

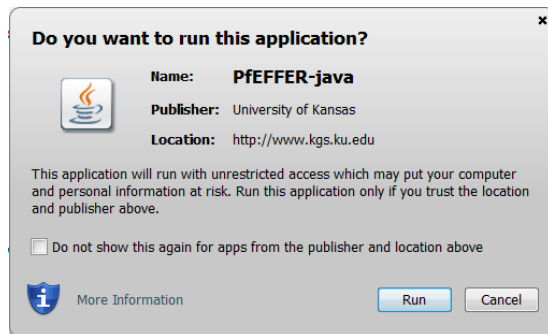
PfEFFER-java Applet

by John R. Victorine

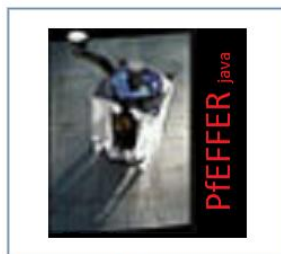
Introduction

The PfEFFER-java web app has 2 sources for importing well data, 1) the user's PC or 2) the Kansas Geological Survey (KGS) Server & ORACLE Database. This program allows the user to import Log, Tops, and Core Data.

There will be occasions when the user would like to inspect the contents of a LAS file. So, for example, the user may wish to find the identity of the well, the types of logs, depth range, well or log parameters. Alternatively, the user can suspect that the file is not coded correctly in LAS format if the Import LAS function fails, and wishes to examine the file to troubleshoot the problem. The LAS file is an ASCII file and can be read by any text editor, i.e. Notepad, WordPad, TextPad, etc. The CSV (Comma Separated Values) files are also ASCII and can be edited in the same way or with Microsoft Excel.



To access PfEFFER-java go to <http://www.kgs.ku.edu/software/PfEFFER-java/>. At the top of the web page there is a menu "Main Page|Description|Applet|Help|Copyright & Disclaimer". Select the "Applet" menu option a "Warning - Security" Dialog will appear. The program has to be able to read and write to the user's PC and access the Kansas Geological Survey (KGS) Database and File Server, ORACLE requires this dialog. The program does not save your files to KGS, but allows you to access the KGS for well information that may be missing in your Kansas logs. The program does not use Cookies or any hidden software it only reads the LAS and CSV files for the PfEFFER-java Session and writes a LAS 3.0 File to your PC to save your PfEFFER-java Session and the well data imported. The blue shield on the warning dialog is a symbol that the Java web app is created by a trusted source, which is the University of Kansas. Select the "Run" Button, which will show the PfEFFER-java "Enter" Panel illustrated below,



Enter

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Loading Well Data

Click the "Pfeffer-java Enter" Icon Button, which will show the "Load Data" Dialog. The dialog below displays an example of the Newby 2-28R well data loaded from the KGS Data icon button with the data in the tables above. The icon buttons in the Data Source Panel assists the user in loading well data into the Pfeffer-java Applet.

Data Source Panel

Load existing well data.
User can load from multiple sources.

Data Loaded Panel

Positive feedback to user to verify what source data was loaded and location of the source.

Dialog Buttons:

Continue – Build
Pfeffer "Spreadsheet"
Clear – Clear loaded data from this dialog.

Data Source

KGS Data KGS (Database & Server) Well Data

PC Data PC (ASCII Data Files) Ver 2.0 & 3.0 LAS File Tops CSV Rock Data CSV

Data Loaded

Data Source Filenames:

Log ASCII Standard (LAS) Files:

1: Pf-Newby-2-28R.las

2:

3:

PC ASCII Files:

Tops CSV:

Core CSV:

Data Type	3.0	LAS	CSV	KGS	Data Type	3.0	LAS	CSV	KGS
Log Data	...	YES	...	...	Rock Measured Data	...	YES	...	...
Perforations	NO	...	...	...	Pfeffer Data	...	YES	...	...
Tops Data	...	YES	...	...	(Previous Saved Session)	...	YES	...	...
Log Curves / Files		LAS	Core		Log Curves / Files		LAS	Core	
Resistivity	...	YES	...	...	Gamma Ray	...	YES	...	...
Porosity	...	YES	YES	...	Spontaneous Potential	...	YES	...	...
-- Neutron	...	YES	...	...	Photoelectric Factor	...	YES	...	...
-- Bulk Density	...	YES	...	...			
-- Sonic	...	YES	...	...			

Continue Clear Exit

Load data from Kansas Geological Survey (KGS) Database and Server.

Load ASCII Delimited Data Files from PC.

Displays the filename of files loaded.

Show the source of the data and type.

Identifies the Log Curves loaded.

Data Source Panel

The Data Source Panel provides two methods of importing data into the Pfeffer-java Web App. The Kansas Geological Survey (KGS) Database & File Server and the user's PC. A number of icon buttons are provided to assist the user in importing the specific data type of interest. When the user selects the icon button a search dialog is provided specific to the data type. The CSV (Comma Separated Values) icon buttons under the "PC ASCII Delimited Data Files" Panel are expecting a general type of data presentation. Although the order of the specific data columns is not important, the "Mnemonics" of the data column is. Each data type in GEMINI Tools web apps have a data mnemonic list that will be presented later as each icon search dialog is presented. The CSV Search Dialog will use the first two lines of the CSV file to automatically match the file column data mnemonics with the web app curve mnemonics, but if the program does not recognize the file data mnemonic then it will leave it blank and expect the

user to match the file data mnemonic to the web app curve mnemonics, this will be explained later.



Kansas Geological Survey (KGS) Database & Server Data



Kansas Well Data

This button allows the user to access well data stored in the Kansas database & Server. LAS ASCII Standard (LAS) version 2.0 Files & Core Images JPEG Files (Boxes, Core Slab, Thin Sections) Database Data: Perforations Depth Data, Formation Tops (Stratigraphic Units), Measured Core Data



PC ASCII Delimited Data Files



Log ASCII Standard (LAS) File Read

This version will read up to 3 Log ASCII Standard (LAS) Files, versions 2.0 & 3.0. This read process does not necessarily distinguish between the two versions. The LAS Java Read classes follow the rules set up by the Canadian Well Logging Society for both versions.



Tops CSV (comma separated values) ASCII File Read

This version will allow the user to map a comma delimited ASCII file data columns to the tops data variables in the Profile Web Application.



Measured Core CSV (comma separated values) ASCII File Read

This version will allow the user to map a comma delimited ASCII file data columns to the measured core data variables in the Profile Web Application.

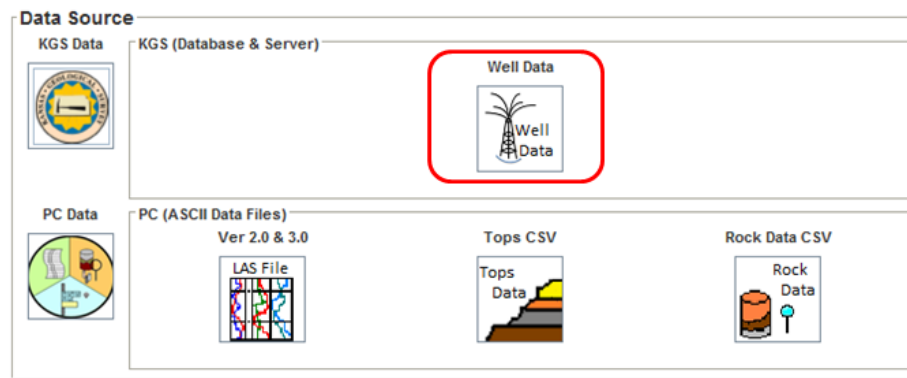
Data Loaded Panel

The Data Loaded Panel provides a visual feedback that the data type was loaded, by the file names of the files that were accessed to load the data and by the data type that is loaded. The data type is important in that it shows where the data came from. The KGS data has the ORACLE Database from which the Tops Data, Core Data and Brine Data, etc. are retrieved from a XML (Extensible Markup Language) data stream that is constructed using the ORACLE PL/SQL for each data type. The user's PC will load the data from CSV (Comma Delimited Values) files or a delimited file for the Geologist Report. The LAS File can be downloaded automatically from the KGS Server in the program or from the user's PC. This program allows the user to import up to 3 Log ASCII Standard (LAS) version 2.0 or 3.0 files. The LAS version 3.0 file can hold all the well data, but if the user wishes to add log curves from a LAS version 2.0 file it is advised that the LAS version 3.0 file be loaded last. In most cases the user is importing multiple LAS version 2.0 files, which can be saved into a single LAS version 3.0 file.

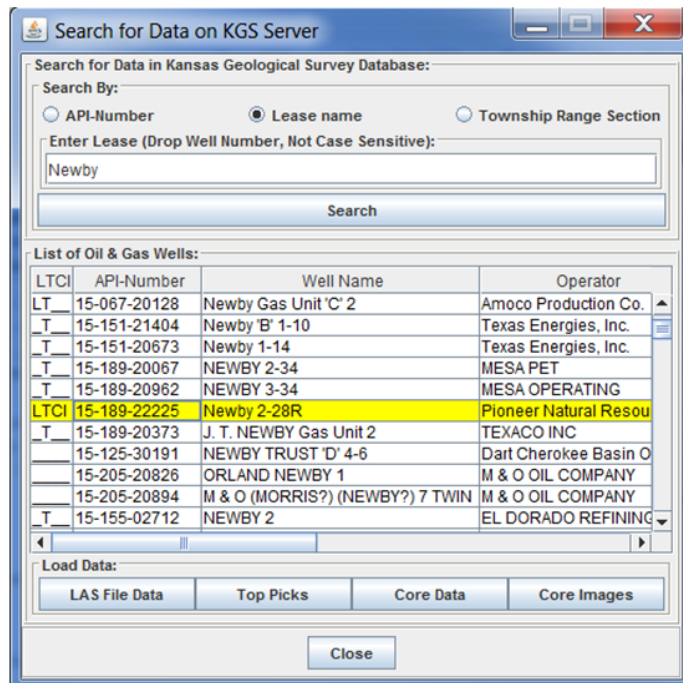
Importing KGS (Database & Server) Data

KGS (Database & Server) - Importing Well Data

The Kansas Geological Survey (KGS) has a good collection of well data stored in the ORACLE Database and File Server as Files Log ASCII Standard (LAS) version 3.0 Files and Core Image Files as Joint Photographic Experts Group (JPEG) images as well as Tagged Image File Format (TIFF) images. In this example the user will download the well data available from the KGS, Log data (LAS version 2.0 File), Tops Data, Measured Core Data, Perforation Data and Core JPEG Image Files. The ORACLE Database is accessed by making Stored Procedure PL/SQL calls to the ORACLE Database from which an Extensible Markup Language (XML) data stream is created containing the well data that is passed back to the web app making the request.



Left Click on the “Well Data” Icon Button in the Data Source Panel of the Load Data Dialog.



Search for Well Data in KGS Database Search By:

- **API-Number** – The user can search the KGS Database for well data by API-Number. The Format for the API is SS-CCC-99999 where
 - SS – Two Digit State Code
 - CCC – Three Digit County Code
 - 99999 – 5 Digit Well Number
- **Lease Name** – The user can search for well data by lease partial phrase, i.e. “Newby”, which will look for all wells with the phrase “Newby” in the lease name.
- **Township-Range-Section** – Search for a list of Wells by a specific area.

List of Kansas wells that match the search criteria

Load Well Data Buttons

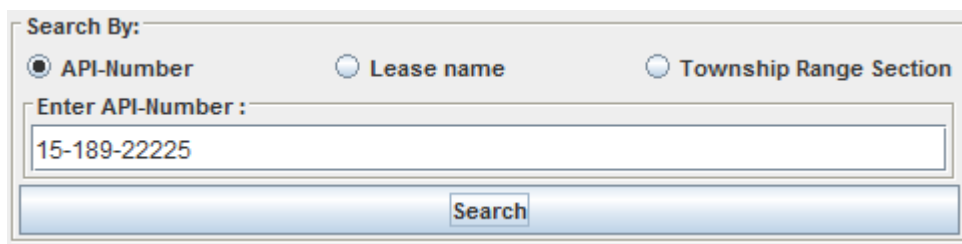
- **LAS File Data** – Load Log ASCII Standard (LAS) Files
- **Tops Picks** – Load Formation Tops Picks
- **Core Data** – Load Measured Core Data
- **Core Images** – Load Core Image File Data

NOTE: LTCI Column in Table: L-LAS Files; T-Formation Tops; C-Measured Core Data; I-Core Images

This will display the “Search for Data on KGS Server” Dialog, see above image. This dialog allows the user to search the KGS database for well data. In this example, the well of interest will be the Newby 2-28R, this well contains all the well data that can be retrieved from the KGS Database, i.e. Log Data (LAS version 3.0 File), Tops Data, Core Data, Perforation Data and Core JPEG Image Files.

As the Summary image suggests there are 3 methods for searching for the well data within this dialog,

- By API-Number – KGS has a specific format for the API-Number, i.e.SS-CCC-99999 where SS is the state code for Kansas 15, CCC is the county code for Newby 2-28R it is 189 for Stevens County and the 5-Digit Well Number for Newby 2-28R it is 22225.



Search By:

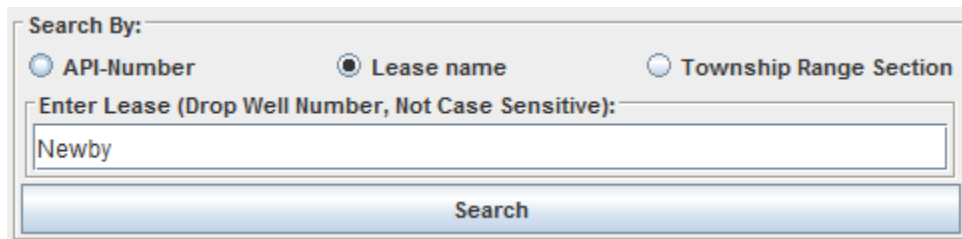
☒ API-Number ☐ Lease name ☐ Township Range Section

Enter API-Number :

15-189-22225

Search

- By Partial Lease Name – The stored procedure used to retrieve the well header information allows the user to enter a partial phrase, in this example Newby. The program places a ‘%’ in front and back of the phrase and sends the request to the Database, i.e. “%Newby%”.



Search By:

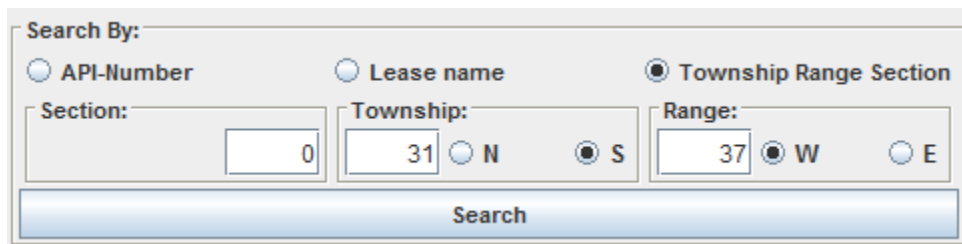
☐ API-Number ☒ Lease name ☐ Township Range Section

Enter Lease (Drop Well Number, Not Case Sensitive):

Newby

Search

- By Township Range Section – This search is by location in Kansas, this search also allows the user to enter just the Township and Range to search for wells, e.g. to look for the Newby 2-28R, enter Township as 31 set the S (South) Radio button and Range as 37 set the W (West) Radio button.



Search By:

☐ API-Number ☐ Lease name ☒ Township Range Section

Section: Township: Range:

0 31 37

☐ N ☒ S ☒ W ☐ E

Search

The user only needs to enter the above data and select the “Search” Button to display the list of Wells in the Kansas Database that match the search criteria. In the image below the Lease Name “Newby” was entered to search for all wells in Kansas with the Phrase Newby in it. The user searches through the list until they find the well of interest. In this example it is the Newby 2-28R, which is highlighted.

Search for Data on KGS Server

Search for Data in Kansas Geological Survey Database:

Search By:

☐ API-Number ☒ Lease name ☐ Township Range Section

Enter Lease (Drop Well Number, Not Case Sensitive):

Newby

Search

List of Oil & Gas Wells:

LTCI	API-Number	Well Name	Operator
LT	15-067-20128	Newby Gas Unit 'C' 2	Amoco Production Co.
T	15-151-21404	Newby 'B' 1-10	Texas Energies, Inc.
T	15-151-20673	Newby 1-14	Texas Energies, Inc.
T	15-189-20067	NEWBY 2-34	MESA PET
T	15-189-20962	NEWBY 3-34	MESA OPERATING
LTCI	15-189-22225	Newby 2-28R	Pioneer Natural Resou
T	15-189-20373	J. T. NEWBY Gas Unit 2	TEXACO INC
	15-125-30191	NEWBY TRUST 'D' 4-6	Dart Cherokee Basin O
	15-205-20826	ORLAND NEWBY 1	M & O OIL COMPANY
	15-205-20894	M & O (MORRIS?) (NEWBY?) 7 TWIN	M & O OIL COMPANY
T	15-155-02712	NEWBY 2	EL DORADO REFINING

Load Data:

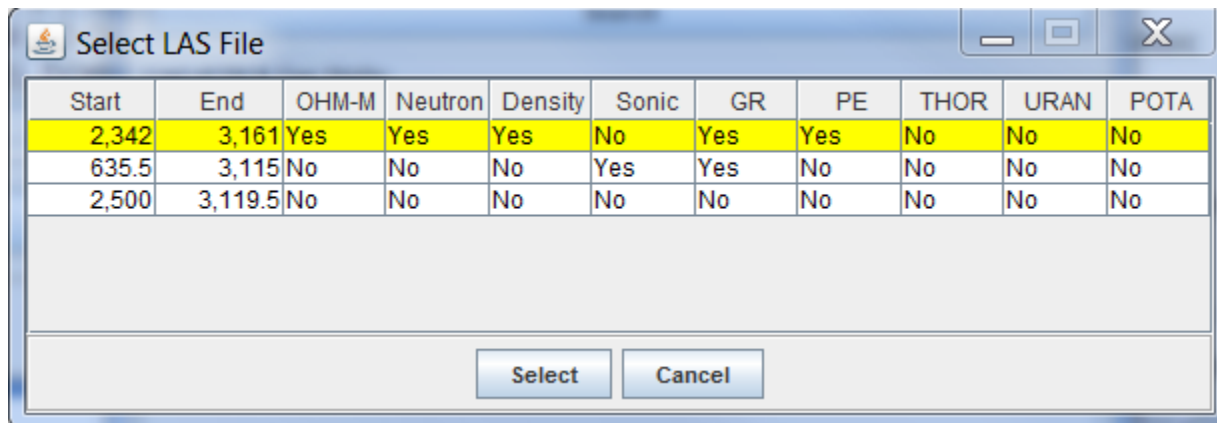
Notice that the LTCI represents the type of data that the well contains. It is a visual aid that lets the user see what is available before trying to download the data. If you require a LAS file you would want to see an L in that column. The LTCI labels stand for the following,

- L – Log ASCII Standard (LAS) version 2.0 Files
- T – Tops Data (Stratigraphic Unit Horizons)
- C – Measured Core Data
- I – Core Joint Photographic Experts Group (JPEG) Image Files

This dialog allows the user to now download each of the data types that are available.

Load KGS Well Data – LAS File Data

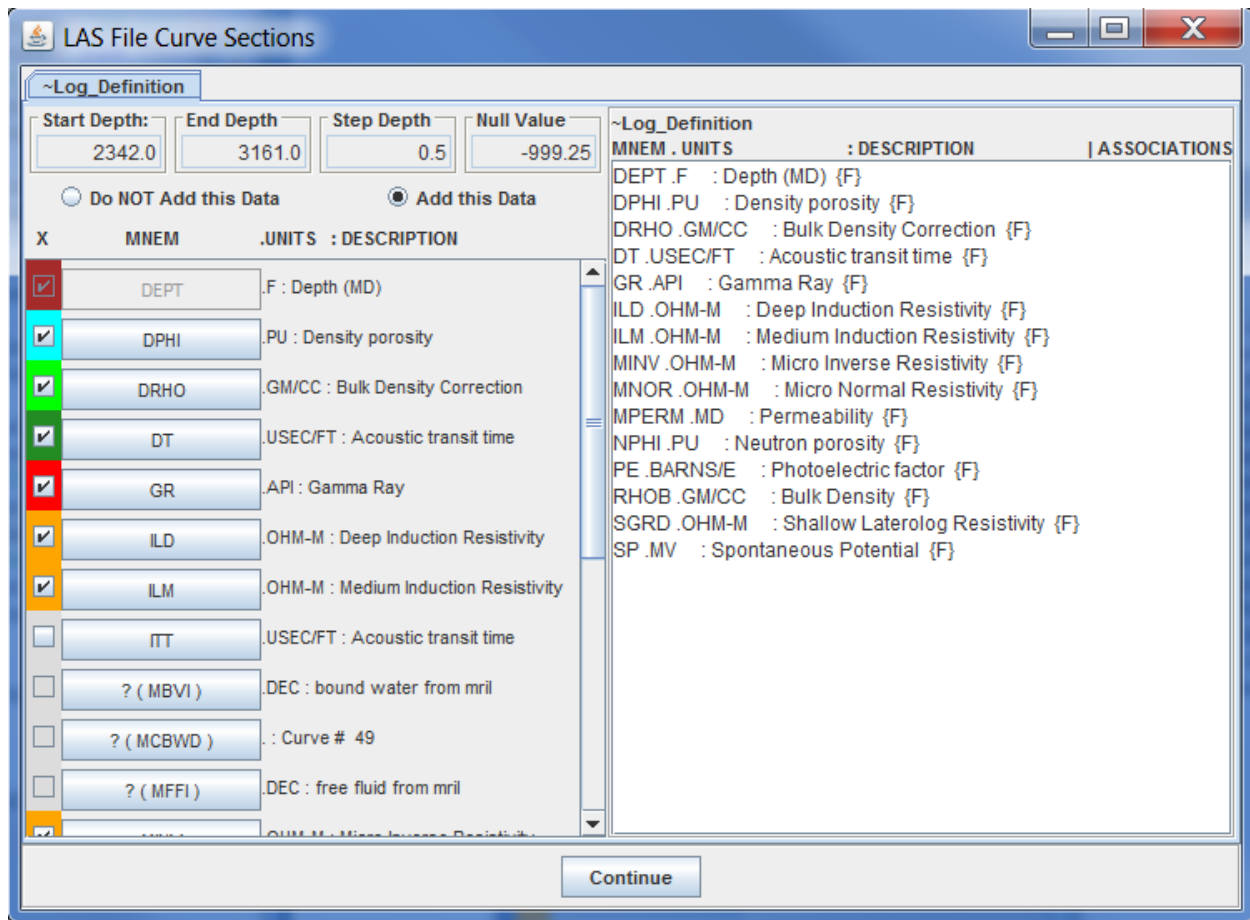
The “Search for Data on KGS Server” Dialog allows the user to download data from the KGS Database & Server to the web app. The “LAS File Data” Button will display the “Select LAS File” Dialog with a list of LAS version 2.0 Files that are available.



In this example there are three LAS files available, with a table suggesting the log data type in the file. In the beginning of the GEMINI Project (2000-2003) a precursor to the GEMINI Tools the KGS populated the Tool Types from every log that was in the KGS Server at that time. Unfortunately KGS has not maintain that table for wells uploaded after 2003 so the LAS File may have “No” for all the log types, which is not accurate. The user will need to open or download the file or search for the Well on the KGS Master List of Oil and Gas Wells in Kansas Web Page (<http://www.kgs.ku.edu/Magellan/Qualified/index.html>) to see what is in the File Header before deciding to download data from this program. For this example the first log has most of the data necessary except the Spectral Gamma Ray Logs. The Table above identifies the following log types,

- OHM-M – Resistivity Logs
- Neutron – Neutron Porosity Log
- Density – Bulk Density and/or Density Porosity Log
- Sonic – Acoustic Transit Time and/or Sonic Porosity Log
- GR – Gamma Ray (API units) Log
- PE – Photoelectric Factor Log
- THOR – Thorium Concentration
- URAN – Uranium Concentration
- POTA – Potassium Concentration)

In this example the first log contains the data needed, highlight the first log and click on the “Select” Button to display the “LAS File Curve Sections” Dialog. The “LAS File Curve Sections” Dialog allows the user to map unknown LAS Curve Mnemonics to the KGS “Standard” Curve Mnemonics so they will be plotted in the Profile Plot. This program reads the “LAS Tool Curve Mnemonics map to KGS Standard Mnemonics” XML File (http://www.kgs.ku.edu/software/gemini/data/las_standard_tools.xml), which will automatically maps the Curve Mnemonics from the LAS file to one of 31 KGS “Standard” Curve Mnemonics.



As you can see this log has all the log types of interest, Gamma Ray API, Resistivity, Neutron/Density, Photoelectric Factor, Sonic and Permeability. If a curve Mnemonic is not recognized the program will place a “?” in front of the Mnemonic, e.g. “?(MPERM16)” for the “: Curve # 51” Log Curve. If the user is satisfied with the automatic curve selections, which are checked and color coded, they only need to select the “Continue” Button at the bottom of the Dialog to import the file. The next section will take the user through a series of examples in changing the curve selections and mapping unknown curve mnemonics.

Notice that some of the check boxes are colored with different colors, which shows that the curves were automatically selected, but also to represent the curve type by color. The Curves are colored by type (data units) as follows,

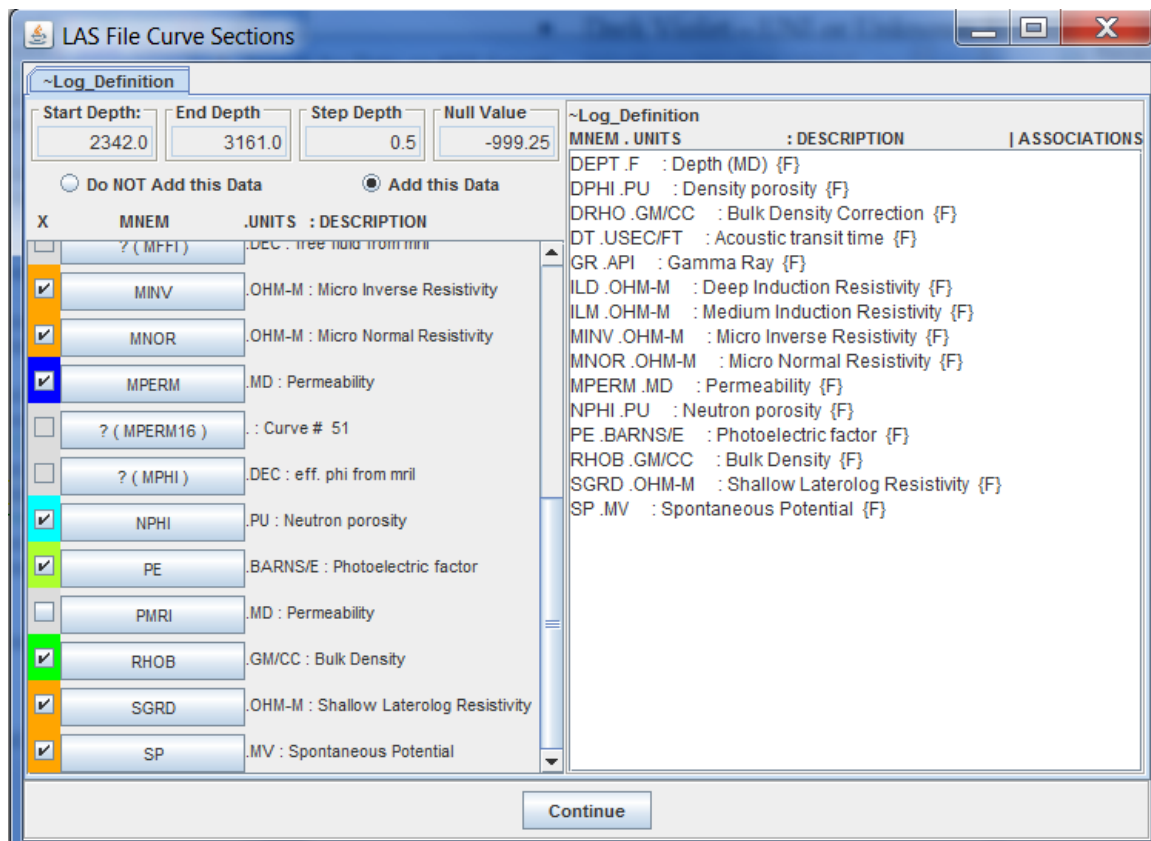
- Orange - OHM-M or Resistivity Logs
- Cyan – PU or porosity Logs, Neutron Porosity, Density Porosity, etc.
- Greenish yellow – BARNS/E or Photoelectric Factor Logs
- Green – GM/CC or Bulk Density Log
- Forest Green – USEC/FT or the Acoustic Transit Time Log
- Red – API, PPM or “%” as Radioactive logs, Gamma Ray, Spectral Gamma Ray, etc.
- Blue – MD or Permeability Logs
- Brown – F, FT or IN or Depth

- Middle yellow – FRAC, or other log curve types.
- Dark Violet – UNI or Unknown Linear Curves
- Medium Violet – UNL or Unknown Logrithum Curves

The color coding of the selected curves were added to also help the user visually recognize that a curve was selected or not.

Map Curves & Change Curve Selections

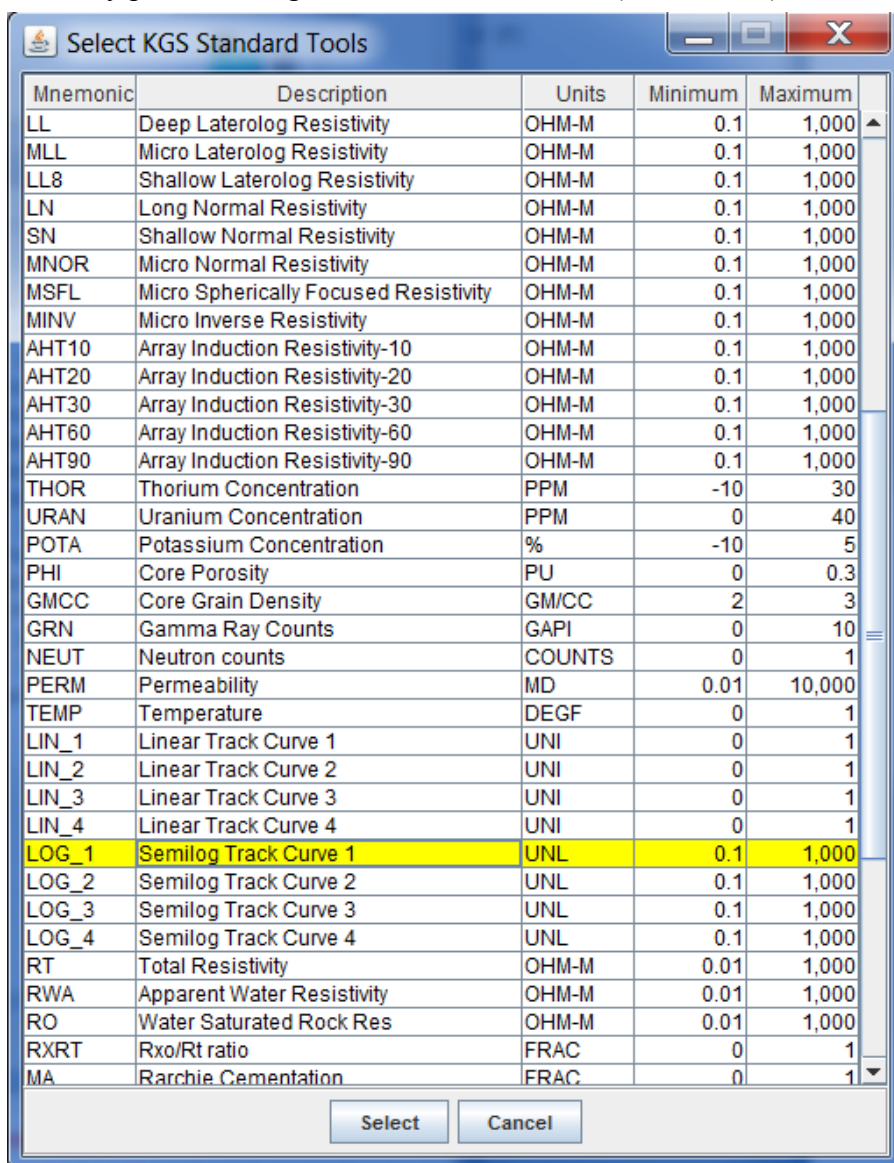
Some logs will have curve mnemonics that are not recognized as one of the KGS “Standard” Curve Mnemonics. The user will need to map the log curve to one of the KGS standard curves if they want to display the curve. Slide the scroll bar down to the Permeability Curves MPERM and ?(MPERM16).



Click on the “?(MPERM16)” Button to display the “Select KGS Standard Tools” Dialog. This dialog provides a list of the KGS “Standard” Curve Mnemonics, from which the user can map an unrecognized log curve to one of the KGS standard curve mnemonics. The KGS “Standard” Curve Mnemonics List was created as a way to standardize the alpha bit soup of Log Mnemonics. Each logging company has their own curve mnemonics to represent similar tools. The Profile program is a later version of code from the GEMINI Project LAS File Viewer Module, which needed to standardize the log curves so the curves could be automatically read and assigned a plot track. The “LAS Tool Curve Mnemonics map to KGS Standard

Mnemonics” XML File was created to map the log curves from logs that were part of the KGS LAS File Collection which is not a complete list of possible curve mnemonics.

To map the unknown curve mnemonic “?(MPERM16)” you first notice that it similar to the MPERM curve above, which is a permeability curve. In this example both curves will be plotted together, but the Permeability Plot Track can only plot one curve. The web app has the ability to allow the user to plot up to 4 unknown logarithm curves and 4 unknown linear curves. The permeability is usually plotted as logarithmic. Click on the “?(MPERM16)” Button to display the



“Select KGS Standard Tools” Dialog. Slide the scroll bar down to the “LOG_1” Mnemonic – Semilog Track Curve 1 and highlight that curve. Click on the “Select” Button to map the “?(MPERM16) to the Semilog Track Curve 1.

LAS File Curve Sections

~Log_Definition

Start Depth: 2342.0 End Depth: 3161.0 Step Depth: 0.5 Null Value: -999.25

☐ Do NOT Add this Data ☒ Add this Data

X	MNEM	.UNITS : DESCRIPTION
<input type="checkbox"/>	? (MFFI)	.DEC : free fluid from mrii
<input checked="" type="checkbox"/>	MINV	.OHM-M : Micro Inverse Resistivity
<input checked="" type="checkbox"/>	MNOR	.OHM-M : Micro Normal Resistivity
<input checked="" type="checkbox"/>	MPERM	.MD : Permeability
<input type="checkbox"/>	MPERM16	.UNL : () Curve # 51
<input type="checkbox"/>	? (MPHI)	.DEC : eff. phi from mrii
<input checked="" type="checkbox"/>	NPHI	.PU : Neutron porosity
<input checked="" type="checkbox"/>	PE	.BARNS/E : Photoelectric factor
<input type="checkbox"/>	PMRI	.MD : Permeability
<input checked="" type="checkbox"/>	RHOB	.GM/CC : Bulk Density
<input checked="" type="checkbox"/>	SGRD	.OHM-M : Shallow Laterolog Resistivity
<input checked="" type="checkbox"/>	SP	.MV : Spontaneous Potential

Continue

~Log_Definition

MNEM . UNITS	: DESCRIPTION	| ASSOCIATIONS
DEPT .F	: Depth (MD) {F}	
DPHI .PU	: Density porosity {F}	
DRHO .GM/CC	: Bulk Density Correction {F}	
DT .USEC/FT	: Acoustic transit time {F}	
GR .API	: Gamma Ray {F}	
ILD .OHM-M	: Deep Induction Resistivity {F}	
ILM .OHM-M	: Medium Induction Resistivity {F}	
MINV .OHM-M	: Micro Inverse Resistivity {F}	
MNOR .OHM-M	: Micro Normal Resistivity {F}	
MPERM .MD	: Permeability {F}	
NPHI .PU	: Neutron porosity {F}	
PE .BARNS/E	: Photoelectric factor {F}	
RHOB .GM/CC	: Bulk Density {F}	
SGRD .OHM-M	: Shallow Laterolog Resistivity {F}	
SP .MV	: Spontaneous Potential {F}	

The ?(MPERM16) Curve has been changed to MPERM16 removing the ?() around the Curve Mnemonic. Also select the check box next to it, which changes to a dark violet.

LAS File Curve Sections

~Log_Definition

Start Depth: 2342.0 End Depth: 3161.0 Step Depth: 0.5 Null Value: -999.25

☐ Do NOT Add this Data ☒ Add this Data

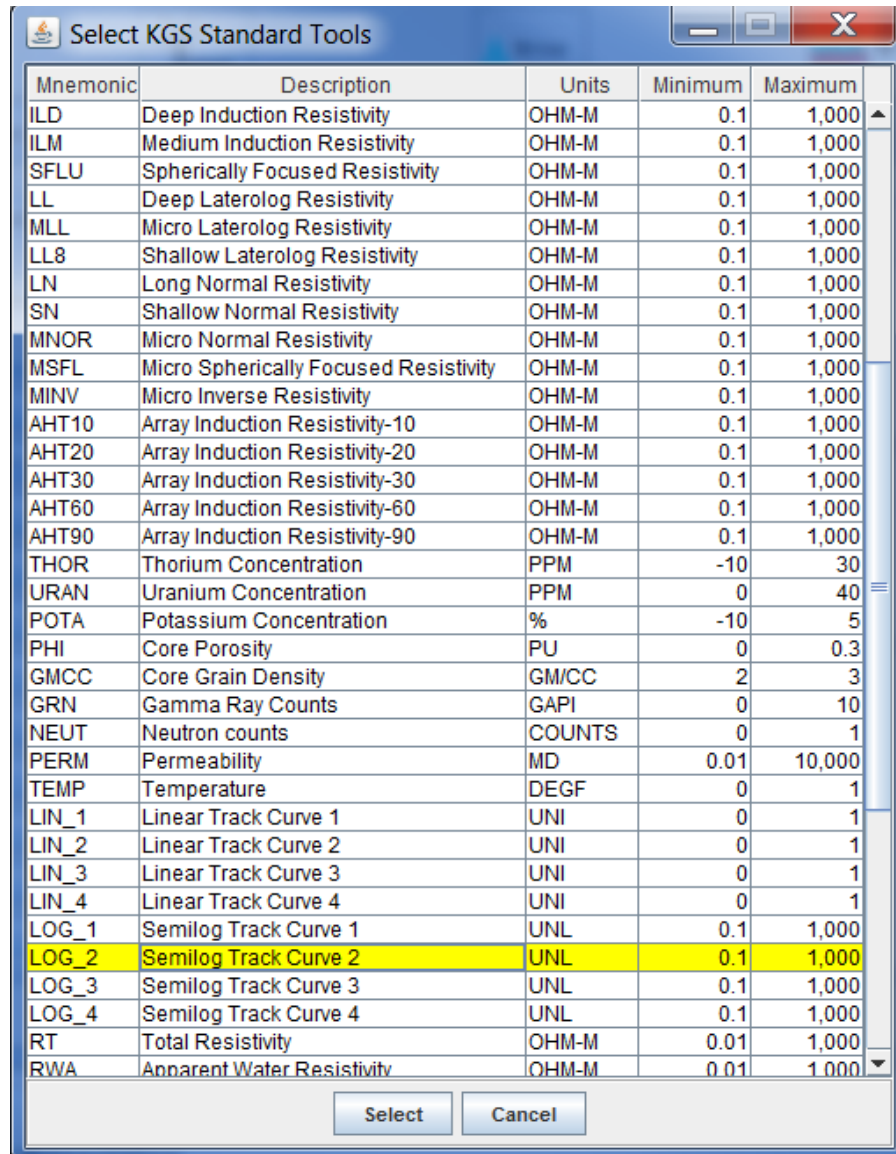
X	MNEM	.UNITS : DESCRIPTION
<input type="checkbox"/>	? (MBVI)	.DEC : bound water from mrii
<input type="checkbox"/>	? (MCBWD)	. : Curve # 49
<input type="checkbox"/>	? (MFFI)	.DEC : free fluid from mrii
<input checked="" type="checkbox"/>	MINV	.OHM-M : Micro Inverse Resistivity
<input checked="" type="checkbox"/>	MNOR	.OHM-M : Micro Normal Resistivity
<input checked="" type="checkbox"/>	MPERM	.MD : Permeability
<input checked="" type="checkbox"/>	MPERM16	.UNL : () Curve # 51
<input type="checkbox"/>	? (MPHI)	.DEC : eff. phi from mrii
<input checked="" type="checkbox"/>	NPHI	.PU : Neutron porosity
<input checked="" type="checkbox"/>	PE	.BARNS/E : Photoelectric factor
<input type="checkbox"/>	PMRI	.MD : Permeability
<input checked="" type="checkbox"/>	RHOB	.GM/CC : Bulk Density

Continue

~Log_Definition

MNEM . UNITS	: DESCRIPTION	| ASSOCIATIONS
DEPT .F	: Depth (MD) {F}	
DPHI .PU	: Density porosity {F}	
DRHO .GM/CC	: Bulk Density Correction {F}	
DT .USEC/FT	: Acoustic transit time {F}	
GR .API	: Gamma Ray {F}	
ILD .OHM-M	: Deep Induction Resistivity {F}	
ILM .OHM-M	: Medium Induction Resistivity {F}	
MINV .OHM-M	: Micro Inverse Resistivity {F}	
MNOR .OHM-M	: Micro Normal Resistivity {F}	
MPERM .MD	: Permeability {F}	
MPERM16 .UNL	: Curve # 51 {F}	
NPHI .PU	: Neutron porosity {F}	
PE .BARNS/E	: Photoelectric factor {F}	
RHOB .GM/CC	: Bulk Density {F}	
SGRD .OHM-M	: Shallow Laterolog Resistivity {F}	
SP .MV	: Spontaneous Potential {F}	

In order to plot both Permeability Curves on the same track, the MPERM must be assigned to the unknown Log Curves with MPERM16. Click on the MPERM Mnemonic Button to display the



Mnemonic	Description	Units	Minimum	Maximum
ILD	Deep Induction Resistivity	OHM-M	0.1	1,000
ILM	Medium Induction Resistivity	OHM-M	0.1	1,000
SFLU	Spherically Focused Resistivity	OHM-M	0.1	1,000
LL	Deep Laterolog Resistivity	OHM-M	0.1	1,000
MLL	Micro Laterolog Resistivity	OHM-M	0.1	1,000
LL8	Shallow Laterolog Resistivity	OHM-M	0.1	1,000
LN	Long Normal Resistivity	OHM-M	0.1	1,000
SN	Shallow Normal Resistivity	OHM-M	0.1	1,000
MNOR	Micro Normal Resistivity	OHM-M	0.1	1,000
MSFL	Micro Spherically Focused Resistivity	OHM-M	0.1	1,000
MINV	Micro Inverse Resistivity	OHM-M	0.1	1,000
AHT10	Array Induction Resistivity-10	OHM-M	0.1	1,000
AHT20	Array Induction Resistivity-20	OHM-M	0.1	1,000
AHT30	Array Induction Resistivity-30	OHM-M	0.1	1,000
AHT60	Array Induction Resistivity-60	OHM-M	0.1	1,000
AHT90	Array Induction Resistivity-90	OHM-M	0.1	1,000
THOR	Thorium Concentration	PPM	-10	30
URAN	Uranium Concentration	PPM	0	40
POTA	Potassium Concentration	%	-10	5
PHI	Core Porosity	PU	0	0.3
GMCC	Core Grain Density	GM/CC	2	3
GRN	Gamma Ray Counts	GAPI	0	10
NEUT	Neutron counts	COUNTS	0	1
PERM	Permeability	MD	0.01	10,000
TEMP	Temperature	DEGF	0	1
LIN_1	Linear Track Curve 1	UNI	0	1
LIN_2	Linear Track Curve 2	UNI	0	1
LIN_3	Linear Track Curve 3	UNI	0	1
LIN_4	Linear Track Curve 4	UNI	0	1
LOG_1	Semilog Track Curve 1	UNL	0.1	1,000
LOG_2	Semilog Track Curve 2	UNL	0.1	1,000
LOG_3	Semilog Track Curve 3	UNL	0.1	1,000
LOG_4	Semilog Track Curve 4	UNL	0.1	1,000
RT	Total Resistivity	OHM-M	0.01	1,000
RWA	Apparent Water Resistivity	OHM-M	0.01	1,000

“Select KGS Standard Tools” Dialog. Slide the scroll bar down to the “LOG_2” Mnemonic – Semilog Track Curve 2 and highlight that curve. Click on the “Select” Button to map the “MPERM to the Semilog Track Curve 2.

LAS File Curve Sections

~Log_Definition

Start Depth: 2342.0 End Depth: 3161.0 Step Depth: 0.5 Null Value: -999.25

☐ Do NOT Add this Data ☒ Add this Data

X	MNEM	.UNITS	DESCRIPTION
<input type="checkbox"/>	? (MBVI)	.DEC	: bound water from mrii
<input type="checkbox"/>	? (MCBWD)	.	: Curve # 49
<input type="checkbox"/>	? (MFFI)	.DEC	: free fluid from mrii
<input checked="" type="checkbox"/>	MINV	.OHM-M	: Micro Inverse Resistivity
<input checked="" type="checkbox"/>	MNOR	.OHM-M	: Micro Normal Resistivity
<input checked="" type="checkbox"/>	MPERM	.UNL : (UNL) (MD)	Permeability
<input checked="" type="checkbox"/>	MPERM16	.UNL : ()	Curve # 51
<input type="checkbox"/>	? (MPHI)	.DEC	: eff. phi from mrii
<input checked="" type="checkbox"/>	NPHI	.PU	: Neutron porosity
<input checked="" type="checkbox"/>	PE	.BARNS/E	: Photoelectric factor
<input type="checkbox"/>	PMRI	.MD	: Permeability

~Log_Definition

MNEM	.UNITS	DESCRIPTION	ASSOCIATIONS
DEPT	.F	: Depth (MD) {F}	
DPHI	.PU	: Density porosity {F}	
DRHO	.GM/CC	: Bulk Density Correction {F}	
DT	.USEC/FT	: Acoustic transit time {F}	
GR	.API	: Gamma Ray {F}	
ILD	.OHM-M	: Deep Induction Resistivity {F}	
ILM	.OHM-M	: Medium Induction Resistivity {F}	
MINV	.OHM-M	: Micro Inverse Resistivity {F}	
MNOR	.OHM-M	: Micro Normal Resistivity {F}	
MPERM	.UNL	: Permeability {F}	
MPERM16	.UNL	: Curve # 51 {F}	
NPHI	.PU	: Neutron porosity {F}	
PE	.BARNS/E	: Photoelectric factor {F}	
RHOB	.GM/CC	: Bulk Density {F}	
SGRD	.OHM-M	: Shallow Laterolog Resistivity {F}	
SP	.MV	: Spontaneous Potential {F}	

Continue

Click the check box next to the MPERM Mnemonic Button you will notice that it has the same color as MPERM16, which now groups the two curves together. Select the “Continue” Button to load the LAS File into the web app.

Load KGS Well Data – Top Picks

The “Search for Data on KGS Server” Dialog allows the user to download data from the KGS Database & Server to the web app. The “Top Picks” Button will display the “Move/Merge KGS Data” Dialog with available top picks grouped by the sources creating the tops.

Move/Merge KGS Data.

KGS Stratigraphic Units:

☒ HUG ELOG-EM
☐ MKD
☐ MKD-07/2006

List of Sources for the tops, e.g. Newby 2-28R has 3 sources of tops data. The user can search through and add some or all to the web app.

Add to User's Stratigraphic Units List:

☐ Remove & Replace ☒ Add to List ☐ Add New Units Only

Source	Top	Base	Name	R
HUG ELOG-EM	0	0	Council Grove	GROL
HUG ELOG-EM	728	0	Day Creek Dolomite	FORM
HUG ELOG-EM	1,090	1,170	Blaine	FORM
HUG ELOG-EM	1,250	1,412	Cedar Hills Sandstone	FORM
HUG ELOG-EM	1,690	1,759	Stone Corral	FORM
HUG ELOG-EM	2,182	2,516	Wellington	FORM
HUG ELOG-EM	2,291	0	Hutchinson Salt	MEMB
HUG ELOG-EM	2,496	0	Hollenberg Limestone	MEMB
HUG ELOG-EM	2,516	2,832	Chase	GROL
HUG ELOG-EM	2,516	2,536	Herington Limestone	MEMB

User's Stratigraphic Units:

Source	Top	Base	Name	Rank	P
HUG ELOG-EM	728	0	Day Creek Dolomite	FORMATION	P
HUG ELOG-EM	1,090	1,170	Blaine	FORMATION	P
HUG ELOG-EM	1,250	1,412	Cedar Hills Sandstone	FORMATION	P
HUG ELOG-EM	1,690	1,759	Stone Corral	FORMATION	P
HUG ELOG-EM	2,182	2,516	Wellington	FORMATION	P
HUG ELOG-EM	2,291	0	Hutchinson Salt	MEMBER	P
HUG ELOG-EM	2,496	0	Hollenberg Limestone	MEMBER	P
HUG ELOG-EM	2,516	2,832	Chase	GROUP	P
HUG ELOG-EM	2,516	2,536	Herington Limestone	MEMBER	P
HUG ELOG-EM	2,536	2,538	Paddock Shale	MEMBER	P
HUG ELOG-EM	2,544	2,580	Krider Limestone	MEMBER	P
HUG ELOG-EM	2,580	2,594	Odell Shale	FORMATION	P
HUG ELOG-EM	2,594	2,629	Winfield Limestone	FORMATION	P
HUG ELOG-EM	2,632	0	Gage Shale	MEMBER	P
HUG ELOG-EM	2,655	2,704	Towanda Limestone	MEMBER	P
HUG ELOG-EM	2,742	2,756	East Diley Limestone	MEMBER	P

Buttons: Add, Add All, Clear Selection, Clear Selection, Remove, Remove All, Load Data, Close

“Add to User's Stratigraphic Units List” Table shows the tops selected by the source, e.g. “HUG ELOG-EM” Source Tops List.

Radio Buttons

Remove & Replace – move the selected tops and replace any duplicate names

Add to List – move the selected tops to the “User's Stratigraphic Units” Table

Add New Units Only – move on the selected tops that are not already in the “User's Stratigraphic Units” Table

Table Buttons

Add – add the highlighted top(s) to the “User's Stratigraphic Units” Table. Note: this table will allow the user to select multiple wells by using the “Ctrl” Key and the left click of mouse.

Add All – copy the list of tops to the “User's Stratigraphic Units” Table.

Clear Selection – remove the highlight on tops selected.

“Add to User's Stratigraphic Units List” Table.

“User's Stratigraphic Units” Table shows the list of tops that will appear in the web app when the user selects the “Load Data” Button.

Table Buttons

Clear Selection – remove the highlight on tops selected.

Remove – remove the highlighted top(s) from the table. Note: this table will allow the user to select multiple wells by using the “Ctrl” Key and the left click of mouse.

Remove All – remove all tops from the table.

Load Data – transfer the tops list to the web app calling.

Close – Close this dialog

This dialog allows the user to add all or some the tops from each of the sources. Both tables are set up so the user can use the “Ctrl” Key with the left click of mouse to select multiple tops, i.e.

Notice that the only some of the tops are selected. You can then select the Add Button to move only the selected tops to the “User’s Stratigraphic Units” Table.

MKD Source Example:

KGS Stratigraphic Units:

☐ HUG ELOG-EM

☒ MKD

☐ MKD-07/2006

Add to User's Stratigraphic Units List:

☒ Remove & Replace ☐ Add to List ☐ Add New Units Only

Source	Top	Base	Name	R
MKD	0	2,773	Fort Riley Limestone	MEMB
MKD	0	2,693	Towanda Limestone	MEMB
MKD	2,538	2,580	Krider Limestone	MEMB
MKD	2,629	0	Gage Shale	MEMB
MKD	2,712	0	Fort Riley Limestone	MEMB
MKD	2,777	2,789	Florence Limestone	MEMB
MKD	2,807	0	Wreford Limestone	FORM
MKD	2,832	0	Council Grove	GROL
MKD	2,832	0	Council Grove	GROL
MKD	2,832	2,853.5	Speiser Shale	FORM

(1) Select the MKD Source, which will be displayed in the “Add to User’s Stratigraphic Units List” Table.

Add Add All Clear Selection

KGS Stratigraphic Units:

☐ HUG ELOG-EM

☒ MKD

☐ MKD-07/2006

Add to User's Stratigraphic Units List:

☐ Remove & Replace ☒ Add to List ☐ Add New Units Only

Source	Top	Base	Name	R
MKD	0	2,773	Fort Riley Limestone	MEMB
MKD	0	2,693	Towanda Limestone	MEMB
MKD	2,538	2,580	Krider Limestone	MEMB
MKD	2,629	0	Gage Shale	MEMB
MKD	2,712	0	Fort Riley Limestone	MEMB
MKD	2,777	2,789	Florence Limestone	MEMB
MKD	2,807	0	Wreford Limestone	FORM
MKD	2,832	0	Council Grove	GROL
MKD	2,832	0	Council Grove	GROL
MKD	2,832	2,853.5	Speiser Shale	FORM

(2) Select the “Add to List” Radio button.

Add Add All Clear Selection

KGS Stratigraphic Units:

☐ HUG ELOG-EM
☒ MKD
☐ MKD-07/2006

Add to User's Stratigraphic Units List:

☐ Remove & Replace ☒ Add to List ☐ Add New Units Only

Source	Top	Base	Name	R
MKD	0	2,773	Fort Riley Limestone	MEMB
MKD	0	2,693	Towanda Limestone	MEMB
MKD	2,538	2,580	Krider Limestone	MEMB
MKD	2,629	0	Gage Shale	MEMB
MKD	2,712	0	Fort Riley Limestone	MEMB
MKD	2,777	2,789	Florence Limestone	MEMB
MKD	2,807	0	Wreford Limestone	FORM
MKD	2,832	0	Council Grove	GROU
MKD	2,832	0	Council Grove	GROU
MKD	2,832	2,853.5	Speiser Shale	FORM

User's Stratigraphic Units:

Source	Top	Base	Name	Rank	
MKD	2,538	2,580	Krider Limestone	MEMBER	P
MKD	2,629	0	Gage Shale	MEMBER	P
MKD	2,712	0	Fort Riley Limestone	MEMBER	P
MKD	2,777	2,789	Florence Limestone	MEMBER	P
MKD	2,807	0	Wreford Limestone	FORMATION	P
MKD	2,832	0	Council Grove	GROUP	P
MKD	2,832	0	Council Grove	GROUP	P
MKD	2,832	2,853.5	Speiser Shale	FORMATION	P
MKD	2,853.5	2,894.5	Funston Limestone	FORMATION	P
MKD	2,894.5	2,910.5	Blue Rapids Shale	FORMATION	P
MKD	2,910.5	2,929	Crouse Limestone	FORMATION	P
MKD	2,929	2,933.5	Easley Creek Shale	FORMATION	P
MKD	2,933.5	2,947	Middleburg Limestone	MEMBER	P
MKD	2,947	2,957.5	Hooser Shale	MEMBER	P
MKD	2,957.5	2,962.5	Eiss Limestone	MEMBER	P
MKD	2,962.5	2,973.5	Stages Shale	FORMATION	P

Once the list of tops are in the "User's Stratigraphic Units" Table the user can edit the list by removing any duplicate or invalid tops. Notice that the "Council Grove" Top occurs 2 times in the list. Highlight the one of the "Council Grove" tops.

