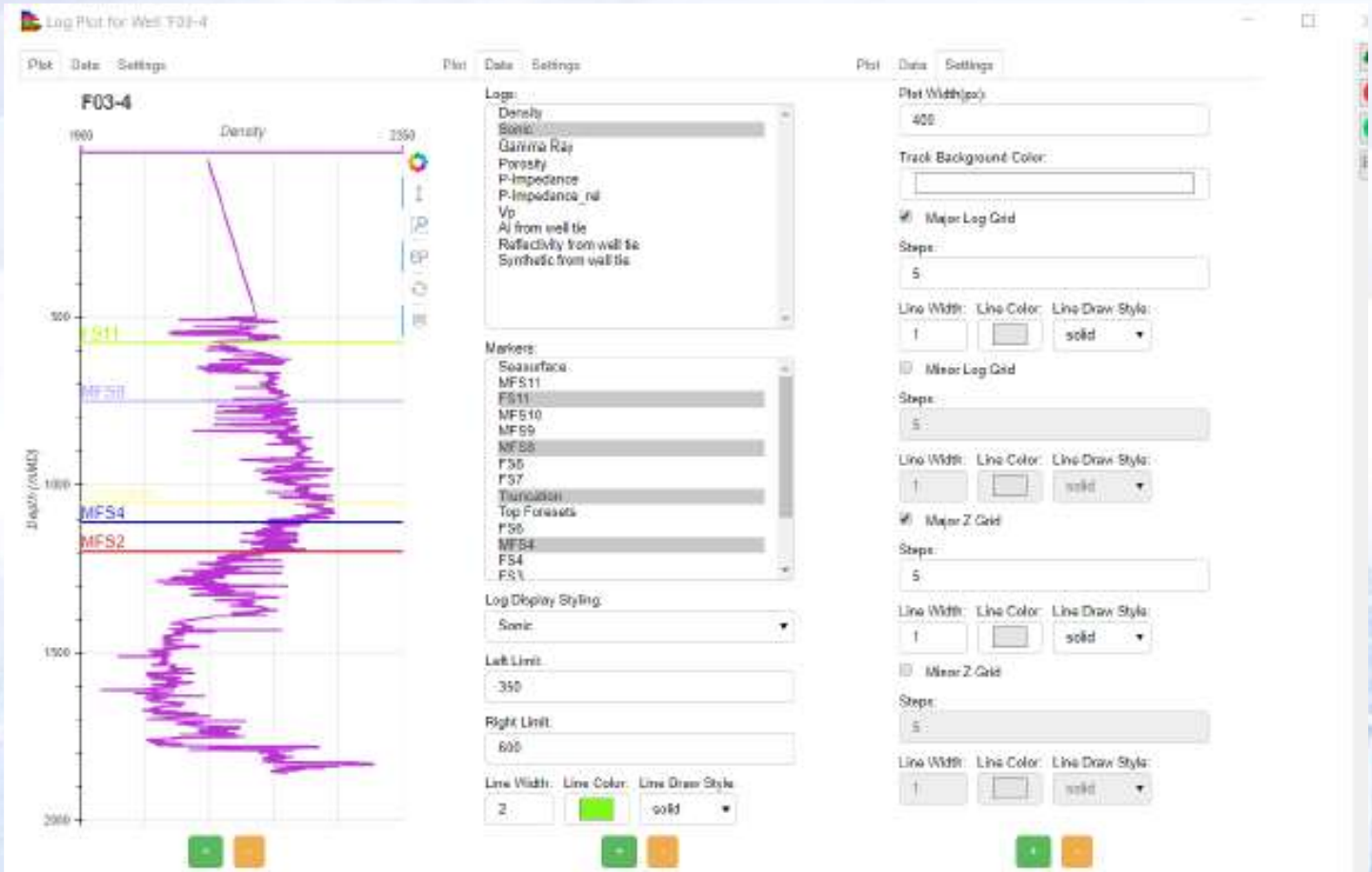
Set Display Filters: set filter on which data (Wells, Logs and/or Markers) you wish to see displayed in the table (image below)

Log CrossPlot (Bokeh): Cross-plot logs within specific depth range or with the markers' depth.



LogPlot (Bokeh): Plot logs and markers for a selected well within specific depth range. Modify display setting e.g. plot width, lines width, colors, etc.



