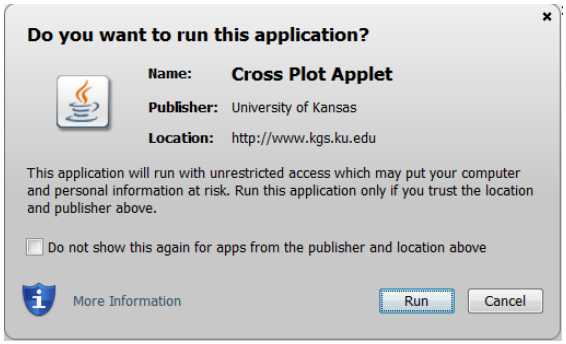
3D Cross Plot Java Applet

by John R. Victorine

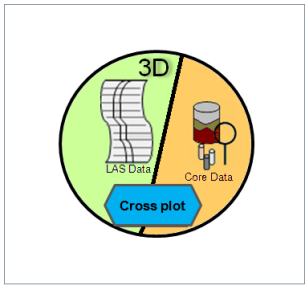
Introduction

The 3D Cross Plot 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, Core, and Geologist Cuttings Report/Core Description/Measured Sections 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 3D Cross Plot go to http://www.kgs.ku.edu/stratigraphic/3DPLOT/. 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 3D Cross Plot Session. 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 3D Cross Plot "Enter" Panel illustrated below,



Enter

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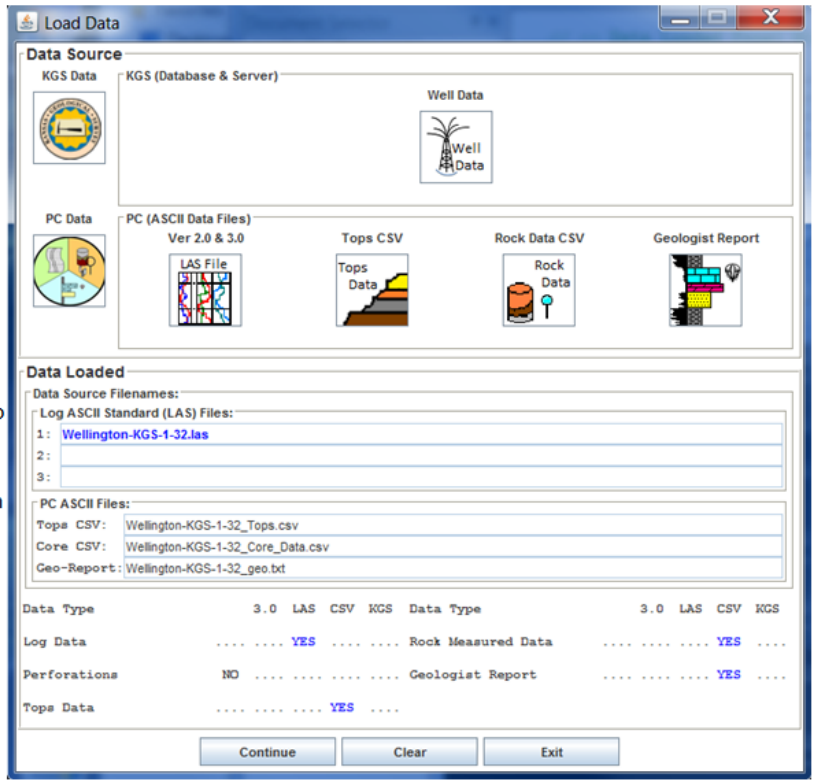
Loading Well Data

Click the "3D Cross Plot Enter" Icon Button, which will show the "Load Data" Dialog. The dialog below displays an example of the Wellington KGS 1-32 well data loaded from the PC Data icon buttons with the data in the tables above. The icon buttons in the Data Source Panel assists the user in loading well data into the 3D Cross Plot 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.



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

Load ASCII Delimited Data Files from PC.