User's Stratigraphic Units:

Source	Top	Base	Name	Rank	
MKD	2,538	2,580	Krider Limestone	MEMBER	P ▲
MKD	2,629	0	Gage Shale	MEMBER	P
MKD	2,712	0	Fort Riley Limestone	MEMBER	P
MKD	2,777	2,789	Florence Limestone	MEMBER	P
MKD	2,807	0	Wreford Limestone	FORMATION	P
MKD	2,832	0	Council Grove	GROUP	P
MKD	2,832	0	Council Grove	GROUP	P
MKD	2,832	2,853.5	Speiser Shale	FORMATION	P
MKD	2,853.5	2,894.5	Funston Limestone	FORMATION	P
MKD	2,894.5	2,910.5	Blue Rapids Shale	FORMATION	P
MKD	2,910.5	2,929	Crouse Limestone	FORMATION	P
MKD	2,929	2,933.5	Easley Creek Shale	FORMATION	P
MKD	2,933.5	2,947	Middleburg Limestone	MEMBER	P
MKD	2,947	2,957.5	Hooser Shale	MEMBER	P
MKD	2,957.5	2,962.5	Eiss Limestone	MEMBER	P
MKD	2,962.5	2,972.5	Stearns Shale	FORMATION	P ▼

Buttons: Clear Selection, Remove, Remove All, Load Data, Close

Now select the "Remove" Button.

User's Stratigraphic Units:

Source	Top	Base	Name	Rank	
MKD	2,538	2,580	Krider Limestone	MEMBER	P ▲
MKD	2,629	0	Gage Shale	MEMBER	P
MKD	2,712	0	Fort Riley Limestone	MEMBER	P
MKD	2,777	2,789	Florence Limestone	MEMBER	P
MKD	2,807	0	Wreford Limestone	FORMATION	P
MKD	2,832	0	Council Grove	GROUP	P
MKD	2,832	2,853.5	Speiser Shale	FORMATION	P
MKD	2,853.5	2,894.5	Funston Limestone	FORMATION	P
MKD	2,894.5	2,910.5	Blue Rapids Shale	FORMATION	P
MKD	2,910.5	2,929	Crouse Limestone	FORMATION	P
MKD	2,929	2,933.5	Easley Creek Shale	FORMATION	P
MKD	2,933.5	2,947	Middleburg Limestone	MEMBER	P
MKD	2,947	2,957.5	Hooser Shale	MEMBER	P
MKD	2,957.5	2,962.5	Eiss Limestone	MEMBER	P
MKD	2,962.5	2,972.5	Stearns Shale	FORMATION	P ▼
MKD	2,972.5	2,972.5	Merrill Limestone	MEMBER	P

Buttons: Clear Selection, Remove, Remove All, Load Data, Close

The MKD-07/2006 has only one top, so this dialog allows the user to add that top to the "User's Stratigraphic Units" Table. The MKD does not have this top and this is an extra top missing from the MKD data set.

KGS Stratigraphic Units:

☐ HUG ELOG-EM
☐ MKD
☒ MKD-07/2006

Add to User's Stratigraphic Units List:

☐ Remove & Replace ☒ Add to List ☐ Add New Units Only

Source	Top	Base	Name	Rank
MKD-07/2006	2,789	2,807	Matfield Shale	FORMATION

(1) Select the MKD-07/2006 Source, which will be displayed in the "Add to User's Stratigraphic Units List" Table.

(2) Select the "Add All" Button to move the contents from the "Add to User's Stratigraphic Units List" Table to the "User's Stratigraphic Units" table.

Buttons: Add, **Add All**, Clear Selection

User's Stratigraphic Units:

Source	Top	Base	Name	Rank	
MKD	2,538	2,580	Krider Limestone	MEMBER	P
MKD	2,629	0	Gage Shale	MEMBER	P
MKD	2,712	0	Fort Riley Limestone	MEMBER	P
MKD	2,777	2,789	Florence Limestone	MEMBER	P
MKD-07/2006	2,789	2,807	Matfield Shale	FORMATION	P
MKD	2,807	0	Wreford Limestone	FORMATION	P
MKD	2,832	0	Council Grove	GROUP	P
MKD	2,832	2,853.5	Speiser Shale	FORMATION	P
MKD	2,853.5	2,894.5	Funston Limestone	FORMATION	P
MKD	2,894.5	2,910.5	Blue Rapids Shale	FORMATION	P
MKD	2,910.5	2,929	Crouse Limestone	FORMATION	P
MKD	2,929	2,933.5	Easily Creek Shale	FORMATION	P
MKD	2,933.5	2,947	Middleburg Limestone	MEMBER	P
MKD	2,947	2,957.5	Hooser Shale	MEMBER	P
MKD	2,957.5	2,962.5	Eiss Limestone	MEMBER	P
MKD	2,962.5	2,972.5	Steele Shale	FORMATION	P

Buttons: Clear Selection, Remove, Remove All, Load Data, Close

Now with the data set complete select the "Load Data" Button to import the Tops data into the web app.

Load KGS Well Data – Core Data

The "Search for Data on KGS Server" Dialog allows the user to download data from the KGS Database & Server to the web app. The "Core Data" Button will automatically load any measured core data that is in the KGS Database and import directly into the web app.

As the user accepted each data type the “Data Source Filenames:” Panel in the Load Data Dialog changes. The LAS File that was downloaded from the KGS Server to the Profile Web App is added to the “Log ASCII Standard (LAS) Files” panel will show the filename downloaded. The Log Data, Perforations, Tops Data, Measured Core Data, Core Images and the Geologist Report Data Type have been downloaded from KGS.

Load Data

Data Source

KGS Data KGS (Database & Server)

Well Data

PC Data PC (ASCII Data Files) Ver 2.0 & 3.0

LAS File

Tops CSV

Rock Data CSV

Data Loaded

Data Source Filenames:

Log ASCII Standard (LAS) Files:

1: 1022012442.las

2:

3:

PC ASCII Files:

Tops CSV:

Core CSV:

Data Type	3.0	LAS	CSV	KGS	Data Type	3.0	LAS	CSV	KGS
Log Data			YES	Rock Measured Data	.....			YES
Perforations			YES	PfEFFER Data	NO			
Tops Data			YES					

Log Curves / Files	LAS	Core	Log Curves / Files	LAS	Core
Resistivity	.... YES	....	Gamma Ray	.... YES	....
Porosity	.... YES	YES	Spontaneous Potential	.... YES	....
-- Neutron	.... YES	....	Photoelectric Factor	.... YES	....
-- Bulk Density	.... YES	....		
-- Sonic	.... YES	....		

Continue Clear Exit

Importing PC Data - Download Well Data to PC

Download either the ASCII Text Files directly or the Zip files extracting the contents into a directory. The problem with the ASCII Text Files being downloaded directly from a web page is that the web page will alter the contents so it does not retain the basic structure and add HTML text to the file. The preferred method if you have Zip or WinZip is to download the zip files to your PC and extract.

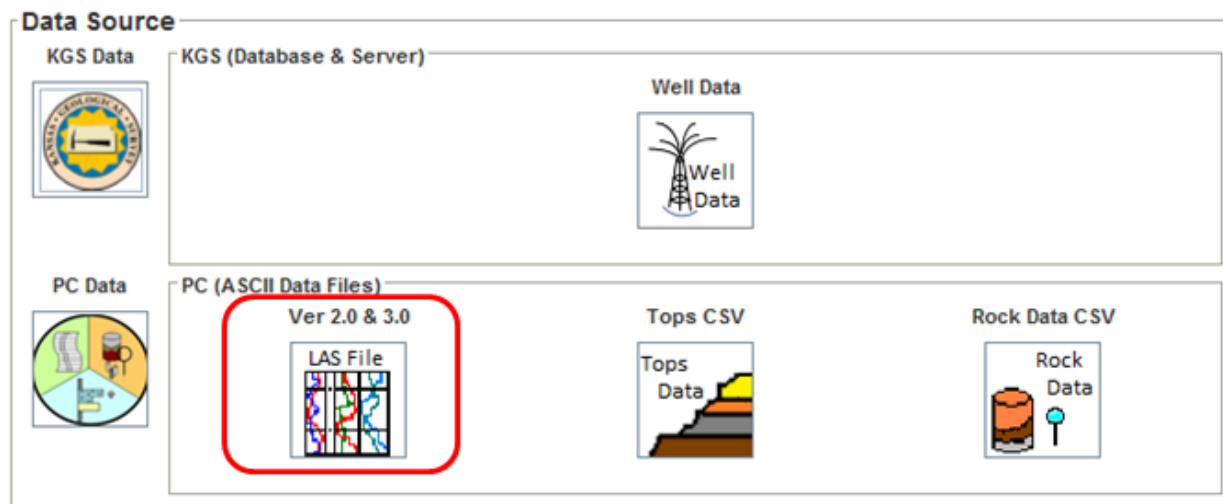
Well Data: Wellington KGS 1-32, Sumner County, Kansas

Type	ASCII Text Files
LAS 2.0	http://www.kgs.ku.edu/Gemini/Tools/documentation/Wellington-KGS-1-32.las
Tops	http://www.kgs.ku.edu/Gemini/Tools/documentation/Wellington-KGS-1-32_Tops.csv
Core	http://www.kgs.ku.edu/Gemini/Tools/documentation/Wellington-KGS-1-32_Core_Data.csv

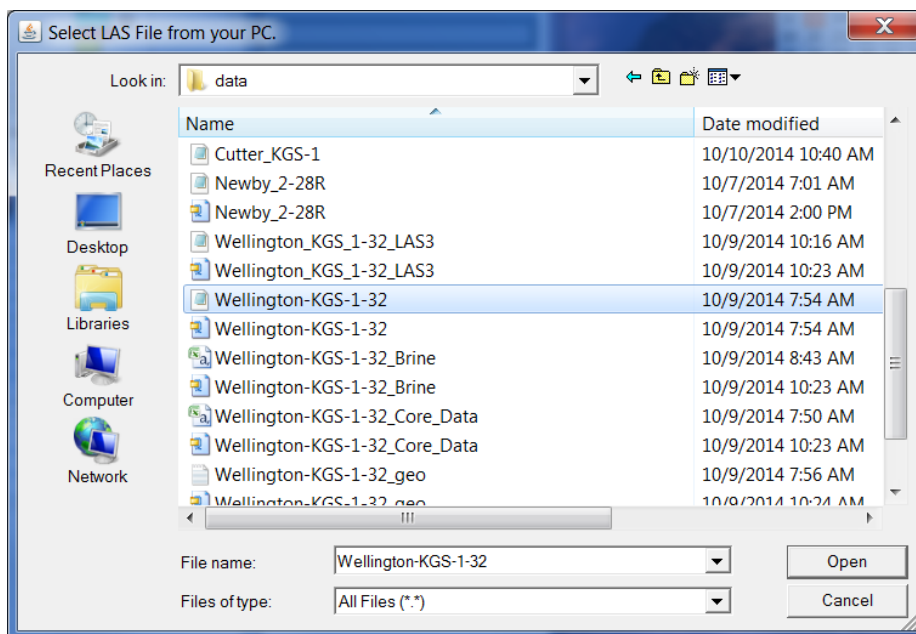
Type	Zip Files
LAS 2.0	http://www.kgs.ku.edu/Gemini/Tools/documentation/Wellington-KGS-1-32.zip
Tops	http://www.kgs.ku.edu/Gemini/Tools/documentation/Wellington-KGS-1-32_Tops.zip
Core	http://www.kgs.ku.edu/Gemini/Tools/documentation/Wellington-KGS-1-32_Core_Data.zip

Importing PC Data – Log ASCII Standard (LAS) version 2.0 File

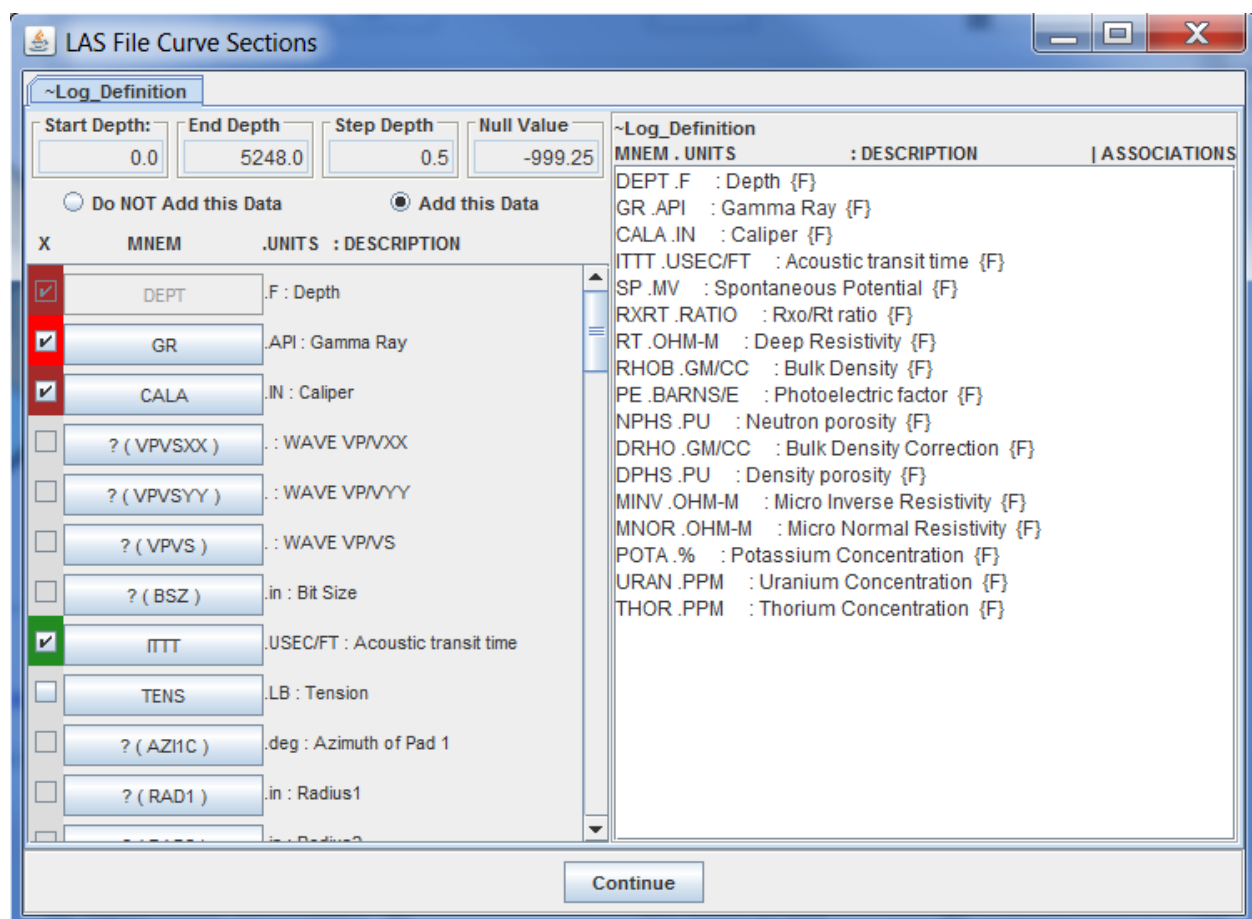
Most of the web apps will use the same input dialogs to import Log ASCII Standard (LAS) version 2.0 or 3.0 files. The Load Data Dialog is basically the same for most of the Web Apps, except they only load a subset of the total data types. In this example a LAS version 2.0 file is being imported into the web app.



Left Click on the “LAS File” Icon Button in the Data Source Panel of the Load Data Dialog. This will display the “Select LAS File from your PC” Dialog. This dialog allows the user to search their PC for the file of interest. In this example it is the LAS version 2.0 file Wellington-KGS-1-32.las, highlighted below. Select the Open button to display the “LAS File Curve Sections” Dialog.



The “LAS File Curve Sections” Dialog allows the user to map unknown LAS Curve Mnemonics to the KGS “Standard” Curve Mnemonics so they will be plotted in the Profile Plot. This program reads the “LAS Tool Curve Mnemonics map to KGS Standard Mnemonics” XML File (http://www.kgs.ku.edu/software/gemini/data/las_standard_tools.xml), which will automatically maps the Curve Mnemonics from the LAS file to one of 31 KGS “Standard” Curve Mnemonics. If a curve Mnemonic is not recognized the program will place a “?” in front of the Mnemonic, e.g. “?(BSZ)” for the “.in : Bit Size” Log Curve. If the user is satisfied with the automatic curve selections, which are checked and color coded, they only need to select the “Continue” Button at the bottom of the Dialog to import the file. The next section will take the user through a series of examples in changing the curve selections and mapping unknown curve mnemonics.



Notice that some of the check boxes are colored with different colors, which shows that the curves were automatically selected, but also to represent the curve type by color. The Curves are colored by type (data units) as follows,

- Orange - OHM-M or Resistivity Logs
- Cyan – PU or porosity Logs, Neutron Porosity, Density Porosity, etc.
- Greenish yellow – BARNS/E or Photoelectric Factor Logs

- Green – GM/CC or Bulk Density Log
- Forest Green – USEC/FT or the Acoustic Transit Time Log
- Red – API, PPM or “%” as Radioactive logs, Gamma Ray, Spectral Gamma Ray, etc.
- Blue – MD or Permeability Logs
- Brown – F, FT or IN or Depth
- Middle yellow – FRAC, or other log curve types.
- Dark Violet – UNI or Unknown Linear Curves
- Medium Violet – UNL or Unknown Logrithum Curves

The color coding of the selected curves were added to also help the user visually recognize that a curve was selected or not.

Map Curves & Change Curve Selections

Some logs will have curve mnemonics that are not recognized as one of the KGS “Standard” Curve Mnemonics. The user will need to map the log curve to one of the KGS standard curves if they want to display the curve. The first example is to map the Acoustic Transit Time (DT), which is labeled as “.uspf : WAVE DTC” log curve in the LAS File. Also notice that the button label “?(DTC)” is not recognized by the PROFILE web app.

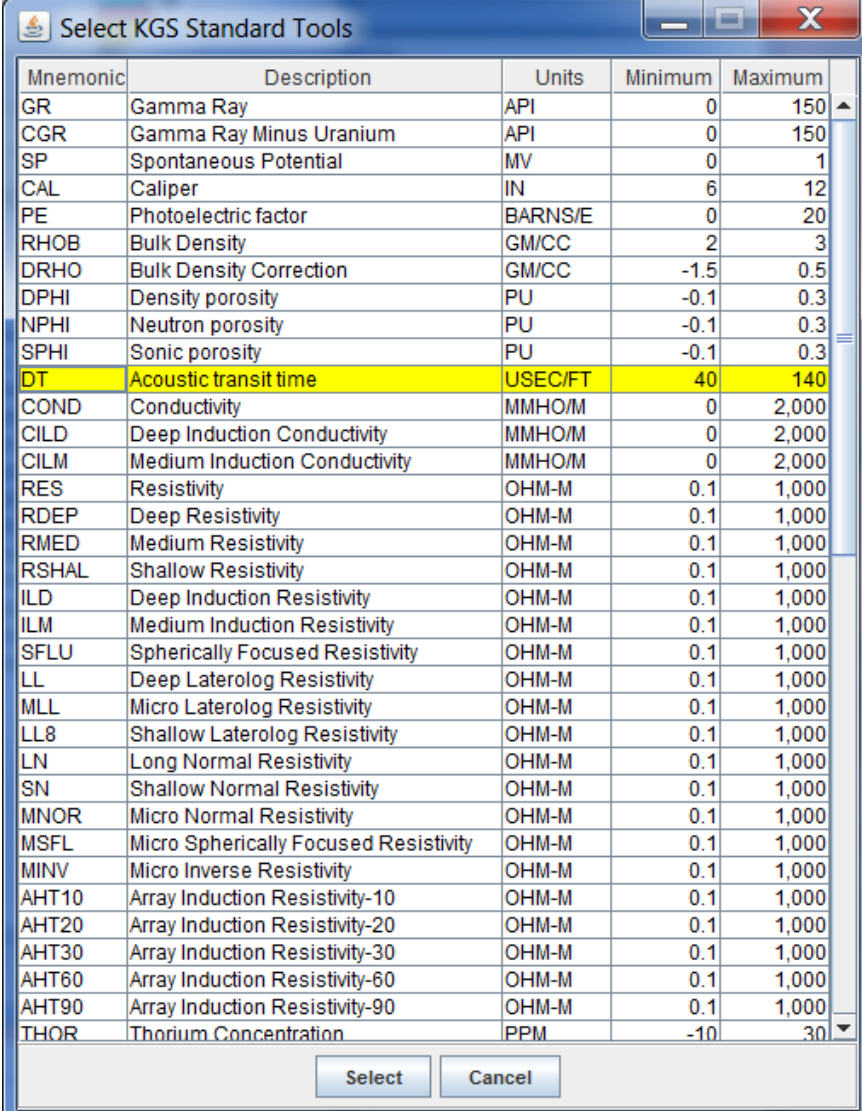
The screenshot shows the "LAS File Curve Sections" dialog box. The "Log Definition" tab is active. The "Start Depth" is 0.0, "End Depth" is 5248.0, "Step Depth" is 0.5, and "Null Value" is -999.25. The "Add this Data" radio button is selected. The list of curves on the left includes:

X	MNEM	.UNITS : DESCRIPTION
<input checked="" type="checkbox"/>	ITTT	USEC/FT : Acoustic transit time
<input type="checkbox"/>	TENS	LB : Tension
<input type="checkbox"/>	? (AZHC)	deg : Azimuth of Pad 1
<input type="checkbox"/>	? (RAD1)	.in : Radius1
<input type="checkbox"/>	? (RAD2)	.in : Radius2
<input type="checkbox"/>	? (RAD3)	.in : Radius3
<input type="checkbox"/>	? (RAD4)	.in : Radius4
<input type="checkbox"/>	? (RAD5)	.in : Radius5
<input type="checkbox"/>	? (RAD6)	.in : Radius6
<input type="checkbox"/>	? (TPUL)	: Tension Pull
<input type="checkbox"/>	? (DTXX)	uspf : WAVE XX Flexural
<input type="checkbox"/>	? (DTC)	uspf : WAVE DTC

The right pane shows the details for the selected curve, "ITTT .USEC/FT : Acoustic transit time {F}". A red arrow points to the "?(DTC)" curve in the list.

Click on the “?(DTC)” Button to display the “Select KGS Standard Tools” Dialog. This dialog provides a list of the KGS “Standard” Curve Mnemonics, from which the user can map an unrecognized log curve to one of the KGS standard curve mnemonics. The KGS “Standard” Curve Mnemonics List was created as a way to standardize the alpha bit soup of Log Mnemonics. Each logging company has their own curve mnemonics to represent similar tools. The Profile program is a later version of code from the GEMINI Project LAS File Viewer Module, which needed to standardize the log curves so the curves could be automatically read and assigned a plot track. The “LAS Tool Curve Mnemonics map to KGS Standard Mnemonics” XML File was created to map the log curves from logs that were part of the KGS LAS File Collection which is not a complete list of possible curve mnemonics.

To map the unknown curve mnemonic “?(DTC)” you first notice that the unit is “uspf” (micro seconds per foot) a unit of time. Also the Acoustic Transit Time Curve Mnemonic is similar to the KGS “Standard” Curve Mnemonic “DT”. By selecting the “?(DTC)” Button you will display the “Select KGS Standard Tools” Dialog.



Mnemonic	Description	Units	Minimum	Maximum
GR	Gamma Ray	API	0	150
CGR	Gamma Ray Minus Uranium	API	0	150
SP	Spontaneous Potential	MV	0	1
CAL	Caliper	IN	6	12
PE	Photoelectric factor	BARNSE	0	20
RHOB	Bulk Density	GM/CC	2	3
DRHO	Bulk Density Correction	GM/CC	-1.5	0.5
DPHI	Density porosity	PU	-0.1	0.3
NPHI	Neutron porosity	PU	-0.1	0.3
SPHI	Sonic porosity	PU	-0.1	0.3
DT	Acoustic transit time	USEC/FT	40	140
COND	Conductivity	MMHO/M	0	2,000
CILD	Deep Induction Conductivity	MMHO/M	0	2,000
CILM	Medium Induction Conductivity	MMHO/M	0	2,000
RES	Resistivity	OHM-M	0.1	1,000
RDEP	Deep Resistivity	OHM-M	0.1	1,000
RMED	Medium Resistivity	OHM-M	0.1	1,000
RSHAL	Shallow Resistivity	OHM-M	0.1	1,000
ILD	Deep Induction Resistivity	OHM-M	0.1	1,000
ILM	Medium Induction Resistivity	OHM-M	0.1	1,000
SFLU	Spherically Focused Resistivity	OHM-M	0.1	1,000
LL	Deep Laterolog Resistivity	OHM-M	0.1	1,000
MLL	Micro Laterolog Resistivity	OHM-M	0.1	1,000
LL8	Shallow Laterolog Resistivity	OHM-M	0.1	1,000
LN	Long Normal Resistivity	OHM-M	0.1	1,000
SN	Shallow Normal Resistivity	OHM-M	0.1	1,000
MNOR	Micro Normal Resistivity	OHM-M	0.1	1,000
MSFL	Micro Spherically Focused Resistivity	OHM-M	0.1	1,000
MINV	Micro Inverse Resistivity	OHM-M	0.1	1,000
AHT10	Array Induction Resistivity-10	OHM-M	0.1	1,000
AHT20	Array Induction Resistivity-20	OHM-M	0.1	1,000
AHT30	Array Induction Resistivity-30	OHM-M	0.1	1,000
AHT60	Array Induction Resistivity-60	OHM-M	0.1	1,000
AHT90	Array Induction Resistivity-90	OHM-M	0.1	1,000
THOR	Thorium Concentration	PPM	-10	30

Highlight the “DT” Mnemonic Row and click on the “Select” Button to map the “?(DTC)” Curve Mnemonic to “DT” KGS Standard Curve Mnemonic.

Start Depth: 0.0 End Depth: 5248.0 Step Depth: 0.5 Null Value: -999.25

☐ Do NOT Add this Data ☒ Add this Data

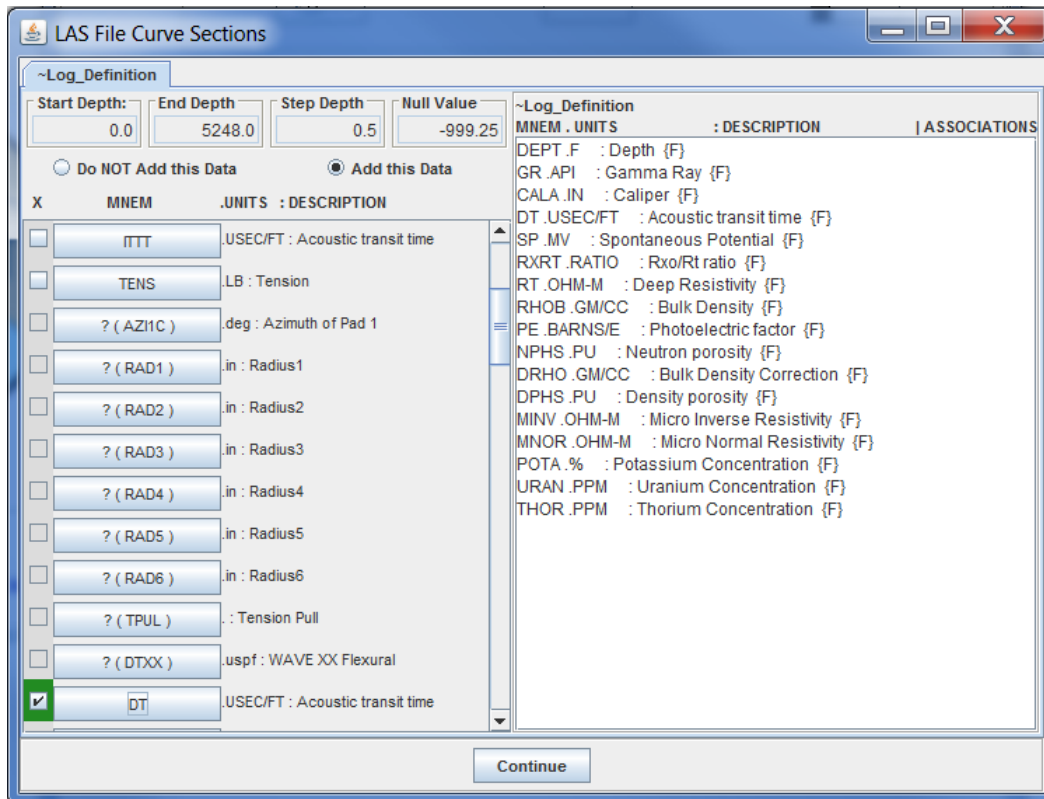
X	MNEM	.UNITS : DESCRIPTION
<input checked="" type="checkbox"/>	ITTT	.USEC/FT : Acoustic transit time
<input type="checkbox"/>	TENS	.LB : Tension
<input type="checkbox"/>	? (AZ11C)	.deg : Azimuth of Pad 1
<input type="checkbox"/>	? (RAD1)	.in : Radius1
<input type="checkbox"/>	? (RAD2)	.in : Radius2
<input type="checkbox"/>	? (RAD3)	.in : Radius3
<input type="checkbox"/>	? (RAD4)	.in : Radius4
<input type="checkbox"/>	? (RAD5)	.in : Radius5
<input type="checkbox"/>	? (RAD6)	.in : Radius6
<input type="checkbox"/>	? (TPUL)	: Tension Pull
<input type="checkbox"/>	? (DTXX)	.uspf : WAVE XX Flexural
<input type="checkbox"/>	DT	.USEC/FT : Acoustic transit time

~Log_Definition

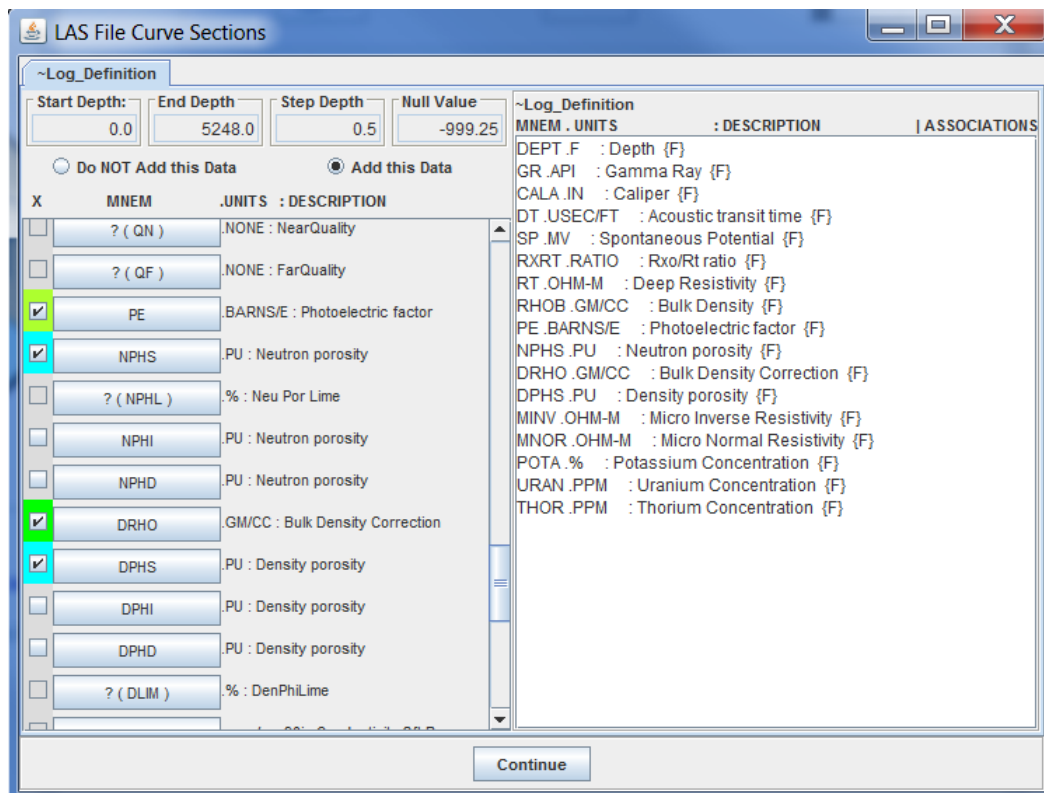
MNEM . UNITS	: DESCRIPTION	| ASSOCIATIONS
DEPT .F	: Depth {F}	
GR .API	: Gamma Ray {F}	
CALA .IN	: Caliper {F}	
ITTT .USEC/FT	: Acoustic transit time {F}	
SP .MV	: Spontaneous Potential {F}	
RXRT .RATIO	: Rxo/Rt ratio {F}	
RT .OHM-M	: Deep Resistivity {F}	
RHOB .GM/CC	: Bulk Density {F}	
PE .BARNS/E	: Photoelectric factor {F}	
NPHS .PU	: Neutron porosity {F}	
DRHO .GM/CC	: Bulk Density Correction {F}	
DPHS .PU	: Density porosity {F}	
MINV .OHM-M	: Micro Inverse Resistivity {F}	
MNOR .OHM-M	: Micro Normal Resistivity {F}	
POTA .%	: Potassium Concentration {F}	
URAN .PPM	: Uranium Concentration {F}	
THOR .PPM	: Thorium Concentration {F}	

Continue

The “?(DTC). .uspf : WAVE DTC” has changed to “DT.usc/ft : Acoustic transit time”. We want to change the selected “ITTT” Log Curve to “DT” Log Curve. The reason is that “ITTT” is the wrong curve type for the Acoustic Transit Time. The program found the curve mnemonic as similar to the “DT” Standard Curve Mnemonic, but this curve will not plot correctly in the Profile Plot. Just click on the green check box in front of the “ITTT” Mnemonic Button to deselect the curve and then click on the check box in front of the “DT” Mnemonic Button to select it. Also notice that the ~Log_Definition Text Area was modified to show the change.



Moving the scroll bar down to the porosity curves, Neutron Porosity, and Density Porosity.



The LAS File Read will select the first curve that it recognizes and selects and color codes the curve. In this case the Neutron porosity mnemonic selected is “NPHS”, which is a valid curve, but the “NPHI” curve is desired so like the Acoustic Transit Time, you can deselect the “NPHS” and then select the “NPHI” Curve. Also the “DPHS” Density Porosity Curve can be deselected since the “RHOB” Bulk Density Curve has been selected. The reason for deselecting the Density Porosity Curve, if the Bulk Density Curve is present, is to force the PROFILE program to recompute the Density Porosity using a Limestone Matrix. If the Neutron Porosity, Bulk Density, Gamma Ray with/without a Photoelectric Factor Logs are present then the program will automatically compute a Lithology Composition Plot, but the Density Porosity has to be computed with a Limestone Matrix or the Lithology Composition Plot will not be computed correctly.

LAS File Curve Sections

~Log_Definition

Start Depth: 0.0 End Depth: 5248.0 Step Depth: 0.5 Null Value: -999.25

☐ Do NOT Add this Data ☒ Add this Data

X	MNEM	.UNITS : DESCRIPTION
<input type="checkbox"/>	? (QN)	NONE : NearQuality
<input type="checkbox"/>	? (QF)	NONE : FarQuality
<input checked="" type="checkbox"/>	PE	BARNS/E : Photoelectric factor
<input type="checkbox"/>	NPHS	PU : Neutron porosity
<input type="checkbox"/>	? (NPHL)	% : Neu Por Lime
<input checked="" type="checkbox"/>	NPHI	PU : Neutron porosity
<input type="checkbox"/>	NPHD	PU : Neutron porosity
<input checked="" type="checkbox"/>	DRHO	GM/CC : Bulk Density Correction
<input type="checkbox"/>	DPHS	PU : Density porosity
<input type="checkbox"/>	DPHI	PU : Density porosity
<input type="checkbox"/>	DPHD	PU : Density porosity
<input type="checkbox"/>	? (DLIM)	% : DenPhiLime

~Log_Definition

MNEM . UNITS	: DESCRIPTION	| ASSOCIATIONS
DEPT .F	: Depth {F}	
GR .API	: Gamma Ray {F}	
CALA .IN	: Caliper {F}	
DT .USEC/FT	: Acoustic transit time {F}	
SP .MV	: Spontaneous Potential {F}	
RXRT .RATIO	: Rxo/Rt ratio {F}	
RT .OHM-M	: Deep Resistivity {F}	
RHOB .GM/CC	: Bulk Density {F}	
PE .BARNS/E	: Photoelectric factor {F}	
NPHI .PU	: Neutron porosity {F}	
DRHO .GM/CC	: Bulk Density Correction {F}	
MINV .OHM-M	: Micro Inverse Resistivity {F}	
MNOR .OHM-M	: Micro Normal Resistivity {F}	
POTA .%	: Potassium Concentration {F}	
URAN .PPM	: Uranium Concentration {F}	
THOR .PPM	: Thorium Concentration {F}	

Continue

The above dialog represents the changes made for the neutron/density porosity logs. The last curves to be modified are the Array Induction Logs. Haliburton uses a different curve mnemonic for these logs. Move the scroll bar up to find the Array Induction Logs, RT90, RT60, etc.

LAS File Curve Sections

~Log_Definition

Start Depth: 0.0 End Depth: 5248.0 Step Depth: 0.5 Null Value: -999.25

☐ Do NOT Add this Data ☒ Add this Data

X	MNEM	.UNITS : DESCRIPTION
<input checked="" type="checkbox"/>	SP	.MV : Spontaneous Potential
<input checked="" type="checkbox"/>	RXRT	.RATIO : Rxo/Rt ratio
<input type="checkbox"/>	RXO	.RATIO : Rxo/Rt ratio
<input type="checkbox"/>	? (RT90)	.ohmm : 90in Resistivity 2ft Res
<input type="checkbox"/>	? (RT60)	.ohmm : 60in Resistivity 2ft Res
<input type="checkbox"/>	? (RT30)	.ohmm : 30in Resistivity 2ft Res
<input type="checkbox"/>	? (RT20)	.ohmm : 20in Resistivity 2ft Res
<input type="checkbox"/>	? (RT10)	.ohmm : 10in Resistivity 2ft Res
<input checked="" type="checkbox"/>	RT	.OHM-M : Deep Resistivity
<input type="checkbox"/>	? (RMUD)	.ohmm : RMUD
<input checked="" type="checkbox"/>	RHOB	.GM/CC : Bulk Density
<input type="checkbox"/>	? (QN)	.NONE : NearQuality

~Log_Definition

MNEM . UNITS	: DESCRIPTION	| ASSOCIATIONS
DEPT .F	: Depth {F}	
GR .API	: Gamma Ray {F}	
CALA .IN	: Caliper {F}	
DT .USEC/FT	: Acoustic transit time {F}	
SP .MV	: Spontaneous Potential {F}	
RXRT .RATIO	: Rxo/Rt ratio {F}	
RT .OHM-M	: Deep Resistivity {F}	
RHOB .GM/CC	: Bulk Density {F}	
PE .BARNS/E	: Photoelectric factor {F}	
NPHI .PU	: Neutron porosity {F}	
DRHO .GM/CC	: Bulk Density Correction {F}	
MINV .OHM-M	: Micro Inverse Resistivity {F}	
MNOR .OHM-M	: Micro Normal Resistivity {F}	
POTA .%	: Potassium Concentration {F}	
URAN .PPM	: Uranium Concentration {F}	
THOR .PPM	: Thorium Concentration {F}	

Continue

Like the Acoustic Transit Time the “?(RT90).ohmm: 90in Resistivity 2ft Res” through “?(RT10).ohmm : 10in Resistivity 2ft Res” are not recognized. These curves can be map to the “AHT90 Array Induction Resistivity-90” to “AHT10 Array Induction Resistivity-10” KGS Curves Respectively. Click on the “?(RT90)” Mnemonic Button to display the “Select KGS Standard Tools” Dialog.

Select KGS Standard Tools

Mnemonic	Description	Units	Minimum	Maximum
GR	Gamma Ray	API	0	150
CGR	Gamma Ray Minus Uranium	API	0	150
SP	Spontaneous Potential	MV	0	1
CAL	Caliper	IN	6	12
PE	Photoelectric factor	BARN/CM	0	20
RHOB	Bulk Density	GM/CC	2	3
DRHO	Bulk Density Correction	GM/CC	-1.5	0.5
DPHI	Density porosity	PU	-0.1	0.3
NPHI	Neutron porosity	PU	-0.1	0.3
SPHI	Sonic porosity	PU	-0.1	0.3
DT	Acoustic transit time	USEC/FT	40	140
COND	Conductivity	MMHO/M	0	2,000
CILD	Deep Induction Conductivity	MMHO/M	0	2,000
CILM	Medium Induction Conductivity	MMHO/M	0	2,000
RES	Resistivity	OHM-M	0.1	1,000
RDEP	Deep Resistivity	OHM-M	0.1	1,000
RMED	Medium Resistivity	OHM-M	0.1	1,000
RSHAL	Shallow Resistivity	OHM-M	0.1	1,000
ILD	Deep Induction Resistivity	OHM-M	0.1	1,000
ILM	Medium Induction Resistivity	OHM-M	0.1	1,000
SFLU	Spherically Focused Resistivity	OHM-M	0.1	1,000
LL	Deep Laterolog Resistivity	OHM-M	0.1	1,000
MLL	Micro Laterolog Resistivity	OHM-M	0.1	1,000
LL8	Shallow Laterolog Resistivity	OHM-M	0.1	1,000
LN	Long Normal Resistivity	OHM-M	0.1	1,000
SN	Shallow Normal Resistivity	OHM-M	0.1	1,000
MNOR	Micro Normal Resistivity	OHM-M	0.1	1,000
MSFL	Micro Spherically Focused Resistivity	OHM-M	0.1	1,000
MINV	Micro Inverse Resistivity	OHM-M	0.1	1,000
AHT10	Array Induction Resistivity-10	OHM-M	0.1	1,000
AHT20	Array Induction Resistivity-20	OHM-M	0.1	1,000
AHT30	Array Induction Resistivity-30	OHM-M	0.1	1,000
AHT60	Array Induction Resistivity-60	OHM-M	0.1	1,000
AHT90	Array Induction Resistivity-90	OHM-M	0.1	1,000
THOR	Thorium Concentration	PPM	-10	30

Select Cancel

Highlight the AHT90 and click on the “Select” Button.

LAS File Curve Sections

~Log_Definition

Start Depth: 0.0 End Depth: 5248.0 Step Depth: 0.5 Null Value: -999.25

☐ Do NOT Add this Data ☒ Add this Data

X	MNEM	.UNITS : DESCRIPTION
<input checked="" type="checkbox"/>	SP	.MV : Spontaneous Potential
<input checked="" type="checkbox"/>	RXRT	.RATIO : Rxo/Rt ratio
<input type="checkbox"/>	RXO	.RATIO : Rxo/Rt ratio
<input checked="" type="checkbox"/>	AHT90	.OHM-M : Array Induction Resistivity-90
<input type="checkbox"/>	? (RT60)	.ohmm : 60in Resistivity 2ft Res
<input type="checkbox"/>	? (RT30)	.ohmm : 30in Resistivity 2ft Res
<input type="checkbox"/>	? (RT20)	.ohmm : 20in Resistivity 2ft Res
<input type="checkbox"/>	? (RT10)	.ohmm : 10in Resistivity 2ft Res
<input checked="" type="checkbox"/>	RT	.OHM-M : Deep Resistivity
<input type="checkbox"/>	? (RMUD)	.ohmm : RMUD
<input checked="" type="checkbox"/>	RHOB	.GM/CC : Bulk Density
<input type="checkbox"/>	? (QN)	.NONE : NearQuality

~Log_Definition

MNEM	.UNITS	: DESCRIPTION	| ASSOCIATIONS
DEPT	.F	: Depth {F}	
GR	.API	: Gamma Ray {F}	
CALA	.IN	: Caliper {F}	
DT	.USEC/FT	: Acoustic transit time {F}	
SP	.MV	: Spontaneous Potential {F}	
RXRT	.RATIO	: Rxo/Rt ratio {F}	
AHT90	.OHM-M	: Array Induction Resistivity-90 {F}	
RT	.OHM-M	: Deep Resistivity {F}	
RHOB	.GM/CC	: Bulk Density {F}	
PE	.BARNS/E	: Photoelectric factor {F}	
NPHI	.PU	: Neutron porosity {F}	
DRHO	.GM/CC	: Bulk Density Correction {F}	
MINV	.OHM-M	: Micro Inverse Resistivity {F}	
MNOR	.OHM-M	: Micro Normal Resistivity {F}	
POTA	.%	: Potassium Concentration {F}	
URAN	.PPM	: Uranium Concentration {F}	
THOR	.PPM	: Thorium Concentration {F}	

Continue

The “(?AHT90).ohmm : 90in Resistivity 2ft Res” has changed to “AHT90.OHM-M : Array Induction Resistivity-90” and the orange check box is selected. The rest of the Array Induction Log Curves each are mapped to the respective KGS Mnemonic Curve as follows,

(?RT90).ohmm : 90in Resistivity 2ft Res to AHT90.OHM-M : Array Induction Resistivity-90
 (?RT60).ohmm : 60in Resistivity 2ft Res to AHT60.OHM-M : Array Induction Resistivity-60
 (?RT30).ohmm : 30in Resistivity 2ft Res to AHT30.OHM-M : Array Induction Resistivity-30
 (?RT20).ohmm : 20in Resistivity 2ft Res to AHT20.OHM-M : Array Induction Resistivity-20
 (?RT10).ohmm : 10in Resistivity 2ft Res to AHT10.OHM-M : Array Induction Resistivity-10

LAS File Curve Sections

~Log_Definition

Start Depth:

0.0

End Depth:

5248.0

Step Depth:

0.5

Null Value:

-999.25

☐ Do NOT Add this Data
 ☒ Add this Data

X	MNEM	.UNITS : DESCRIPTION
<input checked="" type="checkbox"/>	SP	.MV : Spontaneous Potential
<input checked="" type="checkbox"/>	RXRT	.RATIO : Rxo/Rt ratio
<input type="checkbox"/>	RXO	.RATIO : Rxo/Rt ratio
<input checked="" type="checkbox"/>	AHT90	.OHM-M : Array Induction Resistivity-90
<input checked="" type="checkbox"/>	AHT60	.OHM-M : Array Induction Resistivity-60
<input checked="" type="checkbox"/>	AHT30	.OHM-M : Array Induction Resistivity-30
<input checked="" type="checkbox"/>	AHT20	.OHM-M : Array Induction Resistivity-20
<input checked="" type="checkbox"/>	AHT10	.OHM-M : Array Induction Resistivity-10
<input checked="" type="checkbox"/>	RT	.OHM-M : Deep Resistivity
<input type="checkbox"/>	? (RMUD)	.ohmm : RMUD
<input checked="" type="checkbox"/>	RHOB	.GM/CC : Bulk Density
<input type="checkbox"/>	? (QN)	.NONE : NearQuality

~Log_Definition

MNEM . UNITS	: DESCRIPTION	| ASSOCIATIONS
DEPT .F	: Depth {F}	
GR .API	: Gamma Ray {F}	
CALA .IN	: Caliper {F}	
DT .USEC/FT	: Acoustic transit time {F}	
SP .MV	: Spontaneous Potential {F}	
RXRT .RATIO	: Rxo/Rt ratio {F}	
AHT90 .OHM-M	: Array Induction Resistivity-90 {F}	
AHT60 .OHM-M	: Array Induction Resistivity-60 {F}	
AHT30 .OHM-M	: Array Induction Resistivity-30 {F}	
AHT20 .OHM-M	: Array Induction Resistivity-20 {F}	
AHT10 .OHM-M	: Array Induction Resistivity-10 {F}	
RT .OHM-M	: Deep Resistivity {F}	
RHOB .GM/CC	: Bulk Density {F}	
PE .BARNSE	: Photoelectric factor {F}	
NPHI .PU	: Neutron porosity {F}	
DRHO .GM/CC	: Bulk Density Correction {F}	
MINV .OHM-M	: Micro Inverse Resistivity {F}	
MNOR .OHM-M	: Micro Normal Resistivity {F}	
POTA .%	: Potassium Concentration {F}	
URAN .PPM	: Uranium Concentration {F}	
THOR .PPM	: Thorium Concentration {F}	

Continue

Select the Continue Button to read and parse the LAS log curves selected into the PROFILE Web App. Notice that the “Data Source Filenames:” Panel lists the LAS version 2.0 File that was just read in as well as the type of data, i.e. Log Data from LAS Data Type.

Load Data

Data Source

KGS Data: KGS (Database & Server)

Well Data

PC Data: PC (ASCII Data Files)

Ver 2.0 & 3.0

LAS File

Tops CSV

Rock Data CSV

Data Loaded

Data Source Filenames:

Log ASCII Standard (LAS) Files:

1: [Wellington-KGS-1-32.las](#)

2:

3:

PC ASCII Files:

Tops CSV:

Core CSV:

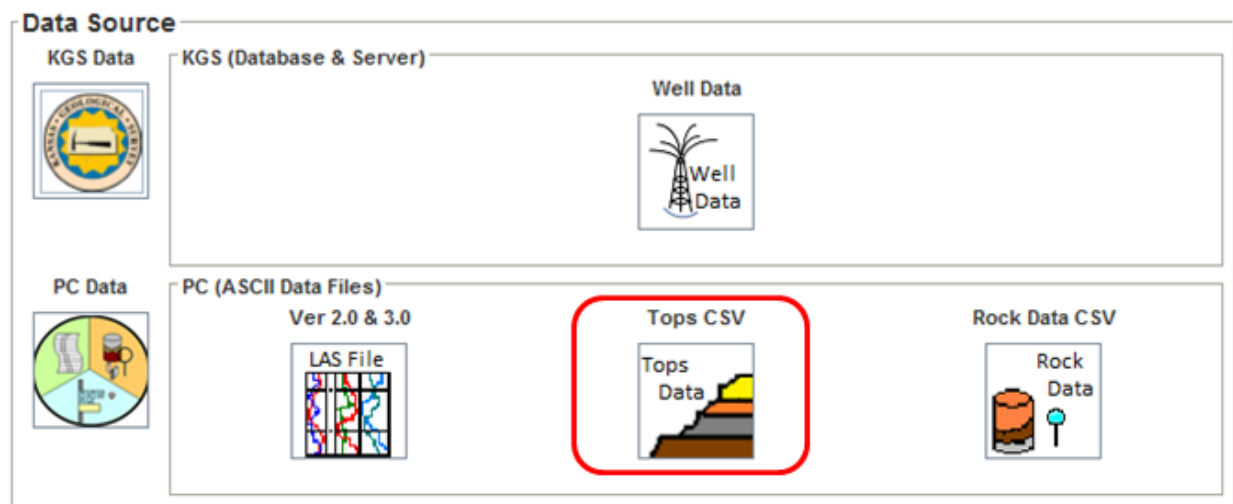
Data Type	3.0	LAS	CSV	KGS	Data Type	3.0	LAS	CSV	KGS
Log Data	.....	YES	.....	.....	Rock Measured Data	NO	.....	.....	.....
Perforations	NO	.....	.....	.....	PFEFFER Data	NO	.....	.....	.....
Tops Data	NO	.....	.....	.....		

Log Curves / Files	LAS	Core	Log Curves / Files	LAS	Core
Resistivity	YES	Gamma Ray	....	YES
Porosity	YES	Spontaneous Potential	....	YES
-- Neutron	YES	Photoelectric Factor	....	YES
-- Bulk Density	YES			
-- Sonic	YES			

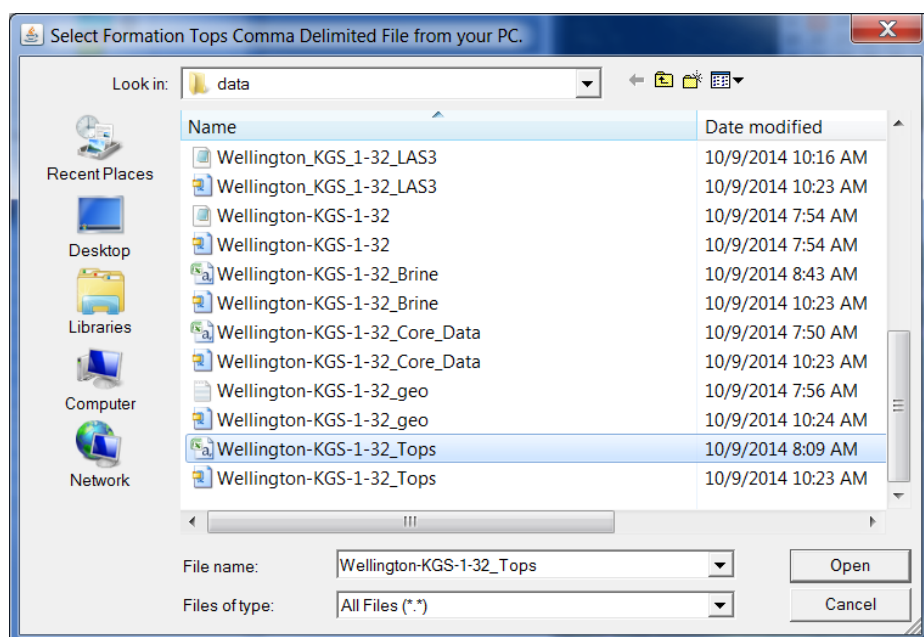
Continue Clear Exit

Importing PC Data – Tops CSV (Comma Separated Values) File.

Most of the web apps will use the same input dialogs to import tops CSV (Comma Separated Values) file. The Load Data Dialog is basically the same for most of the Web Apps except they only load a subset of the total data types. In this example a Tops CSV file is being imported into the web app.



Left Click on the “Tops Data” Icon Button in the Data Source Panel of the Load Data Dialog. This will display the “Select Formation Tops Comma Delimited File from your PC” Dialog. This dialog allows the user to search their PC for the file of interest. In this example it is the Tops CSV file Wellington-KGS-1-32_Tops.csv, highlighted below. Select the Open button to display the “Map File Column Number to Region Column” Dialog.



The “Map File Column Number to Region Column” Dialog allows the user to map the file columns number to the web app tops data structure. In this example the file has the well information in line one of the Tops CSV File and line two of the Tops CSV File has the file data columns. In this case the chosen file columns match the Tops Mnemonics for the tops data structure. The File Column Number is automatically assigned to the Region Column Names. The user only needs to select the “Load Data” Button to parse the Tops Data into the web app.

Map File Column Number to Region Column

1st Line of Comma Delimited File:
Wellington KGS 1-32, 15-191-22591, T31S R1W sec. 32, GL:1259, KB:1272

2nd Line of Comma Delimited File:
Top, Name, Rank, System, Subsystem, Series, source

Formation Tops Columns:

Start Reading Data at Row Assume Row & Column Count is 1,2,3 ...

Region Column Name	File Column Number
Depth Top	<input type="text" value="1"/>
Depth Base	<input type="text" value="0"/>
Stratigraphic Unit Rank [SYSTEM, GROUP, etc.]	<input type="text" value="3"/>
Stratigraphic Name	<input type="text" value="2"/>
Alternate Name	<input type="text" value="0"/>
Era	<input type="text" value="0"/>
System	<input type="text" value="4"/>
Subsystem	<input type="text" value="5"/>
Series	<input type="text" value="6"/>
Subseries { Pennsylvanian & Mississippian Series }	<input type="text" value="0"/>
Stage	<input type="text" value="0"/>
Group	<input type="text" value="0"/>
Subgroup	<input type="text" value="0"/>
Formation	<input type="text" value="0"/>
Start Age (Ma)	<input type="text" value="0"/>
End Age (Ma)	<input type="text" value="0"/>

Tops CSV (Comma Separated Values) File Structure.