On the right of the LogPlot Window, there are a number of menus:

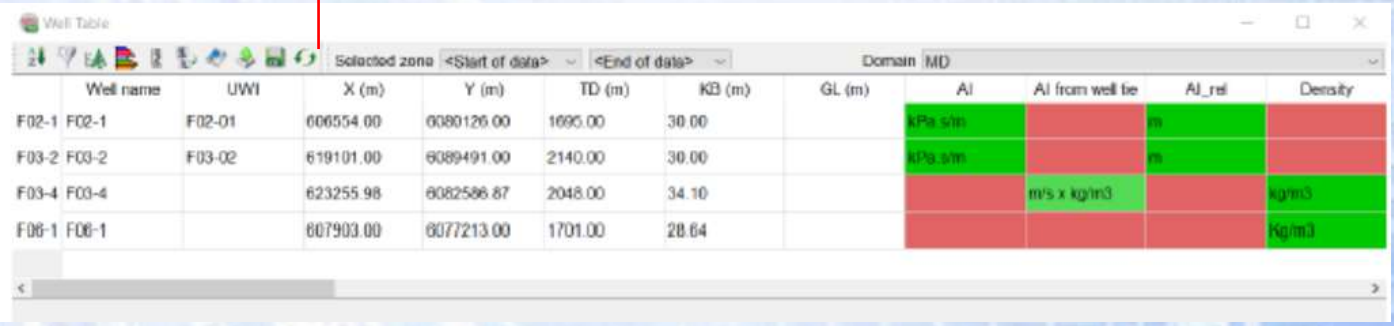
Reload and refresh the data in the tab

Terminate bokeh server

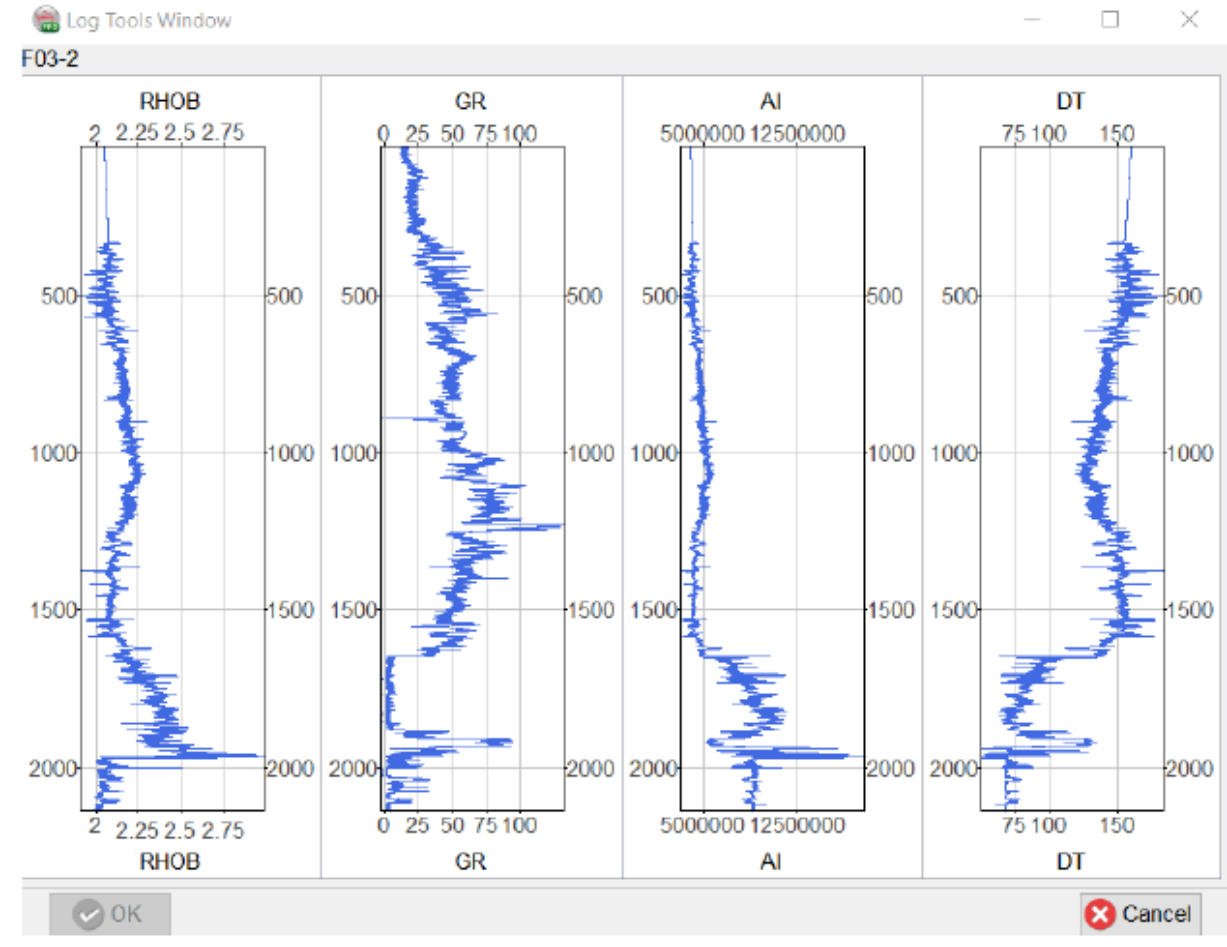
Restart bokeh server

这3个按钮没看到

View Bokeh server Log file

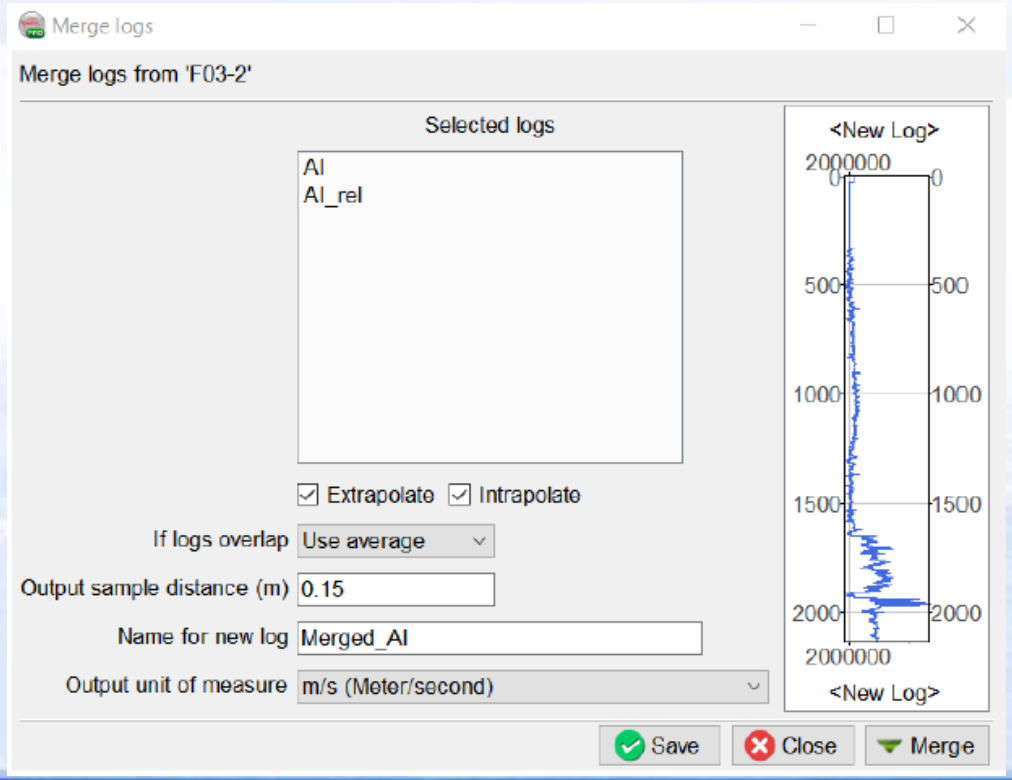


View Selected logs: The selected logs in the table can be viewed using this menu in the Log Plot Viewer:



Merge Well Logs from the same well: This icon will merge the selected logs for a particular well into one which can then be added to the database using the Save icon.

Options are available to: extrapolate and/or interpolate when there are gaps, use average or one of the logs in the overlap area:



 Enable editing well information (Well name, UWI, X, Y, TD, KB, GL): Wells can be renamed, locked, removed or set as default. If the option is toggled off, then the info cannot be edited.

 Exports Well information in ASCII format.

 Save: This writes all the changes made in the well table into the disc.

 Reset Well Table: This button resets the table to its initial format.

**Selected zone** This field allows the selection of a zone of interest (between two markers). Once a zone is set, the availability of logs displayed in the table might change depending on the zone.

**Domain** This field allows the selection of a depth domain to work with. The three options currently supported are MD (Measured Depth), TVD (True Vertical Depth), TVDSS (Truth Vertical Depth Sub-Sea).