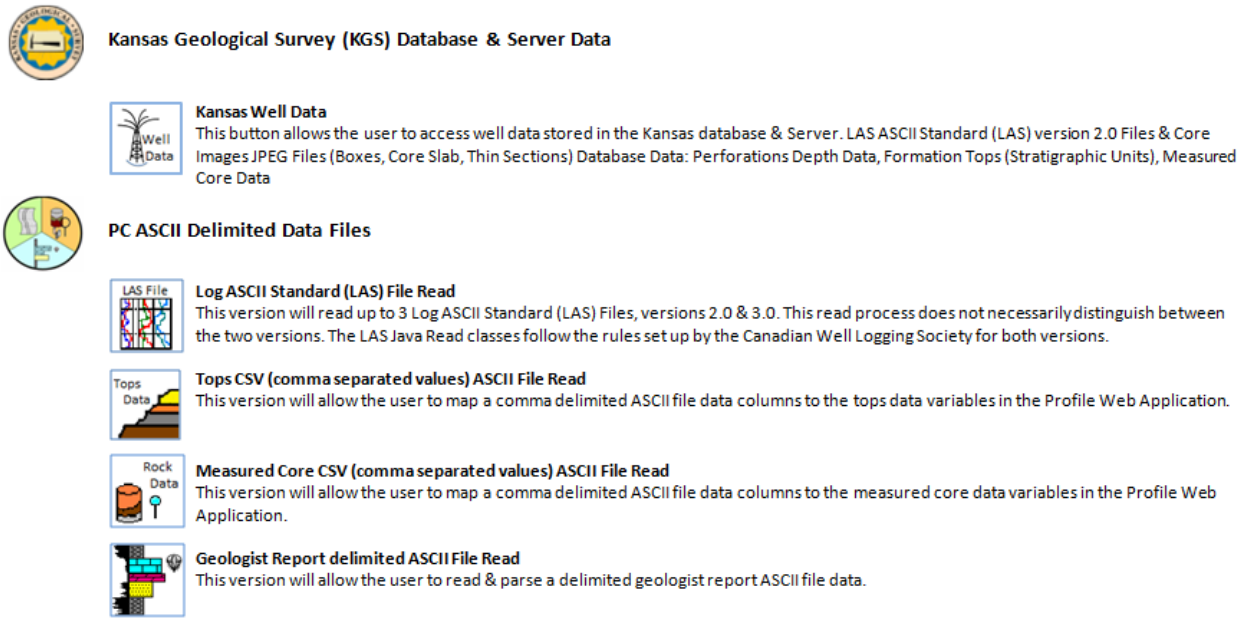
Displays the filename of files loaded.

Show the source of the data and type.

Dialog Buttons:
Continue – Build LAS File Viewer Plot
Clear – Clear loaded data from this dialog.
Exit – Exit Program

Data Source Panel

The Data Source Panel provides two methods of importing data into the 3D Cross Plot 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.



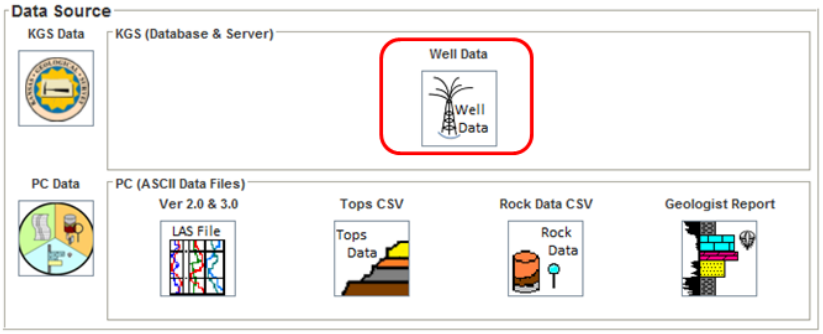
Data Loaded Panel

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, and Core 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.

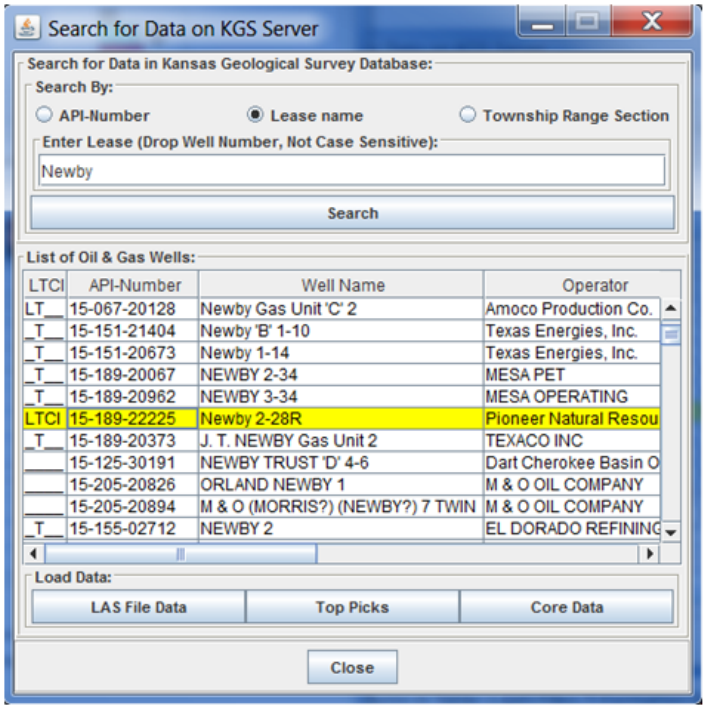
Importing KGS (Database & Server) Data

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. 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, and Perforation Data. 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