The Wellington KGS 1-32 Tops CSV example has two introduction lines, the first line is the well header information and the second line is the actual column labels for the tops data, illustrated below,


```

Line 1 Well Header Info Wellington KGS 1-32, 15-191-22591, T31S R1W sec. 32, GL:1259, KB:1272
Line 2 Data Column Labels Top, Name, Rank, System, Subsystem, Series, source
Line 3 Data Start 620, Chase, GROUP, Permian, , Wolfcampian, PG
748, Towanda Limestone, MEMBER, Permian, , Wolfcampian, PG
1595, Wabaunsee, GROUP, Carboniferous, Pennsylvanian, Upper, PG
1622, Root Shale, FORMATION, Carboniferous, Pennsylvanian, Upper, PG
1662, Stotler Limestone, FORMATION, Carboniferous, Pennsylvanian, Upper, PG
1920, Severy Shale, FORMATION, Carboniferous, Pennsylvanian, Upper, PG
1980, Topeka Limestone, FORMATION, Carboniferous, Pennsylvanian, Upper, PG
2312, Lecompton Limestone, FORMATION, Carboniferous, Pennsylvanian, Upper, PG
2402, Heebner Shale, MEMBER, Carboniferous, Pennsylvanian, Upper, PG
2703, Stalnaker Sandstone, BED, Carboniferous, Pennsylvanian, Upper, PG
3039, Kansas City, GROUP, Carboniferous, Pennsylvanian, Upper, PG
3169, Stark Shale, MEMBER, Carboniferous, Pennsylvanian, Upper, PG

```

Figure: Partial Contents of the Wellington-KGS-1-32_Tops.csv File.

The “Map File Column Number to Region Column” Dialog allows the user to map the data in the Tops CSV File to the web app data structure variables. The program first reads the first and second line of the CSV File looking for the data column headers. The lines are each parsed to single out the data column headers and to match those headers to the tops data structure. The program then assigns the column number to the Region Column Name starting at column 1,2,3, ... if the file column name used matches the expected region column name. The Column Names matrix used to parse the file column variables are listed below,

Depth Top	Top	Start
Depth Base	Base	End
Stratigraphic Unit Rank [SYSTEM, GROUP, etc.]	Rank	
Stratigraphic Name	Name	
Alternate Name	Alt Name	
Era		
System	Sys	
Subsystem	subsys	
Series	Ser	
Subseries { Pennsylvanian & Mississippian Series }	Subseries	Subser
Stage	Stg	
Group	Grp	
Subgroup	subgrp	
Formation	Form	
Start Age (Ma)	Start Age	
End Age (Ma)	End Age	


The Wellington KGS 1-32 Tops CSV File example above line 2 has only the Top, Tops Name, Rank, System, Subsystem, Series and Source as the column name variables. The program was able to map each of the column headers to the tops data structure, except Source, i.e.


Column	File Column Label	Tops Data Name
1	Top	Depth Top
2	Name	Stratigraphic Name
3	Rank	Stratigraphic Unit Rank
4	System	System
5	Subsystem	Subsystem
6	Series	Series
7	Source	


When the user selects the “Load Data” Button on the “Map File Column Number to Region Column” Dialog the data is parsed into the Profile Program, where the Tops CSV file name is entered into the “PC ASCII Files:” Panel as well as the data type source.

Load Data

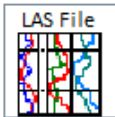
Data Source

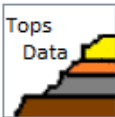
KGS Data  KGS (Database & Server)


Well Data 

PC Data  PC (ASCII Data Files)

Ver 2.0 & 3.0

LAS File 

Tops CSV 

Rock Data CSV 

Data Loaded

Data Source Filenames:

Log ASCII Standard (LAS) Files:

1: Wellington-KGS-1-32.las

2:

3:

PC ASCII Files:

Tops CSV: Wellington-KGS-1-32_Tops.csv

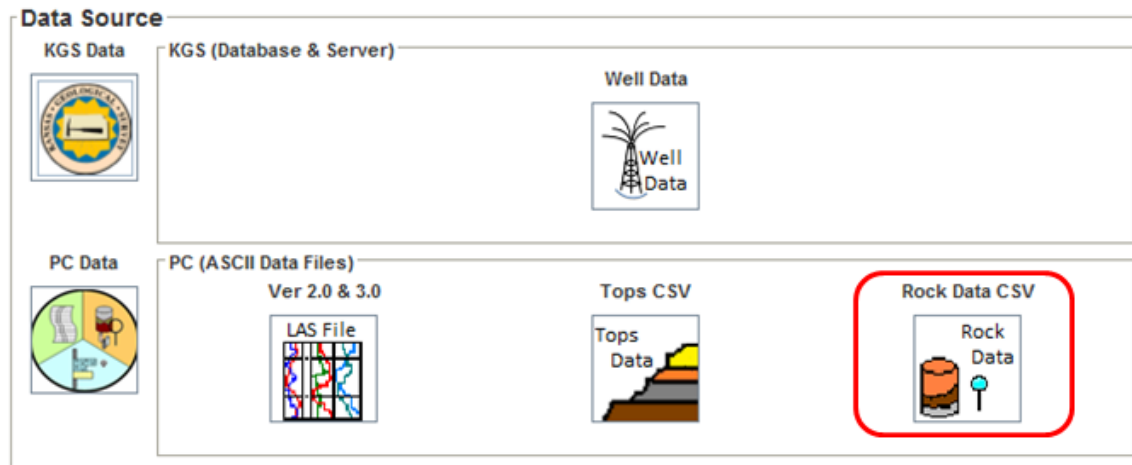
Core CSV:

Data Type	3.0	LAS	CSV	KGS	Data Type	3.0	LAS	CSV	KGS
Log Data	.....	YES	.....	.....	Rock Measured Data	NO	.....	.....	.....
Perforations	NO	.....	.....	.....	PfEFFER Data	NO	.....	.....	.....
Tops Data	.....	.....	YES	.....				
Log Curves / Files		LAS	Core		Log Curves / Files		LAS	Core	
Resistivity	....	YES	....		Gamma Ray	....	YES	....
Porosity	....	YES	....		Spontaneous Potential	....	YES	....
-- Neutron	....	YES	....		Photoelectric Factor	....	YES	....
-- Bulk Density	....	YES	....					
-- Sonic	....	YES	....					

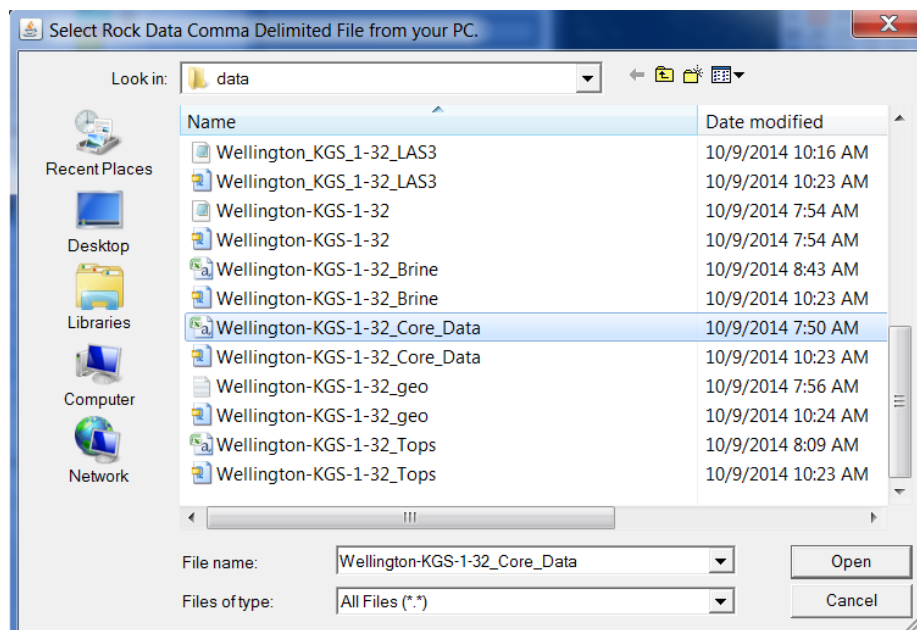
Continue Clear Exit

Importing PC Data – Core CSV (Comma Separated Values) File.

Most of the web apps will use the same input dialogs to import Core Data CSV (Comma Separated Values) file. The Load Data Dialog is basically the same for most of the Web Apps, except they only load a subset of the total data types. In this example a Core Data CSV file is being imported into the web app.



Left Click on the “Rock Data” Icon Button in the Data Source Panel of the Load Data Dialog. This will display the “Select Rock Data Comma Delimited File from your PC” Dialog. This dialog allows the user to search their PC for the file of interest. In this example it is the Core CSV file Wellington-KGS-1-32_Core_Data.csv, highlighted below. Select the Open button to display the “Map File Column Number to Rock Column” Dialog.



Map File Column Number to Rock Data Column

1st Line of Comma Delimited File:
KANSAS GEOLOGICAL SURVEY,FILE NO. : HH-50406,,WELLINGTON-KGS-No. 1-32,FIELD : WELLINGTON,"DATE : August 12, 2011","SUMNER COUNTY, KANSAS","ANALYSTS : WH, SB, JR",

2nd Line of Comma Delimited File:
NO,TOP,-,BASE,KMAX,K90,KVRT,GMCC,PCORE,SW,SOIL

Rock Data Columns:

Start Reading Data at Row Assume Row & Column Count is 1,2,3 ...

Rock Data Column Name	File Column Number
Depth Top	<input type="text" value="2"/>
Depth Bottom	<input type="text" value="4"/>
Depth Correction	<input type="text" value="0"/>
Stratigraphic Unit	<input type="text" value="0"/>
Stratigraphic Name	<input type="text" value="0"/>
Depositional Environment	<input type="text" value="0"/>
Lithofacies	<input type="text" value="0"/>
Whole Core Porosity	<input type="text" value="9"/>
Core Plug Porosity Routine	<input type="text" value="0"/>
Core Plug Porosity 800 PSI	<input type="text" value="0"/>
Core Plug Porosity Insitu	<input type="text" value="0"/>
Effective Rock Porosity	<input type="text" value="0"/>
Whole Core Permeability Maximum	<input type="text" value="5"/>
Whole Core Permeability 90 deg	<input type="text" value="6"/>
Whole Core Permeability Vertical	<input type="text" value="7"/>
Core Plug Permeability Routine	<input type="text" value="0"/>
Core Plug Permeability KL Routine	<input type="text" value="0"/>
Core Plug Permeability Insitu	<input type="text" value="0"/>
Core Plug Permeability KL Insitu	<input type="text" value="0"/>
Core Plug Permeability Vertical	<input type="text" value="0"/>
Oil Saturation	<input type="text" value="11"/>
Water Saturation	<input type="text" value="10"/>
Grain Density (gm/cc)	<input type="text" value="8"/>
Density of Rock Dry (gm/cc)	<input type="text" value="0"/>
Density of Rock Wet (gm/cc)	<input type="text" value="0"/>
Archie Cementation Ambient	<input type="text" value="0"/>
Archie Cementation Insitu	<input type="text" value="0"/>
Archie Saturation Ambient	<input type="text" value="0"/>
Archie Saturation Insitu	<input type="text" value="0"/>
Lithofacies Code	<input type="text" value="0"/>

The “Map File Column Number to Rock Data Column” Dialog allows the user to map the file columns number to the web app tops data structure. In this example the file has the well information in line one of the Core Data CSV File and line two of the Core Data CSV File has the file data columns. In this case the chosen file columns match the Core Mnemonics for the core data structure. The File Column Number is automatically assigned to the Rock Data Column Names. The user only needs to select the “Load Data” Button to parse the Core Data into the web app.

Core Data CSV (Comma Separated Values) File Structure.

The Wellington KGS 1-32 Core Data CSV example has two introduction lines, the first line is the well header information and the second line is the actual column labels for the core data, illustrated below,

```

Line 1 Well Header Info KANSAS GEOLOGICAL SURVEY,FILE NO. : HH-50406,,WELLINGTON-KGS-No. 1-32,FIELD : WELLINGTON,
Line 2 Data Column Labels NO,TOP,-,BASE,KMAX,K90,KVRT,GMCC,PCORE,SW,SOIL
Line 3 Data Start
2-29,3627.55,-,3628.00,0.02,<.01,<.01,2.69,0.3,90.9,0.0
2-39,3638.40,-,3638.90,0.01,<.01,<.01,2.70,0.6,80.5,0.0
3-0,3660.40,-,3660.75,2.00,0.08,2.29,2.62,4.7,82.5,0.0
3-1,3661.70,-,3662.00,2.72,1.74,0.02,2.61,6.8,75.1,0.0
3-2,3662.50,-,3663.00,3.70,2.96,4.55,2.59,11.1,45.5,22.5
3-3,3663.00,-,3663.50,25.36,9.94,29.36,2.60,14.1,41.2,29.2
3-4,3664.30,-,3664.75,12.42,8.97,3.84,2.62,8.0,97.6,0.0
3-5,3665.00,-,3665.60,4.20,3.40,3.38,2.61,7.4,98.6,0.0
3-6,3666.00,-,3666.25,8.64,0.40,<.01,2.58,5.5,46.0,10.7
3-7,3667.20,-,3667.70,6.56,5.97,1.93,2.60,5.8,93.9,0.0
3-8,3668.50,-,3669.00,21.77,10.68,5.78,2.59,12.0,82.4,0.0
3-9,3669.30,-,3669.80,20.30,20.03,10.96,2.60,11.8,70.4,0.0
3-10,3670.00,-,3670.60,64.64,60.27,35.99,2.61,13.1,75.8,0.0
3-11,3671.00,-,3671.50,9.68,8.11,2.41,2.79,19.7,50.2,23.9
3-12,3672.30,-,3672.80,14.08,13.60,7.96,2.77,22.7,48.0,27.1
3-13,3673.40,-,3673.90,13.37,12.95,8.20,2.79,24.3,50.1,24.4
3-14,3674.00,-,3674.50,21.85,21.24,9.30,2.77,22.9,52.8,28.2
3-15,3675.30,-,3675.80,22.31,19.92,11.61,2.78,26.4,58.8,25.2

```

Figure: Partial Contents of the Wellington-KGS-1-32_Core_Data.csv File.

The “Map File Column Number to Rock Data Column” Dialog allows the user to map the data in the Core Data CSV File to the web app data structure variables. The program first reads the first and second line of the CSV File looking for the data column headers. The lines are each parsed to single out the data column headers and to match those headers to the core data structure. The program then assigns the column number to the Rock Data Column Name starting at column 1,2,3, ... if the file column name used matches the expected rock data column name. The Column Names matrix used to parse the file column variables are listed below,

Mnem	Description	Mnem	Description
Depth Data		Density Data	
TOP	Depth Top	GMCC	Grain Density (gm/cc)
BASE	Depth Bottom	RHOD	Density of Rock Dry (gm/cc)
CORR	Depth Correction	RHOW	Density of Rock Wet (gm/cc)
Stratigraphic & Environment Descriptions		Permeability Data	
STU	Stratigraphic Unit	KMAX	Whole Core Permeability Maximum
STN	Stratigraphic Name	K90	Whole Core Permeability 90 deg
ENV	Depositional Environment	KVRT	Whole Core Permeability Vertical
LITHO	Lithofacies	KPLG	Core Plug Permeability Routine
Porosity Data		KKL	Core Plug Permeability KL Routine
PCORE	Whole Core Porosity	KINSI	Core Plug Permeability Insitu
PPLUG	Core Plug Porosity Routine	KKLIN	Core Plug Permeability KL Insitu
P800	Core Plug Porosity 800 PSI	KPVRT	Core Plug Permeability Vertical
PINSI	Core Plug Porosity Insitu	Archie Constants	
PEFF	Effective Rock Porosity	MAMB	Archie Cementation Ambient
Saturation Data		MINSI	Archie Cementation Insitu
SOIL	Oil Saturation	NAMB	Archie Saturation Ambient
SW	Water Saturation	NINSI	Archie Saturation Insitu

Mnem	Description	Mnem	Description
Radioactive Data		Computed Data Types	
GR	Gamma Ray	COMPUTED	Th/U Thorium/Uranium Ratio
CGR	Gamma Ray Minus Uranium	COMPUTED	Th/K Thorium/Potassium Ratio
PGR	Pseudo Gamma Ray	COMPUTED	Gamma Ray
THOR	Thorium Concentration	COMPUTED	Grain Density (gm/cc)
URAN	Uranium Concentration	COMPUTED	Porosity
Unknown Linear Data		Unknown Log Data	
LIN_1	Linear Track Curve 1	LOG_1	Semilog Track Curve 1
LIN_2	Linear Track Curve 2	LOG_2	Semilog Track Curve 2
LIN_3	Linear Track Curve 3	LOG_3	Semilog Track Curve 3
LIN_4	Linear Track Curve 4	LOG_4	Semilog Track Curve 4

The Wellington KGS 1-32 Core Data CSV File example above line 2 has only the Top, Base KMAX, K90, KVRT, GMCC, PCORE, SW and SOIL as the column name variables. The program was able to map each of the column headers to the core data structure, i.e.

Column	File Column Label	Core Data Name
1	NO	
2	TOP	Depth Top
3	-	
4	BASE	Depth Bottom
5	KMAX	Whole Core Permeability Maximum
6	K90	Whole Core Permeability 90 deg
7	KVRT	Whole Core Permeability Vertical
8	GMCC	Grain Density (gm/cc)
9	PCORE	Whole Core Porosity
10	SW	Water Saturation
11	SOIL	Oil Saturation

When the user selects the “Load Data” Button on the “Map File Column Number to Rock Data Column” Dialog the data is parsed into the Profile Program, where the Core Data CSV file name is entered into the “PC ASCII Files:” Panel as well as the data type source.

Load Data

Data Source

KGS Data (Database & Server)

Well Data

PC Data (ASCII Data Files) Ver 2.0 & 3.0

LAS File

Tops CSV

Rock Data CSV

Data Loaded

Data Source Filenames:

Log ASCII Standard (LAS) Files:

1: Wellington-KGS-1-32.las

2:

3:

PC ASCII Files:

Tops CSV: Wellington-KGS-1-32_Tops.csv

Core CSV: Wellington-KGS-1-32_Core_Data.csv

Data Type	3.0	LAS	CSV	KGS	Data Type	3.0	LAS	CSV	KGS
Log Data	.....	YES	.....	.....	Rock Measured Data	.....	YES	.....	.....
Perforations	NO	.....	.....	.....	PfEFFER Data	NO	.....	.....	.....
Tops Data	.....	YES	.....	.....			

Log Curves / Files	LAS	Core	Log Curves / Files	LAS	Core
Resistivity	.... YES	....	Gamma Ray	.... YES	....
Porosity	.... YES	YES	Spontaneous Potential	.... YES	....
-- Neutron	.... YES	....	Photoelectric Factor	.... YES	....
-- Bulk Density	.... YES	....		
-- Sonic	.... YES	....		

Continue Clear Exit

There must be at least one Resistivity and one Porosity curve to run this program. Notice that the Resistivity and the Porosity Log Curves are green in the “Log Curves / Files” table as a flag to the user that the necessary curves are present. The user can now enter “Continue” Button to build the PfEFFER Spreadsheets.

PfEFFER Dialog

The “Load Data” Dialog is the entry to the PfEFFER Spreadsheets. The user searches the KGS Database for well data and/or from the User’s PC. The Image below suggests that the well data came from the KGS Database. Once the well data is loaded the “Continue” Button at the bottom of this dialog becomes enabled. Click on the “Continue” Button load the PfEFFER Dialog.

The screenshot shows the PfEFFER dialog window. The title bar is 'PfEFFER'. Below the title bar is a toolbar with icons for file operations and a 'Sw Model' button. The main area is a data entry form with columns: MNEM, UNIT, VALUE, DESCRIPTION, and { Format }. The form contains various fields for well information, including location, completion date, and well status.

MNEM	UNIT	VALUE	DESCRIPTION	{ Format }
STRT	F	2342.0	START DEPTH	{ F }
STOP	F	3162.0	END DEPTH	{ F }
STEP	F	0.5	STEP LENGTH	{ F }
NULL		-999.25	NULL VALUE	{ F }
COMP		Pioneer Natural Resources USA Inc.	Company	{ S }
WELL		Newby 2-28R	Well Name	{ S }
FLD		PANOMA GAS AREA	Field	{ S }
SEC		28	Section	{ I }
TOWN		31 <input checked="" type="radio"/> S <input type="radio"/> N	Township (e.g. 42S)	{ S }
RANG		37 <input type="radio"/> E <input checked="" type="radio"/> W	Range (e.g. 25E)	{ S }
LOC			Location (Sec Town Range)	{ S }
LOC1			Location 1 (quarter calls)	{ S }
LOC2			Location 2 (footages)	{ S }
COUN		STEVENS	County	{ S }
STAT		Kansas	State	{ S }
CTRY			Country	{ S }
PROV			Province	{ S }
SRVC			Service Company	{ S }
LIC			License Number	{ S }
DATE		06/13/2008	Completion Date	{ DD/MM/YYYY }
API		15-189-22225	API-Number	{ S }
UMI			Unique Well ID Number	{ S }
LATI	DEG	37.317197	Latitude	{ F }
LONG	DEG	-101.3545478	Longitude	{ F }
G DAT			Geodetic Datum	{ S }
X		291354.07	X or East-West coordinate	{ F }
Y		4132456.82	Y or North South coordinate	{ F }
HZCS			Horizontal Co-ordinate System	{ S }
UTM		14.0	UTM Location	{ F }
STUS			Well Status	{ S }
PDAT		GL	Permanent Data	{ S }
APD	F	15.0	Above Permanent Data	{ F }
DREF		KB	Depth Reference (KB,DF,CB)	{ S }
EREF	F	3119.0	Elevation of Depth Reference	{ F }
RUN		1	Run Number	{ F }
TDL	F		Total Depth Logger	{ F }
TDD	F		Total Depth Driller	{ F }
CSGL	F		Casing Bottom Logger	{ F }
CSGD	F		Casing Bottom Driller	{ F }
CSGS	IN		Casing Size	{ F }
CSGW	LB		Casing Weight	{ F }
BS	IN		Bit Size	{ F }

At the bottom left of the window is a tab labeled 'Headers'.

Only the “Headers” Tab is displayed until the user creates flow units, which will appear next to the “Headers” Tab. The header panel allows the user to edit well header information.

PfEPPER Panel Organization

A single “Excel Type” workbook is used to organize all the well log information for a particular well. We will refer to this workbook as a *well workbook* (even when the well is a dry hole). Each well workbook contains *unit worksheets*. A unit is a stratigraphic subdivision as defined by a user. So, a unit may be a formal geologic formation, a reservoir interval, or a reservoir subdivision. Logging data may be downloaded for multiple units from LAS File(s).

The screenshot displays the PfEPPER software interface. The top section contains a **Tool Bar** with icons for file operations and data management. Below it is the **Selected Values** section, which includes a table with columns for RT, Vsh, Clean, Shale, PHIT, matrix, fluid, ? Vsh, Vsh-1, Vsh-2, PHI 2nd, matrix, fluid, ? Vsh, Vsh-2nd, and Rso. The main area is divided into two panels. The left panel, labeled **Archie & Other Parameters**, contains various input fields for parameters like A, M, N, Bv, Rsh, PHIsh, and cumulative values. The right panel, labeled **Flow Units**, displays a table of flow unit data for the Cottonwood Limestone unit. The table has columns for Depth, THK, RT, PHI, RWA, RO, MA, SW, BWV, VSH, PAY, and 1st. The **Home Area** is indicated by a blue arrow pointing to the bottom right of the interface.

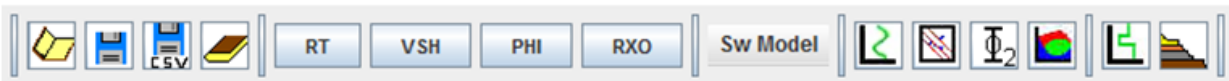
RT	Vsh	Clean	Shale	PHIT	matrix	fluid	? Vsh	Vsh-1	Vsh-2	PHI 2nd	matrix	fluid	? Vsh	Vsh-2nd	Rso
ILD	GR	10.428	150/AVERAGE	2.71	1/NO					DT	47.5	189/NO		LLS	

Flow Unit:	Depth	THK	RT	PHI	RWA	RO	MA	SW	BWV	VSH	PAY	1st
Cottonwood Limestone	2985.5	0.5	3.269/0.21	0.144	0.226	3.709/0.263	0.055	0.507	0.077			
Start Depth:	2986	0.5	3.727/0.15	0.083	0.444	3.12/0.345	0.051	0.385	0.049			
End Depth:	2986.5	0.5	4.364/0.1	0.043	0.999	2.639/0.478	0.047	0.271	0.026			
2985.5	3007.0	0.5	5.253/0.079	0.032	1.602	2.467/0.552	0.043	0.187	0.017			
2987.5	0.5	6.271/0.071	0.031	1.983	2.435/0.562	0.039	0.165	0.015				
2988.5	0.5	7.357/0.07	0.036	2.04	2.482/0.526	0.036	0.175	0.016				
2988.5	0.5	8.263/0.063	0.032	2.519	2.429/0.552	0.034	0.192	0.014				
2989	0.5	8.809/0.055	0.026	3.305	2.337/0.612	0.033	0.198	0.01				
2989.5	0.5	9.056/0.048	0.02	4.34	2.242/0.692	0.033	0.197	0.007				
2990	0.5	9.061/0.042	0.015	5.668	2.147/0.79	0.033	0.177	0.004				
2990.5	0.5	8.864/0.031	0.008	10.405	1.953/1.083	0.033	0.161	0.0				
2991	0.5	8.462/0.026	0.005	14.792	1.846/1.322	0.034	0.146	0.0				
2991.5	0.5	7.842/0.033	0.008	9.182	1.953/1.082	0.035	0.142	0.0				
2992	0.5	7.018/0.055	0.021	3.305	2.259/0.686	0.037	0.148	0.008				
2992.5	0.5	6.03/0.08	0.038	1.562	2.534/0.509	0.04	0.169	0.019				
2993	0.5	5.06/0.098	0.048	1.041	2.68/0.453	0.044	0.179	0.026				
2993.5	0.5	4.148/0.108	0.048	0.857	2.708/0.454	0.049	0.188	0.029				
2994	0.5	3.485/0.124	0.053	0.65	2.804/0.431	0.053	0.194	0.035				
2994.5	0.5	3.029/0.146	0.064	0.469	2.969/0.393	0.057	0.183	0.044				
2995	0.5	2.713/0.166	0.074	0.362	3.12/0.365	0.06	0.182	0.052				
2995.5	0.5	2.49/0.176	0.077	0.322	3.175/0.36	0.063	0.184	0.056				
2996	0.5	2.35/0.178	0.074	0.315	3.163/0.366	0.065	0.174	0.056				
2996.5	0.5	2.282/0.18	0.073	0.308	3.166/0.367	0.066	0.175	0.056				
2997	0.5	2.284/0.178	0.072	0.315	3.146/0.371	0.066	0.182	0.055				
2997.5	0.5	2.331/0.168	0.065	0.354	3.056/0.389	0.065	0.18	0.051				
2998	0.5	2.378/0.161	0.061	0.385	2.995/0.402	0.064	0.195	0.048				
2998.5	0.5	2.387/0.151	0.054	0.438	2.896/0.428	0.064	0.224	0.043				
2999	0.5	2.344/0.145	0.049	0.475	2.825/0.45	0.065	0.257	0.039				
2999.5	0.5	2.275/0.152	0.052	0.432	2.88/0.436	0.066	0.293	0.042				
3000	0.5	2.216/0.163	0.058	0.376	2.977/0.412	0.067	0.313	0.047				
3000.5	0.5	2.194/0.176	0.067	0.322	3.103/0.383	0.067	0.304	0.054				
3001	0.5	2.224/0.183	0.074	0.298	3.182/0.366	0.067	0.286	0.057				
3001.5	0.5	2.299/0.176	0.071	0.322	3.129/0.374	0.065	0.283	0.055				
3002	0.5	2.429/0.153	0.056	0.427	2.925/0.419	0.064	0.361	0.044				
3002.5	0.5	2.627/0.117	0.035	0.73	2.596/0.527	0.061	0.636	0.027				
3003	0.5	2.919/0.083	0.02	1.451	2.28/0.705	0.058	1.121	0.0				
3003.5	0.5	3.366/0.058	0.011	2.972	2.043/0.939	0.054	1.61	0.0				
3004	0.5	3.973/0.048	0.009	4.34	1.971/0.945	0.05	1.97	0.0				
3004.5	0.5	4.63/0.052	0.012	3.698	2.076/0.893	0.046	2.116	0.0				
3005	0.5	5.058/0.056	0.015	3.188	2.16/0.794	0.044	2.012	0.0				
3005.5	0.5	5.012/0.062	0.019	2.601	2.235/0.72	0.044	1.733	0.0				
3006	0.5	4.678/0.101	0.047	0.98	2.681/0.457	0.046	1.419	0.0				
3006.5	0.5	4.284/0.149	0.095	0.45	3.183/0.324	0.048	1.136	0.0				

Flow Units

Cottonwood Limestone flow unit
tab selected to display worksheet

Tool Bar



Add or Remove Flow Units from Workbook



Save Workbook as Log ASCII Standard (LAS) version 3.0 File



Save Individual Flow Unit as Comma Separated Values (CSV) File



Exit Workbook



Select the input log for the Total Resistivity (Rt)



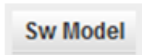
Select the input log for the Shale proportion (Vsh) & log data values for clean formation and for shale.



Select the input logs for the Total Porosity (PHI) & rock matrix, fluid values.



Select the input log for the Bulk Resistivity of Flushed Zone (Rxo)



The Sw Model menu lets you choose between the Archie water saturation model (the default) and two shaly sand models, the Simandoux model and the Dual-water model.



Display Log Profile Plot or PFEFFER Computed Curves Profile Plot



Display Pickett & Hingle plots using information drawn from the home area of a unit worksheet.



Secondary Porosity is computed from the PHI (Total Porosity) Column in home area and the Sonic log porosity.



Movable Hydrocarbon button – launches the movable hydrocarbon plot & control dialogs.



Zonation button – launches a depth-constrained multivariate cluster analysis which segments the entire interval on a worksheet into subintervals based on user-specified set of logs.



Flow units by Top picks. The user selects flow units from a table of top picks.

Selected Values Table

<p>RT-Button Selected Log Curve, e.g. ILD – Deep Induction Resistivity</p>															
RT	Vsh	Clean	Shale	PHIt	matrix	fluid	? Vsh	Vsh-1	Vsh-2	PHI 2nd	matrix	fluid	? Vsh	Vsh-2nd	Rxo
ILD	GR	10.428	150	RHOB	2.71	1	NO			DT	47.5	189	NO		LL8

<p>VSH-Button Selected Log Curve, e.g. GR – Gamma Ray Clean Formation, e.g. GR value of 10.428 API Units Shale Value, e.g. GR value of 150 API Units</p>				<p>PHIT-Button Selected Log Curve, e.g. RHOB– Bulk Density Rock matrix, e.g. 2.71 gm/cc – limestone Fluid Density, e.g. 1.0 gm/cc – fresh water ?Vsh Indicator for shale correction, e.g. No shale correction VSH-1, Log value for 1st porosity log curve VSH-2, Log value for 2nd porosity log curve</p>				<p>PHI 2nd-Button Selected Log Curve, e.g. DT–Sonic if present Rock matrix, e.g. 47.5 μsec / ft - limestone Fluid Density, e.g. 189.0 μsec / ft - fresh water ?Vsh Indicator for shale correction, e.g. No shale correction VSH-1, Log value for 1st porosity log curve VSH-2, Log value for 2nd porosity log curve</p>				<p>Rxo-Button Selected Log Curve, e.g. LL8– Shallow Laterlog Resistivity</p>	
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Archie & Other Parameters Panel

Archie Parameters

The parameters A, M, N and Rw control the intercept and angle lines drawn on the Pickett & Hingle Plots as well as the reservoir characteristics computed in the home area.

Moveable Hydrocarbon Parameters

The parameters Rmf, Total Depth, Surface Temperature and Bottom Hole Temperature are used to compute the Rmfc corrected mud filtrate resistivity at formation temperature.

The **Cut-Offs** values determine what is and is not considered pay, i.e.

- PHI > PHI Cut
- Sw < Sw Cut
- VSH < Vsh Cut
- BVW < Bvw Cut

Wyllie-Rose Equation Parameters

The Pfeiffer default values for P, Q, and R are those of the Timur equation which are appropriate for predicting permeability in typical sandstones.

Flow Unit:		Cottonwood Limestone
Start Depth:	End Depth:	
2985.5	3007.0	
Archie Equation Parameters		
Water Model Used:		
Archie		
A:		.8
M:		1.2
N:		2.0
Rw:		.12
Rsh:		0.0
PHIsh:		0.0
Moveable Hydrocarbon		
Modify in Headers Panel		
Rmf:	0.66	74.0 F
Total Depth:		3150.0
Surface Temp:		74.0 F
Bottom Temp:		101.0 F
Cut-Offs		
PHI Cut:		0.06
Sw Cut:		0.9
Vsh Cut:		1.0
Bvw Cut:		0.103
<input checked="" type="checkbox"/> Cut Off Colors		
Cumulative Values (Computed)		
CTHK:		21.5
FTOIL:		0.69
PAYFEET:		12.5
AVPHI:		0.13
AVSW:		0.58
Wyllie-Rose Equation Parameters		
P:		8581.0
Q:		4.4
R:		2.0

$$S_w = \left[\frac{A \cdot R_w}{R_t \cdot \Phi^M} \right]^{1/N}$$

Rsh and PHIsh used in shaly sand computations

$$S_{xo} = \left[\frac{A \cdot R_{mf}}{R_{xo} \cdot \Phi^M} \right]^{1/N}$$

$$k = \frac{P \Phi^Q}{S_{wi}^R}$$

	Sandstone	Limestone
		Pfeiffer-Pro Example
P	8581.0	5010.0
Q	4.4	4.62
R	2.0	3.89

Variable	Description
----------	-------------

Flow Unit Name of flow unit

Depth Start Minimum depth of flow unit interval

End Start Maximum depth of flow unit interval

Archie Equation

$$S_w = \left[\frac{A \cdot R_w}{R_t \cdot \Phi^M} \right]^{1/N}$$

Archie Equation Parameters

Variable	Description
----------	-------------

A Archie constant

M Cementation exponent

N Saturation exponent

Rw Formation water resistivity at formation temperature

Rsh Shale resistivity used in shaly sand computations

PHIsh Shale porosity used in shaly sand computations

Archie Equation for Moveable Hydrocarbon
--

$$S_{xo} = \left[\frac{A \cdot R_{mf}}{R_{xo} \cdot \Phi^M} \right]^{1/N}$$

Moveable Hydrocarbon Parameters

Variable	Description
----------	-------------

Rmf Mud Filtrate Resistivity @ Temperature

Total Depth Total Depth of Well

Surface Temp Surface temperature [Default same as Mud Filtrate Temperature (Rmft)]

Bottom Temp Bottom hole temperature

Cut-Offs

A zone is considered pay if $\text{PHI} < \text{Phi Cut}$; $\text{SW} < \text{Sw Cut}$; $\text{VSH} < \text{Vsh Cut}$; and $\text{BVW} < \text{Bvw Cut}$. If all these criteria are satisfied of oil ($\text{THK} * \text{PHI} * (1 - \text{SW})$). Otherwise the value of PAY is set to zero. The default values for these cut-offs are 0,1,1 and 1 (for PHI, SW, VSH and BVW, respectively).

Variable	Description
----------	-------------

PHI Cut Porosity Cut Off is not pay if $\text{PHI} > \text{Porosity cut off}$.

Sw Cut Water Saturation Cut Off is not pay if $\text{SW} < \text{Water Saturation cut off}$.

Vsh Cut V-Shale Cut Off is not pay if $\text{VSH} < \text{V-Shale cut off}$.

Bvw Cut Bulk Volume Water Cut Off is not pay if $\text{BVW} < \text{Bulk Volume Water cut off}$.

Cumulative Values (Computed)

Variable	Description
----------	-------------

CTHK Cumulative unit thickness summed from THK Column

FTOIL Cumulative feet (or meters) of oil (or gas) in PAY Column

PAYFEET Cumulative feet (or meters) of section considered to be pay

AVPHI Average Porosity (Φ), computed as a simple average of the porosities in PHI Column

AVSW Average Water Saturation (S_w), computed as a simple average of the water saturations in SW Column

Wyllie-Rose Equation

$k = \frac{P\Phi^Q}{S_{wi}^R}$ P, Q and R: parameters of the Wyllie Rose equation used to estimate permeability (k) from porosity (Φ) and irreducible water.

Home Area

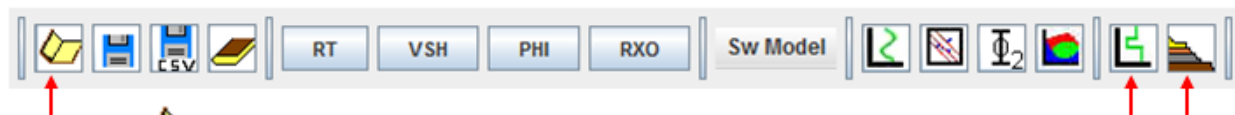
Depth	THK	RT	PHI	RWA	RO	MA	SW	BWW	VSH	PAY		1st PHI	2nd PHI	PHIr	RXO	SXO	BVF
2.985.5	0.5	3.269	0.21	0.628	0.624	2.26	0.437	0.091	0.507	0.059		0.306	0	1.002	2.855	0.955	0.2
2.986	0.5	3.727	0.15	0.478	0.935	1.928	0.5	0.075	0.385	0.037		0.282	0	0.715	3.672	1.031	0.154
2.986.5	0.5	4.364	0.1	0.344	1.521	1.657	0.59	0.059	0.271	0.02		0.242	0	0.475	5.912	1.036	0.103
2.987	0.5	5.253	0.079	0.312	2.018	1.576	0.619	0.048	0.187	0.015		0.186	0	0.393	9.968	0.919	0.072
2.987.5	0.5	6.271	0.071	0.327	2.294	1.58	0.604	0.042	0.165	0.014		0.111	0	0.378	14.254	0.819	0.058
2.988	0.5	7.357	0.07	0.378	2.334	1.631	0.563	0.039	0.175	0.015		0.074	0	0.402	13.917	0.836	0.058
2.988.5	0.5	8.263	0.063	0.374	2.648	1.611	0.566	0.035	0.192	0.013		0.073	0	0.375	11.396	0.985	0.062
2.989	0.5	8.809	0.055	0.339	3.117	1.558	0.594	0.032	0.198	0.0		0.084	0	0.329	10.877	1.094	0.06
2.989.5	0.5	9.056	0.048	0.296	3.67	1.497	0.636	0.03	0.197	0.0		0.093	0	0.283	11.738	1.142	0.054
2.990	0.5	9.061	0.042	0.252	4.308	1.434	0.689	0.028	0.177	0.0		0.092	0	0.241	12.324	1.208	0.05
2.990.5	0.5	8.864	0.031	0.171	6.203	1.302	0.836	0.025	0.161	0.0		0.077	0	0.166	13.867	1.366	0.042
2.991	0.5	8.462	0.026	0.132	7.661	1.227	0.951	0.024	0.146	0.0		0.061	0	0.131	17.159	1.365	0.035
2.991.5	0.5	7.842	0.033	0.163	5.755	1.29	0.856	0.028	0.142	0.0		0.059	0	0.168	23.938	1.001	0.033
2.992	0.5	7.018	0.055	0.27	3.117	1.479	0.666	0.036	0.148	0.0		0.045	0.01	0.294	33.661	0.621	0.034
2.992.5	0.5	6.03	0.08	0.363	1.988	1.639	0.574	0.045	0.169	0.017		0.038	0.042	0.427	28.85	0.536	0.042
2.993	0.5	5.06	0.098	0.389	1.558	1.706	0.555	0.054	0.179	0.021		0.056	0.042	0.499	20.736	0.56	0.054
2.993.5	0.5	4.148	0.108	0.358	1.387	1.692	0.578	0.062	0.188	0.022		0.079	0.028	0.508	17.148	0.581	0.062
2.994	0.5	3.485	0.124	0.355	1.175	1.72	0.58	0.072	0.194	0.025		0.097	0.026	0.55	15.742	0.558	0.069
2.994.5	0.5	3.029	0.146	0.376	0.966	1.793	0.564	0.082	0.183	0.031		0.113	0.032	0.624	14.497	0.527	0.077
2.995	0.5	2.713	0.166	0.393	0.828	1.86	0.552	0.091	0.182	0.037		0.124	0.042	0.688	11.469	0.548	0.091
2.995.5	0.5	2.49	0.176	0.387	0.772	1.874	0.556	0.098	0.184	0.038		0.143	0.033	0.708	8.532	0.614	0.108
2.996	0.5	2.35	0.178	0.37	0.761	1.852	0.569	0.101	0.174	0.038		0.164	0.013	0.697	6.452	0.701	0.124
2.996.5	0.5	2.282	0.18	0.364	0.751	1.847	0.573	0.103	0.175	0.0		0.191	0	0.696	6.168	0.713	0.128
2.997	0.5	2.284	0.178	0.359	0.761	1.836	0.577	0.102	0.182	0.037		0.204	0	0.687	6.309	0.709	0.126
2.997.5	0.5	2.331	0.168	0.342	0.816	1.788	0.591	0.099	0.18	0.034		0.202	0	0.647	6.157	0.743	0.124
2.998	0.5	2.378	0.161	0.332	0.859	1.757	0.601	0.096	0.195	0.032		0.194	0	0.621	6.114	0.765	0.123
2.998.5	0.5	2.387	0.151	0.308	0.927	1.699	0.623	0.094	0.224	0.028		0.182	0	0.576	6.987	0.744	0.112
2.999	0.5	2.344	0.145	0.288	0.974	1.654	0.644	0.093	0.257	0.025		0.167	0	0.544	8.283	0.7	0.101
2.999.5	0.5	2.275	0.152	0.296	0.92	1.68	0.636	0.096	0.293	0.027		0.15	0.002	0.567	9.958	0.621	0.094
3.000	0.5	2.216	0.163	0.314	0.846	1.73	0.618	0.1	0.313	0.031		0.145	0.018	0.609	9.812	0.599	0.097
3.000.5	0.5	2.194	0.176	0.341	0.772	1.801	0.593	0.104	0.304	0.0		0.148	0.027	0.664	8.87	0.602	0.106
3.001	0.5	2.224	0.183	0.362	0.736	1.85	0.575	0.105	0.286	0.0		0.162	0.02	0.701	6.944	0.665	0.121
3.001.5	0.5	2.299	0.176	0.357	0.772	1.828	0.579	0.101	0.283	0.037		0.175	0.001	0.68	5.335	0.776	0.136
3.002	0.5	2.429	0.153	0.319	0.913	1.721	0.613	0.093	0.361	0.029		0.177	0	0.591	4.976	0.875	0.133
3.002.5	0.5	2.627	0.117	0.25	1.26	1.542	0.692	0.081	0.636	0.017		0.164	0	0.445	5.166	1.008	0.118
3.003	0.5	2.919	0.083	0.184	1.902	1.371	0.807	0.067	1.121	0.0		0.139	0	0.311	7.61	1.021	0.084
3.003.5	0.5	3.366	0.058	0.138	2.925	1.249	0.932	0.054	1.61	0.0		0.113	0	0.217	11.24	1.041	0.06
3.004	0.5	3.973	0.048	0.129	3.67	1.226	0.961	0.046	1.97	0.0		0.094	0	0.188	13.826	1.052	0.05
3.004.5	0.5	4.63	0.052	0.166	3.334	1.31	0.848	0.044	2.116	0.0		0.079	0	0.223	12.983	1.034	0.053
3.005	0.5	5.058	0.056	0.198	3.051	1.375	0.776	0.043	2.012	0.0		0.081	0	0.255	11.158	1.067	0.059
3.005.5	0.5	5.012	0.062	0.222	2.7	1.422	0.733	0.045	1.733	0.0		0.095	0	0.287	9.749	1.074	0.066
3.006	0.5	4.678	0.101	0.373	1.503	1.695	0.566	0.057	1.419	0.0		0.103	0	0.498	10.038	0.79	0.079
3.006.5	0.5	4.284	0.149	0.545	0.942	1.995	0.469	0.069	1.136	0.0		0.118	0.031	0.76	8.914	0.664	0.098

Home Area Columns		
Mnemonic	Name	Description
RT	True resistivity	Choice of resistivity log to be used is at the discretion of the user.
PHI	"True porosity"	PHI must contain fractional (as opposed to percentage) data and is generally equated with "true porosity". At the user's discretion, PHI can be derived from a single porosity log (sonic, density, or neutron) stored in the log columns or computed as a function of several porosity logs.
RWA	Reconnaissance (apparent) water resistivity	Apparent water resistivity for each zone, based on the Archie parameters and the zone porosity (PHI) and resistivity (RT) values.
RO	Resistivity of Water Saturated Zone	The resistivity of each zone if it was completely saturated with formation water whose resistivity matched the value recorded in cell Archie parameter RW and a rock with Archie parameters A and M.
MA	Apparent Archie cementation exponent	Apparent Archie cementation exponent is calculated under the assumption that the zone is completely water-saturated and that the Archie parameter value RW is the actual formation water resistivity. This computation is a companion technique to the RWA method, but in this case provides a means to estimate the cementation exponent in water zones where formation water resistivity is known, but the Archie equation parameters are poorly known. The values of MA also represent the slopes of an individual water line that result when the zone is located on the Pickett plot and linked with the formation water resistivity intercept.
SW	Proportional water saturation	The calculated values of proportional water saturation, using the

		zone porosity (PHI) and resistivity (RT) value in conjunction with the Archie equation values of a, m, n and R _w
BVW	Fractional bulk volume water	Calculation of the fractional bulk volume water in each zone as the product of the fractional porosity and water saturation. As described earlier in this manual, the BVW is often known as the "Buckles number" in reservoir zones at "irreducible" water saturation. The value is controlled primarily by pore size, where large pores cause low Buckles numbers, and small pores are matched by high Buckles numbers.
VSH	Fractional proportion of shale	The formula for the VSH column may be set automatically using the Vsh button on the PfeFFER toolbar
PAY	Incremental thickness of oil (or gas)	Incremental thickness of oil (or gas) in each zone, given by $THK * PHI * (1 - SW)$, assuming that the zone satisfies a number of criteria, described below. If a particular zone does not satisfy those criteria, then the PAY entry for that zone is 0, meaning that the zone does not contribute to the net thickness of oil computed in FTOIL
1st PHI	Primary porosity	The primary porosity is determined from the interpolation of the observed bulk transit time between the matrix and fluid transit time extremes, as shown by the formula above. The total porosity column is set equal to column PHI, the porosity in the home area.
2nd PHI	Secondary porosity	Secondary porosity is the total porosity (column PHI) minus the primary porosity determined from the sonic log.
PHIr	"Electrically connected porosity"	PHIr (connected porosity) is estimated from resistivity log as the square root of Reconnaissance (apparent) water resistivity (RWA) divided by the Resistivity of Water Saturation Zone (RO).
RXO	Bulk resistivity of flushed zone	Choice of resistivity log to be used is at the discretion of the user.
SXO	Saturation of total moveable fluid (assumes filtrate has displaced everything moveable)	The calculated values of saturation of total moveable fluid, using the zone porosity (PHI) and bulk resistivity of flushed zone (R _{xo}) value in conjunction with the Archie equation values of a, m, n and R _{mf}
BVF	Bulk volume fluid	Calculation of the fractional bulk volume water in each zone as the product of the fractional porosity and saturation of total moveable fluid. Computed as the product of S _{xo} and PHI.

Adding Flow Units

There are three methods for adding flow units to the PfeFFER Dialog, which can be accessed by the tool bar at the top of the PfeFFER Dialog as follows,



Add or Remove Flow Units from Workbook




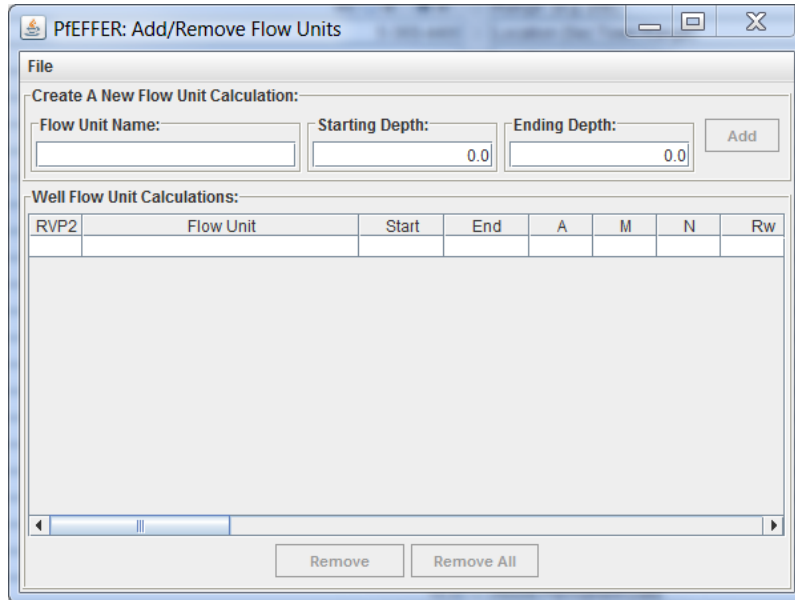
Zonation button – launches a depth-constrained multivariate cluster analysis which segments the entire interval on a worksheet into subintervals based on user-specified set of logs.



Flow units by Top picks (must have both the staring and ending depths). The user selects flow units from a table of top picks.

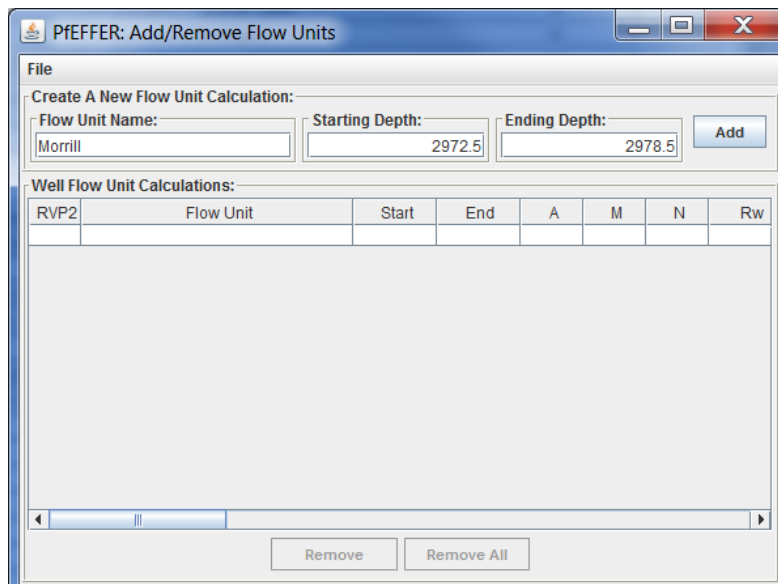
By User Defined Depth Ranges

Click on the  icon image to display the "Add/Remove Flow Units" Dialog.



The dialog box is titled "Pfeffer: Add/Remove Flow Units". It contains a "File" menu and a "Create A New Flow Unit Calculation:" section. This section has three input fields: "Flow Unit Name:" (empty), "Starting Depth:" (0.0), and "Ending Depth:" (0.0), followed by an "Add" button. Below this is a "Well Flow Unit Calculations:" section containing a table with 8 columns: RVP2, Flow Unit, Start, End, A, M, N, and Rw. The table is currently empty. At the bottom of the dialog are "Remove" and "Remove All" buttons.

This dialog allows the user to add flow units to the PfeFFER "Spreadsheet" Dialog. The user can only add or remove the flow unit to or from the spreadsheet. If the user wishes to change the name or the depth range they only need to enter the values in the Archie and Other Parameters Panel on the PfeFFER "Spreadsheet" Dialog. At the top of Archie and Other Parameters Panel is the "Flow Unit:" text fields and the Depth Range text fields. The user can enter the changes directly and the spreadsheet will automatically reflect the depth range in the home area. The tab at the bottom will stay the same, but the name of the flow unit will change. When the user saves the session and returns the tab will reflect the new flow unit name.



The dialog box is titled "Pfeffer: Add/Remove Flow Units". It contains a "File" menu and a "Create A New Flow Unit Calculation:" section. This section has three input fields: "Flow Unit Name:" (Morrill), "Starting Depth:" (2972.5), and "Ending Depth:" (2978.5), followed by an "Add" button. Below this is a "Well Flow Unit Calculations:" section containing a table with 8 columns: RVP2, Flow Unit, Start, End, A, M, N, and Rw. The table is currently empty. At the bottom of the dialog are "Remove" and "Remove All" buttons.

Now enter the 1st flow unit, Morrill for flow name at depths 2975.5' to 2978.5'. The “Add” button will only be enabled when all text fields are filled. To create the flow unit, select the “Add” button, which will add the flow unit to the “Well Flow Unit Calculations” Table.

PFEFFER: Add/Remove Flow Units

Create A New Flow Unit Calculation:

Flow Unit Name: Starting Depth: Ending Depth:

Well Flow Unit Calculations:

RVP2	Flow Unit	Start	End	A	M	N	Rw
RVP2	Morrill	2972.5	2978.5	1.0	2.0	2.0	0.01

The RVP2 column in the “Well Flow Unit Calculations” Table identifies the curves that were computed, i.e. R-True Resistivity, V-Shale Fraction, P-True Porosity, and 2-Second Porosity. Notice that the Morrill Flow Unit has been added to the table. Also notice that a PFEFFER “Spreadsheet” was added in the PFEFFER Dialog with a Morrill tab to the right of the “Headers” tab with the home area columns are automatically filled as follows,

Rt – True Resistivity Hierarchy:

1. ILD - Deep Induction Resistivity
2. AHT90 - Array Induction Resistivity - 90
3. LL - Deep Laterolog Resistivity
4. RDEP - Deep Resistivity
5. First Resistivity found

Φ_t – True Porosity Hierarchy:

1. PHI Average value of
 - a. NPHI - Neutron Porosity
 - b. DPHI - Density Porosity
2. NPHI - Neutron Porosity
3. DPHI - Density Porosity
4. SPHI - Sonic Porosity

Rxo – Bulk Resistivity Hierarchy:

1. SFLU – Spherically Focused Resistivity
2. AHT10 – Array Induction Resistivity – 10
3. LL8 - Shallow Laterolog Resistivity
4. RSHAL - Shallow Resistivity
5. MSFL – Micro Spherically Focused Res.

Vsh – Fractional Shale Hierarchy:

1. GR - Gamma Ray
2. CGR - Gamma Ray Minus Uranium
3. SP - Spontaneous Potential

PFEFFER

RT VSH PHI RXO Sw Model

Rt	Vsh	Clean	Shale	PHIt	matrix	fluid	? Vsh	Vsh-1	Vsh-2	PHI 2nd	matrix	fluid	? Vsh	Vsh-2nd	Rxo
ILD	GR	10.428	150 AVERAGE	2.71	1	NO				DT	47.5	189	NO		LL8

Flow Unit: Morrill

Start Depth: 2972.5 End Depth: 2978.5

Archie Equation Parameters

Water Model Used: Archie

A: 1.0
M: 2.0
N: 2.0
Rw: 0.01
Rsh: 0.0
PHIsh: 0.0

Moveable Hydrocarbon

Modify in Headers Panel

Rmf: 0.55 e 58.0 F
Total Depth: 3162.0
Surface Temp: 58.0 F
Bottom Temp: 120.0 F

Cut-Offs

PHI Cut: 0.0
Sw Cut: 1.0
Vsh Cut: 1.0
Bvw Cut: 1.0

☐ Cut Off Colors

Cumulative Values (Computed)

CTHK: 6.0
FTOIL: 0.19
PAYFEET: 6.0
AVPHI: 0.07
AVSW: 0.61

Wyllie-Rose Equation Parameters

P: 8581.0
Q: 4.4
R: 2.0

Depth	THK	RT	PHI	RWA	RO	MA	SW	BVW	VSH	PAY	1st PH
2,972.5	0.5	4.53	0.142	0.091	0.495	3.133	0.33	0.046	0.355	0.047	0.2
2,973	0.5	4.803	0.109	0.057	0.841	2.785	0.418	0.045	0.275	0.031	0.2
2,973.5	0.5	5.109	0.077	0.03	1.686	2.432	0.574	0.044	0.207	0.016	0.1
2,974	0.5	5.44	0.077	0.032	1.686	2.456	0.556	0.042	0.167	0.017	0.1
2,974.5	0.5	5.726	0.077	0.033	1.686	2.476	0.542	0.041	0.173	0.017	0.0
2,975	0.5	5.844	0.065	0.024	2.366	2.33	0.636	0.041	0.185	0.011	0.0
2,975.5	0.5	5.665	0.059	0.019	2.872	2.239	0.712	0.042	0.172	0.008	0.0
2,976	0.5	5.252	0.063	0.02	2.519	2.265	0.692	0.043	0.145	0.009	0.0
2,976.5	0.5	4.662	0.068	0.021	2.162	2.285	0.681	0.046	0.115	0.01	0.0
2,977	0.5	4.067	0.069	0.019	2.1	2.247	0.718	0.049	0.095	0.009	0.0
2,977.5	0.5	3.552	0.07	0.017	2.04	2.208	0.757	0.053	0.105	0.008	0.0
2,978	0.5	3.167	0.077	0.018	1.686	2.245	0.729	0.056	0.14	0.01	0.0

Headers Morrill

Now enter the 2nd flow unit, Cottonwood for flow name at depths 2986.0' to 3003.0'.

PFEFFER: Add/Remove Flow Units

File

Create A New Flow Unit Calculation:

Flow Unit Name: Cottonwood Starting Depth: 2986.0 Ending Depth: 3003.0 Add

Well Flow Unit Calculations:

RVP2	Flow Unit	Start	End	A	M	N	Rw
RVP2	Morrill	2972.5	2978.5	1.0	2.0	2.0	0.01

Remove Remove All

To create the flow unit, select the “Add” button, which will add the flow unit to the “Well Flow Unit Calculations” Table.

PFEFFER: Add/Remove Flow Units

File

Create A New Flow Unit Calculation:

Flow Unit Name: Starting Depth: Ending Depth:

Well Flow Unit Calculations:

RVP2	Flow Unit	Start	End	A	M	N	Rw
RVP2	Morrill	2972.5	2978.5	1.0	2.0	2.0	0.01
RVP2	Cottonwood	2986.0	3003.0	1.0	2.0	2.0	0.01

Notice that a PFEFFER “Spreadsheet” was added in the PFEFFER Dialog with a Cottonwood tab to the right of the “Morrill” tab with the home area columns is automatically filled.


PFEFFER

RT VSH PHI RXO Sw Model

ILD	GR	10.428	150 AVERAGE	2.71	1 NO	DT	47.5	189 NO	LL8					
Flow Unit:	Cottonwood	2.986	0.5	3.727	0.15	0.083	0.444	3.12	0.345	0.051	0.385	0.049		0.2
Start Depth:	2986.0	2.986.5	0.5	4.364	0.1	0.043	0.999	2.639	0.478	0.047	0.271	0.026		0.2
End Depth:	3003.0	2.987	0.5	5.253	0.079	0.032	1.602	2.467	0.552	0.043	0.187	0.017		0.1
Archie Equation Parameters		2.987.5	0.5	6.271	0.071	0.031	1.983	2.435	0.562	0.039	0.165	0.015		0.1
Water Model Used:	Archie	2.988	0.5	7.357	0.07	0.036	2.04	2.482	0.526	0.036	0.175	0.016		0.0
A:	1.0	2.988.5	0.5	8.263	0.063	0.032	2.519	2.429	0.552	0.034	0.192	0.014		0.0
N:	2.0	2.989	0.5	8.809	0.055	0.026	3.305	2.337	0.612	0.033	0.198	0.01		0.0
Rw:	0.01	2.989.5	0.5	9.056	0.048	0.02	4.34	2.242	0.692	0.033	0.197	0.007		0.0
Rsh:	0.0	2.990	0.5	9.061	0.042	0.015	5.668	2.147	0.79	0.033	0.177	0.004		0.0
PHIsh:	0.0	2.990.5	0.5	8.864	0.031	0.008	10.405	1.953	1.083	0.033	0.161	0.0		0.0
Moveable Hydrocarbon		2.991	0.5	8.462	0.026	0.005	14.792	1.846	1.322	0.034	0.146	0.0		0.0
Rmf:	0.55	2.991.5	0.5	7.842	0.033	0.008	9.182	1.953	1.082	0.035	0.142	0.0		0.0
Total Depth:	3162.0	2.992	0.5	7.018	0.055	0.021	3.305	2.259	0.686	0.037	0.148	0.008		0.0
Surface Temp:	58.0 F	2.992.5	0.5	6.03	0.08	0.038	1.562	2.534	0.509	0.04	0.169	0.019		0.0
Bottom Temp:	120.0 F	2.993	0.5	5.06	0.098	0.048	1.041	2.68	0.453	0.044	0.179	0.026		0.0
Cut-Offs		2.993.5	0.5	4.148	0.108	0.048	0.857	2.708	0.454	0.049	0.188	0.029		0.0
PHI Cut:	0.0	2.994	0.5	3.485	0.124	0.053	0.65	2.804	0.431	0.053	0.194	0.035		0.0
Sw Cut:	1.0	2.994.5	0.5	3.029	0.146	0.064	0.469	2.969	0.393	0.057	0.183	0.044		0.1
Vsh Cut:	1.0	2.995	0.5	2.713	0.166	0.074	0.362	3.12	0.365	0.06	0.182	0.052		0.1
Bvw Cut:	1.0	2.995.5	0.5	2.49	0.176	0.077	0.322	3.175	0.36	0.063	0.184	0.056		0.1
Cumulative Values (Computed)		2.996	0.5	2.35	0.178	0.074	0.315	3.163	0.366	0.065	0.174	0.056		0.1
CTHK:	17.0	2.996.5	0.5	2.282	0.18	0.073	0.308	3.166	0.367	0.066	0.175	0.056		0.1
FTOL:	1.1	2.997	0.5	2.284	0.178	0.072	0.315	3.146	0.371	0.066	0.182	0.055		0.2
PAYFET:	15.5	2.997.5	0.5	2.331	0.168	0.065	0.354	3.056	0.389	0.065	0.18	0.051		0.2
AVPHI:	0.12	2.998	0.5	2.378	0.161	0.061	0.385	2.995	0.402	0.064	0.195	0.048		0.1
AVSW:	0.46	2.998.5	0.5	2.387	0.151	0.054	0.438	2.896	0.428	0.064	0.224	0.043		0.1
Wyllie-Rose Equation Parameters		2.999	0.5	2.344	0.145	0.049	0.475	2.825	0.45	0.065	0.257	0.039		0.1
P:	8581.0	2.999.5	0.5	2.275	0.152	0.052	0.432	2.88	0.436	0.066	0.293	0.042		0.1
Q:	4.4	3.000	0.5	2.216	0.163	0.058	0.376	2.977	0.412	0.067	0.313	0.047		0.1
R:	2.0	3.000.5	0.5	2.194	0.176	0.067	0.322	3.103	0.383	0.067	0.304	0.054		0.1
		3.001	0.5	2.224	0.183	0.074	0.298	3.182	0.366	0.067	0.286	0.057		0.1
		3.001.5	0.5	2.299	0.176	0.071	0.322	3.129	0.374	0.065	0.283	0.055		0.1
		3.002	0.5	2.429	0.153	0.056	0.427	2.925	0.419	0.064	0.361	0.044		0.1
		3.002.5	0.5	2.627	0.117	0.035	0.73	2.596	0.527	0.061	0.636	0.027		0.1

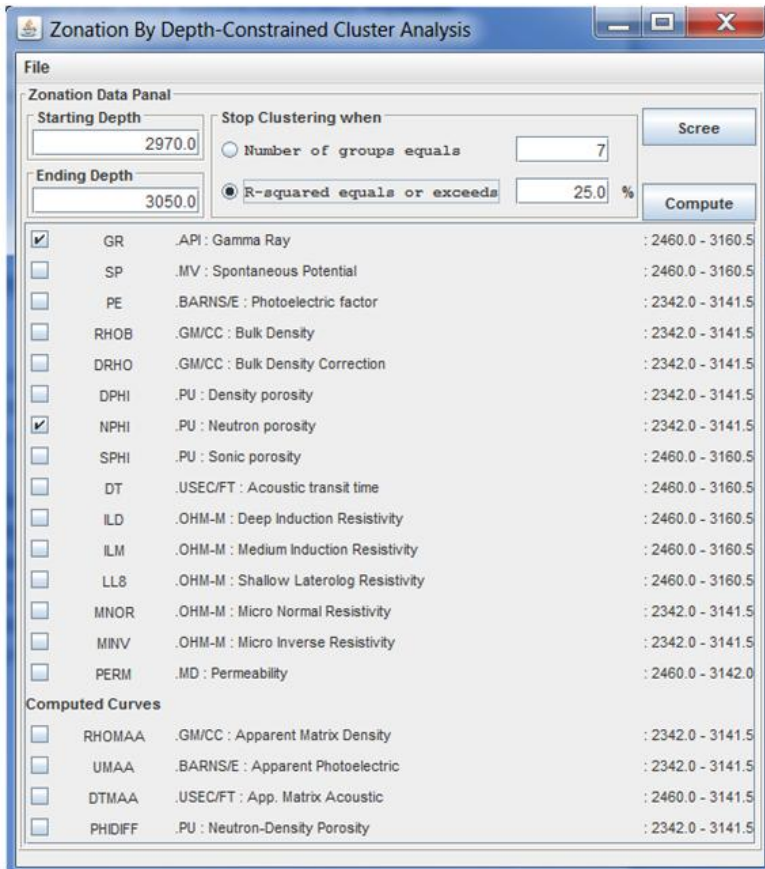
Headers Morrill Cottonwood

By Zonation a Depth-Constrained Cluster Analysis

The Zonation icon button  launches a depth-constrained multivariate cluster analysis which segments the entire depth interval based on user-specified set of logs. A hierarchical cluster is used to produce subintervals that are as homogeneous as possible and distinct as possible from each other, in terms of their log characteristics. The software employs Ward's method which, at each step of the clustering process, joins the two groups (subintervals) whose merger produces the least possible increase in the total within-groups sum-of-squares. The sum-of-squares for a single group, k, is given by

$$W_k = \sum_{i=1}^{n_k} ||x_i - \underline{x}_k||^2$$

where $||x_i - \underline{x}_k||^2$ is the squared distance between the vector of the log values for data point i, x_i , and the vector mean for group k, \underline{x}_k . The within-groups sum-of-squares increases equal the total sum-of-squares, T, given by the sum of the squared distances from all the data points to the global mean. At any step in the process, the relative amount of variation "explained" by the grouping can be measured by the value $R^2 = W/T$. R^2 increases with every merger and equals 100% when all the data points are joined in a single group.



Log Curve	Depth Range	Selected
GR : API : Gamma Ray	: 2460.0 - 3160.5	<input checked="" type="checkbox"/>
SP : MV : Spontaneous Potential	: 2460.0 - 3160.5	<input type="checkbox"/>
PE : BARNS/E : Photoelectric factor	: 2342.0 - 3141.5	<input type="checkbox"/>
RHOB : GM/CC : Bulk Density	: 2342.0 - 3141.5	<input type="checkbox"/>
DRHO : GM/CC : Bulk Density Correction	: 2342.0 - 3141.5	<input type="checkbox"/>
DPHI : PU : Density porosity	: 2342.0 - 3141.5	<input type="checkbox"/>
NPHI : PU : Neutron porosity	: 2342.0 - 3141.5	<input checked="" type="checkbox"/>
SPHI : PU : Sonic porosity	: 2460.0 - 3160.5	<input type="checkbox"/>
DT : USEC/FT : Acoustic transit time	: 2460.0 - 3160.5	<input type="checkbox"/>
ILD : OHM-M : Deep Induction Resistivity	: 2460.0 - 3160.5	<input type="checkbox"/>
ILM : OHM-M : Medium Induction Resistivity	: 2460.0 - 3160.5	<input type="checkbox"/>
LLS : OHM-M : Shallow Laterolog Resistivity	: 2460.0 - 3160.5	<input type="checkbox"/>
MNOR : OHM-M : Micro Normal Resistivity	: 2342.0 - 3141.5	<input type="checkbox"/>
MINV : OHM-M : Micro Inverse Resistivity	: 2342.0 - 3141.5	<input type="checkbox"/>
PERM : MD : Permeability	: 2460.0 - 3142.0	<input type="checkbox"/>
Computed Curves		
RHOMAA : GM/CC : Apparent Matrix Density	: 2342.0 - 3141.5	<input type="checkbox"/>
UMAA : BARNS/E : Apparent Photoelectric	: 2342.0 - 3141.5	<input type="checkbox"/>
DTMAA : USEC/FT : App. Matrix Acoustic	: 2460.0 - 3141.5	<input type="checkbox"/>
PHIDIFF : PU : Neutron-Density Porosity	: 2342.0 - 3141.5	<input type="checkbox"/>

Valid minimum and maximum depth range for each log curve.

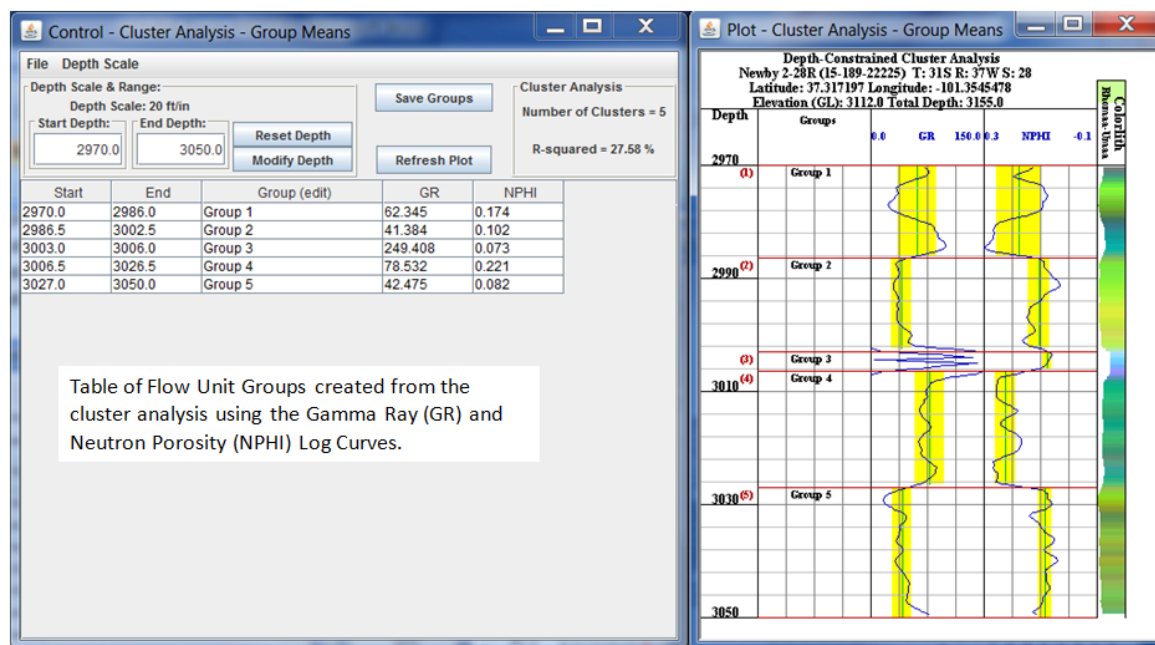
If the check box next to the log curve is checked then the starting and ending depth must be within the minimum and maximum depth range of curves selected otherwise the curve will automatically deselected.

The depth-constrained cluster analysis implemented in PffEFFER only allows vertically adjacent groups (subintervals) to be joined, greatly reducing the amount of computation relative to a more general cluster analysis, which would allow the possibility of joining any possible pair of groups at each step. The depth- constrained cluster analysis always produces a sequence of group memberships, represented as integers, beginning with 1 at the top of the interval and proceeding sequentially downward.

The "Zonation By Depth-Constrained Cluster Analysis" Dialog will display. The depth range panel initially displays the depth range of the log data. The user must set the Starting Depth and Ending Depth within the selected Log Curves or the log curves will be dropped when you select the "Compute" Button.

The stopping criterion can be specified either in terms of the number of groups (clustering will stop when the number of groups has be reduced to the number specified) or in terms of R_2 (clustering will stop when the R_2 equals or exceeds the specified value).

In the example above the Gamma Ray log curve and the Neutron Porosity log curve are selected. The Starting Depth will be from 2970 to the Ending Depth 3050. **NOTE:** The depth range must be within the depth range of all curves selected, i.e., Gamma Ray log curve is set from 2460.0 to 3160.5 and Neutron porosity log curve is set from 2342.0 to 3141.5. Select the "R-squared equals or exceeds" radio button and 25.0% will be used to compute the clusters. Now select the "Compute" Button. The Control & Plot - Cluster Analysis - Group Means" Dialogs will display



The profile plot is provided to illustrate the cluster analysis and where each group begins and ends using red lines as separators, with the groups labeled. The Colorlith is provided as a lithology indicator. The yellow represents the sigma squared value with a green line as the average around each group.

To Transfer the groups to the Pfeiffer Spreadsheet select the "Save Groups" button on the "Control - Cluster Analysis - Group Means" Dialog and the created flow units will be transferred to the Pfeiffer Dialog and automatically loaded, i.e.

Rt – True Resistivity Hierarchy:

1. ILD - Deep Induction Resistivity
2. AHT90 - Array Induction Resistivity - 90
3. LL - Deep Laterolog Resistivity
4. RDEP - Deep Resistivity
5. First Resistivity found

Φt – True Porosity Hierarchy:

1. PHI Average value of
 - a. NPHI - Neutron Porosity
 - b. DPHI - Density Porosity
2. NPHI - Neutron Porosity
3. DPHI - Density Porosity
4. SPHI - Sonic Porosity

Rxo – Bulk Resistivity Hierarchy:

1. SFLU – Spherically Focused Resistivity
2. AHT10 – Array Induction Resistivity – 10
3. LL8 - Shallow Laterolog Resistivity
4. RSHAL - Shallow Resistivity
5. MSFL – Micro Spherically Focused Res.

Vsh – Fractional Shale Hierarchy:

1. GR - Gamma Ray
2. CGR - Gamma Ray Minus Uranium
3. SP - Spontaneous Potential


Group 1 through Group 5 tabs are added with the home area for each automatically loaded with default log curve selections. The SXO and BVF columns are red because the values in those columns are not valid with respect to the Archie Default Parameters values.

References:

Pfeffer-Pro (Petrofacies Evaluation of Formation for Engineering Reservoirs), Kansas Geological Survey, Release Date February 1998. Zonation by Depth-Constrained Cluster Analysis pages 141 to 144.

Numerical zonation of log suites and logfacies recognition by multivariate clustering by Gill, D., Shomrony, A., and Fligelman, H., 1993, AAPG Bulletin, v. 17, no. 10, pp. 1781-1791.

By Tops

Click on the  icon button image to display the “Choose Flow Units From Tops Picks” Dialog, which will display with a list of tops check boxes with the tops Top and Base depths. This dialog will only display if the user imported tops when the well data was loaded.

To enable the Top Name, e.g. Council Grove check box, the Base depth must be greater than the Top depth, which is editable. Change the Base Depth to a greater value.

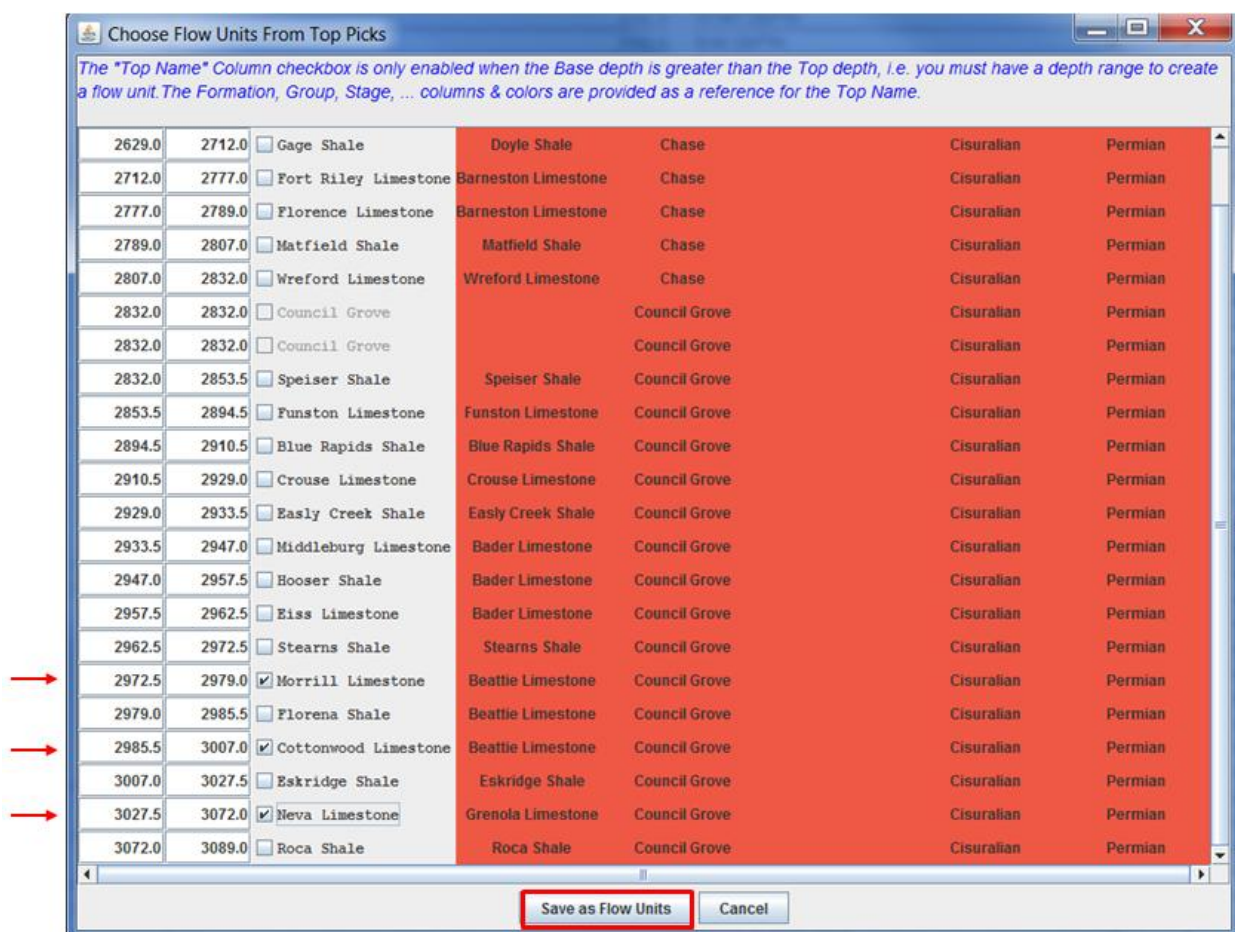
Choose Flow Units From Top Picks

The "Top Name" Column checkbox is only enabled when the Base depth is greater than the Top depth, i.e. you must have a depth range to create a flow unit. The Formation, Group, Stage, ... columns & colors are provided as a reference for the Top Name.

Top	Base	Top Name	Formation	Group	Stage	Series	System
2538.0	2580.0	<input type="checkbox"/> Krider Limestone	Nolans Limestone	Chase		Cisuralian	Permian
2629.0	2712.0	<input type="checkbox"/> Gage Shale	Doyle Shale	Chase		Cisuralian	Permian
2712.0	2777.0	<input type="checkbox"/> Fort Riley Limestone	Barneston Limestone	Chase		Cisuralian	Permian
2777.0	2789.0	<input type="checkbox"/> Florence Limestone	Barneston Limestone	Chase		Cisuralian	Permian
2789.0	2807.0	<input type="checkbox"/> Matfield Shale	Matfield Shale	Chase		Cisuralian	Permian
2807.0	2832.0	<input type="checkbox"/> Wreford Limestone	Wreford Limestone	Chase		Cisuralian	Permian
2832.0	2832.0	<input type="checkbox"/> Council Grove		Council Grove		Cisuralian	Permian
2832.0	2832.0	<input type="checkbox"/> Council Grove		Council Grove		Cisuralian	Permian
2832.0	2853.5	<input type="checkbox"/> Speiser Shale	Speiser Shale	Council Grove		Cisuralian	Permian
2853.5	2894.5	<input type="checkbox"/> Funston Limestone	Funston Limestone	Council Grove		Cisuralian	Permian
2894.5	2910.5	<input type="checkbox"/> Blue Rapids Shale	Blue Rapids Shale	Council Grove		Cisuralian	Permian
2910.5	2929.0	<input type="checkbox"/> Crouse Limestone	Crouse Limestone	Council Grove		Cisuralian	Permian
2929.0	2933.5	<input type="checkbox"/> Easley Creek Shale	Easley Creek Shale	Council Grove		Cisuralian	Permian
2933.5	2947.0	<input type="checkbox"/> Middleburg Limestone	Bader Limestone	Council Grove		Cisuralian	Permian
2947.0	2957.5	<input type="checkbox"/> Hooser Shale	Bader Limestone	Council Grove		Cisuralian	Permian
2957.5	2962.5	<input type="checkbox"/> Eiss Limestone	Bader Limestone	Council Grove		Cisuralian	Permian
2962.5	2972.5	<input type="checkbox"/> Stearns Shale	Stearns Shale	Council Grove		Cisuralian	Permian
2972.5	2979.0	<input type="checkbox"/> Morrill Limestone	Beattie Limestone	Council Grove		Cisuralian	Permian
2979.0	2985.5	<input type="checkbox"/> Florena Shale	Beattie Limestone	Council Grove		Cisuralian	Permian
2985.5	3007.0	<input type="checkbox"/> Cottonwood Limestone	Beattie Limestone	Council Grove		Cisuralian	Permian
3007.0	3027.5	<input type="checkbox"/> Eskridge Shale	Eskridge Shale	Council Grove		Cisuralian	Permian

Save as Flow Units Cancel

This dialog allows the users to build flow units from the top picks. The flow unit is selected by selecting the checkbox next to the tops name. The user can only pick a flow unit if Base Depth is greater than the Top Base, e.g., at depth 2832.0 feet Council Grove is disabled because the Top and Base Depth is equal to each other. The user can change the base depth to enable the checkbox so Council Grove can be selected. Scroll down to the bottom of the table. The dialog can be resized to the width of the user PC's or move the scroll bar to the right down to access the tops.



In this example Morrill Limestone, Cottonwood Limestone and Neva Limestone checkboxes are selected. Select the "Save as Flow Units" Button to transfer the selected tops to the PffEFFER dialog, which will automatically create a spread sheet and load the log curve data for each flow unit selected, i.e.

Rt – True Resistivity Hierarchy:

1. ILD - Deep Induction Resistivity
2. AHT90 - Array Induction Resistivity - 90
3. LL - Deep Laterolog Resistivity
4. RDEP - Deep Resistivity
5. First Resistivity found

Φt – True Porosity Hierarchy:

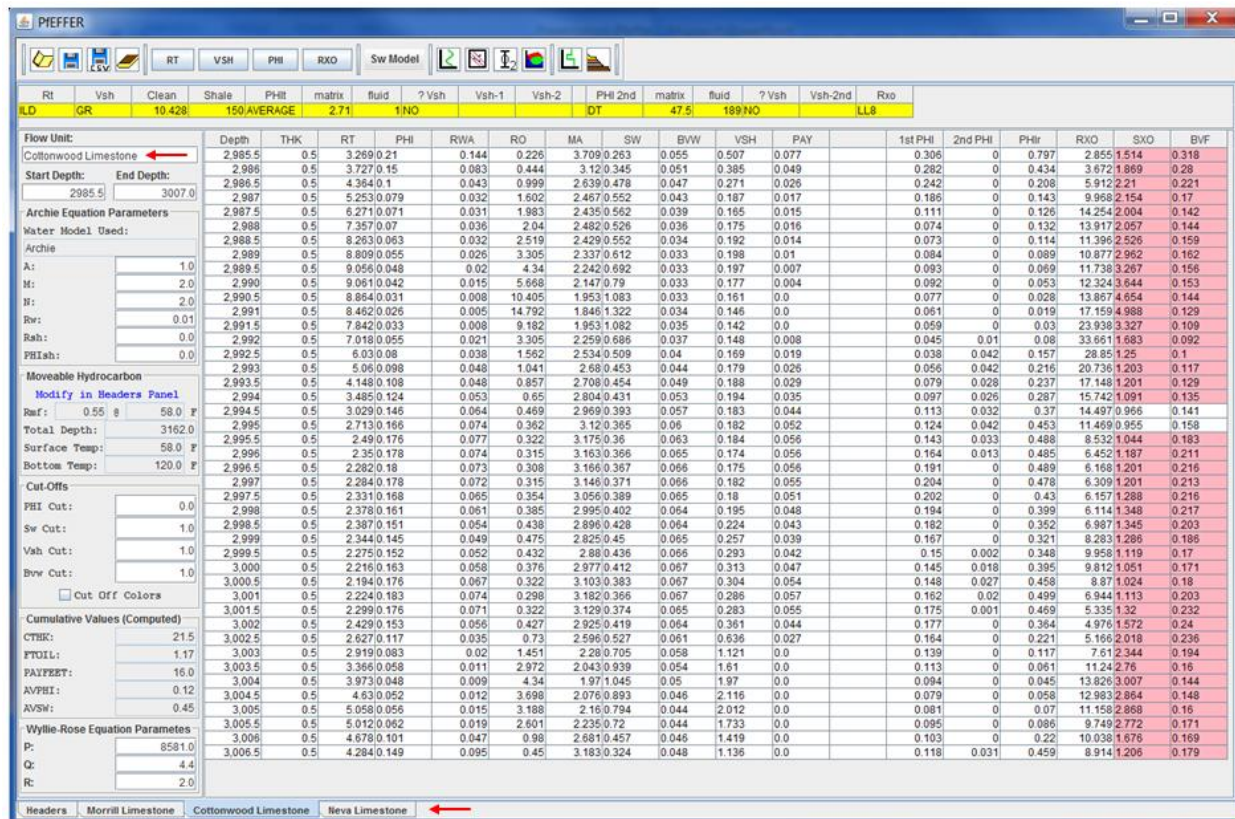
1. PHI Average value of
 - a. NPHI - Neutron Porosity
 - b. DPHI - Density Porosity
2. NPHI - Neutron Porosity
3. DPHI - Density Porosity
4. SPHI - Sonic Porosity

Rxo – Bulk Resistivity Hierarchy:

1. SFLU – Spherically Focused Resistivity
2. AHT10 – Array Induction Resistivity – 10
3. LL8 - Shallow Laterolog Resistivity
4. RSHAL - Shallow Resistivity
5. MSFL – Micro Spherically Focused Res.

Vsh – Fractional Shale Hierarchy:

1. GR - Gamma Ray
2. CGR - Gamma Ray Minus Uranium
3. SP - Spontaneous Potential



Morrill Limestone, Cottonwood Limestone (selected), and Neva Limestone tabs are added with the home area for each automatically loaded with default log curve selections. The SXO and BVF columns are red because the values in those columns are not valid with respect to the Archie Default Parameters values.

Cut-Offs and Colors

The Cut-Offs Panel of the PFEFFER worksheet contain cut-off values which determine what is and is not considered pay. The labels for the cut-offs, are PHI Cut:, Sw Cut:, Vsh Cut: and Bvw Cut. A zone is considered pay if

$\text{PHI} > \text{PHI Cut}$
 $\text{SW} < \text{Sw Cut}$
 $\text{VSH} < \text{Vsh Cut}$
 $\text{BVW} < \text{Bvw Cut}$

If all these criteria are satisfied, then the PAY values for that zone is equal to the increment thickness of oil ($\text{THK} * \text{PHI} * (1 - \text{SW})$). Otherwise the value of pay is set to zero. The default values for these cut-offs are 0, 1, 1, and 1 (for PHI, SW, VSH and BVW respectively). These values would imply that everything is considered pay, except for zones with physically unreasonable values for one or more parameters (such as $\text{SW} > 1$). The user may change the cut-

offs simply by editing the cut-off values. The values in the PAY column will respond dynamically to these changes, as will the two summary values FTOIL and PAYFEET in the Cumulative Values (Computed).

Cut-Offs

PHI Cut:

0.06

Sw Cut:

0.9

Vsh Cut:

1.0

Bvw Cut:

0.103

☒ Cut Off Colors

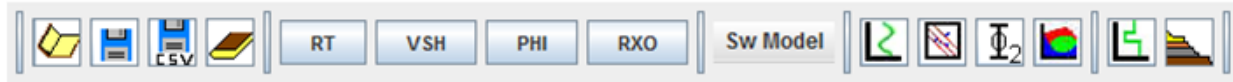
Clicking on the **Cut Off Colors** Checkbox will activate color flagging of pay zones

Depth	THK	RT	PHI	RWA	RO	MA	SW	BVW	VSH	PAY		1st PHI	2nd PHI	PHir	R XO	S XO	BVF
2.985.5	0.5	3.269	0.21	0.628	0.624	2.26	0.437	0.091	0.507	0.059		0.306	0	1.002	2.855	0.725	0.152
2.986	0.5	3.727	0.15	0.478	0.935	1.928	0.5	0.075	0.385	0.037		0.282	0	0.715	3.672	0.783	0.117
2.986.5	0.5	4.364	0.1	0.344	1.521	1.657	0.59	0.059	0.271	0.02		0.242	0	0.475	5.912	0.787	0.078
2.987	0.5	5.253	0.079	0.312	2.018	1.576	0.619	0.048	0.187	0.015		0.186	0	0.393	9.968	0.698	0.055
2.987.5	0.5	6.271	0.071	0.327	2.294	1.58	0.604	0.042	0.165	0.014		0.111	0	0.378	14.254	0.622	0.044
2.988	0.5	7.357	0.07	0.378	2.334	1.631	0.563	0.039	0.175	0.015		0.074	0	0.402	13.917	0.635	0.044
2.988.5	0.5	8.263	0.063	0.374	2.648	1.611	0.566	0.035	0.192	0.013		0.073	0	0.375	11.396	0.747	0.047
2.989	0.5	8.809	0.055	0.339	3.117	1.558	0.594	0.032	0.198	0.0		0.084	0	0.329	10.877	0.83	0.045
2.989.5	0.5	9.056	0.048	0.296	3.67	1.497	0.636	0.03	0.197	0.0		0.093	0	0.283	11.738	0.867	0.041
2.990	0.5	9.061	0.042	0.252	4.308	1.434	0.689	0.028	0.177	0.0		0.092	0	0.241	12.324	0.917	0.038
2.990.5	0.5	8.864	0.031	0.171	6.203	1.302	0.836	0.025	0.161	0.0		0.077	0	0.166	13.867	1.037	0.032
2.991	0.5	8.462	0.026	0.132	7.661	1.227	0.951	0.024	0.146	0.0		0.061	0	0.131	17.159	1.036	0.026
2.991.5	0.5	7.842	0.033	0.163	5.755	1.29	0.856	0.028	0.142	0.0		0.059	0	0.168	23.938	0.76	0.025
2.992	0.5	7.018	0.055	0.27	3.117	1.479	0.666	0.036	0.148	0.0		0.045	0.01	0.294	33.661	0.471	0.025
2.992.5	0.5	6.03	0.08	0.363	1.988	1.639	0.574	0.045	0.169	0.017		0.038	0.042	0.427	28.85	0.407	0.032
2.993	0.5	5.06	0.098	0.389	1.558	1.706	0.555	0.054	0.179	0.021		0.056	0.042	0.499	20.736	0.425	0.041
2.993.5	0.5	4.148	0.108	0.358	1.387	1.692	0.578	0.062	0.188	0.022		0.079	0.028	0.508	17.148	0.441	0.047
2.994	0.5	3.485	0.124	0.355	1.175	1.72	0.58	0.072	0.194	0.025		0.097	0.026	0.55	15.742	0.423	0.052
2.994.5	0.5	3.029	0.146	0.376	0.966	1.793	0.584	0.082	0.183	0.031		0.113	0.032	0.624	14.497	0.4	0.058
2.995	0.5	2.713	0.166	0.393	0.828	1.86	0.552	0.091	0.182	0.037		0.124	0.042	0.688	11.469	0.416	0.069
2.995.5	0.5	2.49	0.176	0.387	0.772	1.874	0.556	0.098	0.184	0.038		0.143	0.033	0.708	8.532	0.466	0.082
2.996	0.5	2.35	0.178	0.37	0.761	1.852	0.569	0.101	0.174	0.038		0.164	0.013	0.697	6.452	0.532	0.094
2.996.5	0.5	2.282	0.18	0.364	0.751	1.847	0.573	0.103	0.175	0.0		0.191	0	0.696	6.168	0.541	0.097
2.997	0.5	2.284	0.178	0.359	0.761	1.836	0.577	0.102	0.182	0.037		0.204	0	0.687	6.309	0.538	0.095
2.997.5	0.5	2.331	0.168	0.342	0.816	1.788	0.591	0.099	0.18	0.034		0.202	0	0.647	6.157	0.564	0.094
2.998	0.5	2.378	0.161	0.332	0.859	1.757	0.601	0.096	0.195	0.032		0.194	0	0.621	6.114	0.581	0.093
2.998.5	0.5	2.387	0.151	0.308	0.927	1.699	0.623	0.094	0.224	0.028		0.182	0	0.576	6.987	0.564	0.085
2.999	0.5	2.344	0.145	0.288	0.974	1.654	0.644	0.093	0.257	0.025		0.167	0	0.544	8.283	0.531	0.077
2.999.5	0.5	2.275	0.152	0.296	0.92	1.68	0.636	0.096	0.293	0.027		0.15	0.002	0.567	9.958	0.471	0.071
3.000	0.5	2.216	0.163	0.314	0.846	1.73	0.618	0.1	0.313	0.031		0.145	0.018	0.609	9.812	0.455	0.074
3.000.5	0.5	2.194	0.176	0.341	0.772	1.801	0.593	0.104	0.304	0.0		0.148	0.027	0.664	8.87	0.457	0.08
3.001	0.5	2.224	0.183	0.362	0.736	1.85	0.575	0.105	0.286	0.0		0.162	0.02	0.701	6.944	0.504	0.092
3.001.5	0.5	2.299	0.176	0.357	0.772	1.828	0.579	0.101	0.283	0.037		0.175	0.001	0.68	5.335	0.589	0.103
3.002	0.5	2.429	0.153	0.319	0.913	1.721	0.613	0.093	0.361	0.029		0.177	0	0.591	4.976	0.663	0.101
3.002.5	0.5	2.627	0.117	0.25	1.26	1.542	0.692	0.081	0.636	0.017		0.164	0	0.445	5.166	0.765	0.089
3.003	0.5	2.919	0.083	0.184	1.902	1.371	0.807	0.067	1.121	0.0		0.139	0	0.311	7.61	0.774	0.064
3.003.5	0.5	3.366	0.058	0.138	2.925	1.249	0.932	0.054	1.61	0.0		0.113	0	0.217	11.24	0.79	0.045
3.004	0.5	3.973	0.048	0.129	3.67	1.226	0.961	0.046	1.97	0.0		0.094	0	0.188	13.826	0.798	0.038
3.004.5	0.5	4.63	0.052	0.166	3.334	1.31	0.848	0.044	2.116	0.0		0.079	0	0.223	12.983	0.785	0.04
3.005	0.5	5.058	0.056	0.198	3.051	1.375	0.776	0.043	2.012	0.0		0.081	0	0.255	11.158	0.81	0.045
3.005.5	0.5	5.012	0.062	0.222	2.7	1.422	0.733	0.045	1.733	0.0		0.095	0	0.287	9.749	0.815	0.05
3.006	0.5	4.678	0.101	0.373	1.503	1.695	0.566	0.057	1.419	0.0		0.103	0	0.498	10.038	0.599	0.06
3.006.5	0.5	4.284	0.149	0.545	0.942	1.995	0.469	0.069	1.136	0.0		0.118	0.031	0.76	8.914	0.503	0.075

When the **Cut Off Colors** Checkbox is checked, cells in the PAY column corresponding to pay zones will be colored yellow. In addition, cells in the PHI column with values less than PHI Cut will be colored light gray, cells with SW > Sw Cut will be cyan, cells with VSH > Vsh Cut will be light gray, and cells with BVW > Bvw Cut will be magenta. These colors will respond dynamically to changes in the cut-offs or to changes in the PHI, SW, VSH and BVW values themselves.

Modifying the Log Curve Selections

PfEFFER Toolbar has a set of buttons designed to ease the transfer of data from the log input columns right into the home area columns RT, VSH and PHI. The **VSH** button is placed before the **PHI** button because the VSH column may be employed in the computation of PHI and so the computation of VSH would logically come first.



RT	Select the input log for the Total Resistivity (Rt)
VSH	Select the input log for the Shale proportion (Vsh) & log data values for clean formation and for shale.
PHI	Select the input logs for the Total Porosity (PHI) & rock matrix, fluid values.
RXO	Select the input log for the Bulk Resistivity of Flushed Zone (Rxo)

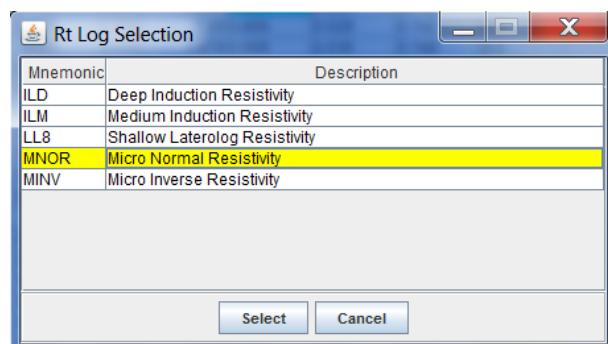
Calculating RT

When the flow unit is created the spread sheet is automatically loaded using a hierarchy of resistivity curves. If Deep Induction Resistivity (ILD) Log Curve is present it is automatically selected as the default True Resistivity (Rt). If ILD is not present it looks for the next resistivity log curve by the following hierarchy,

Rt – True Resistivity Hierarchy:

1. ILD - Deep Induction Resistivity
2. AHT90 - Array Induction Resistivity - 90
3. LL - Deep Laterolog Resistivity
4. RDEP - Deep Resistivity
5. First Resistivity found

If the user wishes to change the curve they only need to select the RT button on the Tool Bar, which will launch the “Rt Log Curve Selection” dialog, with a list of possible resistivity log curves loaded from the LAS file.



With this example there are 5 resistivity log curves available, highlight the Micro Normal Resistivity (MNOR) log curve and click on the “Select” Button to load the MNOR log data into the RT Column of the Home Area and recomputed all the other columns.

RT	Vsh	Clean	Shale	PHIT	matrix	fluid	? Vsh	Vsh-1	Vsh-2	PHI 2nd	matrix	fluid	? Vsh	Vsh-2nd	Rxo
MNOR	GR	10.428	150	AVERAGE	2.71	1	NO			DT	47.5	189	NO		LL8
Flow Unit:															
Cottonwood Limestone															
Start Depth:	End Depth:														
2985.5	3007.0														
Archie Equation Parameters															
Water Model Used:															
Archie															
A:	0.8														
H:	1.2														
N:	2.0														
Rv:	0.12														
Rsh:	0.0														
PHIsh:	0.0														
Moveable Hydrocarbon															
Modify in Headers Panel															
Rmf:	0.55 @	58.0 F													
Total Depth:	3162.0														
Surface Temp:	58.0 F														
Bottom Temp:	120.0 F														
Cut-Offs															
PHI Cut:	0.06														
Sw Cut:	0.9														
Vsh Cut:	1.0														
Bwv Cut:	0.103														
<input checked="" type="checkbox"/> Cut Off Colors															
Cumulative Values (Computed)															
CTHk:	21.5														
FTOIL:	1.17														
PAYTEET:	13.5														
AVPHI:	0.13														
AVSW:	0.38														
Wyllie-Rose Equation Parameters															
P:	8581.0														
Q:	4.4														
R:	2.0														

Calculating VSH

When the flow unit is created the spread sheet is automatically loaded using a hierarchy of log curves that will illustrate change in Shale levels. If Gamma Ray (GR) Log Curve is present it is automatically selected as the default V-Shale (VSH). If GR is not present it looks for the next shale level log curve by the following hierarchy,

Vsh – Fractional Shale Hierarchy:

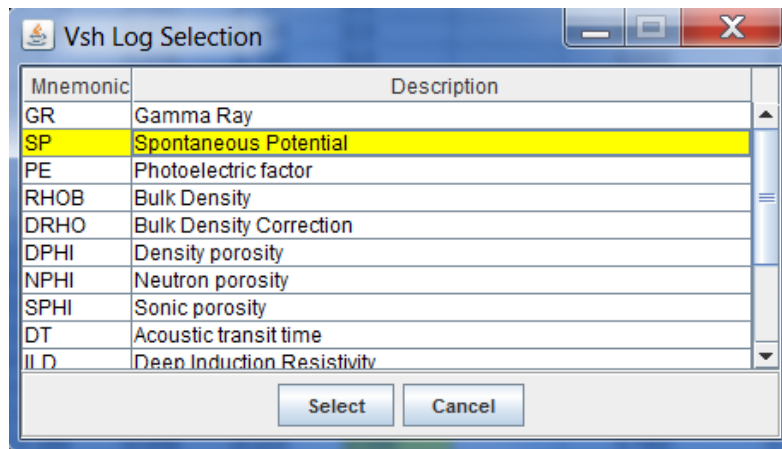
1. GR - Gamma Ray
2. CGR - Gamma Ray Minus Uranium
3. SP - Spontaneous Potential

The VSH button is used to establish the formula for the VSH (shale proportion) column, based on any log curve the user has to decide the clean formation value and the shale value of the log curve selected. Using the Gamma Ray as an example, the VSH will be computed as,

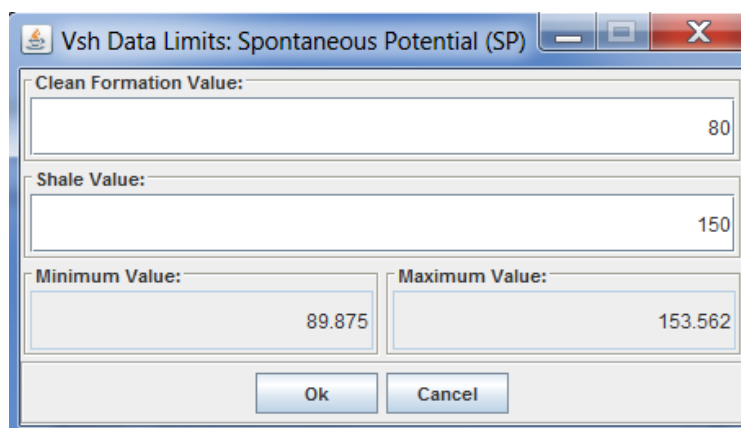
$$Vsh = (GR - GRc) / (GRsh - GRc)$$

Where GR is the observed gamma ray value and GRc and GRsh are the specified gamma ray values for clean formation and for shale formation respectively. The default values for GRc and

GRsh for this formation are 10.428 API and 150.0 API respectively. If the user wishes to change the curve they only need to select the VSH button on the Tool Bar, which will launch the “Vsh Log Selection” dialog, with a list of possible log curves loaded from the LAS file.



As you can see, this dialog is showing all the log curves downloaded from the LAS file. The user can select any curve, but the user has to determine what is the clean formation level and shale formation level. Highlight the Spontaneous Potential (SP) and click on the “Select” button to display the “Vsh Data Limits: Spontaneous Potential” Dialog.



The Dialog will show the minimum and maximum value, but the user will have to enter the Clean Formation value and the Shale Value, e.g. set the Clean Formation Value to 80 and the Shale Value to 150. Now click on the “Ok” button to load the SP log data into the VSH Column of the Home Area and recomputed all the other columns depending on Vsh.

RT	Vsh	Clean	Shale	PHIT	matrix	fluid	? Vsh	Vsh-1	Vsh-2	PHI 2nd	matrix	fluid	? Vsh	Vsh-2nd	Rxo		
MINOR	SP	80	150	AVERAGE	2.71	1NO				DT	47.5	189NO			LL8		
Flow Unit:																	
Cottonwood Limestone				2985.5	0.5	1.247/0.21	0.239	0.624	1.643/0.707	0.148	0.881	0.0	0.306	0	0.619	2.855/0.725	0.152
				2.986	0.5	8.052/0.15	1.033	0.935	2.334/0.34	0.051	0.875	0.049	0.282	0	1.05	3.672/0.783	0.117
Start Depth:	End Depth:			2986.5	0.5	13.893/0.1	1.095	1.521	2.16/0.33	0.033	0.884	0.033	0.242	0	0.848	5.912/0.787	0.078
	2985.5		3007.0	2.987	0.5	10.581/0.079	0.628	2.018	1.852/0.436	0.034	0.881	0.022	0.186	0	0.558	9.968/0.698	0.055
Archie Equation Parameters																	
				2987.5	0.5	12.221/0.071	0.639	2.294	1.832/0.433	0.03	0.888	0.02	0.111	0	0.527	14.254/0.622	0.044
Water Model Used:				2.988	0.5	9.278/0.07	0.476	2.334	1.718/0.501	0.035	0.877	0.017	0.074	0	0.452	13.917/0.635	0.044
				2988.5	0.5	5.796/0.063	0.262	2.648	1.483/0.676	0.042	0.878	0.01	0.073	0	0.314	11.396/0.747	0.047
Archie				2.989	0.5	10.319/0.055	0.397	3.117	1.812/0.549	0.03	0.867	0.0	0.084	0	0.356	10.877/0.83	0.045
A:	0.8			2989.5	0.5	16.004/0.048	0.523	3.67	1.684/0.478	0.022	0.841	0.0	0.093	0	0.377	11.738/0.867	0.041
M:	1.2			2.990	0.5	11.294/0.042	0.314	4.308	1.503/0.617	0.025	0.807	0.0	0.092	0	0.27	12.324/0.917	0.038
N:	2.0			2.990.5	0.5	12.139/0.031	0.234	6.203	1.393/0.714	0.022	0.766	0.0	0.077	0	0.194	13.867/1.037	0.032
Rv:	0.12			2.991	0.5	29.899/0.026	0.468	7.661	1.573/0.506	0.013	0.703	0.0	0.061	0	0.247	17.159/1.036	0.026
Rh:	0.0			2.991.5	0.5	22.969/0.033	0.478	5.755	1.605/0.5	0.016	0.626	0.0	0.059	0	0.288	23.938/0.76	0.025
PHIsh:	0.0			2.992	0.5	12.361/0.055	0.475	3.117	1.674/0.502	0.027	0.538	0.01	0.045	0.01	0.39	33.661/0.471	0.025
				2992.5	0.5	9.067/0.08	0.547	1.988	1.8/0.468	0.037	0.451	0.021	0.038	0.042	0.524	28.85/0.407	0.032
Moveable Hydrocarbon																	
				2.993	0.5	7.749/0.098	0.596	1.558	1.89/0.448	0.043	0.379	0.027	0.056	0.042	0.618	20.736/0.425	0.041
				2993.5	0.5	8.857/0.108	0.766	1.387	2.032/0.395	0.042	0.322	0.032	0.079	0.028	0.743	17.148/0.441	0.047
Modify in Headers Panel				2.994	0.5	9.267/0.124	0.946	1.175	2.189/0.356	0.044	0.264	0.039	0.097	0.026	0.897	15.742/0.423	0.052
Rmf: 0.55 @ 58.0 F				2994.5	0.5	10.09/0.146	1.253	0.966	2.419/0.309	0.045	0.231	0.05	0.113	0.032	1.138	14.497/0.4	0.058
Total Depth:	3162.0			2.995	0.5	7.915/0.166	1.146	0.828	2.456/0.323	0.053	0.206	0.056	0.124	0.042	1.178	11.469/0.416	0.069
Surface Temp:	58.0 F			2995.5	0.5	6.841/0.176	1.063	0.772	2.455/0.335	0.059	0.184	0.058	0.143	0.033	1.173	8.532/0.466	0.082
Bottom Temp:	120.0 F			2.996	0.5	7.184/0.178	1.131	0.761	2.5/0.325	0.057	0.178	0.06	0.164	0.013	1.219	6.452/0.532	0.094
				2996.5	0.5	8.055/0.18	1.286	0.751	2.583/0.305	0.054	0.162	0.062	0.191	0	1.308	6.168/0.541	0.097
Cut-Offs				2.997	0.5	8.384/0.178	1.32	0.761	2.589/0.301	0.053	0.151	0.062	0.204	0	1.316	6.309/0.538	0.095
				2997.5	0.5	7.236/0.168	1.063	0.816	2.423/0.335	0.056	0.141	0.055	0.202	0	1.141	6.157/0.564	0.094
PHI Cut: 0.06				2.998	0.5	6.202/0.161	0.866	0.859	2.282/0.372	0.059	0.153	0.05	0.194	0	1.004	6.114/0.581	0.093
Sw Cut: 0.9				2998.5	0.5	6.121/0.151	0.791	0.927	2.197/0.389	0.058	0.167	0.046	0.182	0	0.923	6.987/0.564	0.085
				2.999	0.5	7.129/0.145	0.878	0.974	2.23/0.369	0.053	0.189	0.045	0.167	0	0.949	8.283/0.531	0.077
Vsh Cut: 1.0				2999.5	0.5	8.676/0.152	1.13	0.92	2.39/0.325	0.049	0.176	0.051	0.15	0.002	1.108	9.958/0.471	0.071
Bvv Cut: 0.103				3.000	0.5	8.473/0.163	1.201	0.846	2.469/0.316	0.051	0.166	0.055	0.145	0.018	1.191	9.812/0.455	0.074
<input checked="" type="checkbox"/> Cut Off Colors				3000.5	0.5	6.867/0.176	1.067	0.772	2.457/0.335	0.059	0.169	0.058	0.148	0.027	1.175	8.870/0.457	0.08
				3.001	0.5	5.6/0.183	0.912	0.736	2.394/0.362	0.066	0.199	0.058	0.162	0.02	1.112	6.944/0.504	0.092
Cumulative Values (Computed)				3001.5	0.5	5.327/0.176	0.827	0.772	2.311/0.38	0.067	0.248	0.054	0.175	0.001	1.035	5.335/0.589	0.103
				3.002	0.5	6.099/0.153	0.801	0.913	2.211/0.388	0.059	0.296	0.046	0.177	0	0.936	4.976/0.663	0.101
CTHK: 21.5				3002.5	0.5	7.192/0.117	0.684	1.26	2.011/0.418	0.048	0.381	0.034	0.164	0	0.737	5.166/0.765	0.089
FTOIL: 1.22				3.003	0.5	10.633/0.083	0.67	1.902	1.891/0.423	0.035	0.466	0.023	0.139	0	0.593	7.61/0.774	0.064
PAYTEET: 15.0				3003.5	0.5	16.496/0.058	0.676	2.925	1.807/0.421	0.024	0.572	0.0	0.113	0	0.48	11.24/0.79	0.045
AVPHI: 0.13				3.004	0.5	9.621/0.048	0.314	3.67	1.517/0.617	0.029	0.684	0.0	0.094	0	0.292	13.826/0.798	0.038
				3004.5	0.5	5.279/0.052	0.189	3.334	1.355/0.794	0.041	0.782	0.0	0.079	0	0.238	12.983/0.785	0.04
AVSW: 0.39				3.005	0.5	5.556/0.056	0.218	3.051	1.407/0.741	0.041	0.857	0.0	0.081	0	0.267	11.158/0.81	0.045
				3005.5	0.5	6.058/0.062	0.269	2.7	1.49/0.667	0.041	0.913	0.01	0.095	0	0.315	9.749/0.815	0.05
Wyllie-Rose Equation Parameters				3.006	0.5	4.6/0.101	0.367	1.503	1.687/0.571	0.057	0.968	0.021	0.103	0	0.494	10.038/0.599	0.06
P: 8581.0				3006.5	0.5	3.178/0.149	0.404	0.942	1.838/0.544	0.081	1.023	0.0	0.118	0.031	0.654	8.914/0.503	0.075

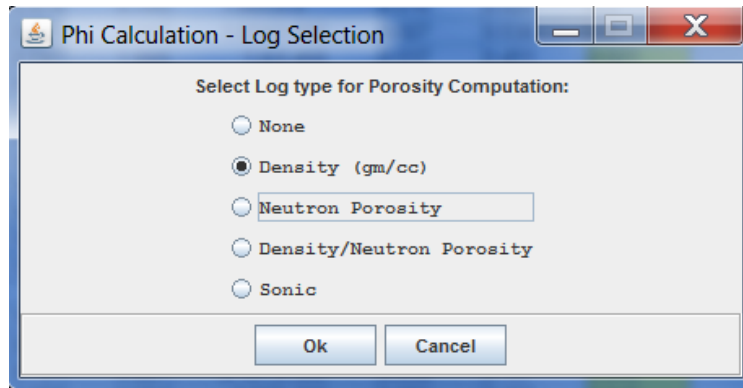
Calculating PHI

When the flow unit is created the spread sheet is automatically loaded using a hierarchy of Porosity log curves. If Average Porosity can be calculated, both Neutron and Density Porosity curves are available) then the PHI is automatically is calculated as the default. If both NPHI and DPHI are not both present it looks for the next porosity log curve by the following hierarchy,

Φt – True Porosity Hierarchy:

1. PHI Average value of
 - a. NPHI - Neutron Porosity
 - b. DPHI - Density Porosity
2. NPHI - Neutron Porosity
3. DPHI - Density Porosity
4. SPHI - Sonic Porosity

If the user wishes to change the curve they only need to select the PHI button on the Tool Bar, which will launch the “Phi Calculation - Log Selection” dialog, with a set of radio buttons of possible porosity curves to select. If the Sonic log curve is not present then the Sonic radio button would be disabled, but as you can see in the image below that all possible porosity log curves are present. The default button selected is None, but you must have a porosity curve so for this example the Density (gm/cc) radio button will be selected.