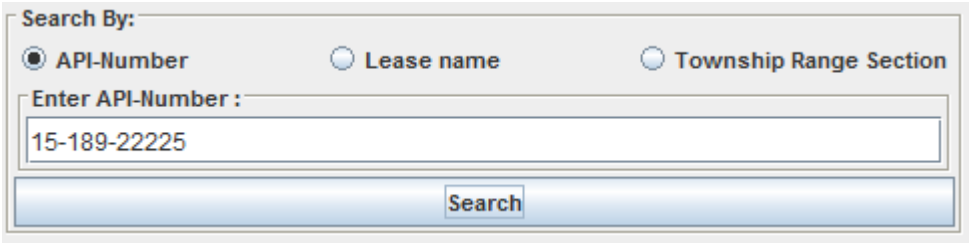
- LAS File Data – Load Log ASCII Standard (LAS) Files
- Tops Picks – Load Formation Tops Picks
- Core Data – Load Measured Core Data

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

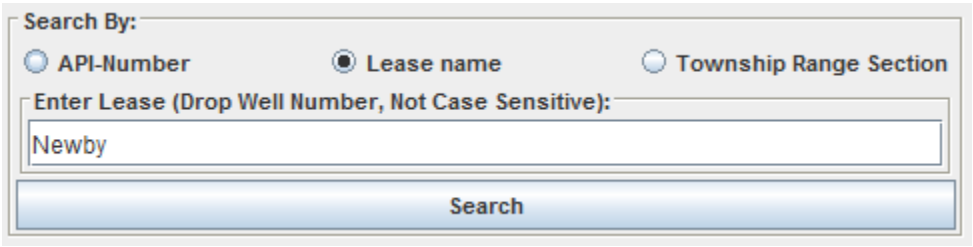
This will display the "Search for Data on KGS Server" Dialog, see above image. This dialog allows the user to search the KGS database for well data. In this example, the well of interest will be the Newby 2-28R, this well contains all the well data that can be retrieved from the KGS Database, i.e. Log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

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

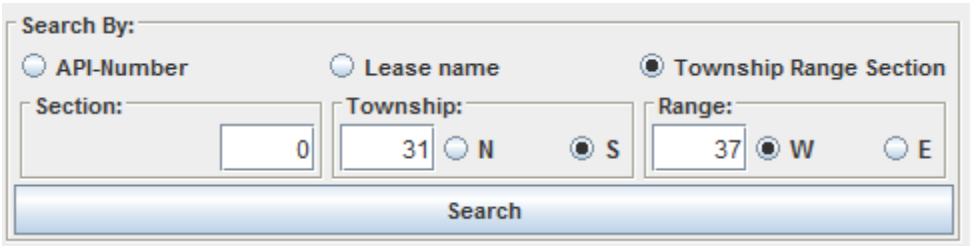
- By API-Number – KGS has a specific format for the API-Number, i.e.SS-CCC-99999 where SS is the state code for Kansas 15, CCC is the county code for Newby 2-28R it is 189 for Stevens County and the 5-Digit Well Number for Newby 2-28R it is 22225.