The four options correspond to the following formulas, with and without correction for shale volume,

	Without correction	With correction
Density	$(\rho_{ma} - \rho_b) / (\rho_{ma} - \rho_f)$	$[\rho_{ma} - \rho_b - V_{sh}(\rho_{ma} - \rho_{sh})] / [\rho_{ma} - \rho_f]$
Neutron	Φ_n	$\Phi_n - V_{sh} * \Phi_{n\ sh}$
Density/Neutron	$\sqrt{[(\Phi_n^2 + \Phi_d^2) / 2]}$	$[\Phi_n - (\Phi_{n\ sh} / \Phi_{d\ sh}) * \Phi_d] / [1 - \Phi_{n\ sh} / \Phi_{d\ sh}]$
Sonic	$(\Delta t_{ma} - \Delta t_b) / (\Delta t_{ma} - \Delta t_f)$	$[\Delta t_{ma} - \Delta t_b - V_{sh} * (\Delta t_{ma} - \Delta t_{sh})] / [\Delta t_{ma} - \Delta t_f]$

In each case you will be requested to specify columns containing the appropriate logs and also to specify the constants in the selected equation (such as ρ_{ma} and ρ_f). You will also be asked whether you want to correct for V_{sh} , as described below. Indicate your choice of logs by selecting the appropriate radio button on the Log Selection dialog box and then clicking OK. Here we have chosen to compute the porosity from a density log.

You are now presented with the Parameter Values dialog box ...

which lets you specify the parameters in the selected equation, in this case matrix (or grain) density and fluid density (ρ_{ma} and ρ_f). Since the Cottonwood is a limestone interval, we have

entered 2.71 for the grain density above. The default value for fluid density is 1.0, which we will leave unchanged.

We could choose to include a Vsh correction by clicking on the “Correct for Vsh?” check box. Doing so will activate the Shale Density (RHOsh) edit box, allowing us to enter the needed value. The shale correction is based on the values in the VSH column. (If you select the Vsh correction prior to filling the VSH column, the formula for PHI will still be set up correctly, but the resulting porosity values will be null. The porosity values will be set to their proper numeric values once values are entered for VSH.) For now we will choose not to use the Vsh correction. The Parameter Values dialog box is similar for the other three porosity computation options, although it contains only the Vsh Correction box for the neutron porosity and density/neutron porosity options. After clicking OK on the Parameter Values dialog box, the program will set up the formula for the PHI column ...

RT	Vsh	Clean	Shale	PHI	matrix	fluid	? Vsh	Vsh-1	Vsh-2	PHI 2nd	matrix	fluid	? Vsh	Vsh-2nd	Rxo			
MINOR	SP		80	150	RHO	2.71	1.0			DT	47.5	189	NO		LL8			
Flow Unit:																		
Cottonwood Limestone	Depth	THK	RT	PHI	RWA	RO	MA	SW	BWV	VSH	PAY		1st PHI	2nd PHI	PHIR	RXO	SXO	BVF
	2985.5	0.5	1.247	0.163	0.176	0.846	1.413	0.823	0.134	0.881	0.0	0.306	0	0.456	2.855	0.844	0.137	
Start Depth:	2986.5	0.5	8.052	0.132	0.886	1.09	2.187	0.367	0.048	0.875	0.041	0.282	0	0.901	3.672	0.845	0.111	
End Depth:	2986.5	0.5	13.893	0.087	0.927	1.798	2.037	0.359	0.031	0.884	0.027	0.242	0	0.718	5.912	0.855	0.074	
	2987.5	0.5	10.581	0.073	0.572	2.219	1.796	0.458	0.033	0.881	0.019	0.186	0	0.507	9.968	0.732	0.053	
Archie Equation Parameters	2987.5	0.5	12.221	0.053	0.449	3.259	1.649	0.516	0.027	0.888	0.0	0.111	0	0.371	14.254	0.741	0.039	
Water Model Used:	2988.5	0.5	9.278	0.054	0.349	3.187	1.566	0.586	0.031	0.877	0.0	0.074	0	0.331	13.917	0.742	0.04	
Archie	2988.5	0.5	5.796	0.048	0.189	3.67	1.35	0.795	0.038	0.878	0.0	0.073	0	0.227	11.396	0.88	0.042	
A:	2989.5	0.5	10.315	0.039	0.262	4.709	1.441	0.675	0.026	0.867	0.0	0.084	0	0.236	10.877	1.02	0.039	
M:	2989.5	0.5	16.004	0.032	0.321	5.971	1.486	0.61	0.019	0.841	0.0	0.093	0	0.232	11.738	1.106	0.035	
N:	2990.5	0.5	11.294	0.03	0.21	6.452	1.359	0.755	0.022	0.807	0.0	0.092	0	0.18	12.324	1.122	0.033	
Rv:	2990.5	0.5	12.135	0.023	0.164	8.875	1.283	0.855	0.019	0.766	0.0	0.077	0	0.135	13.867	1.24	0.028	
Rsh:	2991.5	0.5	29.893	0.022	0.383	9.361	1.504	0.559	0.012	0.703	0.0	0.061	0	0.202	17.159	1.145	0.025	
PHIsh:	2991.5	0.5	22.958	0.035	0.513	5.362	1.633	0.483	0.016	0.626	0.0	0.059	0	0.309	23.938	0.734	0.025	
	2992.5	0.5	12.361	0.061	0.538	2.753	1.736	0.471	0.028	0.538	0.016	0.045	0.016	0.442	33.661	0.443	0.027	
	2992.5	0.5	9.067	0.088	0.613	1.773	1.871	0.442	0.038	0.451	0.024	0.038	0.049	0.588	28.85	0.384	0.033	
	2993.5	0.5	7.745	0.111	0.692	1.342	1.997	0.416	0.046	0.379	0.032	0.056	0.055	0.718	20.736	0.394	0.043	
Moveable Hydrocarbon	2993.5	0.5	8.857	0.123	0.895	1.186	2.159	0.366	0.045	0.322	0.038	0.079	0.044	0.868	17.148	0.407	0.05	
Modify in Readers Panel	2994.5	0.5	9.267	0.145	1.141	0.974	2.366	0.324	0.047	0.264	0.048	0.097	0.047	1.082	15.742	0.385	0.055	
Rmf: 0.55 @ 58.0 F	2994.5	0.5	10.05	0.171	1.514	0.799	2.635	0.281	0.048	0.231	0.051	0.113	0.058	1.376	14.497	0.364	0.062	
Total Depth:	2995.5	0.5	7.915	0.194	1.382	0.686	2.691	0.294	0.057	0.206	0.069	0.124	0.07	1.418	11.489	0.379	0.073	
Surface Temp:	2995.5	0.5	6.841	0.207	1.291	0.635	2.708	0.304	0.063	0.184	0.071	0.143	0.064	1.425	8.532	0.423	0.087	
Bottom Temp:	2996.5	0.5	7.184	0.209	1.372	0.628	2.756	0.295	0.061	0.178	0.073	0.164	0.044	1.478	6.452	0.483	0.101	
	2996.5	0.5	8.055	0.212	1.565	0.617	2.855	0.276	0.058	0.162	0.076	0.191	0.02	1.592	6.168	0.49	0.103	
Cut-Offs	2997.5	0.5	8.384	0.207	1.583	0.635	2.837	0.275	0.056	0.151	0.075	0.204	0.003	1.578	6.309	0.491	0.101	
PHI Cut:	2997.5	0.5	7.236	0.19	1.232	0.704	2.602	0.311	0.059	0.141	0.065	0.202	0	1.323	6.157	0.524	0.099	
Sw Cut:	2998.5	0.5	6.202	0.185	1.023	0.727	2.47	0.342	0.063	0.153	0.06	0.194	0	1.186	6.114	0.534	0.098	
Vsh Cut:	2998.5	0.5	6.121	0.174	0.938	0.782	2.376	0.357	0.062	0.167	0.055	0.182	0	1.094	6.987	0.518	0.09	
	2999.5	0.5	7.125	0.169	1.055	0.81	2.422	0.337	0.056	0.189	0.056	0.167	0.002	1.141	8.283	0.484	0.081	
Vsh Cut:	2999.5	0.5	8.676	0.18	1.385	0.751	2.626	0.294	0.052	0.176	0.063	0.15	0.03	1.357	9.958	0.425	0.076	
Bvr Cut:	3000.5	0.5	8.473	0.19	1.443	0.704	2.697	0.288	0.054	0.166	0.067	0.145	0.045	1.431	9.812	0.415	0.078	
	3000.5	0.5	6.867	0.201	1.251	0.658	2.661	0.309	0.062	0.169	0.069	0.148	0.053	1.378	8.87	0.422	0.084	
<input checked="" type="checkbox"/> Cut Off Colors	3001.5	0.5	5	0.203	1.032	0.65	2.551	0.34	0.069	0.199	0.066	0.162	0.041	1.26	6.944	0.474	0.096	
	3001.5	0.5	5.327	0.194	0.93	0.686	2.449	0.359	0.069	0.248	0.062	0.175	0.019	1.163	5.335	0.556	0.107	
Cumulative Values (Computed)	3002.5	0.5	6.099	0.17	0.909	0.804	2.342	0.363	0.061	0.296	0.054	0.177	0	1.062	4.976	0.623	0.105	
CTHk:	3002.5	0.5	7.192	0.132	0.791	1.09	2.131	0.389	0.051	0.381	0.04	0.164	0	0.851	5.166	0.711	0.093	
PTDIL:	3003.5	0.5	10.633	0.094	0.778	1.638	1.99	0.392	0.036	0.466	0.028	0.139	0	0.689	7.610	0.719	0.067	
PAYFEET:	3003.5	0.5	16.496	0.058	0.676	2.925	1.807	0.421	0.024	0.572	0.0	0.113	0	0.48	11.240	0.79	0.045	
AVPHI:	3004.5	0.5	9.621	0.03	0.178	6.452	1.313	0.818	0.024	0.684	0.0	0.094	0	0.166	13.826	1.058	0.031	
AVSW:	3004.5	0.5	5.275	0.025	0.078	8.03	1.086	1.233	0.03	0.782	0.0	0.079	0	0.099	12.983	1.218	0.03	
	3005.5	0.5	5.556	0.025	0.083	8.03	1.11	1.202	0.03	0.857	0.0	0.081	0	0.101	11.158	1.314	0.032	
Wyllie-Rose Equation Parameters	3005.5	0.5	6.055	0.038	0.149	4.858	1.267	0.895	0.034	0.913	0.0	0.095	0	0.175	9.749	1.093	0.041	
	3006.5	0.5	4	0.099	0.358	1.539	1.673	0.578	0.057	0.968	0.02	0.103	0	0.482	10.038	0.606	0.06	
P:	8581.0	0.5	3.178	0.15	0.407	0.935	1.844	0.542	0.081	1.023	0.0	0.118	0.032	0.66	8.914	0.501	0.075	
Q:	4.4																	
R:	2.0																	

Note that the Pickett plot computations expect porosity as a fraction, not in percent. Using the density and sonic options to compute porosity will yield fractional values automatically. PffEFFER-java automatically converts porosity logs that are in percent to fractional values when the LAS file is imported into the program.

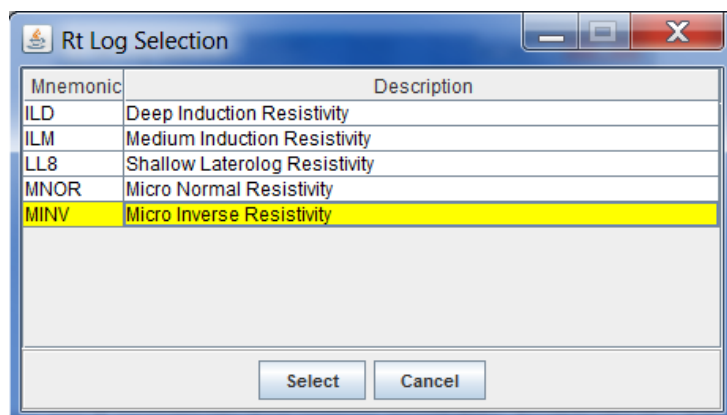
Calculating RXO

When the flow unit is created the spread sheet is automatically loaded using a hierarchy of resistivity curves. If Shallow Laterolog Resistivity (LL8) Log Curve is present it is automatically selected as the default Bulk resistivity of flushed zone (Rxo). If LL8 is not present it looks for the next resistivity log curve by the following hierarchy,

Rt – True Resistivity Hierarchy:

1. SFLU – Spherically Focused Resistivity
2. AHT10 - Array Induction Resistivity - 10
3. LL8 - Shallow Laterolog Resistivity
4. RSHAL - Shallow Resistivity
5. MSFL – Micro Spherically Focused Resistivity

If the user wishes to change the curve they only need to select the RXO button on the Tool Bar, which will launch the “Rt Log Curve Selection” dialog, with a list of possible resistivity log curves loaded from the LAS file.













With this example there are 5 resistivity log curves available, highlight the Micro Inverse Resistivity (MINV) log curve and click on the “Select” Button to load the MINV log data into the RXO Column of the Home Area and recomputed all the Moveable Oil columns, SXO and BVF.

RT	Vsh	Clean	Shale	PHIT	matrix	fluid	? Vsh	Vsh-1	Vsh-2	PHI 2nd	matrix	fluid	? Vsh	Vsh-2nd	Rxo
MNOR	SP	80	150 RHOB	2.71	1NO					DT	47.5	189 NO			MINV

Flow Unit:	Depth	THK	RT	PHI	RWA	RO	MA	SW	BWW	VSH	PAY	1st PHI	2nd PHI	PHIR	RXO	SXO	BVF
Cottonwood Limestone	2985.5	0.5	1.247/0.163	0.176	0.846	1.413/0.823	0.134	0.881	0.0	0.0		0.306	0	0.456	0.935/1.473	0.24	
Start Depth:	2986	0.5	8.052/0.132	0.886	1.09	2.187/0.367	0.048	0.875	0.041			0.282	0	0.905	9.98/0.512	0.067	
End Depth:	2986.5	0.5	13.893/0.087	0.927	1.798	2.037/0.359	0.031	0.884	0.027			0.242	0	0.718	13.19/0.572	0.049	
2985.5	2987	0.5	10.581/0.073	0.572	2.219	1.796/0.458	0.033	0.881	0.019			0.186	0	0.507	10.63/0.703	0.051	
3007.0	2987.5	0.5	12.221/0.053	0.449	3.259	1.649/0.516	0.027	0.888	0.0			0.111	0	0.375	20.32/0.621	0.032	
Archie Equation Parameters	2988	0.5	9.278/0.054	0.349	3.187	1.556/0.586	0.031	0.877	0.0			0.074	0	0.335	15.66/0.699	0.037	
Water Model Used:	2988.5	0.5	5.795/0.048	0.189	3.67	1.35/0.795	0.038	0.878	0.0			0.073	0	0.227	10.55/0.914	0.043	
Archie	2989	0.5	10.319/0.039	0.282	4.709	1.441/0.675	0.025	0.867	0.0			0.084	0	0.238	15.10/0.866	0.033	
A:	2989.5	0.5	16.004/0.032	0.321	5.971	1.486/0.61	0.019	0.841	0.0			0.093	0	0.232	18.42/0.883	0.028	
M:	2990	0.5	11.294/0.03	0.21	6.452	1.359/0.755	0.022	0.807	0.0			0.092	0	0.15	13.72/1.063	0.031	
N:	2990.5	0.5	12.139/0.023	0.164	8.875	1.283/0.855	0.019	0.766	0.0			0.077	0	0.135	13.74/1.246	0.028	
Rv:	2991	0.5	29.899/0.022	0.383	9.361	1.504/0.559	0.012	0.703	0.0			0.061	0	0.202	21.27/1.028	0.022	
Rsh:	2991.5	0.5	22.969/0.035	0.513	5.362	1.633/0.483	0.016	0.626	0.0			0.059	0	0.308	17.23/0.864	0.03	
PHIsh:	2992	0.5	12.361/0.061	0.538	2.753	1.736/0.471	0.028	0.538	0.016			0.045	0.016	0.442	12.89/0.716	0.043	
Moveable Hydrocarbon	2992.5	0.5	9.067/0.088	0.613	1.773	1.871/0.442	0.038	0.451	0.024			0.038	0.049	0.588	6.067/0.838	0.073	
Modify in Headers Panel	2993	0.5	7.749/0.111	0.692	1.342	1.997/0.416	0.046	0.379	0.032			0.056	0.055	0.718	5.476/0.767	0.085	
Rmf: 0.55 @ 58.0 F	2993.5	0.5	8.857/0.123	0.895	1.186	2.159/0.366	0.045	0.322	0.038			0.079	0.044	0.868	6.487/0.663	0.081	
Total Depth: 3162.0	2994	0.5	9.267/0.145	1.141	0.974	2.366/0.324	0.047	0.264	0.048			0.097	0.047	1.062	7.227/0.569	0.082	
Surface Temp: 58.0 F	2994.5	0.5	10.09/0.171	1.514	0.799	2.635/0.281	0.048	0.231	0.061			0.113	0.058	1.376	7.506/0.505	0.086	
Bottom Temp: 120.0 F	2995	0.5	7.915/0.194	1.382	0.696	2.69/0.294	0.057	0.206	0.068			0.124	0.07	1.418	5.716/0.537	0.104	
Cut-Offs	2995.5	0.5	6.841/0.207	1.291	0.635	2.708/0.304	0.063	0.184	0.071			0.143	0.064	1.426	5.687/0.518	0.107	
PHI Cut: 0.06	2996	0.5	7.184/0.209	1.372	0.628	2.756/0.295	0.061	0.178	0.073			0.164	0.044	1.478	6.255/0.491	0.102	
Sw Cut: 0.9	2996.5	0.5	8.055/0.212	1.565	0.617	2.855/0.276	0.058	0.162	0.076			0.191	0.02	1.592	7.10/0.457	0.096	
Vsh Cut: 1.0	2997	0.5	8.384/0.207	1.583	0.635	2.837/0.275	0.056	0.151	0.075			0.204	0.003	1.578	7.047/0.465	0.096	
Bv Cut: 0.103	2997.5	0.5	7.236/0.19	1.232	0.704	2.602/0.311	0.059	0.141	0.065			0.202	0	1.323	6.25/0.518	0.098	
Cut Off Colors	2998	0.5	6.202/0.185	1.023	0.727	2.47/0.342	0.063	0.153	0.06			0.194	0	1.188	5.89/0.544	0.1	
	2998.5	0.5	6.121/0.174	0.938	0.782	2.376/0.357	0.062	0.167	0.055			0.182	0	1.094	5.518/0.583	0.101	
	2999	0.5	7.129/0.169	1.055	0.81	2.422/0.337	0.056	0.189	0.056			0.167	0.002	1.14	5.826/0.578	0.097	
	2999.5	0.5	8.676/0.18	1.385	0.751	2.626/0.294	0.052	0.176	0.063			0.15	0.03	1.357	6.982/0.508	0.091	
	3000	0.5	8.473/0.19	1.443	0.704	2.697/0.288	0.054	0.166	0.067			0.145	0.045	1.435	6.36/0.514	0.097	
	3000.5	0.5	6.867/0.201	1.251	0.658	2.651/0.309	0.062	0.169	0.069			0.148	0.053	1.378	5.85/0.518	0.104	
	3001	0.5	5.6/0.203	1.032	0.65	2.55/0.34	0.069	0.199	0.066			0.162	0.041	1.26	5.414/0.537	0.109	
	3001.5	0.5	5.327/0.194	0.93	0.686	2.449/0.359	0.069	0.248	0.062			0.175	0.019	1.163	5.896/0.528	0.102	
	3002	0.5	6.099/0.17	0.909	0.804	2.342/0.363	0.061	0.296	0.054			0.177	0	1.062	6.118/0.562	0.095	
	3002.5	0.5	7.192/0.132	0.791	1.09	2.131/0.399	0.051	0.381	0.04			0.164	0	0.855	6.325/0.643	0.084	
	3003	0.5	10.633/0.094	0.778	1.638	1.99/0.392	0.036	0.466	0.028			0.139	0	0.688	10.15/0.622	0.058	
	3003.5	0.5	16.496/0.058	0.676	2.925	1.807/0.421	0.024	0.572	0.0			0.113	0	0.48	22.27/0.561	0.032	
	3004	0.5	9.621/0.03	0.178	6.452	1.313/0.818	0.024	0.684	0.0			0.094	0	0.166	12.73/1.102	0.033	
	3004.5	0.5	5.279/0.025	0.078	8.03	1.086/1.233	0.03	0.782	0.0			0.079	0	0.095	6.85/1.676	0.041	
	3005	0.5	5.556/0.025	0.083	8.03	1.112/0.202	0.03	0.857	0.0			0.081	0	0.101	8.28/1.524	0.038	
	3005.5	0.5	6.056/0.038	0.149	4.858	1.267/0.895	0.034	0.913	0.0			0.095	0	0.175	8.036/1.204	0.045	
	3006	0.5	4.6/0.099	0.368	1.538	1.673/0.578	0.057	0.968	0.02			0.103	0	0.482	6.806/0.736	0.072	
	3006.5	0.5	3.178/0.15	0.407	0.935	1.844/0.542	0.081	1.023	0.0			0.118	0.032	0.66	4.432/0.711	0.106	

Selecting a Water Saturation Model

The Sw Model menu lets you choose between the Archie water saturation model (the default) and two shaly sand models, the Simandoux model and the Dual-water model. These options will be demonstrated using the Cottonwood Limestone worksheet. PffEFFER determines which model is currently in effect by checking the contents of "Water Model Used:" text field, which reads Archie whenever a new worksheet is created. The Archie model assumes that column RT contains true resistivity log data, the measured bulk resistivity. You switch to one of the shaly sand models by selecting the appropriate entry from the Sw Model menu in the Tool Bar at the top of the "spreadsheet".

<div><div></div><div><div>RT</div><div>VSH</div><div>PHI</div><div>RXO</div><div>Sw Model</div></div><div><div></div></div></div>														
Rt	Vsh	Clean	Shale	PHIt	matrix	Archie	Vsh-1	Vsh-2	PHI 2nd	matrix	fluid	? Vsh	Vsh-2nd	Rxo
ILD	GR	10.428	150	AVERAGE	2.71	Simandoux			DT	47.5	189	NO		LL8
						Dual water								

The values of the parameters displayed in the dialog box are those found in the appropriate cells on the current worksheet, Archie parameters for A, m, n, and Rw, Archie parameter Rsh (shale resistivity), and Archie parameter Phish (shale porosity), Rsh is required for the Simandoux model and both Rsh & PHish are required for the Dual-water model. Changing the value of a parameter on the dialog box changes the corresponding value on the worksheet. If one of the cells on the worksheet is initially empty, then the corresponding text box on the dialog box will initially be empty as well. You must supply all the relevant parameters for a given model before calculations can proceed.

Archie Equation Parameters needed for Water Model Calculations with "Water Model Used" showing Archie.

Flow Unit:	Depth	THK	RT	PHI	RWA	RO	MA	SW	BWW	VSH	PAY	1st PHI	2nd PHI	PHIR	RKO	SXO	BVF
Cottonwood Limestone	2,985.5	0.5	3,269.0.21	0.628	0.624	2,260.437	0.091	0.507	0.059	0.059		0.306	0	1.002	2,855.0.725	0.152	
Start Depth: End Depth:	2,986	0.5	3,727.0.15	0.478	0.935	1,928.0.5	0.075	0.385	0.037			0.282	0	0.715	3,672.0.783	0.117	
2,985.5 3007.0	2,986.5	0.5	4,364.0.1	0.344	1.521	1,657.0.59	0.059	0.271	0.02			0.242	0	0.475	5,912.0.787	0.078	
Archie Equation Parameters	2,987	0.5	5,253.0.079	0.312	2.018	1,576.0.619	0.048	0.187	0.015			0.186	0	0.393	9,968.0.698	0.055	
Water Model Used:	2,987.5	0.5	6,271.0.071	0.327	2.294	1,580.604	0.042	0.165	0.014			0.111	0	0.378	14,254.0.622	0.044	
Archie	2,988	0.5	7,357.0.07	0.378	2.334	1,631.0.563	0.039	0.175	0.015			0.074	0	0.402	13,917.0.635	0.044	
A:	2,988.5	0.5	8,263.0.063	0.374	2.648	1,611.0.566	0.035	0.192	0.013			0.073	0	0.375	11,396.0.747	0.047	
M:	2,989	0.5	8,809.0.055	0.339	3.117	1,559.0.594	0.032	0.198	0.011			0.084	0	0.329	10,877.0.83	0.045	
II:	2,989.5	0.5	9,055.0.048	0.296	3.57	1,497.0.636	0.03	0.197	0.0			0.093	0	0.283	11,738.0.867	0.041	
Rv:	2,990	0.5	9,061.0.042	0.252	4.308	1,434.0.689	0.028	0.177	0.0			0.092	0	0.241	12,324.0.917	0.038	
Rsh:	2,990.5	0.5	8,864.0.031	0.171	6.203	1,302.0.836	0.025	0.161	0.0			0.077	0	0.166	13,867.1.037	0.032	
PHIsh:	2,991	0.5	8,462.0.026	0.132	7.661	1,227.0.951	0.024	0.146	0.0			0.061	0	0.131	17,159.1.036	0.026	
Moveable Hydrocarbon	2,991.5	0.5	7,842.0.033	0.163	5.755	1,290.856	0.028	0.142	0.0			0.059	0	0.168	23,938.0.76	0.025	
Modify in Headers Panel	2,992	0.5	7,018.0.055	0.27	3.117	1,479.0.666	0.036	0.148	0.009			0.045	0.01	0.294	33,661.0.471	0.025	
Rmf: 0.55 58.0 F	2,992.5	0.5	6,030.0.08	0.363	1.988	1,639.0.574	0.045	0.169	0.017			0.038	0.042	0.427	28,850.407	0.032	
Total Depth: 3162.0	2,993	0.5	5,060.0.098	0.389	1.558	1,706.0.555	0.054	0.179	0.021			0.056	0.042	0.499	20,736.0.425	0.041	
Surface Temp: 58.0 F	2,993.5	0.5	4,148.0.108	0.358	1.387	1,692.0.578	0.062	0.188	0.022			0.079	0.028	0.508	17,148.0.441	0.047	
Bottom Temp: 120.0 F	2,994	0.5	3,485.0.124	0.355	1.175	1,720.58	0.072	0.194	0.025			0.097	0.026	0.55	15,742.0.423	0.052	
Cut-Offs	2,994.5	0.5	3,029.0.146	0.376	0.966	1,793.0.584	0.082	0.183	0.031			0.113	0.032	0.624	14,497.0.4	0.058	
PHI Cut: 0.05	2,995	0.5	2,713.0.166	0.393	0.828	1,865.0.552	0.091	0.182	0.037			0.124	0.042	0.688	11,469.0.416	0.069	
Sw Cut: 0.9	2,995.5	0.5	2,490.0.176	0.387	0.772	1,874.0.566	0.098	0.184	0.038			0.143	0.033	0.708	8,532.0.466	0.082	
Vsh Cut: 1.0	2,996	0.5	2,350.0.178	0.37	0.761	1,852.0.569	0.101	0.174	0.038			0.164	0.013	0.697	6,452.0.532	0.094	
Bvv Cut: 0.103	2,996.5	0.5	2,282.0.18	0.364	0.751	1,847.0.573	0.103	0.175	0.0			0.191	0	0.696	6,168.0.541	0.097	
✓ Cut Off Colors	2,997	0.5	2,284.0.178	0.359	0.761	1,836.0.577	0.102	0.182	0.037			0.204	0	0.687	6,309.0.538	0.095	
Cumulative Values (Computed)	2,997.5	0.5	2,331.0.168	0.342	0.816	1,788.0.591	0.099	0.18	0.034			0.202	0	0.647	6,157.0.564	0.094	
CTBK: 21.5	2,998	0.5	2,378.0.161	0.332	0.859	1,757.0.601	0.096	0.195	0.032			0.194	0	0.621	6,114.0.581	0.093	
FTCIL: 0.71	2,998.5	0.5	2,387.0.151	0.308	0.927	1,699.0.623	0.094	0.224	0.028			0.182	0	0.576	6,987.0.564	0.085	
PAYFEET: 13.5	2,999	0.5	2,344.0.145	0.288	0.974	1,654.0.644	0.093	0.257	0.025			0.167	0	0.544	8,283.0.531	0.077	
AVPHI: 0.12	2,999.5	0.5	2,275.0.152	0.296	0.92	1,680.636	0.096	0.293	0.027			0.15	0.002	0.567	9,958.0.471	0.071	
AVSW: 0.58	3,000	0.5	2,216.0.163	0.314	0.846	1,730.618	0.1	0.313	0.031			0.145	0.018	0.609	9,812.0.455	0.074	
Wyllie-Rose Equation Parameters	3,000.5	0.5	2,194.0.176	0.341	0.772	1,801.0.593	0.104	0.304	0.0			0.148	0.027	0.664	8,870.457	0.08	
P: 8581.0	3,001	0.5	2,224.0.183	0.362	0.736	1,850.575	0.105	0.286	0.0			0.162	0.02	0.701	6,944.0.504	0.092	
Q: 4.4	3,001.5	0.5	2,299.0.176	0.357	0.772	1,828.0.579	0.101	0.283	0.037			0.175	0.001	0.68	5,335.0.589	0.103	
R: 2.0	3,002	0.5	2,429.0.153	0.319	0.913	1,721.0.613	0.093	0.361	0.029			0.177	0	0.591	4,976.0.663	0.101	
	3,002.5	0.5	2,627.0.117	0.25	1.26	1,542.0.692	0.081	0.636	0.017			0.164	0	0.445	5,166.0.765	0.089	
	3,003	0.5	2,919.0.083	0.184	1.902	1,371.0.807	0.067	1.121	0.0			0.139	0	0.311	7,610.774	0.064	
	3,003.5	0.5	3,366.0.058	0.138	2.925	1,249.0.932	0.054	1.61	0.0			0.113	0	0.217	11,240.79	0.045	
	3,004	0.5	3,973.0.048	0.129	3.67	1,226.0.961	0.046	1.97	0.0			0.094	0	0.188	13,826.0.798	0.038	
	3,004.5	0.5	4,630.0.052	0.166	3.334	1,310.848	0.044	2.116	0.0			0.079	0	0.223	12,983.0.785	0.04	
	3,005	0.5	5,059.0.056	0.198	3.051	1,370.776	0.043	2.912	0.0			0.081	0	0.255	11,158.0.81	0.045	
	3,005.5	0.5	5,012.0.062	0.222	2.7	1,422.0.733	0.045	1.733	0.0			0.095	0	0.287	9,749.0.815	0.05	
	3,006	0.5	4,678.0.101	0.373	1.503	1,695.0.566	0.057	1.419	0.0			0.103	0	0.498	10,038.0.599	0.06	
	3,006.5	0.5	4,284.0.149	0.545	0.942	1,995.0.469	0.069	1.136	0.0			0.118	0.031	0.76	8,914.0.503	0.075	

RT column presently
holds the Deep Induction
Resistivity Log Data

SW column will reflect the
changes to the RT column.

The Iteration settings are fixed at Maximum iterations of 100 and Maximum change of 0.0001 for the shaly sand models, which both use an iterative approach to solve the relevant equations:

Both shaly sand models can be written in the form

$$a*Sw^n + b*Sw + c = 0$$

For the Simandoux model,

$$a = Co = \phi^m / (A * R_w)$$

$$b = Csh = Vsh / Rsh$$

$$c = -Ct = -1 / Rt$$

and for the Dual-water model,

$$a = 1$$

$$b = -W = -[Sb * (1 - A * R_w / R_b)]$$

$$c = -Ish = -A * R_w / (Rt * \phi_t^m)$$

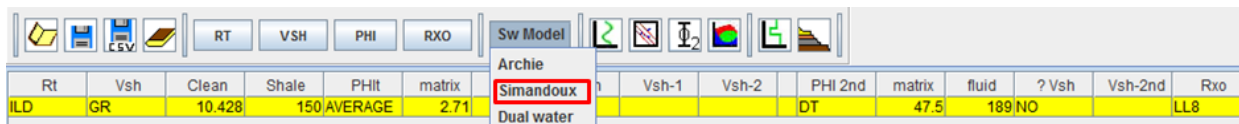
and note that "a" here is distinct from the Archie parameter, denoted "A" above. This polynomial equation can be solved iteratively using Newton's method, yielding the following iterative equation for Sw:

$$Sw_{(k+1)} = Sw_k - (a * Sw_k^n + b * Sw_k + c) / (n * a * Sw_k^{n-1} + b)$$

where the subscript k is the iteration index. This iteration can be implemented by PffEFFER-Math using a self-referential formula for each cell containing Sw. The code initializes the Sw values using the quadratic equation, i.e., assuming that n = 2. It then sets the formula for each Sw cell to the right-hand side of the equation above, where the Sw_k value is in fact a reference to the cell itself.

Selecting Simandoux Menu Option

The Rsh value in the “Archie Equation Parameters” Panel must not be 0.0 and for this example it is set to 5.0. The user can select the  icon image button to display the Profile plot and then turn on the LAS - Induction Resistivity Logs radio button and observe that the Deep Induction Resistivity shale value is about 5.



The user now selects the “Sw Model” Menu and then selects the “Simandoux” Menu Option and the program will automatically compute the resistivity and insert the new resistivity values in the RT column and recomputed the other columns in the Home Area.


Archie Equation Parameters needed for Water Model Calculations with “Water Model Used” showing Simandoux.

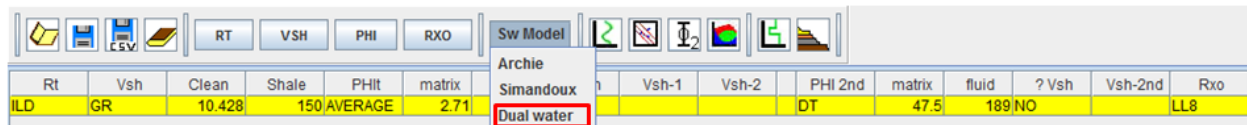
Flow Unit:	Depth	THK	RT	PHI	RWA	RO	MA	SW	BWV	VSH	PAY	1st PHI	2nd PHI	PHIR	RHO	SXO	BVF
Cottonwood Limestone	2985.5	0.5	3.778/0.21	0.725	0.624	2.353/0.406	0.085	0.507	0.062			0.306	0	1.078	2.855/0.725	0.152	
Start Depth:	2986	0.5	4.302/0.15	0.552	0.935	2.004/0.466	0.069	0.385	0.04			0.282	0	0.768	3.672/0.783	0.117	
End Depth:	2986.5	0.5	5.017/0.1	0.395	1.521	1.718/0.55	0.055	0.271	0.022			0.242	0	0.509	5.912/0.787	0.078	
2985.5	2987	0.5	5.932/0.079	0.352	2.018	1.624/0.583	0.046	0.187	0.016			0.186	0	0.417	9.968/0.698	0.055	
3007.0	2987.5	0.5	7.106/0.071	0.371	2.294	1.627/0.568	0.04	0.165	0.015			0.111	0	0.402	14.254/0.622	0.044	
Archie Equation Parameters	2988	0.5	8.504/0.07	0.437	2.334	1.686/0.523	0.036	0.175	0.016			0.074	0	0.432	13.917/0.635	0.044	
Water Model Used:	2988.5	0.5	9.886/0.063	0.447	2.648	1.676/0.517	0.032	0.192	0.015			0.073	0	0.411	11.396/0.747	0.047	
Simandoux	2989	0.5	10.836/0.055	0.417	3.117	1.629/0.536	0.029	0.198	0.012			0.084	0	0.365	10.877/0.83	0.045	
A:	2989.5	0.5	11.36/0.048	0.371	3.67	1.572/0.568	0.027	0.197	0.0			0.093	0	0.318	11.738/0.887	0.041	
M:	2990	0.5	11.299/0.042	0.314	4.308	1.504/0.617	0.025	0.177	0.0			0.092	0	0.27	12.324/0.917	0.038	
N:	2990.5	0.5	11.248/0.031	0.217	6.203	1.371/0.742	0.023	0.161	0.0			0.077	0	0.187	13.867/1.037	0.032	
Rv:	2991	0.5	10.699/0.028	0.167	7.661	1.291/0.846	0.022	0.146	0.0			0.061	0	0.147	17.159/1.036	0.026	
Rsh: Required	2991.5	0.5	9.487/0.033	0.197	5.755	1.346/0.778	0.025	0.142	0.0			0.059	0	0.185	23.938/0.76	0.025	
PHIsh:	2992	0.5	8.059/0.055	0.31	3.117	1.527/0.621	0.034	0.148	0.01			0.045	0.01	0.315	33.661/0.471	0.025	
Moveable Hydrocarbon	2992.5	0.5	6.778/0.08	0.409	1.988	1.685/0.541	0.043	0.169	0.018			0.038	0.042	0.453	28.85/0.407	0.032	
Modify in Headers Panel	2993	0.5	5.594/0.098	0.43	1.558	1.75/0.527	0.051	0.179	0.023			0.056	0.042	0.525	20.736/0.425	0.041	
Raf: 0.55 @ 58.0 F	2993.5	0.5	4.539/0.108	0.392	1.387	1.732/0.552	0.059	0.188	0.024			0.079	0.028	0.532	17.148/0.441	0.047	
Total Depth: 3162.0	2994	0.5	3.769/0.124	0.384	1.175	1.758/0.558	0.069	0.194	0.027			0.097	0.026	0.572	15.742/0.423	0.052	
Surface Temp: 58.0 F	2994.5	0.5	3.224/0.146	0.4	0.966	1.826/0.547	0.079	0.183	0.033			0.113	0.032	0.643	14.497/0.4	0.058	
Bottom Temp: 120.0 F	2995	0.5	2.865/0.166	0.415	0.828	1.891/0.537	0.089	0.182	0.038			0.124	0.042	0.707	11.469/0.416	0.069	
Cut-Offs	2995.5	0.5	2.62/0.176	0.407	0.772	1.993/0.542	0.095	0.184	0.04			0.143	0.033	0.726	8.532/0.466	0.082	
PHI Cut: 0.05	2996	0.5	2.461/0.178	0.387	0.761	1.879/0.556	0.099	0.174	0.039			0.164	0.013	0.713	6.452/0.532	0.094	
Sw Cut: 0.9	2996.5	0.5	2.389/0.18	0.381	0.751	1.874/0.56	0.1	0.175	0.039			0.191	0	0.712	6.168/0.541	0.097	
Vsh Cut: 1.0	2997	0.5	2.396/0.178	0.377	0.761	1.864/0.563	0.1	0.182	0.038			0.204	0	0.704	6.309/0.538	0.095	
Bvw Cut: 0.103	2997.5	0.5	2.449/0.168	0.36	0.816	1.815/0.577	0.096	0.18	0.035			0.202	0	0.664	6.157/0.564	0.094	
Cumulative Values (Computed)	2998	0.5	2.514/0.161	0.351	0.859	1.787/0.584	0.094	0.195	0.033			0.194	0	0.639	6.114/0.581	0.093	
CTBK: 21.5	2998.5	0.5	2.551/0.151	0.329	0.927	1.735/0.603	0.091	0.224	0.029			0.182	0	0.596	6.987/0.564	0.085	
PTOIL: 0.88	2999	0.5	2.533/0.145	0.312	0.974	1.694/0.62	0.089	0.257	0.027			0.167	0	0.565	8.283/0.531	0.077	
PAYTEET: 15.0	2999.5	0.5	2.476/0.152	0.322	0.92	1.725/0.609	0.092	0.293	0.029			0.15	0.002	0.592	9.958/0.471	0.071	
AVPHI: 0.13	3000	0.5	2.414/0.163	0.342	0.846	1.777/0.592	0.096	0.313	0.033			0.145	0.018	0.635	9.812/0.455	0.074	
AVSW: 0.55	3000.5	0.5	2.374/0.176	0.369	0.772	1.840/0.57	0.1	0.304	0.037			0.148	0.027	0.691	8.870/0.457	0.08	
Wyllie-Rose Equation Parameters	3001	0.5	2.392/0.183	0.389	0.736	1.893/0.554	0.101	0.286	0.04			0.162	0.02	0.727	6.944/0.504	0.092	
P: 8581.0	3001.5	0.5	2.479/0.176	0.385	0.772	1.871/0.558	0.098	0.283	0.038			0.175	0.001	0.706	5.335/0.589	0.103	
Q: 4.4	3002	0.5	2.704/0.153	0.355	0.913	1.778/0.581	0.088	0.361	0.032			0.177	0	0.623	4.976/0.653	0.101	
R: 2.0	3002.5	0.5	3.309/0.117	0.315	1.26	1.649/0.617	0.072	0.636	0.022			0.164	0	0.5	5.166/0.765	0.089	
	3003	0.5	4.921/0.083	0.31	1.902	1.581/0.621	0.051	1.121	0.0			0.139	0	0.403	7.610/0.774	0.064	
	3003.5	0.5	8.894/0.058	0.364	2.925	1.59/0.573	0.033	1.61	0.0			0.113	0	0.353	11.24/0.79	0.045	
	3004	0.5	15.951/0.048	0.521	3.67	1.683/0.479	0.023	1.97	0.0			0.094	0	0.376	13.826/0.798	0.038	
	3004.5	0.5	21.044/0.052	0.757	3.334	1.823/0.398	0.02	2.116	0.0			0.079	0	0.476	12.983/0.785	0.04	
	3005	0.5	21.569/0.056	0.848	3.051	1.878/0.376	0.021	2.012	0.0			0.081	0	0.527	11.158/0.81	0.045	
	3005.5	0.5	16.665/0.062	0.74	2.7	1.854/0.402	0.024	1.733	0.0			0.095	0	0.523	9.749/0.815	0.05	
	3006	0.5	9.764/0.101	0.779	1.503	2.016/0.392	0.039	1.419	0.0			0.103	0	0.72	10.038/0.599	0.06	
	3006.5	0.5	6.737/0.149	0.857	0.942	2.232/0.374	0.055	1.136	0.0			0.118	0.031	0.953	8.914/0.503	0.075	

RT column presently holds the Simandoux Resistivity Computed Data

SW column will reflect the changes to the RT column.

Selecting Dual Water Menu Option

The Rsh value in the “Archie Equation Parameters” Panel must not be 0.0 and for this example it is set to 5.0 and the PHIs value in the “Archie Equation Parameters” Panel must not be 0.0 and for this example it is set to 0.1. The user can select the  icon image button to display the Profile plot and then turn on the LAS - Induction Resistivity Logs radio button and observe that the Deep Induction Resistivity shale value is about 5. In the Shale region the Neutron porosity is about 0.2 PU and the Density porosity is about 0.02 PU and the average is about 0.1005 rounding down to 0.1.



The user now selects the “Sw Model” Menu and then selects the “Dual water” Menu Option and the program will automatically compute the resistivity and insert the new resistivity values in the RT column and recomputed the other columns in the Home Area.

Archie Equation Parameters needed for Water Model Calculations with “Water Model Used” showing Dual Water.

Flow Unit:	Depth	THK	RT	PHI	RWA	RO	MA	SW	BVW	VSH	PAY	1st PHI	2nd PHI	PHIR	RXO	SXO	BVF
Cottonwood Limestone	2.985.5	0.5	33.330.21	0.624	6.403	0.624	3.7480.136	0.028	0.507	0.09		0.306	0	3.201	2.8550.725	0.152	
	2.986	0.5	26.8280.15	3.442	0.935	2.9690.186	0.028	0.385	0.06			0.282	0	1.918	3.6720.783	0.117	
Start Depth: 2985.5	End Depth: 3007.0																
	2.986.5	0.5	21.4880.1	1.694	1.521	2.3490.266	0.026	0.271	0.036			0.242	0	1.055	5.9120.787	0.078	
	2.987	0.5	17.6640.079	1.049	2.018	2.0540.338	0.026	0.187	0.026			0.186	0	0.721	9.9680.698	0.055	
	2.987.5	0.5	21.460.071	1.122	2.294	2.0450.327	0.023	0.165	0.023			0.111	0	0.599	14.2540.622	0.044	
	2.988	0.5	34.1310.07	1.754	2.334	2.2090.281	0.018	0.175	0.025			0.074	0	0.866	13.8170.635	0.044	
	2.988.5	0.5	66.0740.063	2.993	2.648	2.2630.2	0.012	0.192	0.025			0.073	0	1.063	11.3960.747	0.047	
	2.989	0.5	111.4470.055	4.289	3.117	2.4330.167	0.009	0.198	0.022			0.084	0	1.172	10.8770.683	0.045	
A: 0.8	2.989.5	0.5	152.0890.048	4.971	3.67	2.4260.155	0.007	0.197	0.0			0.093	0	1.163	11.7380.857	0.041	
M: 1.2	2.990	0.5	105.8080.042	2.946	4.308	2.2090.201	0.008	0.177	0.0			0.092	0	0.826	12.3240.917	0.038	
N: 2.0	2.990.5	0.5	92.3890.031	1.787	6.203	1.9770.259	0.008	0.161	0.0			0.077	0	0.536	13.8671.037	0.032	
Rw: 0.12	2.991	0.5	63.8770.026	1	7.661	1.7810.346	0.009	0.146	0.0			0.061	0	0.361	17.1591.036	0.026	
Rsh: 5.0	2.991.5	0.5	39.8760.033	0.831	5.755	1.7670.379	0.012	0.142	0.0			0.059	0	0.38	23.9380.76	0.025	
PHIsh: 0.1	2.992	0.5	25.3520.055	0.975	3.117	1.9220.35	0.019	0.148	0.017			0.045	0.01	0.559	33.6610.471	0.025	
	2.992.5	0.5	19.520.08	1.177	1.988	2.1040.319	0.025	0.169	0.027			0.038	0.042	0.769	28.850.407	0.032	
	2.993	0.5	14.0730.098	1.083	1.558	2.1470.332	0.032	0.179	0.032			0.056	0.042	0.833	20.7360.425	0.041	
	2.993.5	0.5	10.2610.108	0.887	1.387	2.0990.367	0.039	0.168	0.034			0.079	0.028	0.799	17.1480.441	0.047	
	2.994	0.5	7.6760.124	0.783	1.175	2.0990.391	0.048	0.194	0.037			0.097	0.026	0.816	15.7420.423	0.052	
	2.994.5	0.5	5.6940.146	0.707	0.966	2.1210.411	0.05	0.183	0.042			0.113	0.032	0.855	14.4970.4	0.058	
	2.995	0.5	4.7370.166	0.686	0.828	2.1710.418	0.059	0.182	0.048			0.124	0.042	0.91	11.4890.416	0.069	
	2.995.5	0.5	4.1990.176	0.652	0.772	2.1740.428	0.075	0.184	0.05			0.143	0.033	0.919	8.5320.466	0.082	
	2.996	0.5	3.7620.178	0.592	0.761	2.1250.449	0.08	0.174	0.048			0.164	0.013	0.882	6.4520.532	0.094	
	2.996.5	0.5	3.6250.18	0.578	0.751	2.1170.455	0.081	0.175	0.049			0.191	0	0.877	6.1680.541	0.097	
	2.997	0.5	3.7120.178	0.584	0.761	2.1170.452	0.08	0.182	0.048			0.204	0	0.876	6.3090.538	0.095	
	2.997.5	0.5	3.8250.168	0.562	0.816	2.0650.461	0.077	0.18	0.045			0.202	0	0.829	6.1570.564	0.094	
	2.998	0.5	4.1530.161	0.58	0.859	2.0620.454	0.073	0.195	0.043			0.194	0	0.821	6.1140.581	0.093	
	2.998.5	0.5	4.6670.151	0.693	0.927	2.0540.445	0.067	0.224	0.041			0.182	0	0.806	6.9870.564	0.085	
	2.999	0.5	5.1670.145	0.636	0.974	2.0640.434	0.062	0.257	0.041			0.167	0	0.808	8.2830.531	0.077	
	2.999.5	0.5	5.560.152	0.724	0.92	2.1540.406	0.061	0.293	0.045			0.15	0.002	0.887	9.9580.471	0.071	
	3.000	0.5	5.6060.163	0.794	0.846	2.2420.388	0.063	0.313	0.049			0.145	0.018	0.968	9.8120.455	0.074	
	3.000.5	0.5	5.2070.176	0.809	0.772	2.2980.385	0.067	0.304	0.054			0.148	0.027	1.023	8.870.457	0.08	
	3.001	0.5	4.9430.183	0.805	0.736	2.320.386	0.07	0.286	0.056			0.162	0.02	1.045	6.9440.504	0.092	
	3.001.5	0.5	5.2140.176	0.81	0.772	2.2990.384	0.067	0.283	0.054			0.175	0.001	1.024	5.3350.589	0.103	
	3.002	0.5	8.30.153	1.09	0.913	2.3750.331	0.05	0.361	0.051			0.177	0	1.092	4.9760.663	0.101	
	3.002.5	0.5	277.1930.117	26.394	1.26	3.7130.067	0.007	0.636	0.054			0.164	0	4.576	5.1660.765	0.089	
	3.003	0.5	4.1550.083	0.262	1.902	1.5130.076	-0.056	1.121	0.0			0.139	0	0.371	7.610.774	0.064	
	3.003.5	0.5	0.7190.058	0.029	2.925	0.7070.016	-0.116	1.61	0.0			0.113	0	0.1	11.240.79	0.045	
	3.004	0.5	0.3250.048	0.01	3.67	0.4030.352	-0.16	1.97	0.0			0.094	0	0.053	13.8260.798	0.038	
	3.004.5	0.5	0.2780.052	0.01	3.334	0.3590.3462	-0.18	2.116	0.0			0.079	0	0.054	12.9830.785	0.04	
	3.005	0.5	0.3250.056	0.012	3.051	0.4230.306	-0.171	2.012	0.0			0.081	0	0.064	11.1580.81	0.045	
	3.005.5	0.5	0.5160.062	0.022	2.7	0.6050.286	-0.141	1.733	0.0			0.095	0	0.092	9.7490.815	0.05	
	3.006	0.5	1.4480.101	0.115	1.503	1.1830.1018	-0.102	1.419	0.0			0.103	0	0.277	10.0380.599	0.06	
	3.006.5	0.5	5.1450.149	0.654	0.942	2.0910.428	-0.063	1.136	0.0			0.118	0.031	0.833	8.9140.503	0.075	


RT column presently holds the Dual Water Resistivity Computed Data

SW column will reflect the changes to the RT column.

Reference

Pfeffer-Pro (Petrofacies Evaluation of Formation for Engineering Reservoirs), Kansas Geological Survey, Release Date February 1998. Selecting a Water Saturation Model, pages 101 to 105.

Profile Plot Control Dialog & Profile Plot

To display the profile plot of the log & pfeffer data click on the  icon image button. The “Profile Plot Control” dialog allows the user to change the presentation of the Profile Plot, by depth range, by depth scale, by data type, by log type, modify the track curve limits.

Menu Option Buttons

File – Menu Option

The file menu option allows the user to load, save and print well, horizon, rock and geo-report data's into the Profile Plot.

Depth Scale – Menu Option

The depth scale menu option allows the user to change the scale (feet / inch) of the Profile Plot Data.

Control

File Depth Scale Help

Header Information:
Name: Newby 2-28R Status: GAS
15-189-22225 Lat: 37.317197 Long: -101.3545478
Depth: 3155.0 Elev (GL): 3112.0

Depth Scale & Range:
Depth Scale: 100 ft/in
Cursor: Start Depth: End Depth:
3107.0 2450.0 3150.0
Reset Depth Modify Depth

Stratigraphic Plot Tracks:
Show Available Tracks by Type of Data:
LAS PFEFFER

Change Plot Limits

Type of LAS Track to Display
☒ Single ☐ Expanded

Default Track Order

Digital LAS File Curve Data

- ☒ Lithology - Gamma Ray
- ☒ LAS - Reference - GR,SP,CAL Logs
- ☒ LAS - Induction Resistivity Logs
- ☐ LAS - Micro Resistivity Logs
- ☐ LAS - Laterlog Resistivity Logs
- ☐ LAS - Litho-Density - PE, NPHI, DPHI
- ☒ LAS - Litho-Density - NPHI,RHOB,PE Logs
- ☒ LAS - Sonic - SPHLDT Logs
- ☐ LAS - Permeability
- ☐ LAS - Rhomaa-Umaa Computed Curves
- ☐ LAS - Rhomaa-NPHI Curves
- ☒ Colorith - Rhomaa-Umaa Track
- ☒ Lithology - Rhomaa-Umaa Track
- ☒ Thin Porosity Track

Horizons

- ☒ Horizons - Stratigraphic Units

Header Information Panel

Basic well header information

Depth Scale & Range Panel

Controls the Starting Depth and Ending Depth of the Profile Plot.

Data Type Plot Icons Buttons

These buttons allow the user to toggle from the Log Data Plot and the PFEFFER Data Plot.

Plot Control Buttons

- Change Plot Limits**
Allows the user to change the plot limits of the curves.
- Change Primary Track Widths**
Allows the user to change plot track widths from a default 200 pixels for “Expanded” to a standard 100 pixels for “Single” radio buttons for primary plot tracks, i.e. Resistivity, Porosity, etc.
- Available Plot Tracks**
Allows the user to turn plot tracks on or off to present the desired plot tracks.

Control

File Depth Scale Help

Header Information:
Name: Newby 2-28R Status: GAS
15-189-22225 Lat: 37.317197 Long: -101.3545478
Depth: 3155.0 Elev (GL): 3112.0

Depth Scale & Range:
Depth Scale: 100 ft/in
Cursor: Start Depth: End Depth:
2559.0 2450.0 3150.0
Reset Depth Modify Depth

Stratigraphic Plot Tracks:
Show Available Tracks by Type of Data:
LAS PFEFFER

Change Plot Limits

Type of LAS Track to Display
☒ Single ☐ Expanded

Default Track Order

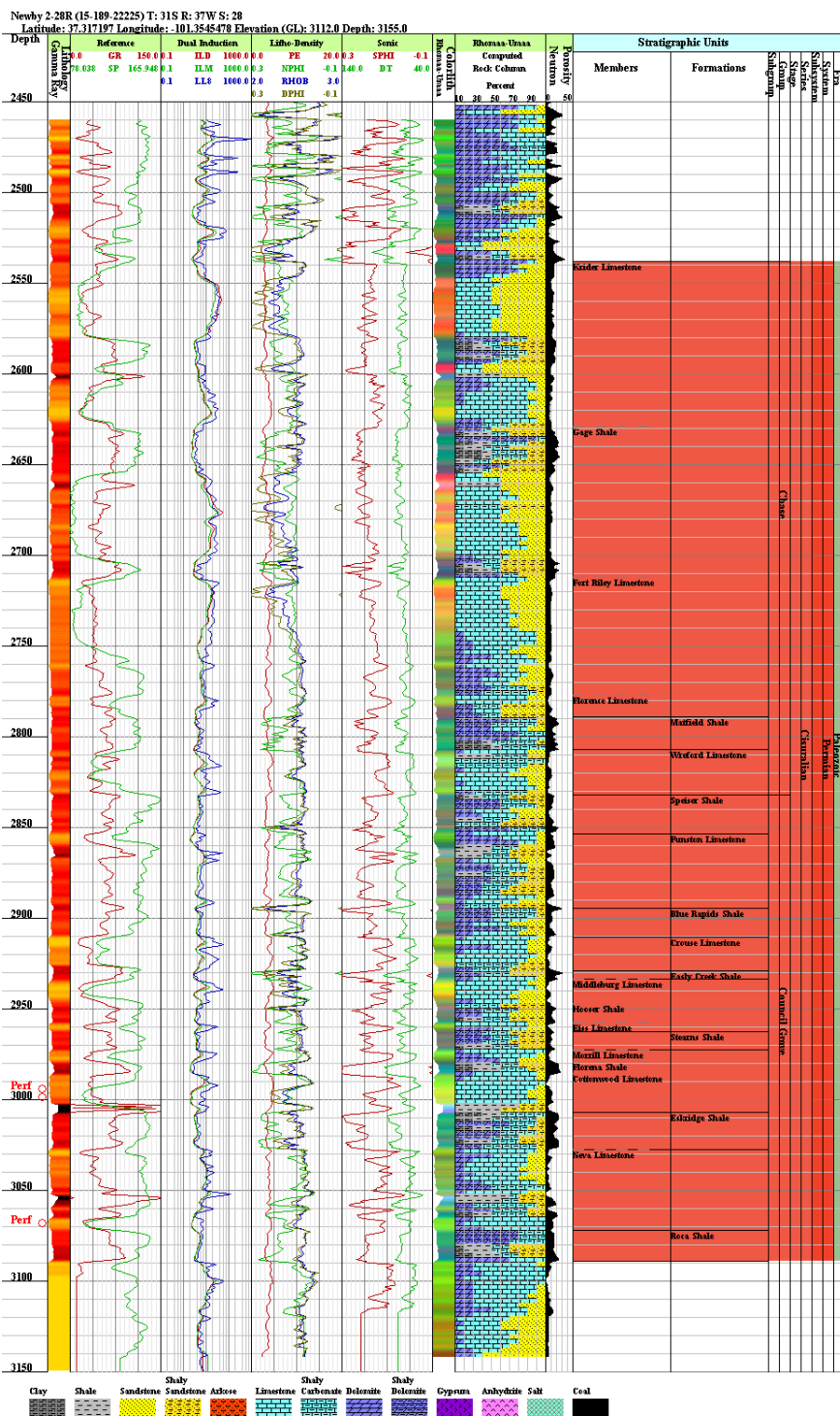
Digital LAS File Curve Data

- ☒ Lithology - Gamma Ray
- ☒ LAS - Reference - GR,SP,CAL Logs
- ☒ PFEFFER - Resistivity
- ☒ PFEFFER - Porosity
- ☒ PFEFFER - 2nd Porosity
- ☒ PFEFFER - Ohm Connect Porosity
- ☒ PFEFFER - Other
- ☒ PFEFFER - Flow Units

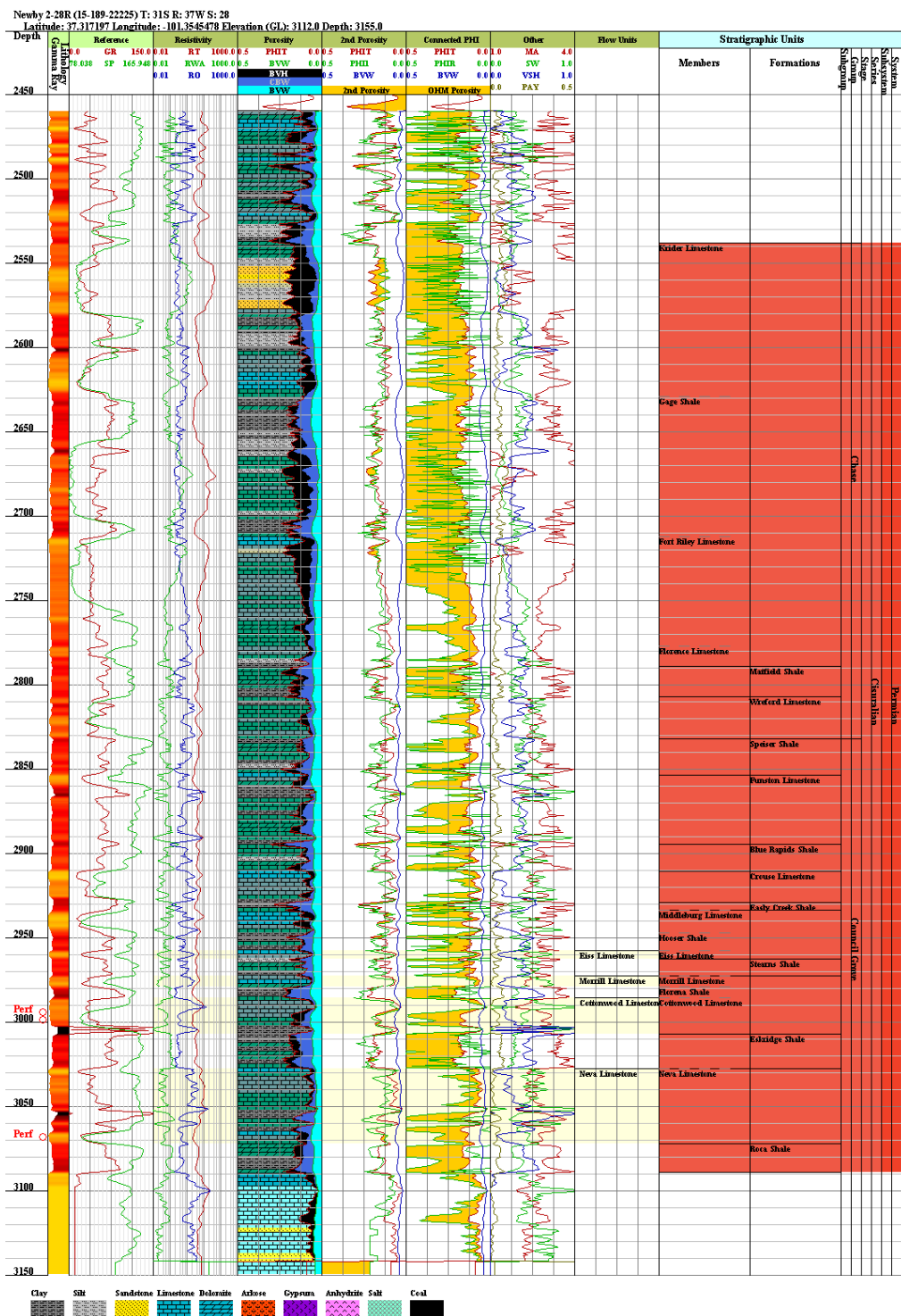
Horizons

- ☒ Horizons - Stratigraphic Units

When the user first launches the Profile Plot the depth range of the panel that is displayed will automatically set the depth range of the profile plot except when the “Headers” tab is displayed, which will display the whole log. The user has two profile plot presentations, log data and pfeffer data. The pfeffer profile plot displays the contents of the “spreadsheet” with the selected flow units highlighted in a pale yellow across the whole pfeffer profile plot.



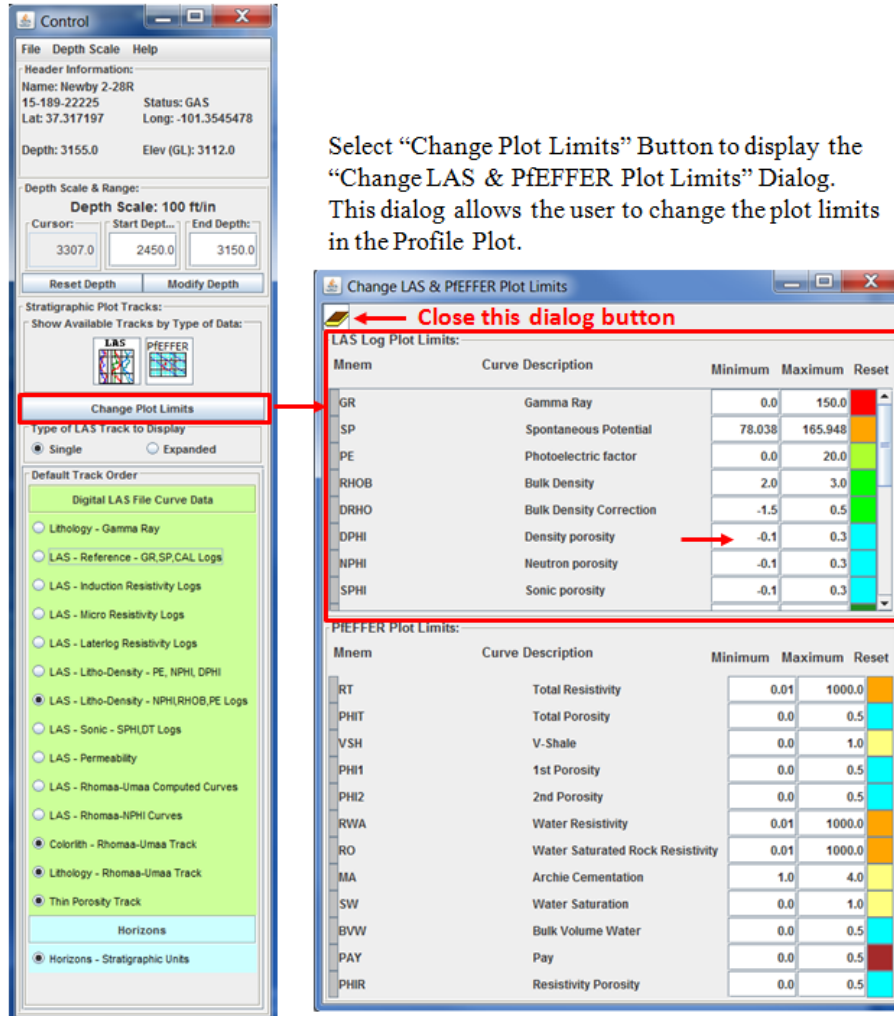
76



77

Data Entry Dialogs

The “Change Plot Limits” Button on the Profile Control Dialog allows the user to change the limits of the log curves.



The user can change the limits of the curve limits in the plot track by changing the contents in the Minimum and Maximum text fields. The limits will change by group so if you change one porosity limit, e.g. DPHI from “-0.1 - 0.3” to “0.0 - 0.5” then all the porosity curves will change to the same limit.

Each color curve is color coded by unit to visually assist the user in the type of curves present.

Notice that the color boxes next to the curve limits of the curves are colored with different colors, which shows the curve type by unit. The Curves are colored by type (data units) as follows,

- Orange - OHM-M or Resistivity Logs
- Cyan – PU or porosity Logs, Neutron Porosity, Density Porosity, etc.
- Greenish yellow – BARNS/E or Photoelectric Factor Logs
- Green – GM/CC or Bulk Density Log
- Forest Green – USEC/FT or the Acoustic Transit Time Log
- Red – API, PPM or “%” as Radioactive logs, Gamma Ray, Spectral Gamma Ray, etc.
- Blue – MD or Permeability Logs

- Brown – F, FT or IN or Depth
- Middle yellow – FRAC, or other log curve types.
- Dark Violet – UNI or Unknown Linear Curves
- Medium Violet – UNL or Unknown Logrithum Curves

The color coding is the same as the “LAS File Curve Sections” Dialog that helps the user distinguish the type of curves available at a glance.

LAS Log Plot Limits:

Mnem	Curve Description	Minimum	Maximum	Reset
GR	Gamma Ray	0.0	150.0	
SP	Spontaneous Potential	78.038	165.948	
PE	Photoelectric factor	0.0	10.0	
RHOB	Bulk Density	2.0	3.0	
DRHO	Bulk Density Correction	-1.5	0.5	
DPHI	Density porosity	0.0	0.5	
NPHI	Neutron porosity	0.0	0.5	
SPHI	Sonic porosity	0.0	0.5	
DT	Acoustic transit time	40.0	140.0	
ILD	Deep Induction Resistivity	0.1	1000.0	
ILM	Medium Induction Resistivity	0.1	1000.0	
LL8	Shallow Laterolog Resistivity	0.1	1000.0	
MNOR	Micro Normal Resistivity	0.1	1000.0	
MINV	Micro Inverse Resistivity	0.1	1000.0	
PERM	Permeability	0.01	10000.0	
RHOMAA	Apparent Matrix Density	2.0	3.0	
UMAA	Apparent Photoelectric	0.0	20.0	
DTMAA	App. Matrix Acoustic	0.0	60.0	
PHIDIFF	Neutron-Density Porosity	-0.3	0.3	

Notice that the color boxes are changed from gray to the color of the curve that was changed to reflect that the curve limit values have been changed.

Change the Photoelectric factor (PE) curve from “0.0 – 20.0” to “0.0 – 10.0”

The limits will change by group so if you change one porosity limit, e.g. DPHI from “-0.1 - 0.3” to “0.0 – 0.5” then all the porosity curves will change to the same limit.

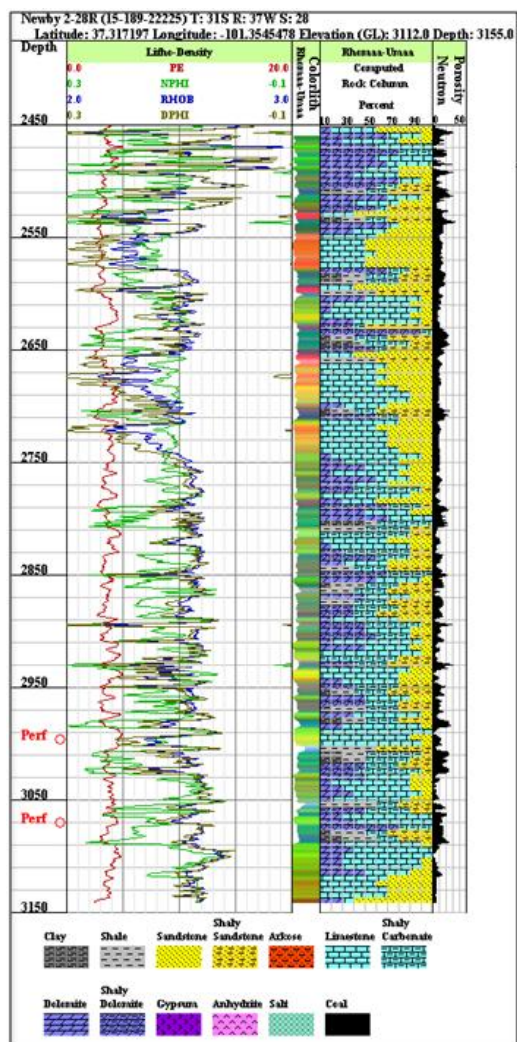
Note: As the user changes each curve limit, the change is automatically updated in the Profile Plot.

The user can change as many curves as they wish, understanding that each plot curves are grouped together, i.e. Porosity. The Resistivity curves are grouped by Plot Track so that if you change the Micro Normal Resistivity (MNOR) and Micro Inverse Resistivity (MINV) the Induction Resistivity Curves will not automatically change unless the user wishes.

The above changes above are entered, i.e.

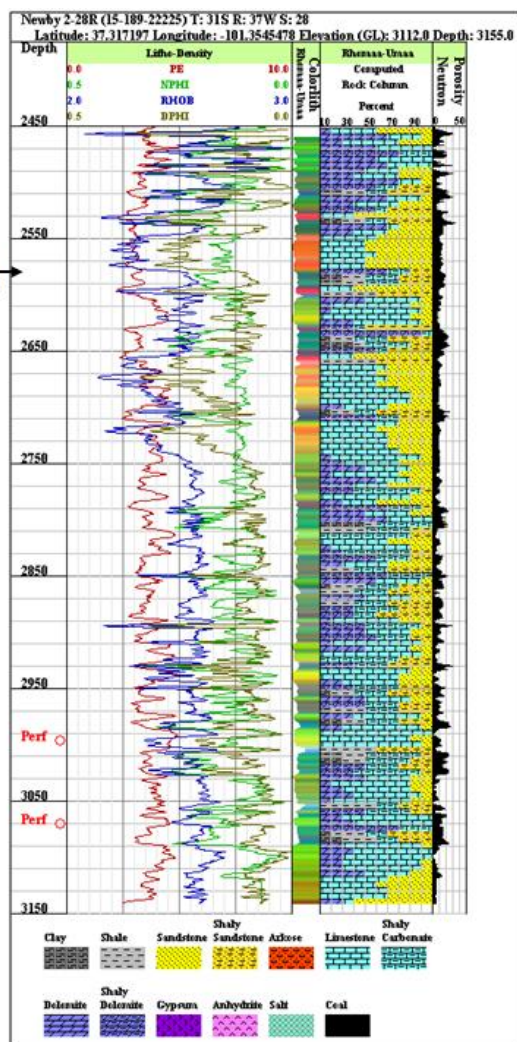
- The Photoelectric factor (PE) curve is changed from “0.0 to 20.0” to 0.0 to 10.0”
- The Neutron Porosity (NPHI) curve is changed from “-0.1 to 0.3” to “0.0 to 0.5” which also modifies the Density Porosity (DPHI) and the Sonic Porosity (SPHI) to the same limits.

As noted in the image the Profile plot is automatically modified as the user makes changes to each text field. View the “Litho-Density” Plot track (see image below) reflects the changes made to the plot curves.




Before Limits
are changed.

After Limits
are changed.



Pickett & Hingle Plots

To display the Pickett & Hingle Plots click on the  icon image button. The Pickett & Hingle “Plot Control” dialog allows the user to change the presentation of the Pickett & Hingle Plots.

Tool Bar

Well Header Information
Plot Titles

Total Resistivity Plot Axis
Minimum, Maximum, Log Cycles

Connect Data Points if checked

PfEPPER Parameters
Archie Equation Parameters
A = Archie Constant
M = Cementation Constant
N = Saturation Exponent
Rw = Formation Water Resistivity

Wyllie-Rose Equation Parameters

$$k = \frac{P \Phi^Q}{S_{wi}^R}$$
 Permeability (K)
 P, Q, and R to be calibrated from core measurements

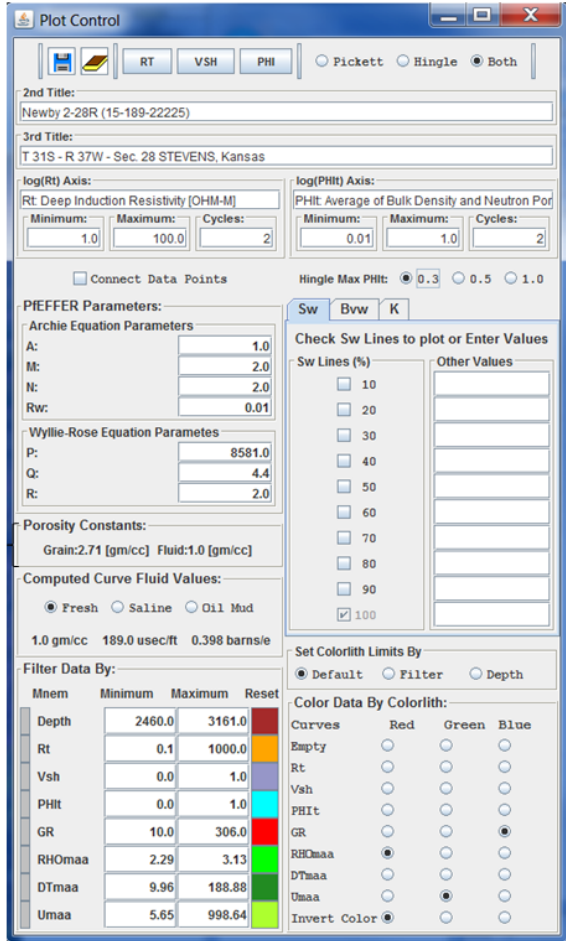
Porosity Constants: Grain & Fluid

Computed Curve Fluid Values

- Fresh Water
- Saline Water
- Oil Based Mud

Grain & Fluid Values used to compute RH0maa, Dtmaa, Umaa.

Rt – Total Resistivity
Vsh – V-Shale
PHIt – Total Porosity
GR – Gamma Ray
RH0maa – Apparent Grain Density
Dtmaa – Apparent Acoustic Time
Umaa – Apparent Photoelectric Factor



Total Porosity Plot Axis
Minimum, Maximum, Log Cycles

Maximum Limit for Porosity Axis in the Hingle Plot

Pickett Plot

- Water Saturation (Sw) Lines
- Bulk Volume Water (Bvw) Lines
- Permeability (K) Lines

Hingle Plot

- Water Saturation (Sw) Lines

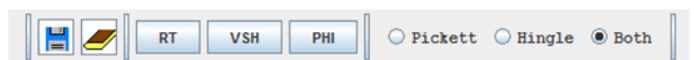
10 Fix Lines and 10 Other Values Text fields set by the User.


Set Colorlith RGB Values


- Default – Set Values for each Data Type
- Filter – Set Values for each Data Type from Filter Data By Panel
- Depth – Automatic RGB Colors set equally over depth range (40 Colors Maximum)


Invert Color Limits allows the user to reverse the limit for color selected.


Tool Bar



 Save as Hingle & Pickett Plot Portable Network Graphics (PNG) File

 Exit Hingle & Pickett Plot Control Dialog

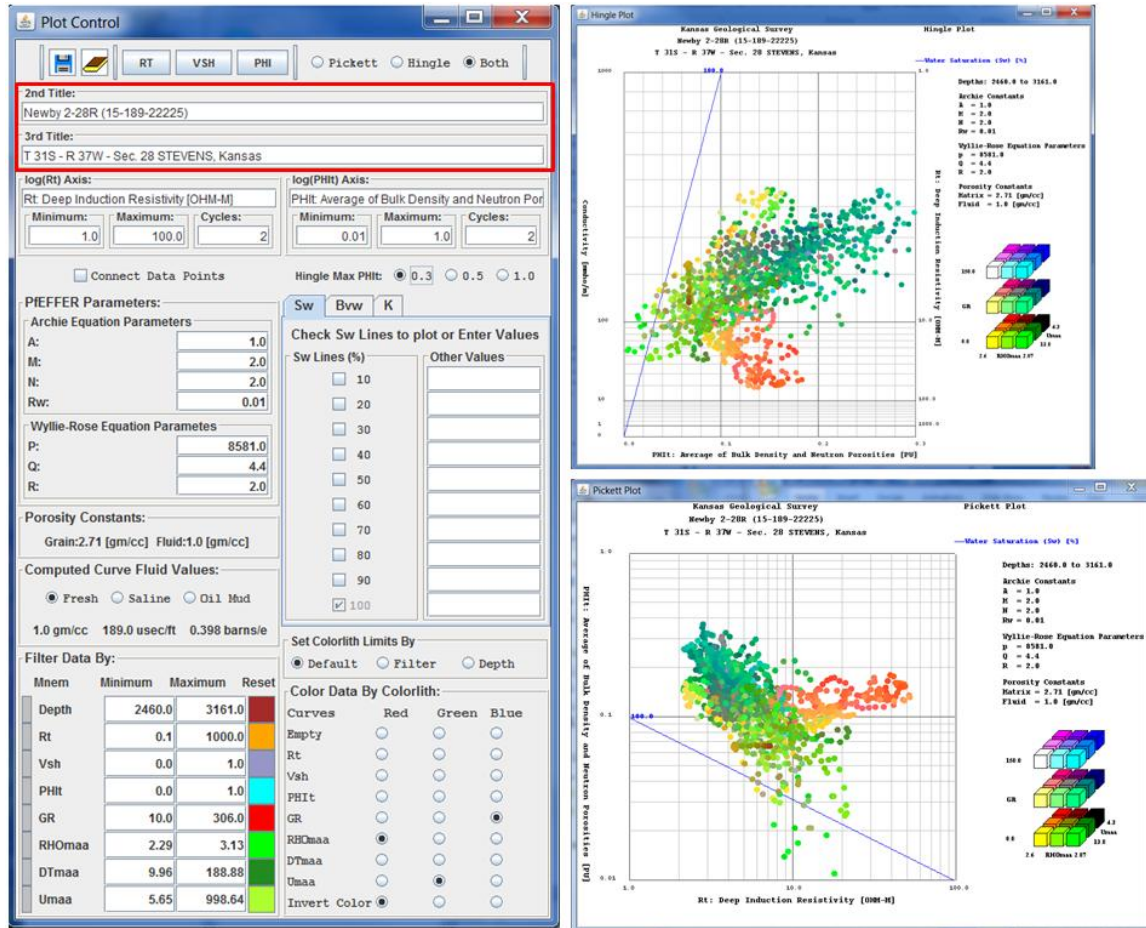
 Select the input log for the Total Resistivity (Rt)

 Select the input log for the Shale proportion (Vsh) & log data values for clean formation and for shale.

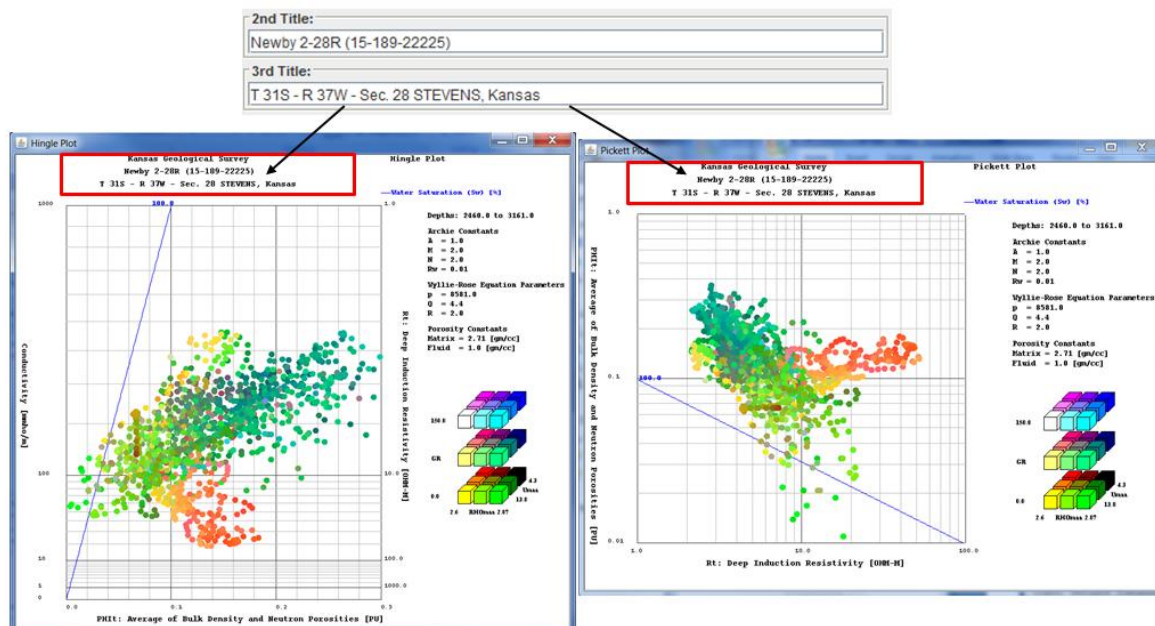
 Select the input logs for the Total Porosity (PHI) & rock matrix, fluid values.

- Pickett Radio Button – Display Pickett Plot Only
- Hingle Radio Button – Display Hingle Plot Only
- Both Radio Button – Display Both Pickett and Hingle Plots

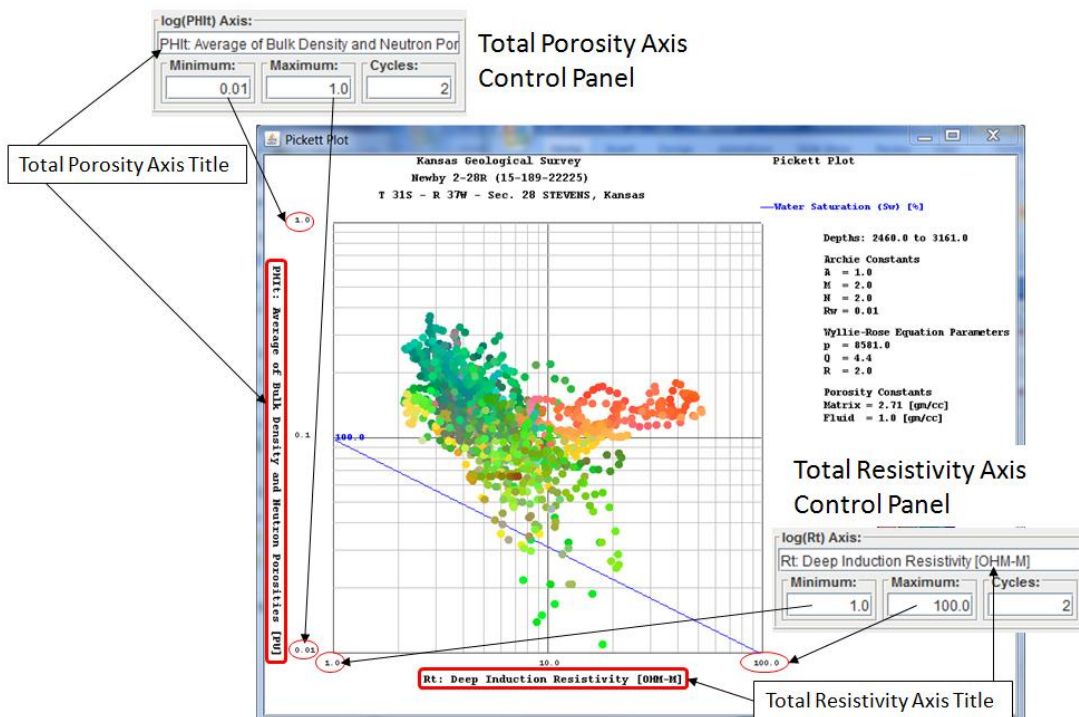
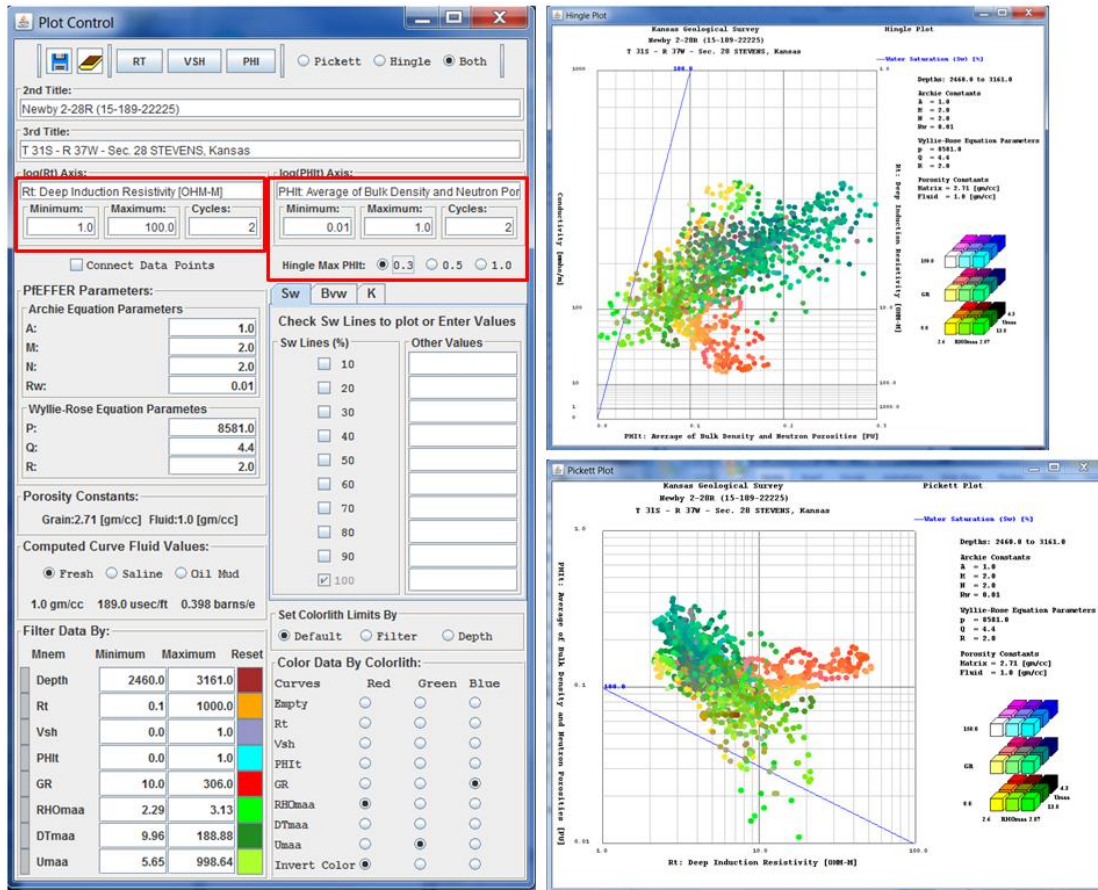
Modify Plot Titles



2nd & 3rd Titles Text Fields control the titles on both the Hingle & Pickett Plots.

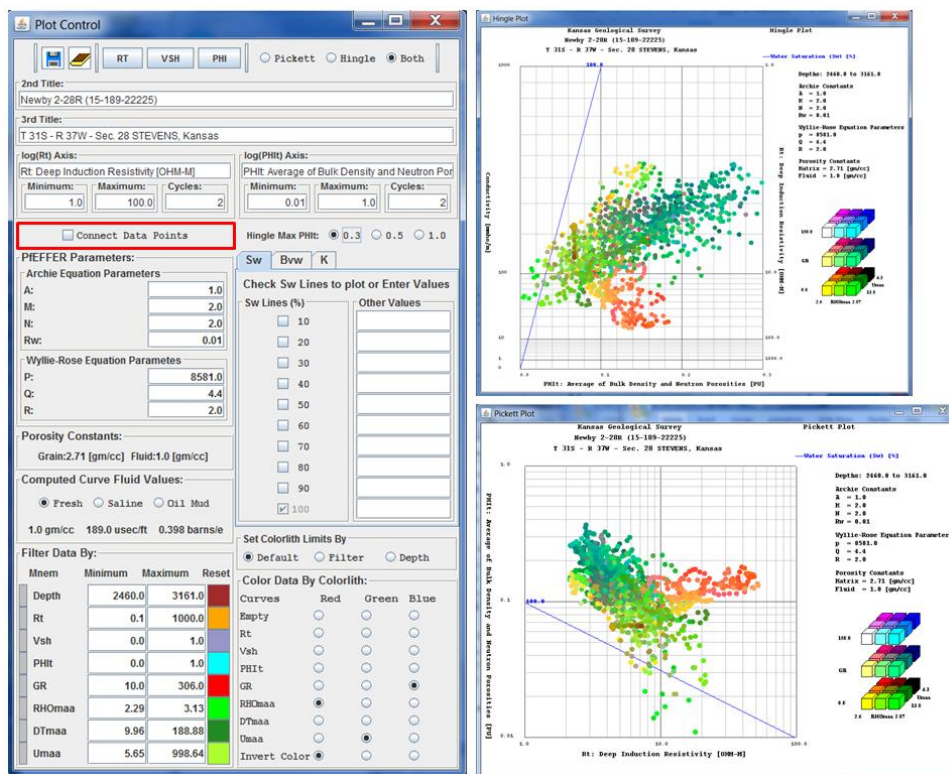


Modify Plot Axes

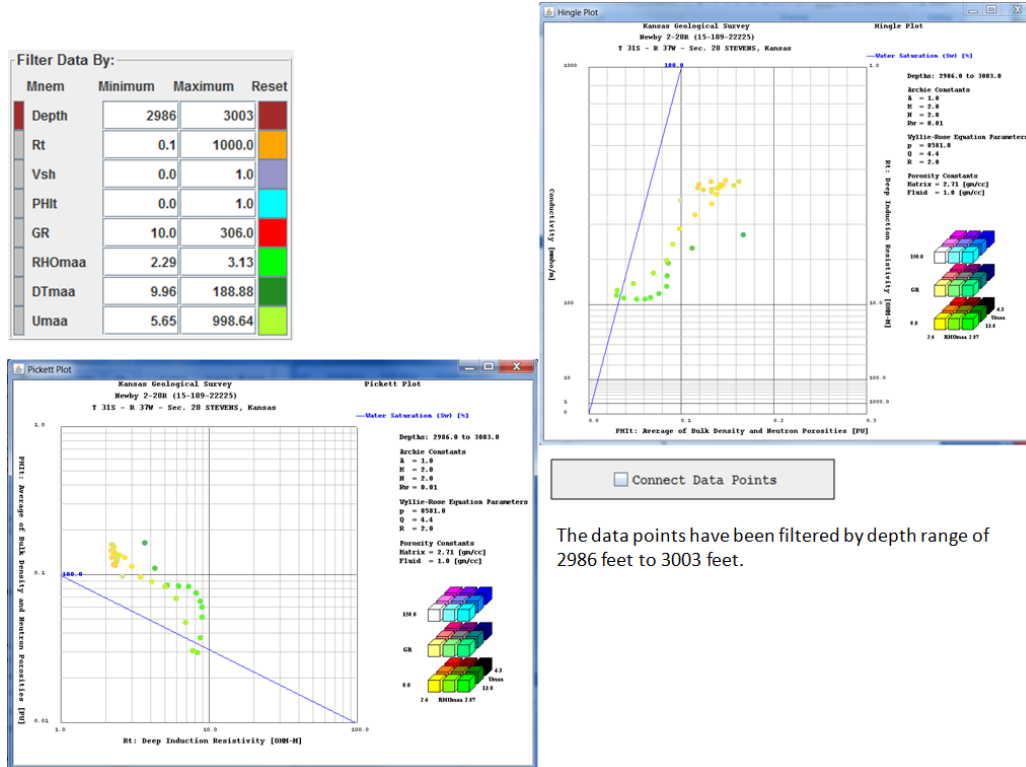




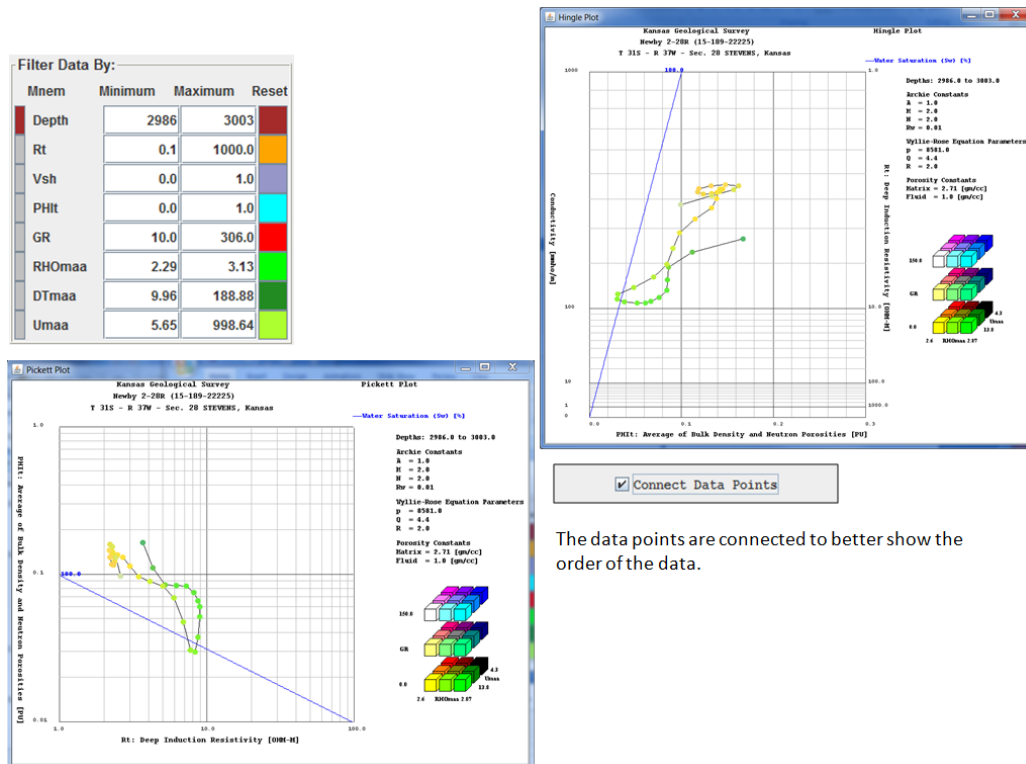
Connect Data Points



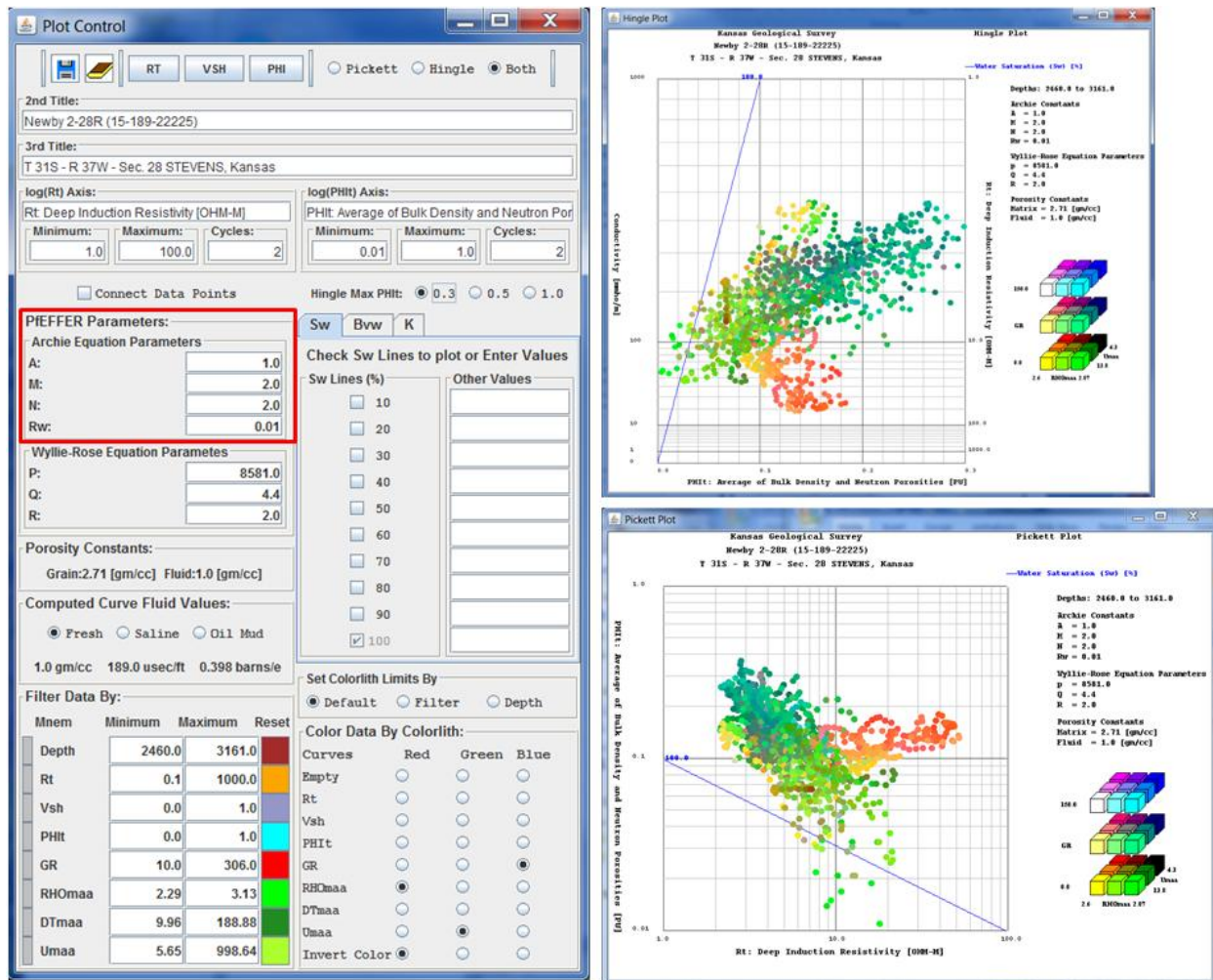
Filter Data before points are connected



Filter Data after points are connected

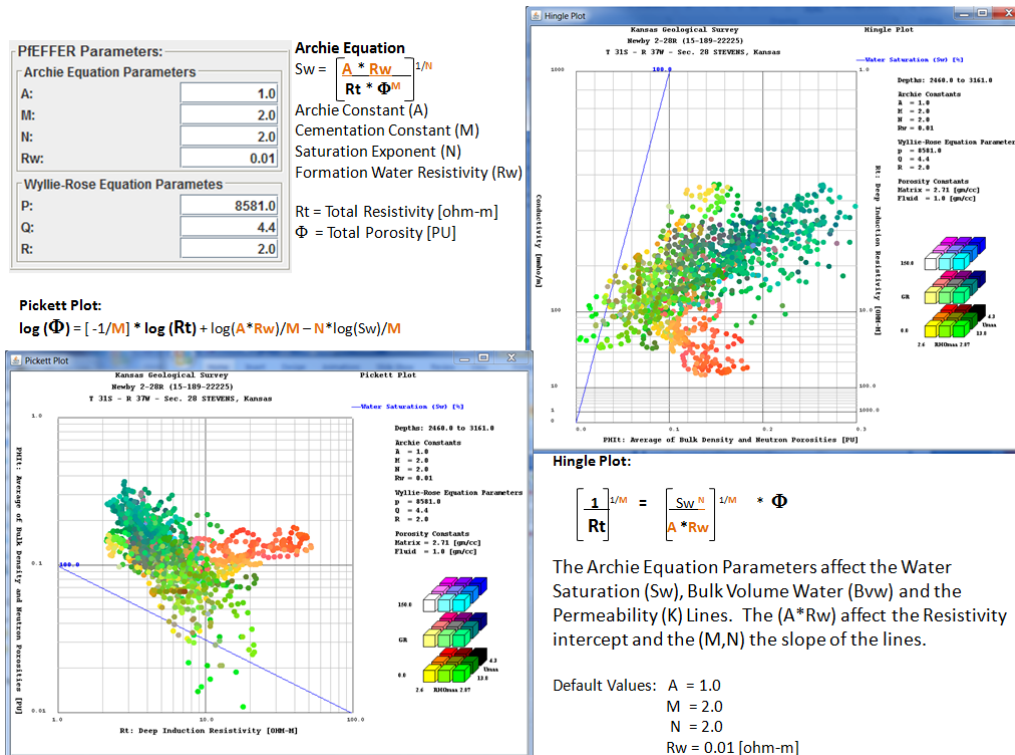


Modify Archie Equation Parameters

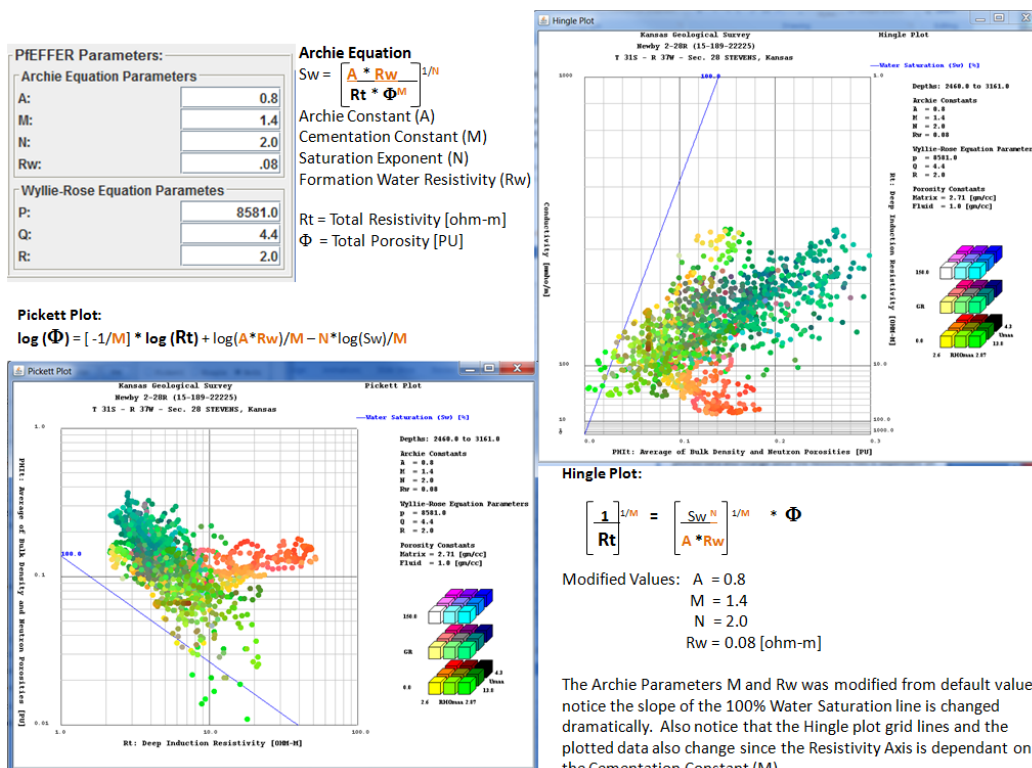


The slope of the Water Saturation (Sw), Bulk Volume Water (Bvw), and Permeability (K) Plot lines are affected by the Archie Parameters. Two examples are provided below, which show two distinct slopes and different interpretation for the data. The Hingle & Pickett Plots do not automatically determine the correct Archie Parameters, but requires that the user has some understanding of the plot data and geology.

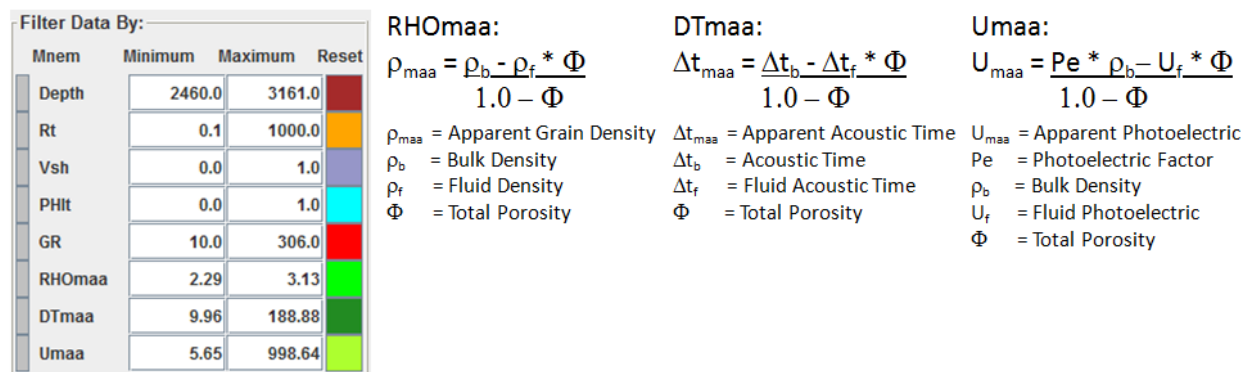
Default 100% Water Saturation (Sw) Plot Line



Modified 100% Water Saturation (Sw) Plot Line



The “Filter By Data” Table is used to filter the data in the Hingle & Pickett Plots. The Minimum and Maximum data values table to the right is the default values. The log data modifies the default minimum and maximum values for the Depth, Apparent Grain Density, Apparent Acoustic Time, and Apparent Photoelectric values.