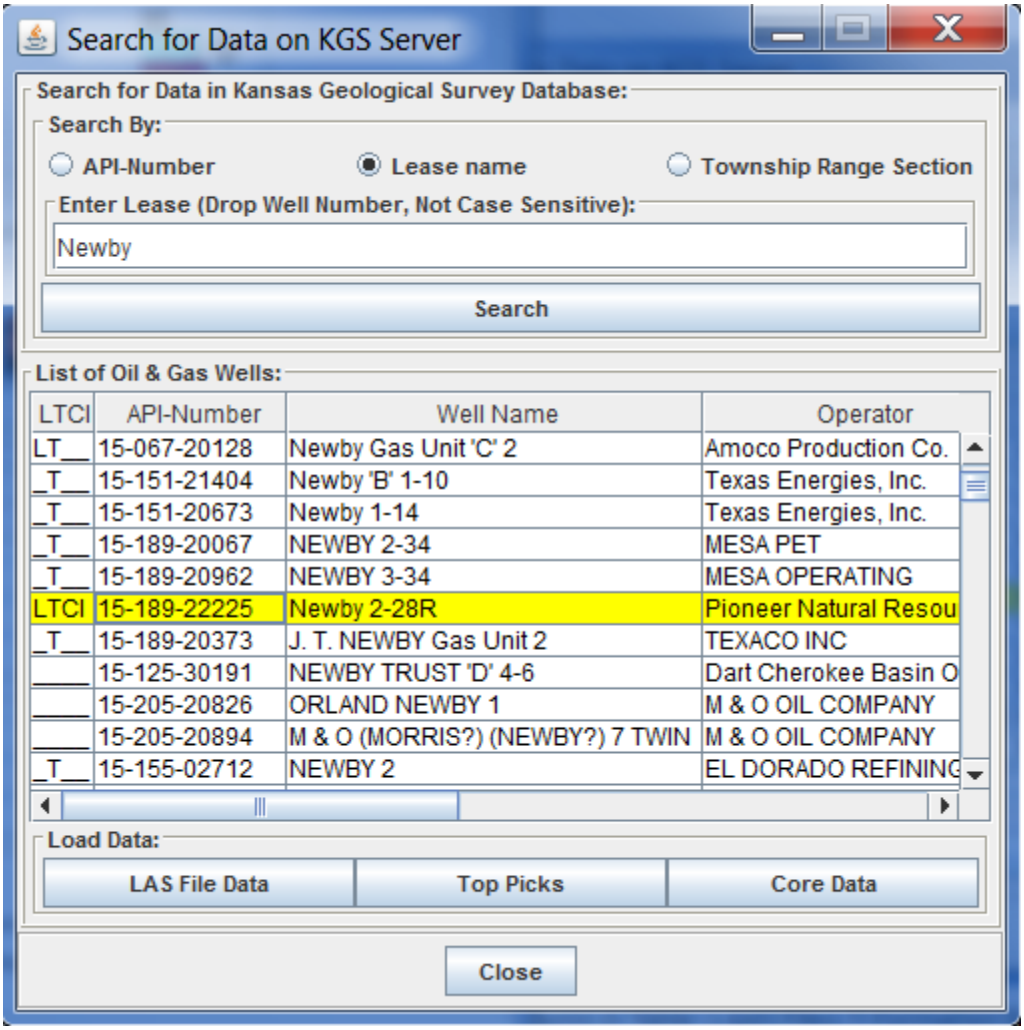
- By Partial Lease Name – The stored procedure used to retrieve the well header information allows the user to enter a partial phrase, in this example Newby. The program places a '%' in front and back of the phrase and sends the request to the Database, i.e. "%Newby%".



- 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.



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.



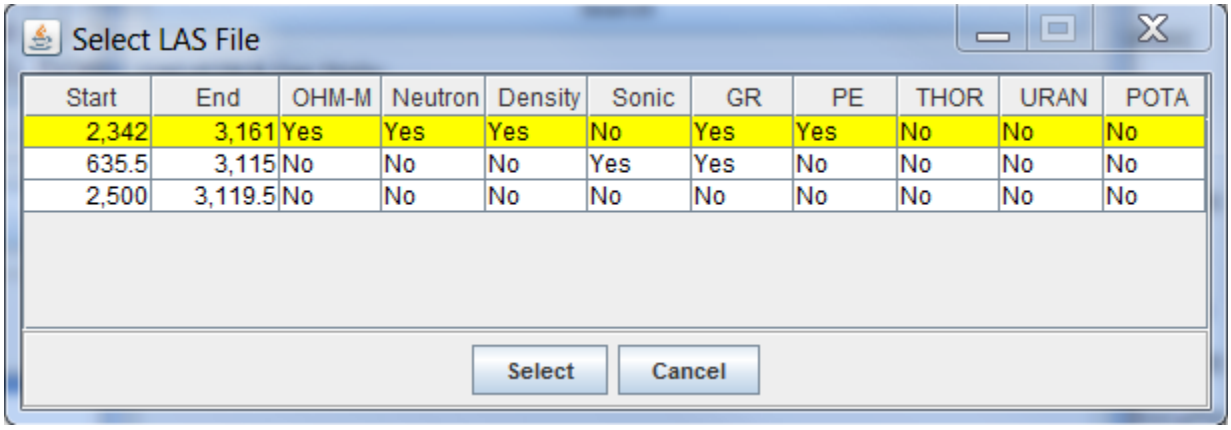
Notice that the LTCI represents the type of data that the well contains. It is a visual aid that lets the user see what is available before trying to download the data. If you require a LAS file you would want to see an L in that column. The LTCI labels stand for the following,

- 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

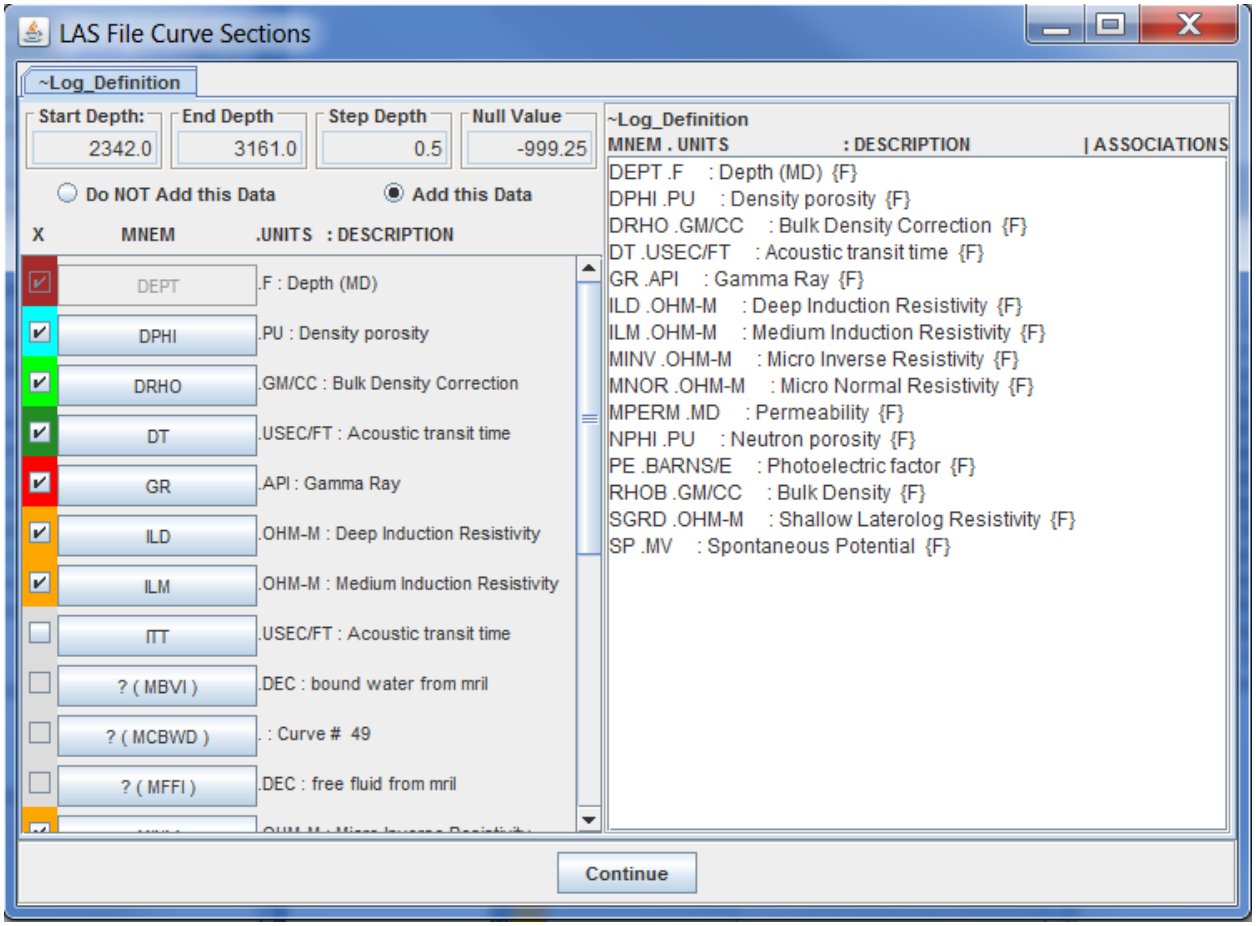
The "Search for Data on KGS Server" Dialog allows the user to download data from the KGS Database & Server to the web app. The "LAS File Data" Button will display the "Select LAS File" Dialog with a list of LAS version 2.0 Files that are available.