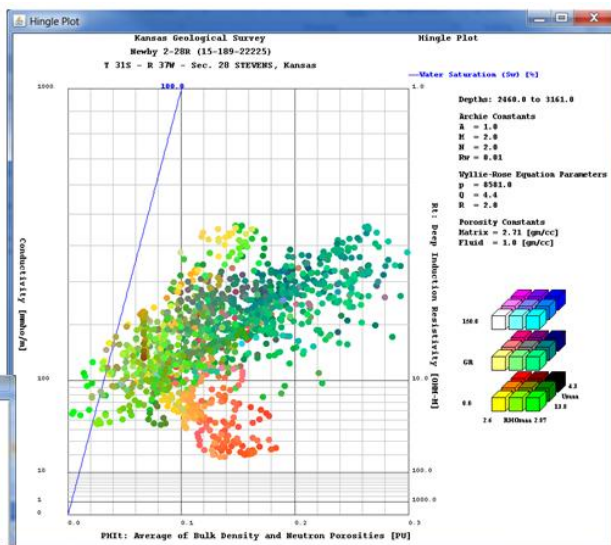
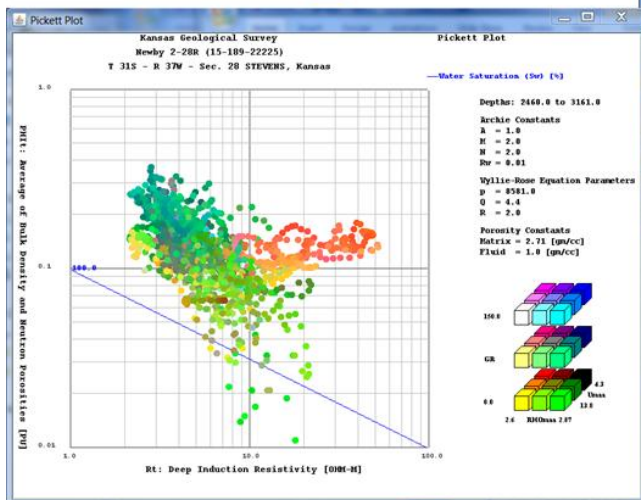


Default Table Values				Fluid Values			
Mnemonic	Description	Minimum	Maximum	Fresh	Saline	Oil Mud	Units
Depth	Depth Range						feet (ft)
Rt	Total Resistivity	0.1	1000.0				ohm-m
Vsh	V-Shale	0.0	1.0				
PHIt	Total Porosity (Φ)	0.0	1.0				PU
GR	Gamma Ray	0.0	150.0				API
RHOMaa	Apparent Grain Density (ρ_{maa})	2.5	3.2	1.0	1.1	0.985	gm/cc
DTmaa	Apparent Acoustic Time (Δt_{maa})	35.0	65.0	189.0	185.0	204.5	usec/ft
Umaa	Apparent Photoelectric (U_{maa})	2.0	15.0	0.398	1.36	0.136	usec/ft

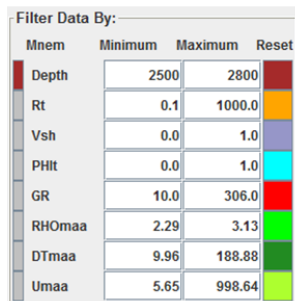
Filter Data By:

Mnem	Minimum	Maximum	Reset
Depth	2460.0	3161.0	
Rt	0.1	1000.0	
Vsh	0.0	1.0	
PHIt	0.0	1.0	
GR	10.0	306.0	
RHOMaa	2.29	3.13	
DTmaa	9.96	188.88	
Umaa	5.65	998.64	

The initial values are determine from the log curves with the minimum and maximum values determine for the depth range present.

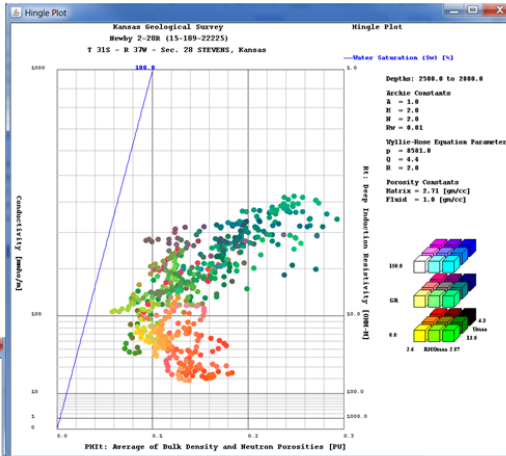
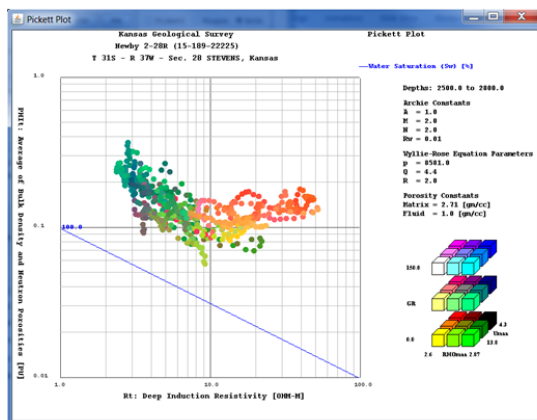


Change Depth Range

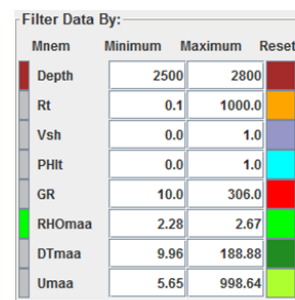


Notice that changing the depth range from 2460.0 ft and 3161.0 ft to 2500.0 ft and 2800 ft, thins the data points displaying only the data that falls within the depth range.

Notice also that the field before the Mnem column also changes color to illustrate the row data has been modified.

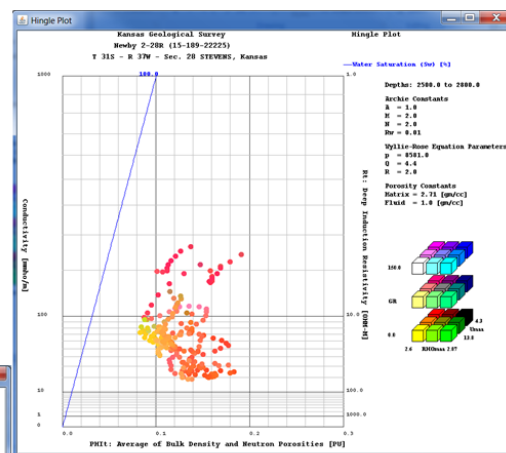
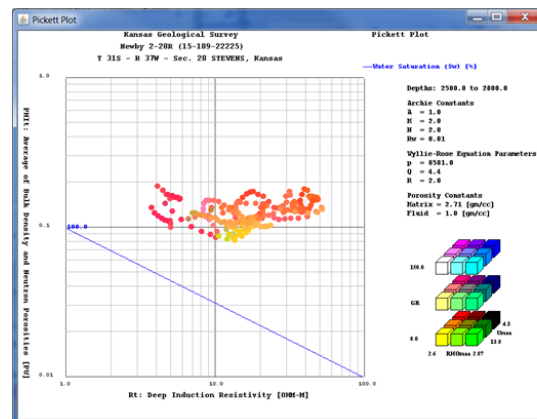


Change Apparent Grain Density



Notice that changing the RH0maa range from 2.29 gm/cc and 3.13 gm/cc to 2.28 gm/cc and 2.67 gm/cc, thins the data points displaying only the data that falls within the new range.

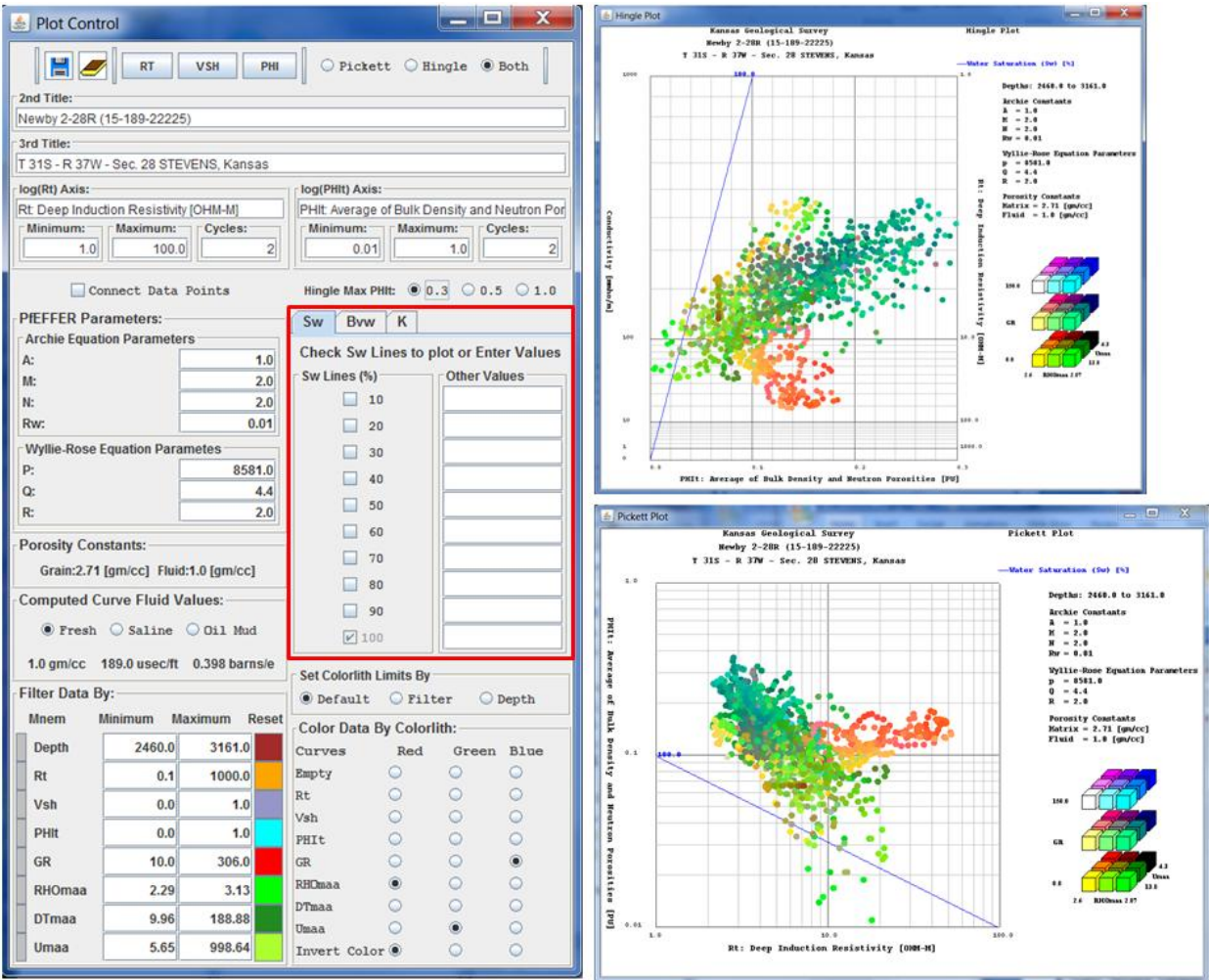
Notice also that the field before the Mnem column also changes color to illustrate the row data has been modified.



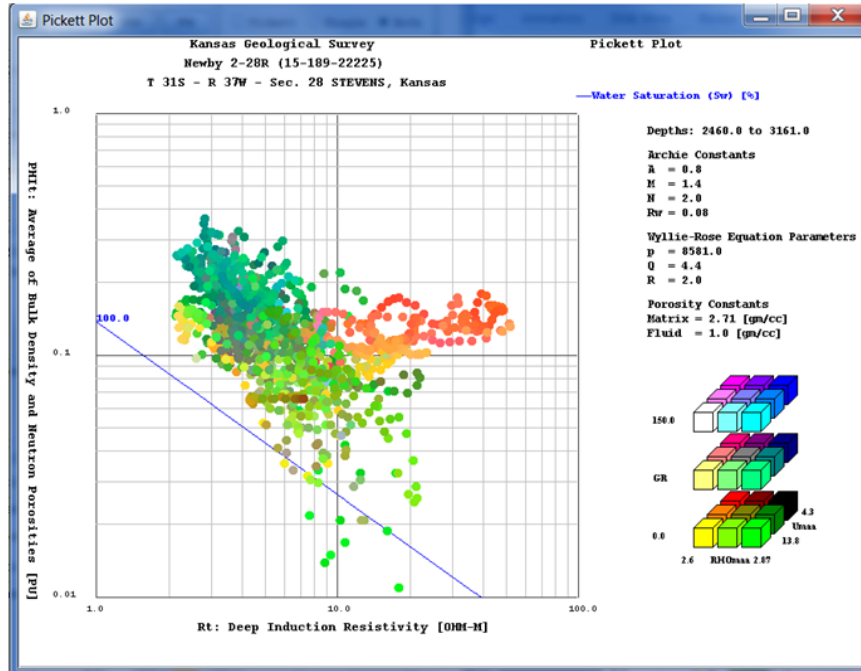
Both Depth and RHO_{maa} ranges are applied to the data. The red color illustrates a sandstone layer with orange color illustrates a sandy limestone.

To reset the minimum and maximum data ranges to the original values click on the Reset buttons. The Mnem colors will then reset to light gray.

Modify Plot Sw, Bvw, K Lines



Water Saturation (Sw) Plot Lines



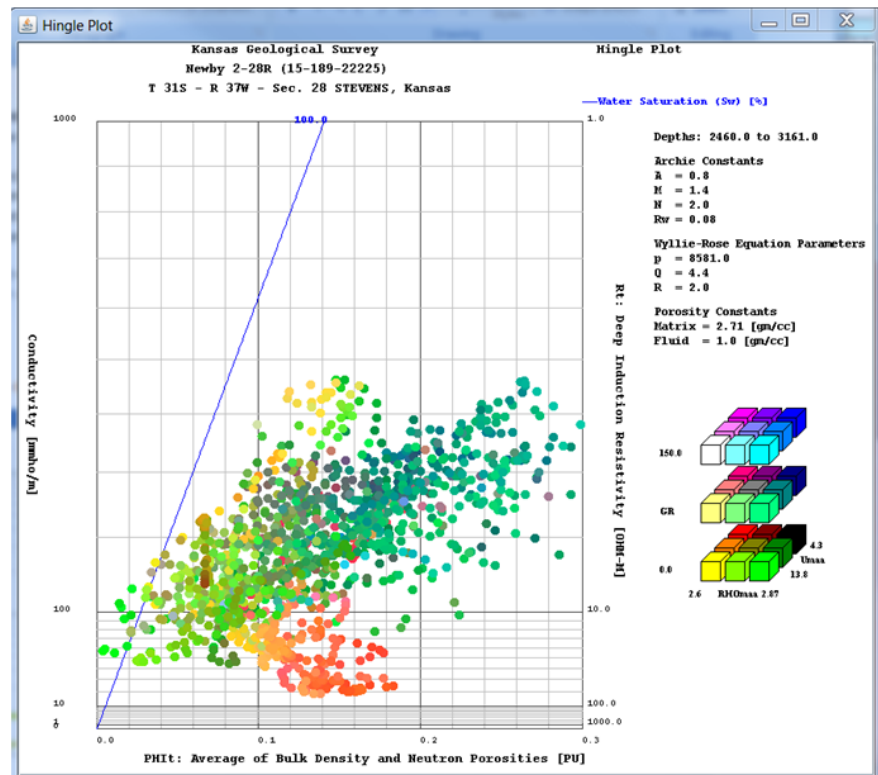
Sw Bwv K

Check Sw Lines to plot or Enter Values

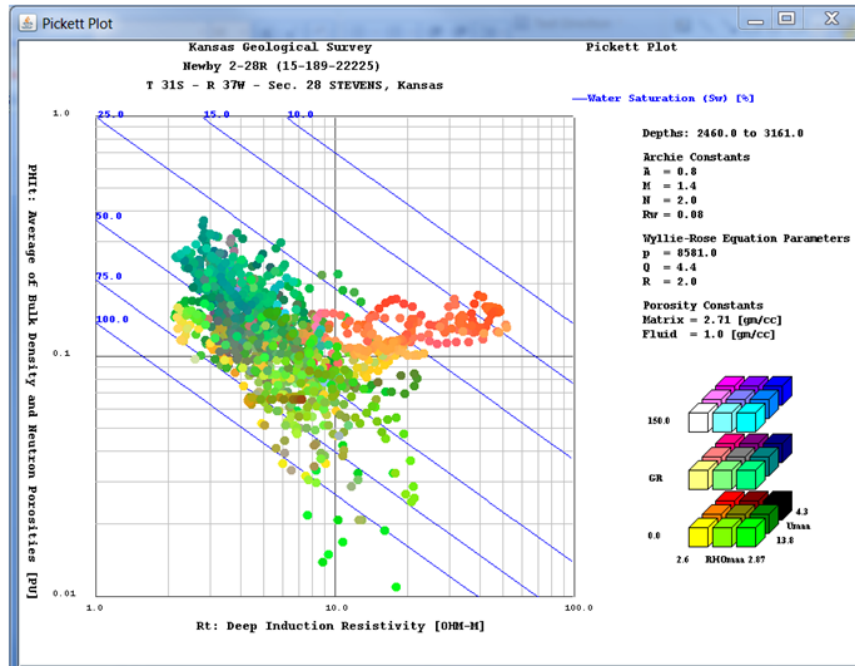
Sw Lines (%)	Other Values
<input type="checkbox"/> 10	
<input type="checkbox"/> 20	
<input type="checkbox"/> 30	
<input type="checkbox"/> 40	
<input type="checkbox"/> 50	
<input type="checkbox"/> 60	
<input type="checkbox"/> 70	
<input type="checkbox"/> 80	
<input type="checkbox"/> 90	
<input checked="" type="checkbox"/> 100	

Only the 100% Water Saturation (Sw) line is initially displayed for both Pickett & Hingle plots. The location of the line is dependant on $(a \cdot R_w)$ and M .

Notice that the Water Saturation (Sw) 100% line starts from 0 Porosity and 0 Conductivity.



Adding the Water Saturation (Sw) Plot Lines



Sw Bvw K

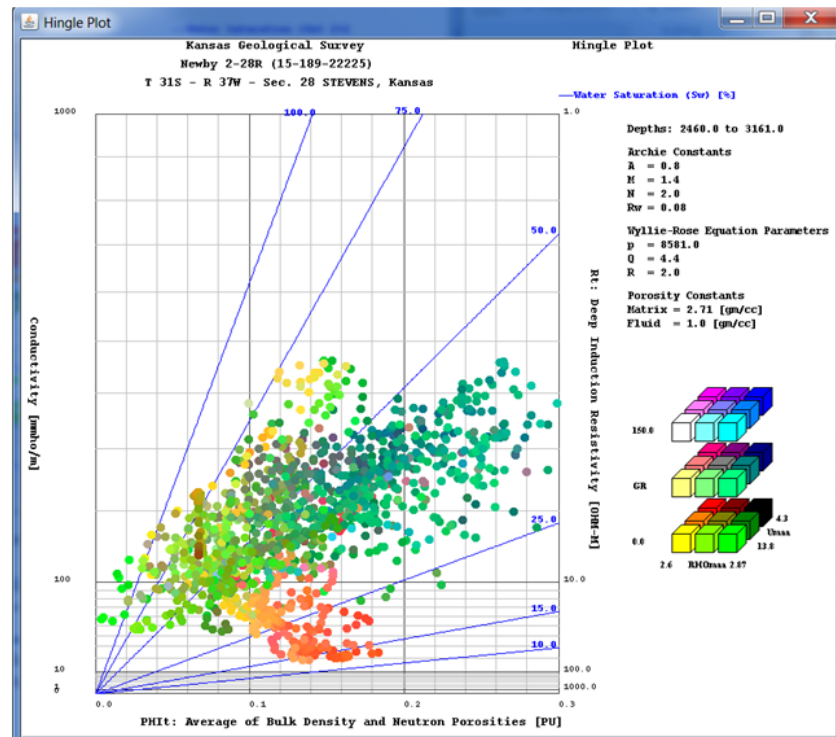
Check Sw Lines to plot or Enter Values

Sw Lines (%)	Other Values
<input checked="" type="checkbox"/> 10	25
<input type="checkbox"/> 20	75
<input type="checkbox"/> 30	15
<input type="checkbox"/> 40	
<input checked="" type="checkbox"/> 50	
<input type="checkbox"/> 60	
<input type="checkbox"/> 70	
<input type="checkbox"/> 80	
<input type="checkbox"/> 90	
<input checked="" type="checkbox"/> 100	

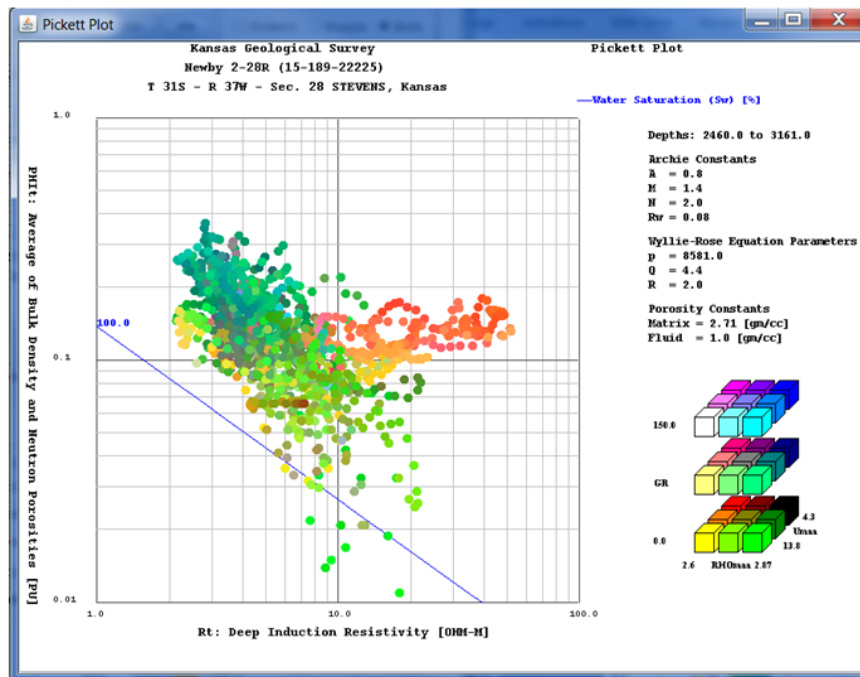
The Saturation Water Lines (Sw) Panel allows the user to select from 10 fixed lines and up to 10 Other Values text field user define lines. In this example, 10%, 50% radio buttons were selected and 15%, 25% 75% entered into to the Other Values text fields. Notice that entering the data does not follow any order.

Notice that as you select the check box or enter and leave the Other Values text field the Pickett and Hingle Plots automatically reflect the lines entered.

Notice that the Water Saturation lines are presented in a fan.



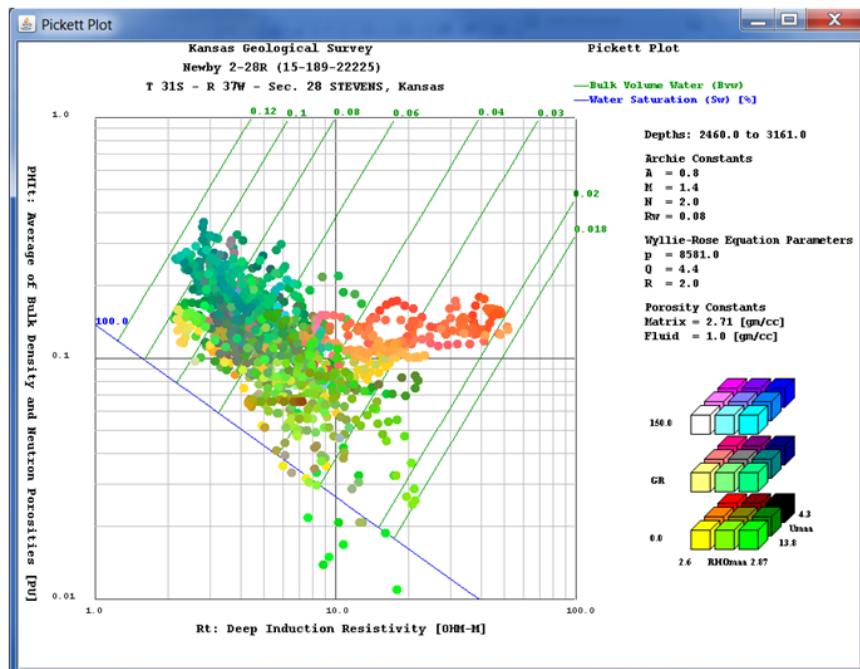
Bulk Volume Water (Bvw) Plot Lines



Sw	Bvw	K
Check Bvw Lines to plot or Enter Values		
Bvw Lines		Other Values
<input type="checkbox"/>	0.01	
<input type="checkbox"/>	0.02	
<input type="checkbox"/>	0.03	
<input type="checkbox"/>	0.04	
<input type="checkbox"/>	0.05	
<input type="checkbox"/>	0.06	
<input type="checkbox"/>	0.07	
<input type="checkbox"/>	0.08	
<input type="checkbox"/>	0.09	
<input type="checkbox"/>	0.10	

Only the 100% Water Saturation (Sw) line is initially displayed for the Pickett plot. The location of the line is dependant on $(a \cdot R_w)$ and M.

Adding the Bulk Volume Water (Bvw) Plot Lines

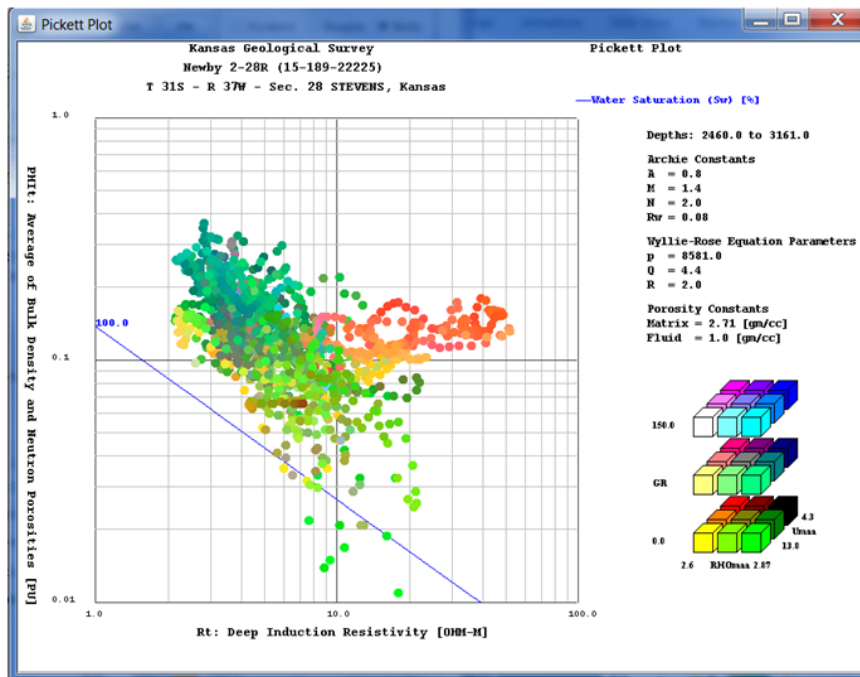


Sw	Bvw	K
Check Bvw Lines to plot or Enter Values		
Bvw Lines		Other Values
<input type="checkbox"/>	0.01	0.12
<input checked="" type="checkbox"/>	0.02	0.018
<input checked="" type="checkbox"/>	0.03	
<input checked="" type="checkbox"/>	0.04	
<input type="checkbox"/>	0.05	
<input checked="" type="checkbox"/>	0.06	
<input type="checkbox"/>	0.07	
<input checked="" type="checkbox"/>	0.08	
<input type="checkbox"/>	0.09	
<input checked="" type="checkbox"/>	0.10	

Notice that as you select the check box or enter and leave the Other Values text field the Pickett Plot automatically reflect the lines entered.

The Bulk Volume Water (Bvw) Lines Panel allows the user to select from 10 fixed lines and up to 10 Other Values text field user define lines. In this example 0.01, 0.02, 0.03, 0.04, 0.06, 0.08, 0.10 check boxes were selected and in the Other Values text fields 0.018, 0.12 values were entered. Notice order is not important.

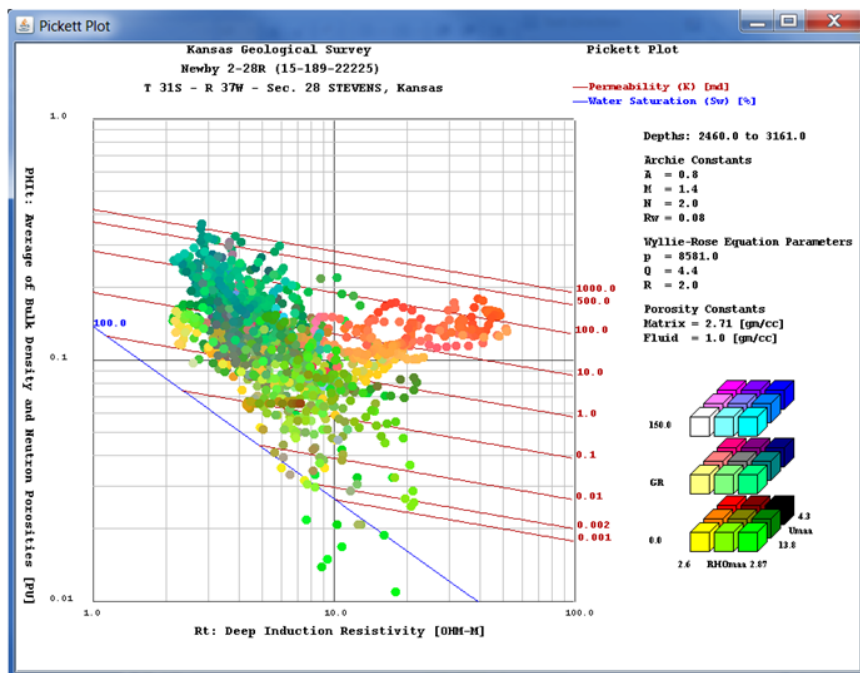
Permeability (K) Plot Lines



Sw	Bvw	K
Check K Lines to plot or Enter Values		
K Lines (md)		Other Values
<input type="checkbox"/>	0.001	
<input type="checkbox"/>	0.01	
<input type="checkbox"/>	0.1	
<input type="checkbox"/>	1.0	
<input type="checkbox"/>	10.0	
<input type="checkbox"/>	100.0	
<input type="checkbox"/>	1000.0	
<input type="checkbox"/>	10000.0	
<input type="checkbox"/>	100000.0	
<input type="checkbox"/>	1000000.0	

Only the 100% Water Saturation (Sw) line is initially displayed for the Pickett plot. The location of the line is dependant on $(a \cdot R_w)$ and M.

Adding the Permeability (K) Plot Lines

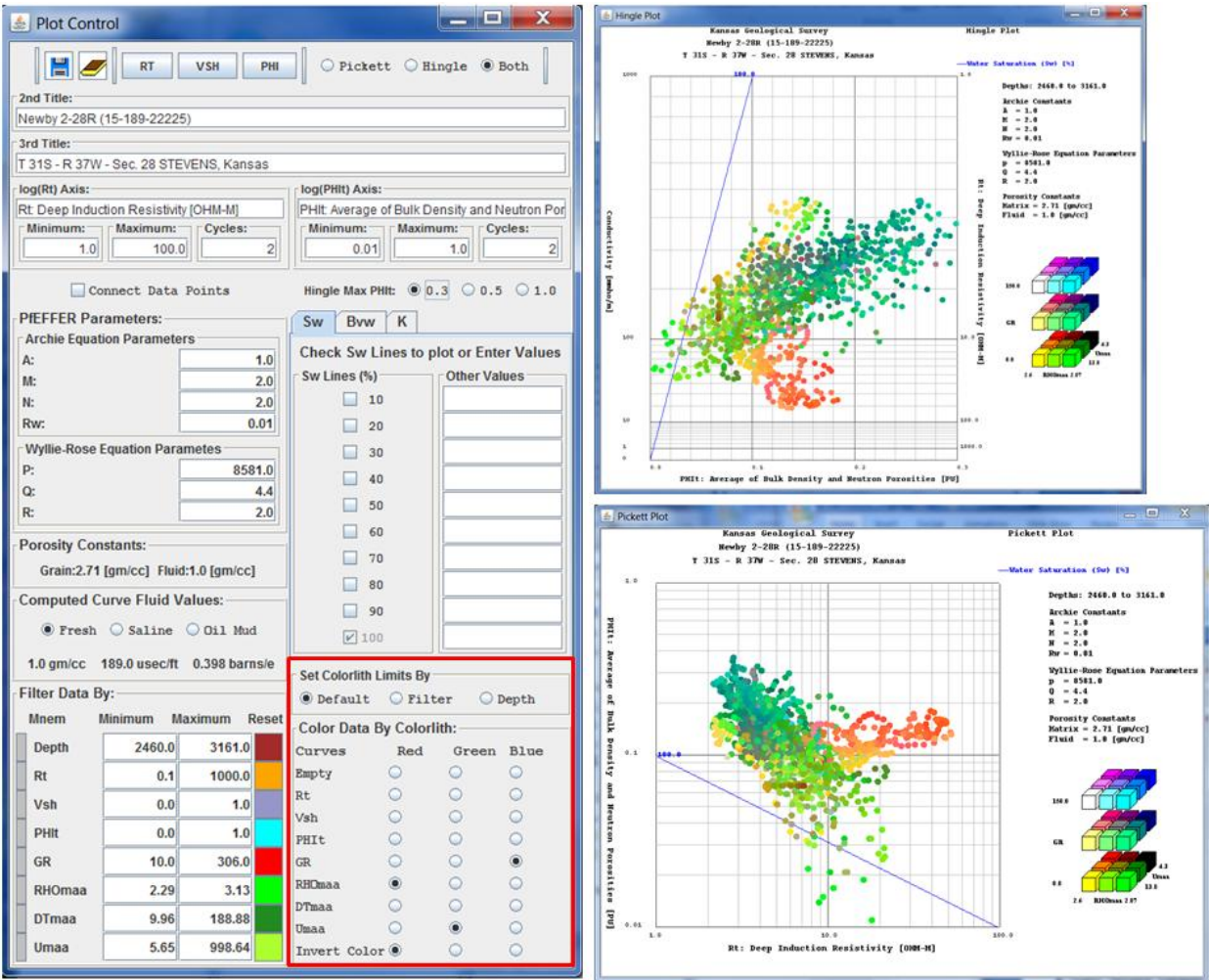


Sw	Bvw	K
Check K Lines to plot or Enter Values		
K Lines (md)		Other Values
<input checked="" type="checkbox"/>	0.001	.002
<input checked="" type="checkbox"/>	0.01	500
<input checked="" type="checkbox"/>	0.1	
<input checked="" type="checkbox"/>	1.0	
<input checked="" type="checkbox"/>	10.0	
<input checked="" type="checkbox"/>	100.0	
<input checked="" type="checkbox"/>	1000.0	
<input type="checkbox"/>	10000.0	
<input type="checkbox"/>	100000.0	
<input type="checkbox"/>	1000000.0	

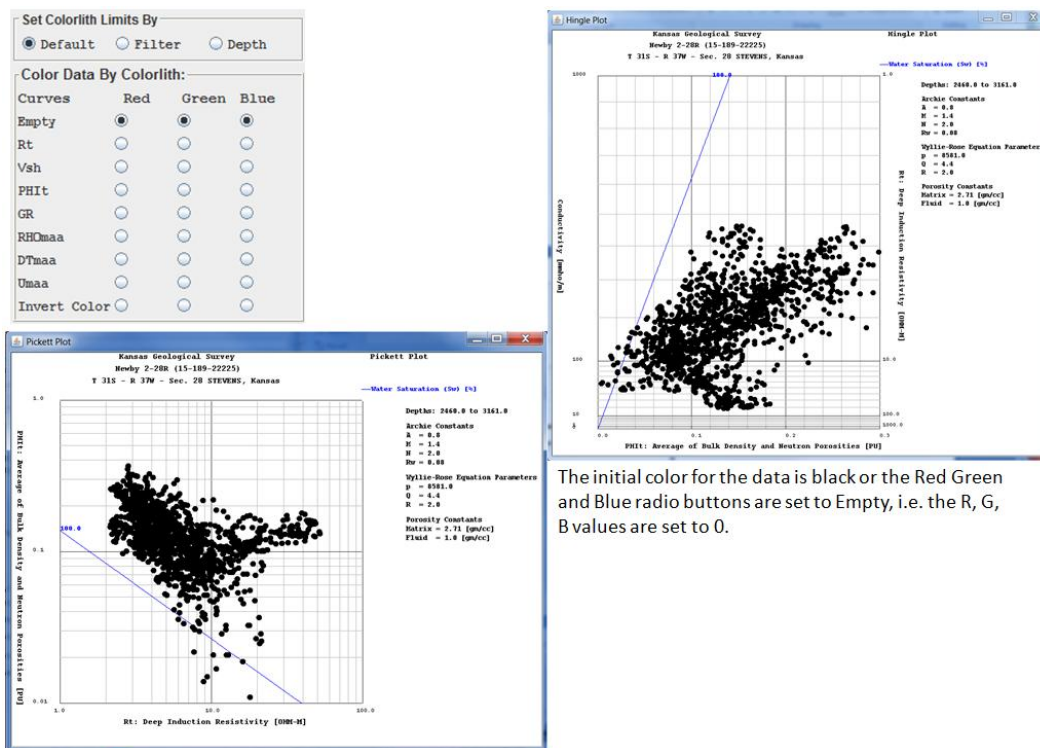
The Permeability (K) Lines Panel allows the user to select from 10 fixed lines and up to 10 Other Values text field user define lines. In this example all but the last three check boxes were selected and in the Other Values text fields 0.002 and 500.0 value were entered.

Notice that as you select the check box or enter and leave the Other Values text field the Pickett Plot automatically reflect the lines entered.

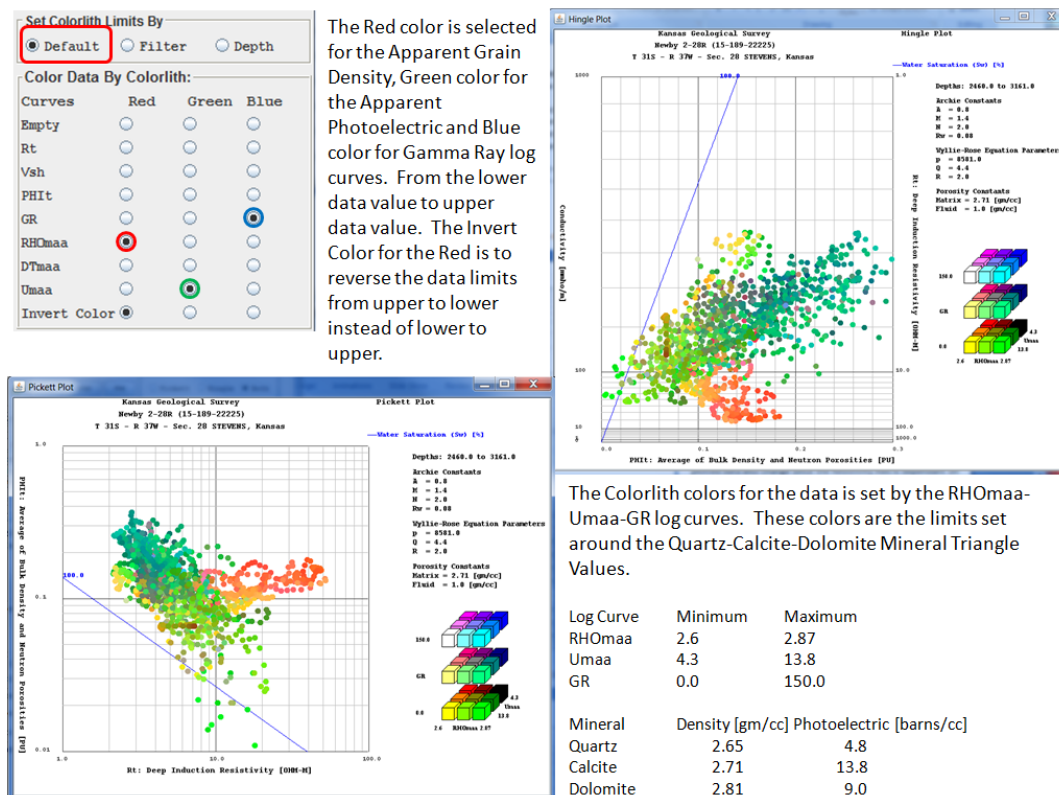
Modify Plot Data Colors



Initial Data Point Color – Black



Default Button: RHOMaa-Umaa-GR Data Limits – Use Default Limits



Filter Button: RH0maa-Umaa-GR Data Limits – Set using Filter Data Limits

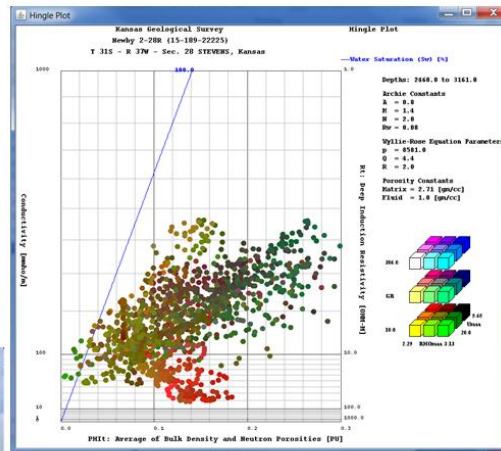
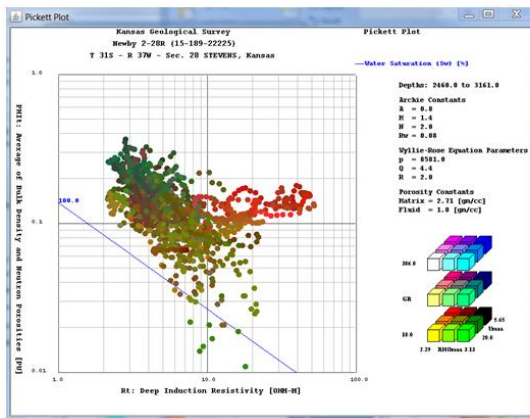
Set Colorlith Limits By

☐ Default ☒ Filter ☐ Depth

Color Data By Colorlith:

Curves	Red	Green	Blue
Empty	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Rt	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Vsh	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PHIt	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
GR	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
RH0maa	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
DTmaa	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Umaa	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Invert Color	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

The Red color is selected for the Apparent Grain Density, Green color for the Apparent Photoelectric and Blue color for Gamma Ray log curves. From the lower data value to upper data value. The Invert Color for the Red is to reverse the data limits from upper to lower instead of lower to upper.



The Colorlith colors for the data is set by the RH0maa-Umaa-GR log curves. The color ranges are set to the Filter By Data range values.

Log Curve	Minimum	Maximum
RH0maa	2.29	3.13
Umaa	5.65	20.0
GR	10.0	306.0

Depth Button: Evenly distribute 40 colors over depth range

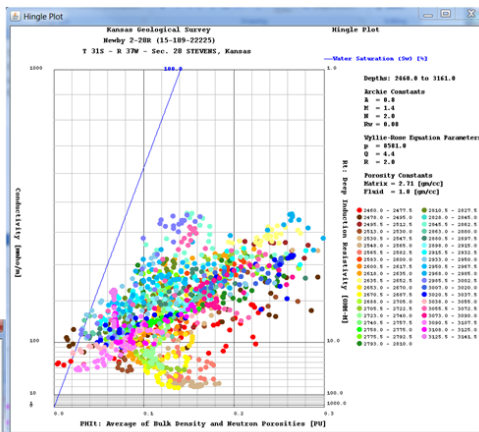
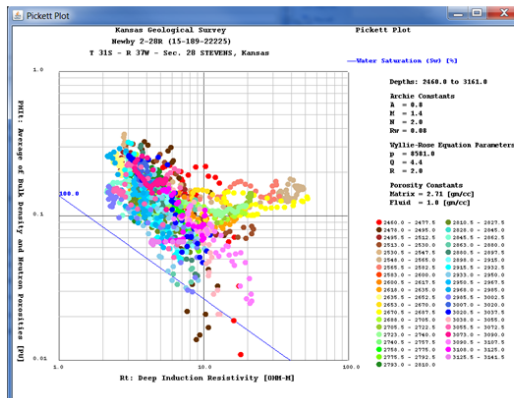
Set Colorlith Limits By

☐ Default ☐ Filter ☒ Depth

Color Data By Colorlith:

Curves	Red	Green	Blue
Empty	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Rt	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Vsh	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
PHIt	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
GR	<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
RH0maa	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
DTmaa	<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
Umaa	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Invert Color	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>

The Color Data By Colorlith Panel is not used for the Depth Colors.



The color over the depth range is equally divided between 40 colors automatically. The colors are basically set to follow a range from red to purple for upper depth value to the lower depth value.

Modifying the Log Curve Selections

PfEFFER Toolbar has a set of buttons designed to ease the transfer of data from the log input columns right into the home area columns RT, VSH and PHI. The **VSH** button is placed before the **PHI** button because the VSH column may be employed in the computation of PHI and so the computation of VSH would logically come first.



Save as Hingle & Pickett Plot Portable Network Graphics (PNG) File



Exit Hingle & Pickett Plot Control Dialog



Select the input log for the Total Resistivity (Rt)



Select the input log for the Shale proportion (Vsh) & log data values for clean formation and for shale.



Select the input logs for the Total Porosity (PHI) & rock matrix, fluid values.

- Pickett Radio Button – Display Pickett Plot Only
- Hingle Radio Button – Display Hingle Plot Only
- Both Radio Button – Display Both Pickett and Hingle Plots

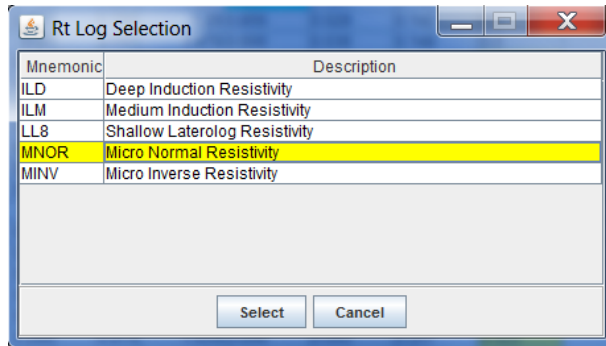
Calculating RT

When the flow unit is created the spread sheet is automatically loaded using a hierarchy of resistivity curves. If Deep Induction Resistivity (ILD) Log Curve is present it is automatically selected as the default True Resistivity (Rt). If ILD is not present it looks for the next resistivity log curve by the following hierarchy,

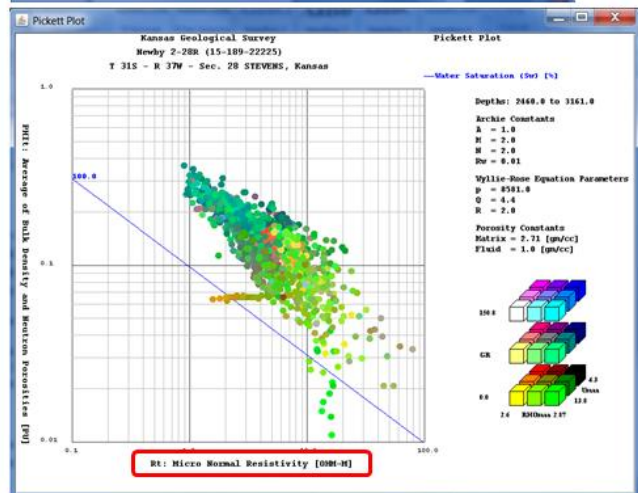
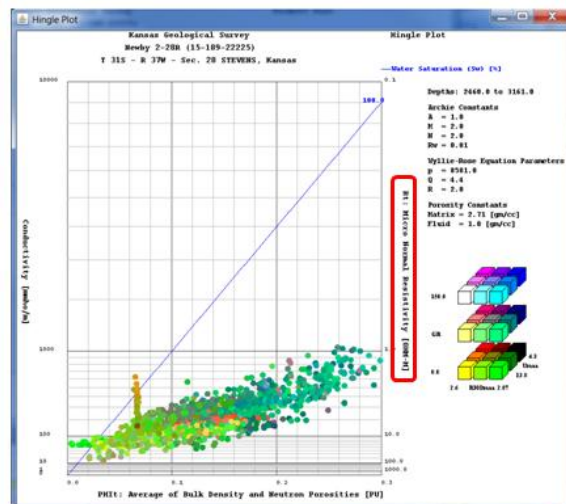
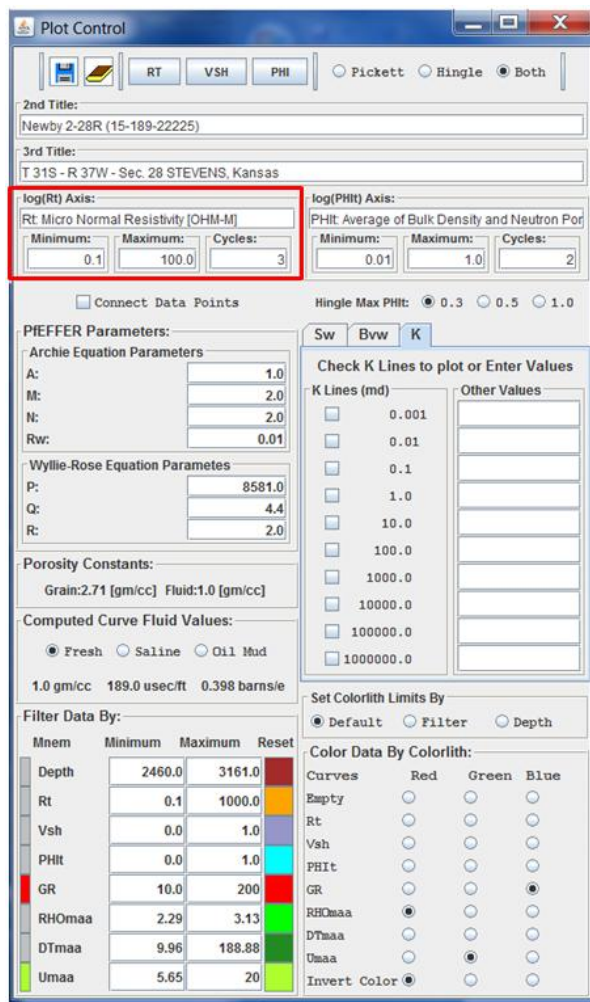
Rt – True Resistivity Hierarchy:

1. ILD - Deep Induction Resistivity
2. AHT90 - Array Induction Resistivity - 90
3. LL - Deep Laterolog Resistivity
4. RDEP - Deep Resistivity
5. First Resistivity found

If the user wishes to change the curve they only need to select the RT button on the Tool Bar, which will launch the “Rt Log Curve Selection” dialog, with a list of possible resistivity log curves loaded from the LAS file.



With this example there are 5 resistivity log curves available, highlight the Micro Normal Resistivity (MNOR) log curve and click on the “Select” Button to the resistivity log curve data selected will be downloaded to the Pickett and Hingle Plots. Notice also that the Total Resistivity Axis title is modified on the Control dialog as well as the both plots.



Calculating VSH

When the flow unit is created the spread sheet is automatically loaded using a hierarchy of log curves that will illustrate change in Shale levels. If Gamma Ray (GR) Log Curve is present it is automatically selected as the default V-Shale (VSH). If GR is not present it looks for the next shale level log curve by the following hierarchy,

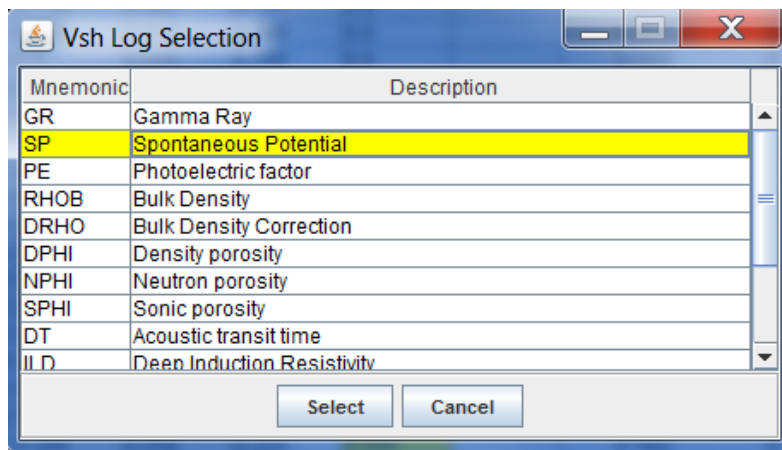
Vsh – Fractional Shale Hierarchy:

1. GR - Gamma Ray
2. CGR - Gamma Ray Minus Uranium
3. SP - Spontaneous Potential

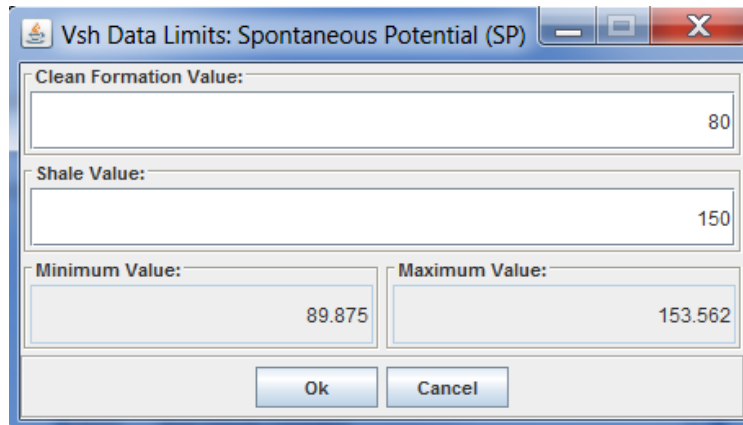
The VSH button is used to establish the formula for the VSH (shale proportion) column, based on any log curve the user has to decide the clean formation value and the shale value of the log curve selected. Using the Gamma Ray as an example, the VSH will be computed as,

$$Vsh = (GR - GRc) / (GRsh - GRc)$$

Where GR is the observed gamma ray value and GRc and GRsh are the specified gamma ray values for clean formation and for shale formation respectively. The default values for GRc and GRsh for this formation are 10.428 API and 150.0 API respectively. If the user wishes to change the curve they only need to select the VSH button on the Tool Bar, which will launch the “Vsh Log Selection” dialog, with a list of possible log curves loaded from the LAS file.



As you can see, this dialog is showing all the log curves downloaded from the LAS file. The user can select any curve, but the user has to determine what is the clean formation level and shale formation level. Highlight the Spontaneous Potential (SP) and click on the “Select” button to display the “Vsh Data Limits: Spontaneous Potential” Dialog.



The dialog box titled "Vsh Data Limits: Spontaneous Potential (SP)" contains the following fields and values:

Field	Value
Clean Formation Value:	80
Shale Value:	150
Minimum Value:	89.875
Maximum Value:	153.562

Buttons: Ok, Cancel

The Dialog will show the minimum and maximum value, but the user will have to enter the Clean Formation value and the Shale Value, e.g. set the Clean Formation Value to 80 and the Shale Value to 150. Now click on the “Ok” button to load the SP log data into the Pickett & Hingle Plots.

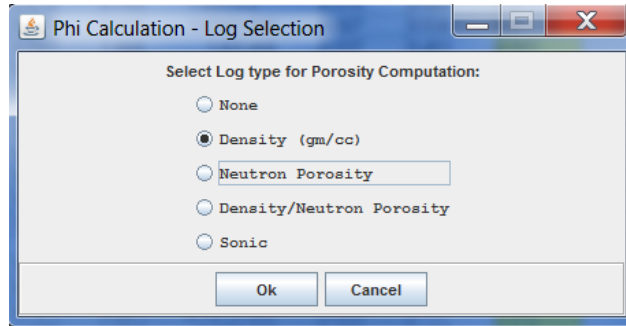
Calculating PHI

When the flow unit is created the spread sheet is automatically loaded using a hierarchy of Porosity log curves. If Average Porosity can be calculated, both Neutron and Density Porosity curves are available) then the PHI is automatically is calculated as the default. If both NPHI and DPHI are not both present it looks for the next porosity log curve by the following hierarchy,

Φ_t – True Porosity Hierarchy:

1. PHI Average value of
 - a. NPHI - Neutron Porosity
 - b. DPHI - Density Porosity
2. NPHI - Neutron Porosity
3. DPHI - Density Porosity
4. SPHI - Sonic Porosity

If the user wishes to change the curve they only need to select the PHI button on the Tool Bar, which will launch the “Phi Calculation - Log Selection” dialog, with a set of radio buttons of possible porosity curves to select. If the Sonic log curve is not present then the Sonic radio button would be disabled, but as you can see in the image below that all possible porosity log curves are present. The default button selected is None, but you must have a porosity curve so for this example the Density (gm/cc) radio button will be selected.