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 3D Cross 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,

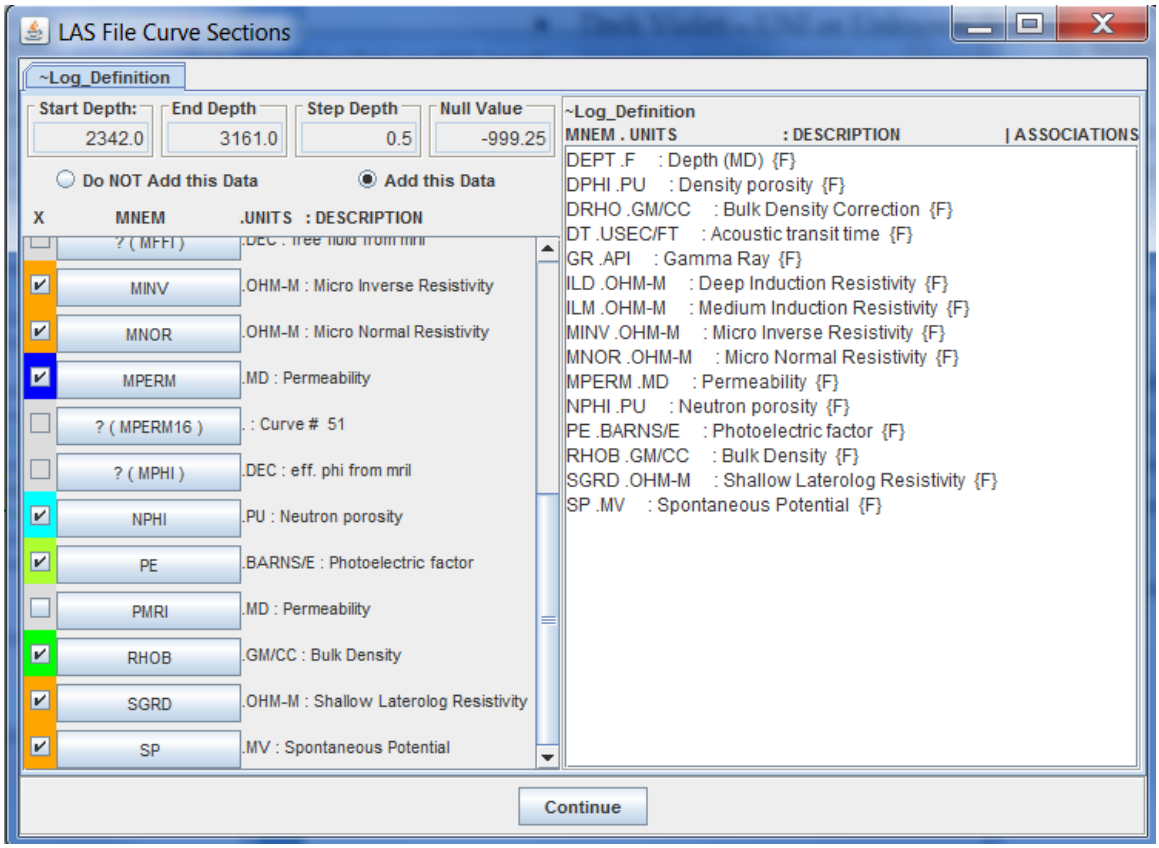
- Orange - OHM-M or Resistivity Logs
- Cyan – PU or porosity Logs, Neutron Porosity, Density Porosity, etc.
- Greenish yellow – BARNS/E or Photoelectric Factor Logs
- Green – GM/CC or Bulk Density Log
- Forest Green – USEC/FT or the Acoustic Transit Time Log
- Red – API, PPM or "%" as Radioactive logs,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

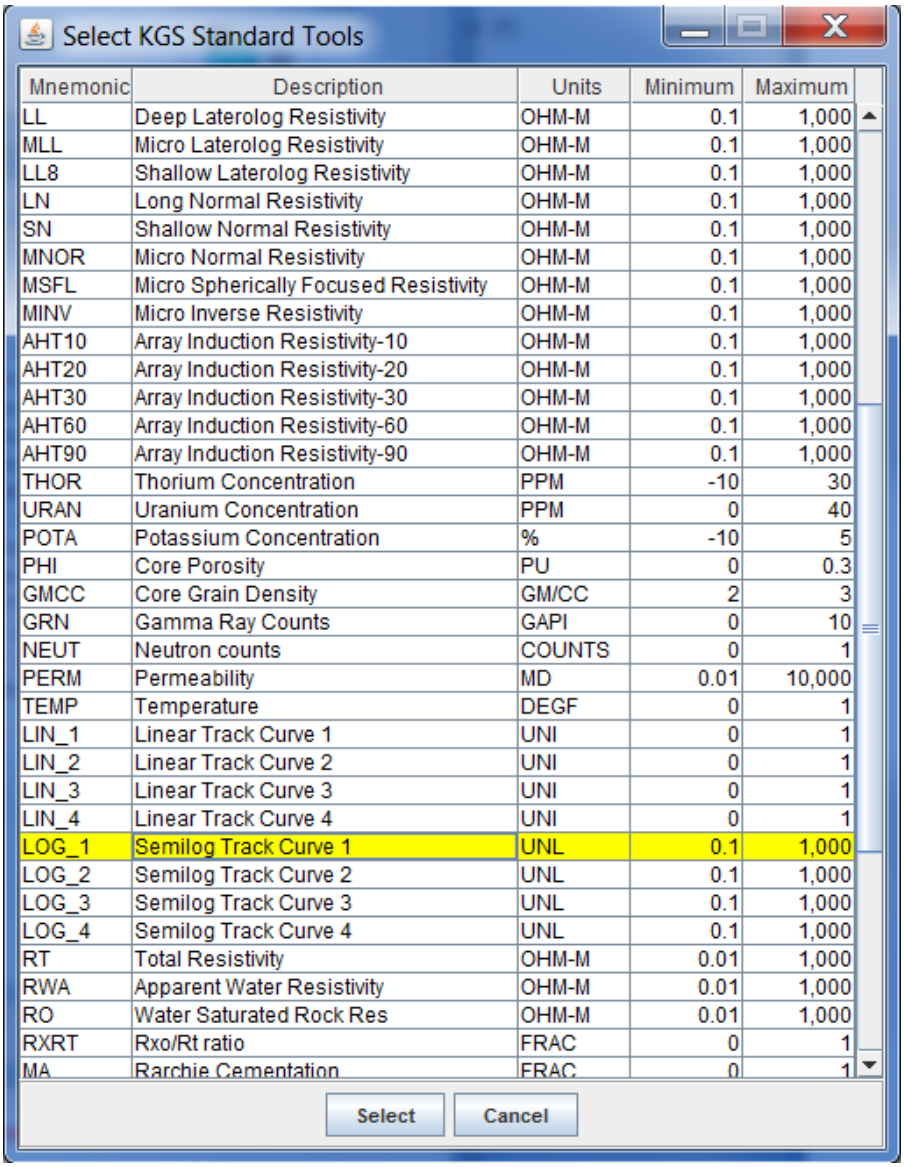
Some logs will have curve mnemonics that are not recognized as one of the KGS "Standard" Curve Mnemonics. The user will need to map the log curve to one of the KGS standard curves if they want to display the curve. Slide the scroll bar down to the Permeability Curves MPERM and ?(MPERM16).



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 3D Cross Plot program is a later version of code from the GEMINI Project 3D Cross Plot 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

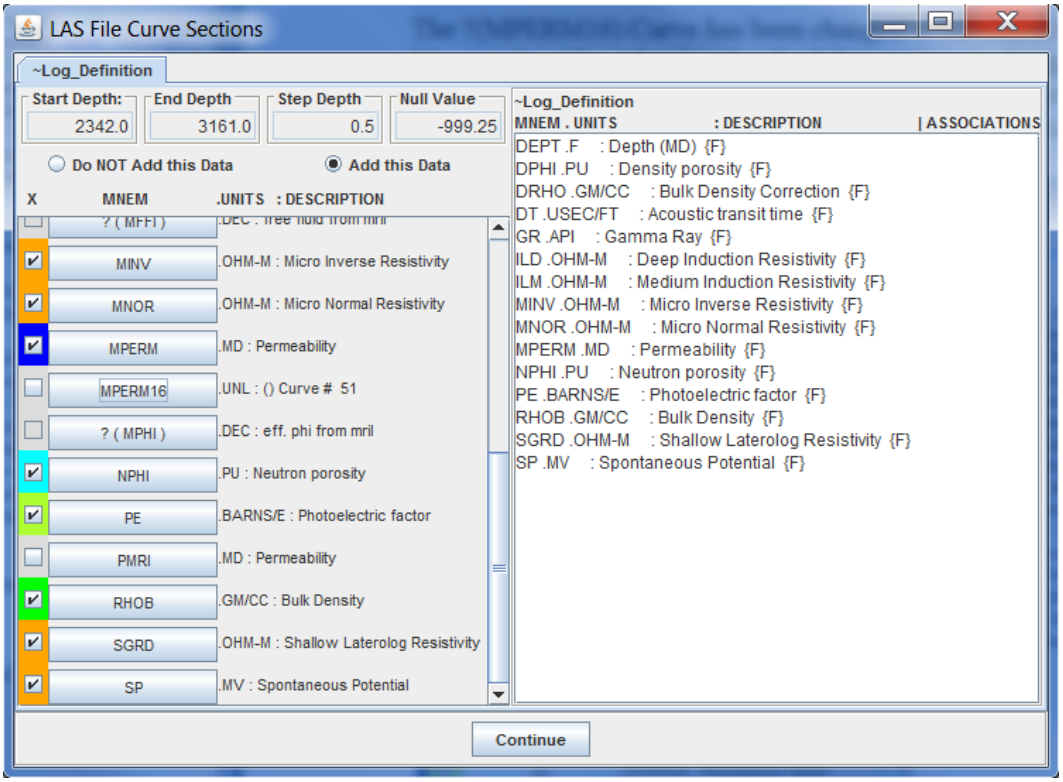
Mnemonics" XML File was created to map the log curves from logs that were part of the KGS LAS File Collection which is not a complete list of possible curve mnemonics.