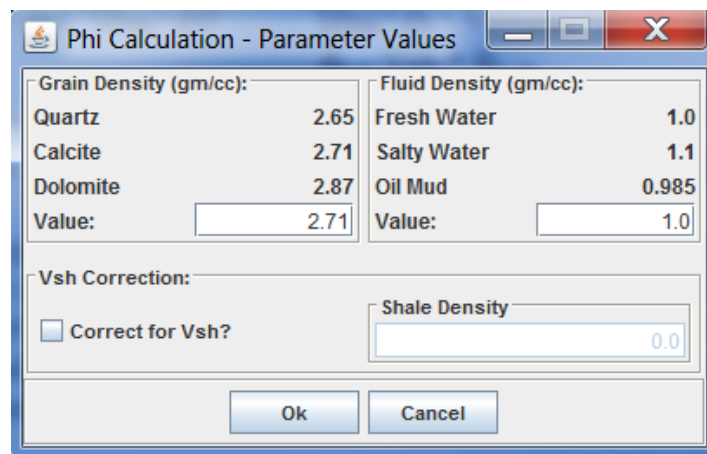


The four options correspond to the following formulas, with and without correction for shale volume,

	Without correction	With correction
Density	$(\rho_{ma} - \rho_b) / (\rho_{ma} - \rho_f)$	$[\rho_{ma} - \rho_b - V_{sh}(\rho_{ma} - \rho_{sh})] / [\rho_{ma} - \rho_f]$
Neutron	Φ_n	$\Phi_n - V_{sh} * \Phi_{n\ sh}$
Density/Neutron	$\sqrt{[(\Phi_n^2 + \Phi_d^2) / 2]}$	$[\Phi_n - (\Phi_{n\ sh} / \Phi_{d\ sh}) * \Phi_d] / [1 - \Phi_{n\ sh} / \Phi_{d\ sh}]$
Sonic	$(\Delta t_{ma} - \Delta t_b) / (\Delta t_{ma} - \Delta t_f)$	$[\Delta t_{ma} - \Delta t_b - V_{sh} * (\Delta t_{ma} - \Delta t_{sh})] / [\Delta t_{ma} - \Delta t_f]$

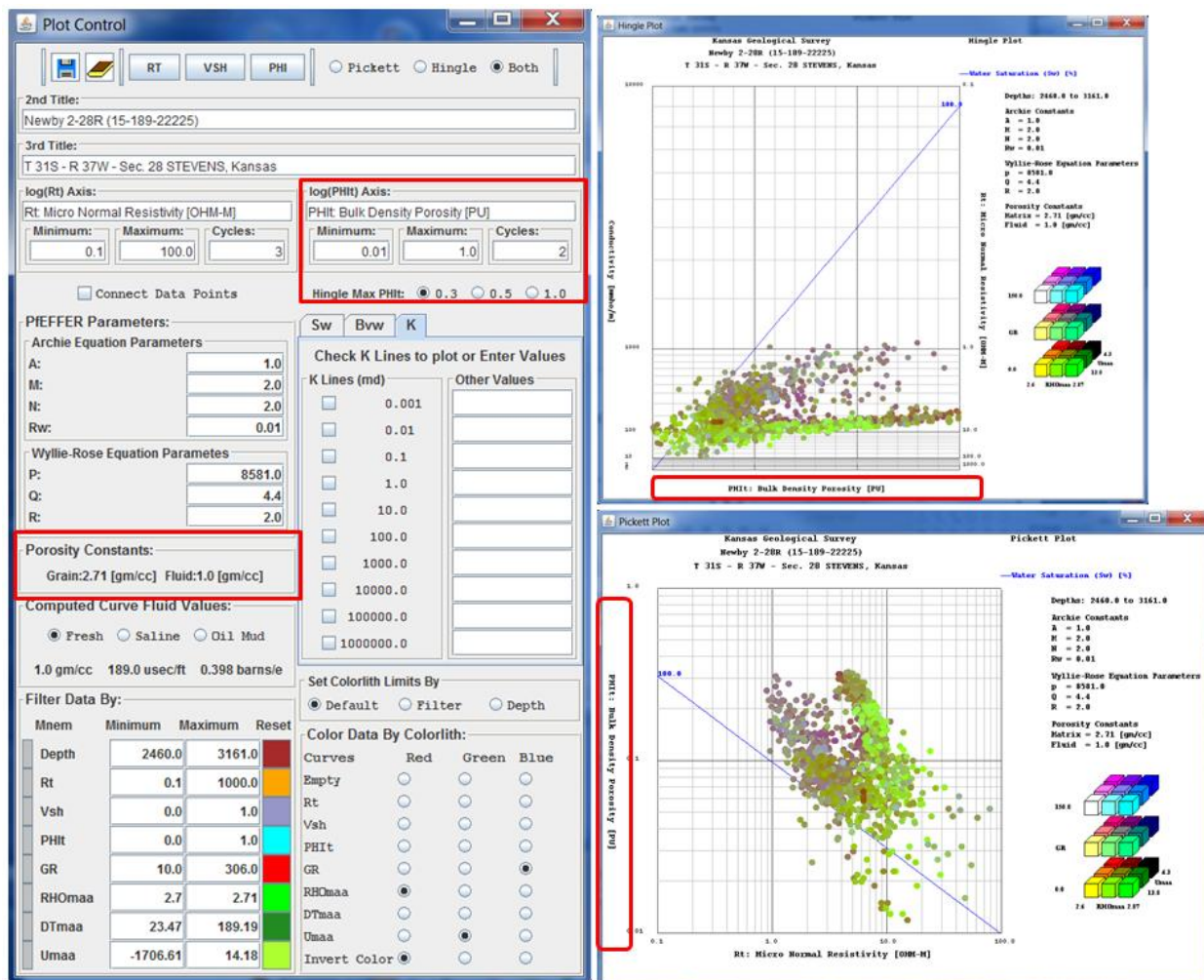
In each case you will be requested to specify columns containing the appropriate logs and also to specify the constants in the selected equation (such as ρ_{ma} and ρ_f). You will also be asked whether you want to correct for V_{sh} , as described below. Indicate your choice of logs by selecting the appropriate radio button on the Log Selection dialog box and then clicking OK. Here we have chosen to compute the porosity from a density log.

You are now presented with the Parameter Values dialog box ...



which lets you specify the parameters in the selected equation, in this case matrix (or grain) density and fluid density (ρ_{ma} and ρ_f). Since the Cottonwood is a limestone interval, we have entered 2.71 for the grain density above. The default value for fluid density is 1.0, which we will leave unchanged.


We could choose to include a Vsh correction by clicking on the “Correct for Vsh?” check box. Doing so will activate the Shale Density (RHOsh) edit box, allowing us to enter the needed value. The shale correction is based on the values in the VSH column. (If you select the Vsh correction prior to filling the VSH column, the formula for PHI will still be set up correctly, but the resulting porosity values will be null. The porosity values will be set to their proper numeric values once values are entered for VSH.) For now we will choose not to use the Vsh correction. The Parameter Values dialog box is similar for the other three porosity computation options, although it contains only the Vsh Correction box for the neutron porosity and density/neutron porosity options. After clicking OK on the Parameter Values dialog box, the program will set up the formula for the PHI column and transfer the Total Porosity Data to the Hingle & Pickett Plots. Notice also that the Total Porosity Axis title is modified on the Control dialog as well as the both plots. The Porosity Constants will also be modified.



Note that the Pickett plot computations expect porosity as a fraction, not in percent. Using the density and sonic options to compute porosity will yield fractional values automatically.

PfEFFER-java automatically converts porosity logs that are in percent to fractional values when the LAS file is imported into the program.

Moveable Hydrocarbon Plot

A moveable hydrocarbon plot (referred to hereafter simply as a moveable oil plot) can be created using the  image icon button provided that a shallow resistivity log is available on the unit worksheet. The **S_{xo}** computations are based on the assumption that the zone near the well is permeated with mud filtrate. The Archie equation is used to compute S_{xo}, the filtrate saturation of this flushed zone based on the mud filtrate hydrocarbon saturations. We will illustrate the S_{xo} computation using the Cottonwood Limestone worksheet.

The Moveable Hydrocarbon Panel displays the mud filtrate Values as well as the total depth and temperature values.

In order to modify these values you must go to the Headers Tab at the bottom of the worksheet and scroll to the bottom page to the Resistivity measurements in the Parameters section. Any changes to the mud filtrate values will be automatically modified in the Moveable Hydrocarbon Panel for all flow units.

The Moveable Hydrocarbon Panel displays the Mud Filtrate Resistivity @ Temperature along with the Total Depth @ Bottom Temperature degrees Fahrenheit. The Surface Temperature is assumes the mud filtrate temperature unless it is specifically available in the log.

To modify these values you must select the Headers Tab at the bottom of the worksheet and scroll to the bottom of the page where the Resistivity measurements are provided. If the Resistivity or Temperatures are not present then the following values are used by default,

Variable	Value	Units	Description
Rmf	0.55	ohm-m	Mud Filtrate Resistivity
Rmft	58.0	°F	Mud Filtrate Temperature
ST	58.0	°F	Surface Temperature
BHT	120.0	°F	Bottom Hole Temperature
TD		Feet	Total Depth of Hole

The TD is determined automatically from the LAS File when it is imported into P_fEFFER-java.

If you wish to enter or modify go to the "Value" Column in the Headers Column next to the variable you wish to change, the "Description" Column will describe the variable. Changing any of the variables above will automatically be reflected in every flow panel. To change the Temperature units you only need to change one of the units for the temperature to reflect all the temperature variables assuming that all were measured with the same units. The only accepted values are **DEG-F** for Fahrenheit and **DEG-C** for Celsius.

FIELD	UNIT	VALUE	DESCRIPTION	FORM
STRT	F	2342.0	START DEPTH	F
STOP	F	3162.0	END DEPTH	F
STEP	F	0.5	STEP LENGTH	F
WFLA		-999.25	NULL VALUE	F
COMP		Pioneer Natural Resources USA Inc	Company	S
WELL		Newby 2-28R	Well Name	S
FLD		PANOMA GAS AREA	Field	S
SEC		28	Section	I
TOWN		31 N 37 E 28 W	Township (e.g. 42S)	S
RANG		37 E 28 W	Range (e.g. 25E)	S
LOC		T31S R37W Sec. 28	Location (Sec Town Range)	S
LOC1		SW NE SW SW	Location 1 (quarter calls)	S
LOC2		680 North, 4600 West from SE corner	Location 2 (footages)	S
COUN		STEVEN	County	S
STAT		Kansas	State	S
CTRY		US	Country	S
PRCV			Province	S
SERV		Halliburton	Service Company	S
LTC			License Number	S
DATE		06/13/2008	Completion Date	DDMMYYYY
API		15-189-2225	API-Number	S
WZ			Unique Well ID Number	S
LAT1 DEG		37.317197	Latitude	F
LONG DEG		-101.3545478	Longitude	F
GDAT			Geodetic Datum	S
K		291354.07	X or East-West coordinate	F
Y		4132456.82	Y or North-South coordinate	F
UTM		UTM	Horizontal Co-ordinate System	S
PTH		14.0	UTM Location	F
STAT		GAS	Well Status	S
PGAT		GL	Permanent Data	S
APD F		15.0	Above Permanent Data	S
DEPT		KB	Depth Reference (KB,DF,CB)	S
DEPT F		3119.0	Elevation of Depth Reference	F
RUN		1	Run Number	I
TDL F		3155.0	Total Depth Logger	F
TDD F		3150.0	Total Depth Driller	F
CBSL F		640.0	Casing Bottom Logger	F
CBSD F		639.0	Casing Bottom Driller	F
CBSZ IN		8.625	Casing Size	F
CSDW LB			Casing Weight	F
BS IN		7.875	Bit Size	F
MUD		Chemical	Mud Type	S
FLOW		Flowline	Mud Flowline	S
MUD GMCC		8.9	Mud Density	F
MUD CC		40	Mud Viscosity (Funnel)	F
FL LB/S		6.4	Fluid Loss	F
PH		11.0	PH	F
RES OHM-F		0.75	Resistivity of Mud	F
TEMP DEG-F		71.0	Temperature of Mud	F
RES OHM-F		0.66	Resistivity of Mud Filtrate	F
TEMP DEG-F		74.0	Temperature of Mud Filtrate	F
RES OHM-F		1.10	Resistivity of Mud Cake	F
TEMP DEG-F		74.0	Temperature of Mud Cake	F
MAX DEG-F		101.0	Maximum Recorded Temp	F
TIME DATE			Date/Time Circulation Stopped	DDMMYYYY
TIME DATE			Date/Time Logger Tagged Bottom	DDMMYYYY
UNIT		51781	Logging Unit Number	S
HAIR		Liberal, KS	Home Base of Logging Unit	S
ENG		Montgomery	Recording Engineer	S
WIT		Useiton, Ratliff	Witnessed By	S

HALLIBURTON EXCELL <small>Computerized Performance</small>		DUAL INDUCTION LATEROLOG	
COMPANY <u>PIONEER NATURAL RESOURCES USA</u>		COMPANY <u>PIONEER NATURAL RESOURCES USA INC.</u>	
WELL <u>NEWBY 2-28R</u>		WELL <u>NEWBY 2-28R</u>	
FIELD <u>PANOMA</u>		FIELD <u>PANOMA</u>	
COUNTY <u>STEVENS</u>		COUNTY <u>STEVENS</u> STATE <u>KANSAS</u>	
API No. <u>15-189-22225000</u> Location <u>680 FSL</u> <u>4600 FEL</u>		Other Services SOL/D5N FWST ML MRIL	
Sect <u>28</u> Twp <u>31S</u> Rge <u>37W</u>		Other Services SOL/D5N FWST ML MRIL	
Permanent Datum <u>G.L.</u> Elev <u>3113'</u>		Elev. <u>K.B.</u> <u>3119'</u>	
Log measured from <u>K.B.</u> <u>6</u> ft. above perm. datum		D.F. <u>3118'</u>	
Drilling measured from <u>K.B.</u>		G.L. <u>3113'</u>	

Date	09/30/1997		
Run No.	ONE		
Depth - Driller	3150		
Depth - Logger	3155		
Bottom - Logged Interval	3150		
Top - Logged Interval	640		
Casing - Driller	8.625 @ 639	@	@
Casing - Logger	640		
Bit Size	7.075"		
Type Fluid in Hole	CHEMICAL		
Dens. / Visc.	8.9 / 40		
Phi / Fluid Loss	11.0 / 6.4		
Source of Sample	FLOWLINE		
Rm @ Meas. Temp.	75 @ 71	@	@
Rmf @ Meas. Temp.	66 @ 74	@	@
Rmc @ Meas. Temp.	1.1 @ 74	@	@
Source Rmf / Rmc	MEAS / MEAS		
Rm @ BHT	58 @ 101	@	@
Time Since Circ.	6.0 HRS		
Time on Bottom	12:30:30		
Max. Rec. Temp.	101 @ TD	@	@
Equip. / Location	51781 / LIB	@	@
Recorded By	MONTGOMERY		
Witnessed By	USELTON	PATZLAFF	AMCS

KCC

SEP 8 1998

RECEIVED
STATE CORPORATION COMMISSION

SEP 17 1998

CONSERVATION DIVISION
W-100

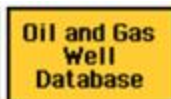
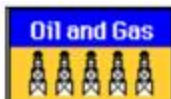
Variable	Value	Units	Description
Rmf	0.66	ohm-m	Mud Filtrate Resistivity
Rmft	74.0	°F	Mud Filtrate Temperature
ST	74.0	°F	Surface Temperature
BHT	101.0	°F	Bottom Hole Temperature
TD	3162.0	Feet	Total Depth of Hole

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The screenshot shows the Kansas Geological Survey website. On the left is a navigation menu with links for Water, Energy, Geology, Geophysics, Publications, and Education. The Energy section is expanded, showing sub-links like Oil and Gas Wells, Production Data, Current Info, Interactive Maps, Publications, Reports, Gemini Tools, Tutorials and Courses, and Other Projects. The main content area has a header 'Repository and Ordering Information' with links to Data Resources Library, Wichita Well Sample Library, and Drill Core Library. Below this is 'Oil and Gas Production Data' with a note about data added through August 2014, followed by links for State Production and Historical Info, County Production, Field Production, Gas Storage Fields in Kansas, Lease Production, Production by Operator, and Top Ten lists of oil and gas production. At the bottom, under 'Wells, Logs, Core, and other databases', the link 'Master list of oil and gas wells' is highlighted with a red box and a red arrow pointing to it. A tooltip for this link states: 'All oil and gas wells in the KGS database. Can save lists of wells to a text file. Linked to the other types of data available (LAS files, cuttings, scans, tops, etc.).'

Click on the “Master list of oil and gas wells” link to search the KGS database for well information and well data of Kansas Wells.

To retrieve the electric log in Kansas, the user can search the Kansas Geological Survey Database (<http://www.kgs.ku.edu/PRS/petroDB.html>) for logs by clicking on the “Master list of oil and gas wells” and searching by Township-Range-Section, Partial Lease Name, or API-Number, i.e.



Master List of Oil and Gas Wells in Kansas

Use this form to search our complete list of Oil and Gas Wells in Kansas.

In Kansas, Township values vary from 1 in the north to 35 in the south, and the values for Range are from 1-43 West and 1-25 East. Values for Section are 1 to 36. If you are selecting data from other states, ignore the county names associated with each code.

Enter values for any or all parameters			
Township:	<input type="text"/>	South; Range:	<input type="text"/>
		East: <input type="radio"/> or West: <input checked="" type="radio"/> ; Section:	<input type="text"/>
Lease:	<input type="text"/>		
	(Enter all or part of a lease name. Case doesn't matter. Leave off well number.)		
Operator:	<input type="text"/>		
	(Enter all or part of an operator name. Case doesn't matter.)		
State:	<div><div>Kansas--15</div><div>Stafford--185</div><div>Stanton--187</div><div>Stevens--189</div><div>Sumner--191</div></div>	<div><div>^</div><div>v</div></div>	API Well No.: <input type="text" value="22225"/>
API Well No. is the 5-digit well number. Use the menus to select state and county.			
	<div>All Wells</div>		
	<div>Select Wells</div>		

Other information online...

- [Show Horizontal or Slant Wells in Kansas](#)
- [File Format Tools](#)
- [Landgrid data](#)
- [FGDC Metadata for the Well Database](#)
- [Pre-created files of all the state's wells](#)

Enter the API-Number of the well, e.g. Newby 2-28R API-Number is 15-189-22225.

15 is the state code

189 is the county code

22225 is the well number.

[Kansas Geological Survey](#), Oil and Gas Well Database

Comments to webadmin@kgs.ku.edu

Program Updated May 27, 2014

KGS

Oil and Gas Well Database

Select location of well to view details.

Click on column heading to sort.

Save Data to File

2 records returned.

T-R-S	Original operator (current operator)	Well	API	Elevation Ascend. Desc.	Total Depth Ascend. Desc.	Field	Spud Date Ascend. Desc.	Plug Date Ascend. Desc.	Status ?
T31S R37W, Sec. 28, SW SW	Pioneer Natural Resources USA, Inc. (Pioneer Natural Resources USA, Inc.)	Newby 2-28R	15-189-22225-0001	3119 KB 3113 GL	3150	PANOMA GAS AREA	04-JUL-2007		GAS Producing
T31S R37W, Sec. 28, SW NE SW SW	Pioneer Natural Resources USA Inc. (Pioneer Natural Resources USA, Inc.)	Newby 2-28R	15-189-22225	3119 KB 3112 GL	3155	PANOMA GAS AREA	23-SEP-1997		GAS Recompleted

[Kansas Geological Survey](#), Oil and Gas Well Database

Comments to webadmin@kgs.ku.edu

URL=<http://www.kgs.ku.edu/Magellan/Qualified/index.html>

Well Database Programs Updated June 6, 2014. Data added continuously.

Click on the “T-R-S” Column link of the second entry, which contains the Well Header Information and Well Data for the Newby 2-28R.

KGS

Oil and Gas Well Database

Specific Well—15-189-22225

All Well Data

API: 15-189-22225 KID: 1006159553 Lease: Newby Well: 2-28R Original operator: Pioneer Natural Resources USA Inc. Current operator: Pioneer Natural Resources USA, Inc. Field: Panoma Gas Area Location: T31S R37W, Sec. 28 SW NE SW SW 680 North, 4600 West, from SE corner Longitude: -101.3545478 Latitude: 37.317197 Lat-long calculated from footages County: Stevens Replacement well.	Permit Date: Aug-07-1997 Spud Date: Sep-23-1997 Completion Date: Jan-16-1998 Plugging Date: Well Type: GAS Status: Recompleted Total Depth: 3155 Elevation: 3119 KB Producing Formation: Council Grove Group IP Oil (bbl): IP Water (bbl): IP GAS (MCF): KDOR code for Gas: 208110 KCC Docket No.:
View well on interactive map	

Wireline Log Header Data

Logger: Halliburton Tool: Cement Bond Log Operator on log: Pioneer Natural Resources USA Inc. Top: 20; Bottom: 3097 Log Date: Nov-11-1997 BHT: F Gamma Ray: Y Spontaneous Potential: Holdings at: Lawrence	
Logger: Halliburton Tool: Dual Induction Laterolog Operator on log: Pioneer Natural Resources USA Inc. Top: 640; Bottom: 3150 Log Date: Sep-30-1997 BHT: 101F Gamma Ray: Y Spontaneous Potential: Y Holdings at: Lawrence	<div style="border: 2px solid red; padding: 5px;"> <p>• Download Black and White Scan (Zip size: 3.5 megs)</p> </div> <p>Click on the “Download Black and White Scan” URL link to retrieve the electric log from the KGS Server.</p>

The RMF, RMFT and BHT are used to compute Rmfc, the corrected mud filtrate resistivity at the formation temperature, T. This is given by,

$$R_{mfc} = R_{mf} * (R_{mft} + 6.77) / (T + 6.77) \text{ Fahrenheit}$$

$$R_{mfc} = R_{mf} * (R_{mft} + 21.5) / (T + 21.5) \text{ Celsius}$$

$$\text{where } T = ST + \text{depth} * (BHT - ST) / TD$$

T = Formation Temperature

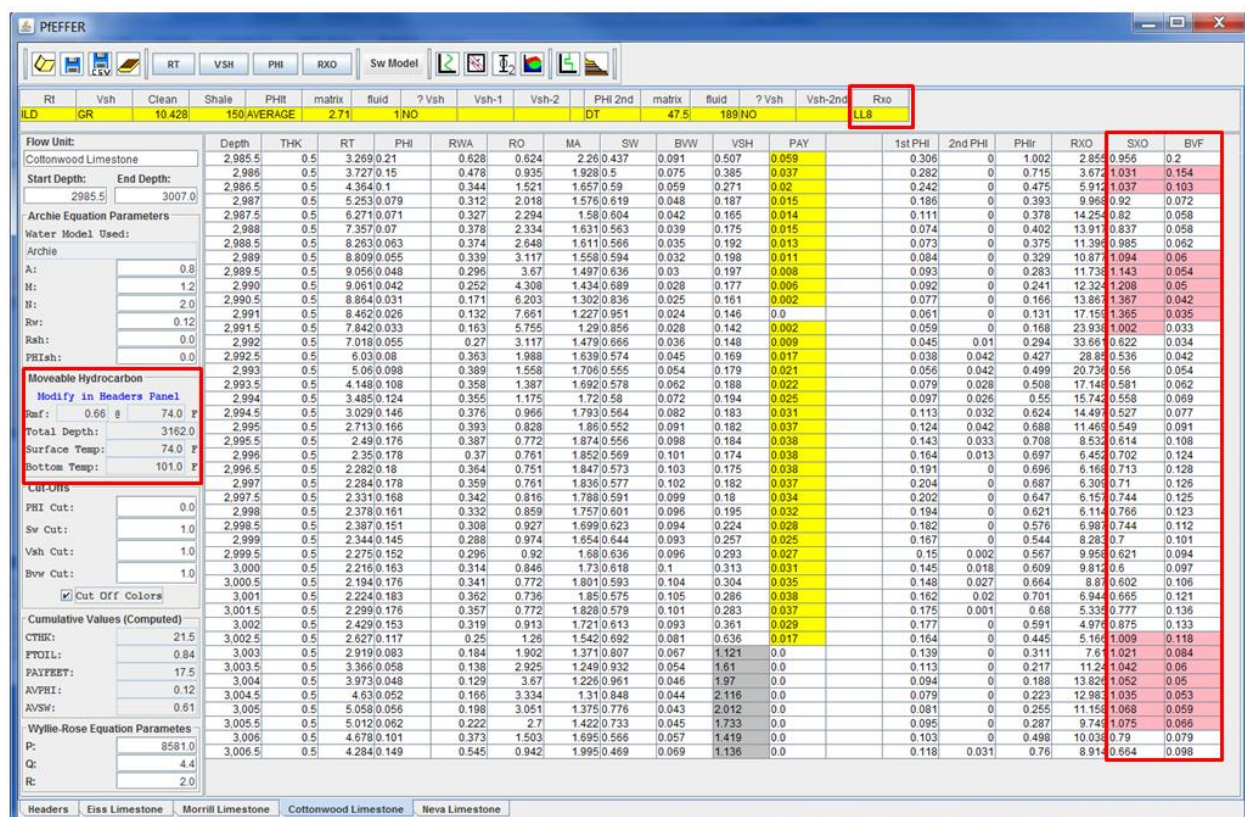
ST = Surface Temperature (Default is Rmft)


depth = depth within the flow unit

BHT = Bottom Hole Temperature

TD = Total Depth of Hole

PfEFFER-java automatically computes the temperature from the formation depth (interpolated from the surface and the bottom hole temperature) and then loads the SXO and BVF columns.



Now Click on the  icon button will display the moveable oil plot.

Menu Bar

File

- Create PNG Image of Moveable Oil Plot
- Show Memory used dialog.
- Exit from dialog

Depth Scale

Allows the user to change the depth ft/in scale of plot.

Menu Bar

Header Information Panel

Basic well header information data
- Lease Name, API-Number,
Latitude & Longitude, Total Depth,
Elevation, Well Status

Depth Scale & Range Panel

Controls the Starting Depth and
Ending Depth of the Profile Plot.
The "Cursor:" text field shows the
location of the cursor on the plot.

Porosity Maximum Panel

These radio buttons control the
maximum "porosity" values on the
Moveable Hydrocarbon Plot Track.
Default is 0.5 PU.

Control

File Depth Scale Help

Header Information:

Name: Newby 2-28R
15-189-22225 Status: GAS
Lat: 37.317197 Long: -101.3545478
Depth: 3162.0 Elev (GL): 3112.0

Depth Scale & Range:

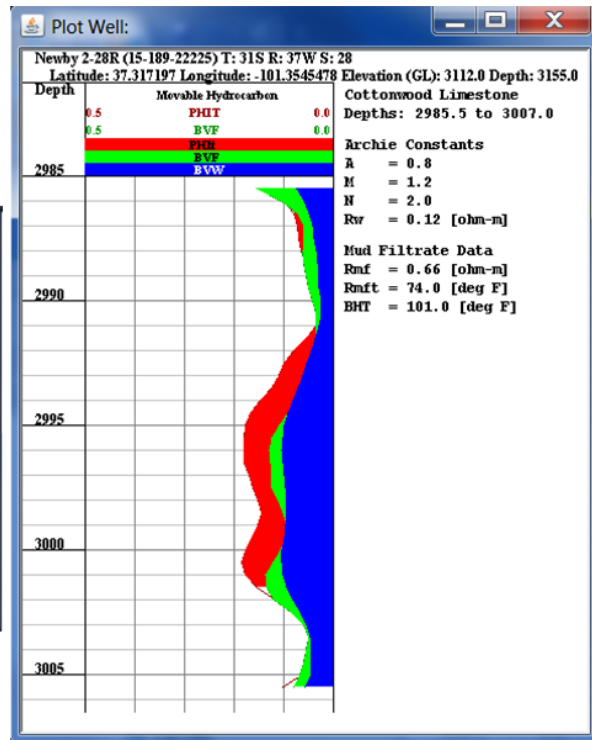
Depth Scale: 5 ft/in

Start Depth: 2985.5 End Depth: 3007.0

Reset Depth Modify Depth

Porosity Maximum:

☐ 0.2 ☐ 0.3 ☒ 0.5 ☐ 1.0



The plot, BVW is represented as blue, BVF as green, and PHI as red. The differences between BVF and BVW represent the moveable hydrocarbon saturation, and the difference between PHI and BVF represents the residual hydrocarbon saturation.

Reference

Pfeffer-Pro (Petrofacies Evaluation of Formation for Engineering Reservoirs), Kansas Geological Survey, Release Date February 1998. Moveable Hydrocarbon Plot, pages 131 to 134.

Save Well Data as Log ASCII Standard (LAS) version 3.0 File

The LAS (Log ASCII Standard) is rapidly becoming the accepted industry standard for electronic transmission of digital wire-line logs. Earlier digital formats were commonly coded in binary (such as LIS) and so required specialized software to read them. The LAS standard was introduced by the Canadian Well Logging Society (<http://www.cwls.org/>) in 1989 to standardize the organization of digital log curve information for personal computer users. It did this very successfully and the standard became popular worldwide. Version 1.2 was the first version and was followed in September 1992 by version 2.0 to address some inconsistencies. A more versatile version LAS 3.0 was released in 1999 however at present LAS 2.0 remains the dominant product. LAS 3.0 clarify several of the poorly defined specifications of LAS 2.0 and provide expanded data storage capabilities, but have seen limited implementation.

The GEMINI Tools programs will read either a Log ASCII Standard (LAS) version 2.0 or 3.0 file and version 1.2 but the Well Information Section is backward in data definition and will not be parsed correctly in the GEMINI Tools web apps.

The sections defined for the LAS 2.0 standard are as follows (http://www.cwls.org/wp-content/uploads/2014/09/LAS_20_Update_Jan2014.pdf):

- "**~V**" (also known as "**~VERSION INFORMATION SECTION**") is a required section; has formatting requirements; must be the first section; identifies the version number and whether data is in "wrapped" or "un-wrapped" mode.
- "**~W**" (also known as "**~WELL INFORMATION SECTION**") is a required section; has formatting requirements; is preferably the second section; contains information on the well name, location, and start and stop values of the data in this file.
- "**~C**" (also known as "**~CURVE INFORMATION SECTION**") is a required section; has formatting requirements; contains curve mnemonics and their definitions in the order that they appear in the data section.
- "**~P**" (also known as "**~PARAMETER INFORMATION SECTION**") is an optional section; has formatting requirements; contains information on parameters or constants relevant to the wellbore such as mud resistivity, wire line engineer, truck number, elevation data, etc.
- "**~O**" (also known as "**~OTHER**") is an optional section; has no formatting requirements; contains other information or comments.
- "**~A**" (also known as "**~ASCII LOG DATA**") is a required section; has formatting requirements; is the last section in the file and also referred to as the data section. The index of the data columns is either Depth or Time. The index values always appear in the first column and each column of data must be separated by at least one space (ASCII 32). All values in the ASCII log data section must be floating point or integer (long) values. Other formats such as Text or Exponential values are not supported.

LAS 3.0 (http://www.cwls.org/wp-content/uploads/2014/09/LAS_3_File_Structure.pdf) will be used to save the well data for the GEMINI Tools web apps since it can hold all the well data in one file. You can even think of LAS 2.0 as a subset of LAS 3.0 since the LAS 2.0 is only

concerned with the LOG Data. Note this section includes some of the referenced LAS 3 File Structure PDF; see the above URL for the complete LAS 3.0 File structure.

The **~Version** and **~Well** sections must appear in every LAS 3.0 file as the first and second sections respectively.

Other sections are grouped by data type. Each group consists of two or three sections; a **Parameter Data** section (optional for all but Log data), a **Column Definition** section, and a **Column Data** section, in that order.

For example, core analysis data would have the following three sections:

~Core_Parameter
~Core_Definition
~Core_Data.

At least one group or data type of either the defined LAS 3.0 data types or a user defined type must exist in every LAS 3.0 file.

The **Column Definition** and the **Column Data** sections for each data type are matched sets and must both appear in that order. The corresponding **Parameter Data** section is optional (except for Log data), but if used must appear before the corresponding **Column Definition** Section.

LAS 3.0 defines six specific well related data types and their root Section Title names. They are:

~Ascii or ~Log
~Core
~Inclinometry
~Drilling
~Tops
~Test

Additional data types can be defined by the user and content rules discussed elsewhere in the document may define other section titles.

Stand alone user defined **Parameter Data** sections can be included. Care must be taken to use standalone **Parameter Data** sections only when the data contained does not fit into any of the other defined data types.

When used, the section order of each set of the three sections for each data type must be Parameter, Definition, and then Data.

Blank lines and comment lines can appear within **Column Data** sections, but can only appear BEFORE the first **Column Data** line of that section, or after the LAST **Column Data** line of that section.

The names of each channel can optionally appear above each channel as a comment line immediately before, after or on the section title line of that section if space allows.

Note: Do not use the ~Other section recognized by LAS version 2.0. It is no longer allowed in LAS 3.0. Any data that can be stored in this section must now be stored properly in a user defined **Parameter Data** or **Column Data** section.

The LAS version 3.0 file has the potential to hold all the well data that was collected, i.e. multiple log data files, core data, tops data, DST data, Perforation data, Cuttings Report data, etc. As an example the Newby 2-28R has log, core, tops, perforation data as well as the PfeFFER data created from the log analysis tool, PfeFFER-java. You can view the file at the following URL addresses,

LAS 3.0 Example File: http://www.kgs.ku.edu/Gemini/Tools/documentation/Newby-2-28R_LAS3.las

LAS 3.0 in WinZip File: http://www.kgs.ku.edu/Gemini/Tools/documentation/Newby-2-28R_LAS3.zip

Standard LAS 3.0 Data Sections for the Newby-2-28R_LAS3.las

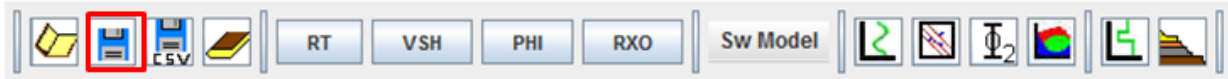
- ~Version - Version Section
- ~Well - Well Header Information Section
- ~Log - Log Data Section – for single log data file, see LAS 3.0 PDF reference below for multiple log data runs.
 - ~Parameter
 - ~Curve
 - ~ASCII, which must be the last section in the LAS File if the Log data is present.
- ~Tops - Formation Top (Stratigraphic Units) Picks Data Section
 - ~Tops_Parameter
 - ~Tops_Definition
 - ~Tops_Data | Tops_Definition
- ~Perforation – Perforation Data Section
 - ~Perforation_Parameter
 - ~Perforation_Definition
 - ~Perforation_Data | Perforation_Definition

GEMINI Tools Defined LAS 3.0 Data Sections for the Newby-2-28R_LAS3.las

- ~IQ_Control - Recreate the Profile Plot Data Section
 - ~IQ_Control_Parameter
 - ~IQ_Control_Definition
 - ~IQ_Control_Data | IQ_Control_Definition
- ~IQ_Flow – This data holds the geologist cuttings report/core description
 - ~IQ_Flow_Parameter
 - ~IQ_Flow_Definition
 - ~IQ_Flow | IQ_Flow_Definition
- ~IQ_Pfeffer – This data holds the file location of Core Image JPEG images.
 - ~IQ_Pfeffer_Parameter
 - ~IQ_Pfeffer_Definition
 - ~IQ_Pfeffer | IQ_Pfeffer_Definition

- ~IQ_Las_Parameter - Selected LAS Curves – This Parameter Section was designed to remember the Log Curves selected by the user so the user does not have to map LAS File Curve Mnemonics to KGS Standard Tool Mnemonics when they run this file with other GEMINI Tools.

PfEFFER Dialog Tool Bar



LAS File Data Types

File

~WELL ~Log ~Core[1] ~IQ_Brine ~Tops ~IQ_Control ~IQ_Geo_Report ~IQ_Images

MNEM	UNIT	VALUE	DESCRIPTION	(Format)
STRT	F	0.0	START DEPTH	(F)
STOP	F	5251.0	END DEPTH	(F)
STEP	F	0.5	STEP LENGTH	(F)
NULL		-999.25	NULL VALUE	(F)
COMP		BEREXCO LLC	Company	(S)
WELL		WELLINGTON KGS 1-32	Well Name	(S)
FLD		WELLINGTON	Field	(S)
SEC		32	Section	(I)
TOWN		31 S N	Township (e.g. 42S)	(S)
RANG		1 E W	Range (e.g. 25E)	(S)
LOC		T31S R1W, Sec. 32	Location (Sec Town Range)	(S)
LOC1		NE SW NE NE	Location 1 (quarter calls)	(S)
LOC2		955 South, 877 West, from NE corner	Location 2 (footages)	(S)
COUN		SUMNER	County	(S)
STAT		Kansas	State	(S)
CTRY		US	Country	(S)
PROV			Province	(S)
SRVC		Halliburton	Service Company	(S)
LIC			License Number	(S)
DATE		08/21/2013	Completion Date	(YYY)
API		15-191-22591	API-Number	(S)
UNI			Unique Well ID Number	(S)
LATI	DEG	37.3153	Latitude	(F)
LONG	DEG	-97.4424	Longitude	(F)
GDAT		NAD27	Geodetic Datum	(S)
X		638021.23	X or East-West coordinate	(F)
Y		4130799.98	Y or North South coordinate	(F)
HECS		UTM	Horizontal Co-ordinate System	(S)
UTM		14.0	UTM Location	(F)
STUS		OTHER	Well Status	(S)

Select the “File” Menu, Click on the “Save Data” Button, which will display the “LAS File Data Types” Dialog.

The Tabs at the top identifies the data that will be saved to the Log ASCII Standard (LAS) version 3.0 File. This example saves the well info, log data, core data, brine data, tops data, profile plot control data, cuttings/core description and core image file locations on the KGS Server. The “LAS File Data Types” Dialog allows the user to modify the well header data that is being saved to the LAS version 3.0 file. Also noted in the two images below are identified “required” fields for a valid LAS file. The GEMINI Tools Web Apps doesn’t care that the LAS file is not valid, just that the data follows the basic rules for the well data sections in the LAS 3.0 file.

LAS File Data Types

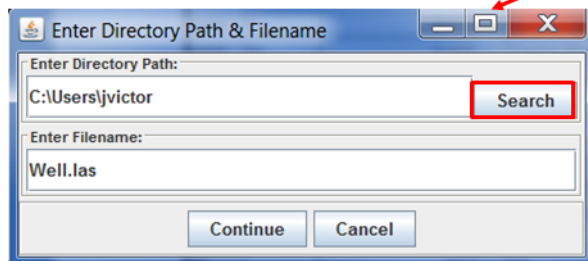
File

~WELL ~Log ~Tops ~Perforation ~IQ_Control ~IQ_Flow ~IQ_Pfeffer

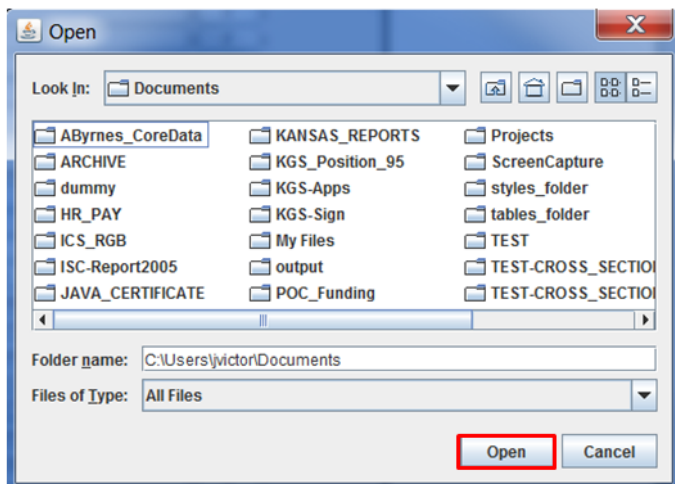
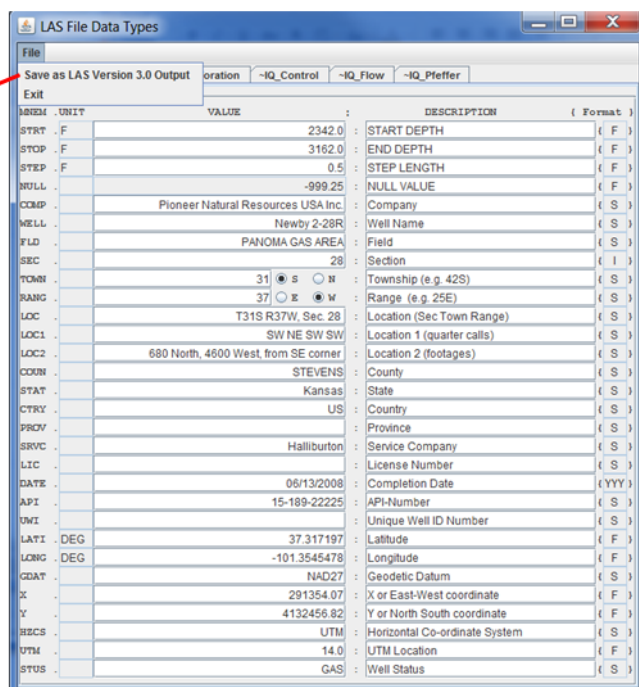
MNEM	UNIT	VALUE	DESCRIPTION	{ Format }
STRT	F	Required 2342.0	START DEPTH	{ F }
STOP	F	Required 3162.0	END DEPTH	{ F }
STEP	F	Required 0.5	STEP LENGTH	{ F }
NULL		Required -999.25	NULL VALUE	{ F }
COMP		Pioneer Natural Resources USA Inc.	Company	{ S }
WELL		Newby 2-28R	Well Name	{ S }
FLD		PANOMA GAS AREA	Field	{ S }
SEC		28	Section	{ I }
TOWN		31 <input checked="" type="radio"/> S <input type="radio"/> N	Township (e.g. 42S)	{ S }
RANG		37 <input type="radio"/> E <input checked="" type="radio"/> W	Range (e.g. 25E)	{ S }
LOC		T31S R37W, Sec. 28	Location (Sec Town Range)	{ S }
LOC1		SW NE SW SW	Location 1 (quarter calls)	{ S }
LOC2		680 North, 4600 West, from SE corner	Location 2 (footages)	{ S }
COUN		STEVENS	County	{ S }
STAT		Required for US Kansas	State	{ S }
CTRY		Required for US US	Country	{ S }
PROV		Required for CANADA	Province	{ S }
SRVC		Halliburton	Service Company	{ S }
LIC			License Number	{ S }
DATE		06/13/2008	Completion Date	{ YYYY }
API		Required for US 15-189-22225	API-Number	{ S }
UWI		Required for CANADA	Unique Well ID Number	{ S }
LATI	DEG	Lat/Long Required 37.317197	Latitude	{ F }
LONG	DEG	-101.3545178	Longitude	{ F }
GDAT		NAD27	Geodetic Datum	{ S }
X		or X/Y Required 291354.07	X or East-West coordinate	{ F }
Y		4132456.82	Y or North South coordinate	{ F }
HZCS		UTM	Horizontal Co-ordinate System	{ S }
UTM		14.0	UTM Location	{ F }
STUS		GAS	Well Status	{ S }

~Log_Parameters~						
MNEM		UNIT	VALUE	:	DESCRIPTION	{ Format } | Association
PDAT		Required	GL	:	Permanent Data	{ S }
APD	F	Required	15.0	:	Above Permanent Data	{ F }
DREF		Required	KB	:	Depth Reference (KB,DF,CB)	{ S }
EREF	F	Required	3119.0	:	Elevation of Depth Reference	{ F }
RUN		Required	1	:	Run Number	{ F }
TDL	F		3155.0	:	Total Depth Logger	{ F }
TDD	F		3150.0	:	Total Depth Driller	{ F }
CSGL	F		640.0	:	Casing Bottom Logger	{ F }
CSGD	F		639.0	:	Casing Bottom Driller	{ F }
CSGS	IN		8.625	:	Casing Size	{ F }
CSGW	LB			:	Casing Weight	{ F }
BS	IN		7.875	:	Bit Size	{ F }
MUD		Chemical		:	Mud type	{ S }
MUDS		Flowline		:	Mud Source	{ S }
MUDD	GM/CC		8.9	:	Mud Density	{ F }
MUDV	CC		40.0	:	Mud Viscosity (Funnel)	{ F }
FL	LB/S		6.4	:	Fluid Loss	{ F }
PH			11.0	:	PH	{ F }
RM	OHM-M		0.75	:	Resistivity of Mud	{ F }
RMT	DEG-F		71.0	:	Temperature of Mud	{ F }
RMF	OHM-M		0.66	:	Resistivity of Mud Filtrate	{ F }
RMFT	DEG-F		74.0	:	Temperature of Mud Filtrate	{ F }
RMC	OHM-M		1.1	:	Resistivity of Mud Cake	{ F }
RMCT	DEG-F		74.0	:	Temperature of Mud Cake	{ F }
TMAX	DEG-F		101.0	:	Maximum Recorded Temp.	{ F }
TIMC	DATE			:	Date/Time Circulation Stopped	{ D/M/YYYY }
TIML	DATE			:	Date/Time Logger Tagged Bottom	{ D/M/YYYY }
UNIT			51781	:	Logging Unit Number	{ F }
BASE		Liberal, KS		:	Home Base of Logging Unit	{ S }
ENG		Montgomery		:	Recording Engineer	{ S }
WIT		Uselton, Ratzlaff		:	Witnessed By	{ S }

Select the “File” Menu, Click on the “Save as LAS Version 3.0 Output” Button, which will display the “Enter Directory Path & Filename” Dialog.

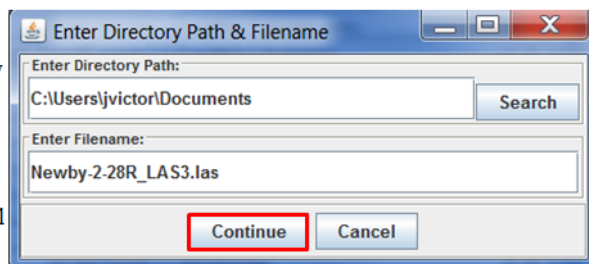


Select the “Search” Button to display the “Open” Dialog to search through the PC for the directory to save the Log ASCII Standard (LAS) version 3.0 File.




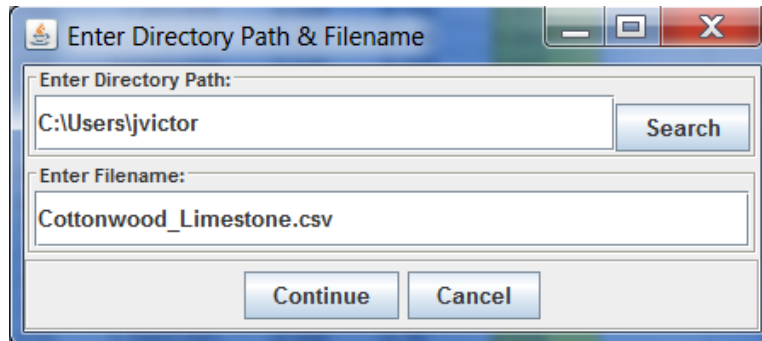
Search the PC for the directory that the LAS version 3.0 File will be saved to. Select “Open” Button to transfer the Directory path to the “Enter Directory Path” text field in the “Enter Directory Path & Filename” Dialog.

Change the file name in the “Enter Filename” field, e.g. “Newby-2-28R_LAS3.las”, then select the “Continue” Button to save the Newby 2-28R well data to the LAS version 3.0 file.

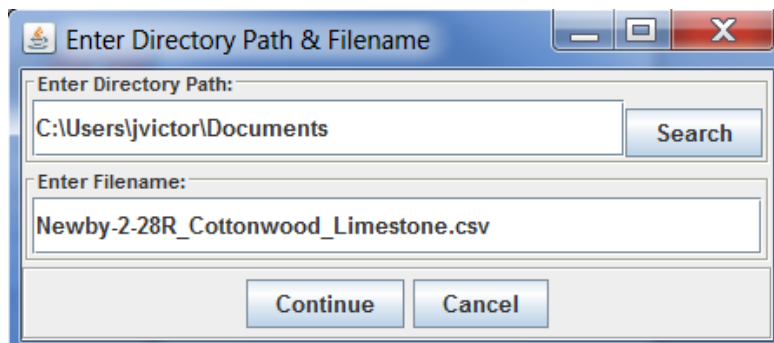


Save Cottonwood Flow Unit as a Comma Separated Values (CSV) File

To save the contents of a flow unit “spreadsheet” as a Comma Separated Values (CSV) File to be imported into Excel or another log analysis program, click on the  icon image button when the flow unit “spreadsheet” you wish to save as a CSV file is displayed, which will display the “Enter Directory Path & Filename” dialog, which the user can search their PC for the directory they wish to save the CSV file in.



Notice that the name of the flow unit appears in the “Enter Filename” text field with a “.csv” appended to it. You can change the Filename to anything you wish, e.g. Cottonwood_Limestone.csv will be altered to be Newby-2-28R-Cottonwood_Limestone.csv



Click on the “Continue” Button to save the contents of the flow unit “spreadsheet” as a CSV File. The following URL address will display the CSV file,

LAS 3.0 Example File: http://www.kgs.ku.edu/Gemini/Tools/documentation/Newby-2-28R_Cottonwood_Limestone.csv

LAS 3.0 in WinZip File: http://www.kgs.ku.edu/Gemini/Tools/documentation/Newby-2-28R_Cottonwood_Limestone.zip

The contents of the above csv file can be imported directly into Excel as illustrated below,

Newby-2-28R-Cottonwood_Limestone - Microsoft Excel																					
Well Name=Newby 2-28R																					
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T		
1	Well Name=Newby 2-28R																				
2	API-Number=15-189-22225																				
3	TRS=315-37W-28																				
4																					
5	Description	Parameter	Depth	Thickness	Rt	PHIt	Rwa	Ro	Ma	Sw	Bvw	Vsh	Pay	1st PHI	2nd PHI	Rtc	PHIr	Rxo	Sxo	BVF	
6	Flow Unit= Cottonwo		2985.5	0.5	3.269	0.21	0.628	0.624	2.26	0.437	0.091	0.507	0.059	0.306	0	3.269	1.002	2.855	0.955	0.2	
7	Start Depth		2985.5	2986	0.5	3.727	0.15	0.478	0.935	1.928	0.5	0.075	0.385	0.037	0.282	0	3.727	0.715	3.672	1.031	0.154
8	End Depth	3007	2986.5	0.5	4.364	0.1	0.344	1.521	1.657	0.59	0.059	0.271	0.02	0.242	0	4.364	0.475	5.912	1.036	0.103	
9	Water Mo Archie		2987	0.5	5.253	0.079	0.312	2.018	1.576	0.619	0.048	0.187	0.015	0.186	0	5.253	0.393	9.968	0.919	0.072	
10	Archie Cor		2987.5	0.5	6.271	0.071	0.327	2.294	1.58	0.604	0.042	0.165	0.014	0.111	0	6.271	0.378	14.254	0.819	0.058	
11	A=	0.8	2988	0.5	7.357	0.07	0.378	2.334	1.631	0.563	0.039	0.175	0.015	0.074	0	7.357	0.402	13.917	0.836	0.058	
12	M=	1.2	2988.5	0.5	8.263	0.063	0.374	2.648	1.611	0.566	0.035	0.192	0.013	0.073	0	8.263	0.375	11.396	0.985	0.062	
13	N=	2	2989	0.5	8.809	0.055	0.339	3.117	1.558	0.594	0.032	0.198	0	0.084	0	8.809	0.329	10.877	1.094	0.06	
14	Rw=	0.12	2989.5	0.5	9.056	0.048	0.296	3.67	1.497	0.636	0.03	0.197	0	0.093	0	9.056	0.283	11.738	1.142	0.054	
15	Rsh=	0	2990	0.5	9.061	0.042	0.252	4.308	1.434	0.689	0.028	0.177	0	0.092	0	9.061	0.241	12.324	1.208	0.05	
16	PHIsh=	0	2990.5	0.5	8.864	0.031	0.171	6.203	1.302	0.836	0.025	0.161	0	0.077	0	8.864	0.166	13.867	1.366	0.042	
17	Cut-Offs:		2991	0.5	8.462	0.026	0.132	7.661	1.227	0.951	0.024	0.146	0	0.061	0	8.462	0.131	17.159	1.365	0.035	
18	PHI=	0.06	2991.5	0.5	7.842	0.033	0.163	5.755	1.29	0.856	0.028	0.142	0	0.059	0	7.842	0.168	23.938	1.001	0.033	
19	Sw=	0.9	2992	0.5	7.018	0.055	0.27	3.117	1.479	0.666	0.036	0.148	0	0.045	0.01	7.018	0.294	33.661	0.621	0.034	
20	Vsh=	1	2992.5	0.5	6.03	0.08	0.363	1.988	1.639	0.574	0.045	0.169	0.017	0.038	0.042	6.03	0.427	28.85	0.536	0.042	
21	Bvw=	0.103	2993	0.5	5.06	0.098	0.389	1.558	1.706	0.555	0.054	0.179	0.021	0.056	0.042	5.06	0.499	20.736	0.56	0.054	
22	Cumulative		2993.5	0.5	4.148	0.108	0.358	1.387	1.692	0.578	0.062	0.188	0.022	0.079	0.028	4.148	0.508	17.148	0.581	0.062	
23	CTHK=	21.5	2994	0.5	3.485	0.124	0.355	1.175	1.72	0.58	0.072	0.194	0.025	0.097	0.026	3.485	0.55	15.742	0.558	0.069	
24	FTOIL=	0.69	2994.5	0.5	3.029	0.146	0.376	0.966	1.793	0.564	0.082	0.183	0.031	0.113	0.032	3.029	0.624	14.497	0.527	0.077	
25	PAYFEET=	12.5	2995	0.5	2.713	0.166	0.393	0.828	1.86	0.552	0.091	0.182	0.037	0.124	0.042	2.713	0.688	11.469	0.548	0.091	
26	AVPHI=	0.13	2995.5	0.5	2.49	0.176	0.387	0.772	1.874	0.556	0.098	0.184	0.038	0.143	0.033	2.49	0.708	8.532	0.614	0.108	
27	AVSW=	0.58	2996	0.5	2.35	0.178	0.37	0.761	1.852	0.569	0.101	0.174	0.038	0.164	0.013	2.35	0.697	6.452	0.701	0.124	
28	Wylie-Rosi		2996.5	0.5	2.282	0.18	0.364	0.751	1.847	0.573	0.103	0.175	0	0.191	0	2.282	0.696	6.168	0.713	0.128	
29	P=	8581	2997	0.5	2.284	0.178	0.359	0.761	1.836	0.577	0.102	0.182	0.037	0.204	0	2.284	0.687	6.309	0.709	0.126	
30	Q=	4.4	2997.5	0.5	2.331	0.168	0.342	0.816	1.788	0.591	0.099	0.18	0.034	0.202	0	2.331	0.647	6.157	0.743	0.124	
31	R=	2	2998	0.5	2.378	0.161	0.332	0.859	1.757	0.601	0.096	0.195	0.032	0.194	0	2.378	0.621	6.114	0.765	0.123	