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 logrithum curves and 4 unknown linear curves. The permeability is usually plotted as logrithmic. Click on the "?(MPERM16)" Button to display the

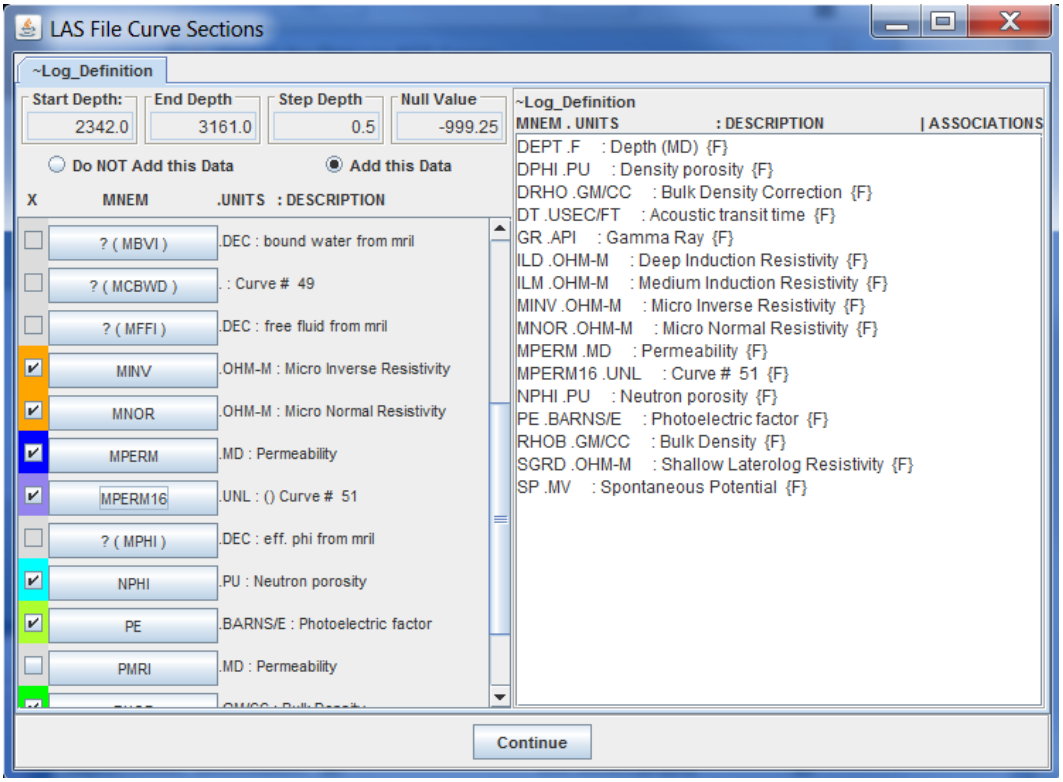


Mnemonic	Description	Units	Minimum	Maximum
LL	Deep Laterolog Resistivity	OHM-M	0.1	1,000
MLL	Micro Laterolog Resistivity	OHM-M	0.1	1,000
LL8	Shallow Laterolog Resistivity	OHM-M	0.1	1,000
LN	Long Normal Resistivity	OHM-M	0.1	1,000
SN	Shallow Normal Resistivity	OHM-M	0.1	1,000
MNOR	Micro Normal Resistivity	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
RO	Water Saturated Rock Res	OHM-M	0.01	1,000
RXRT	Rxo/Rt ratio	FRAC	0	1
MA	Archie Cementation	FRAC	0	1

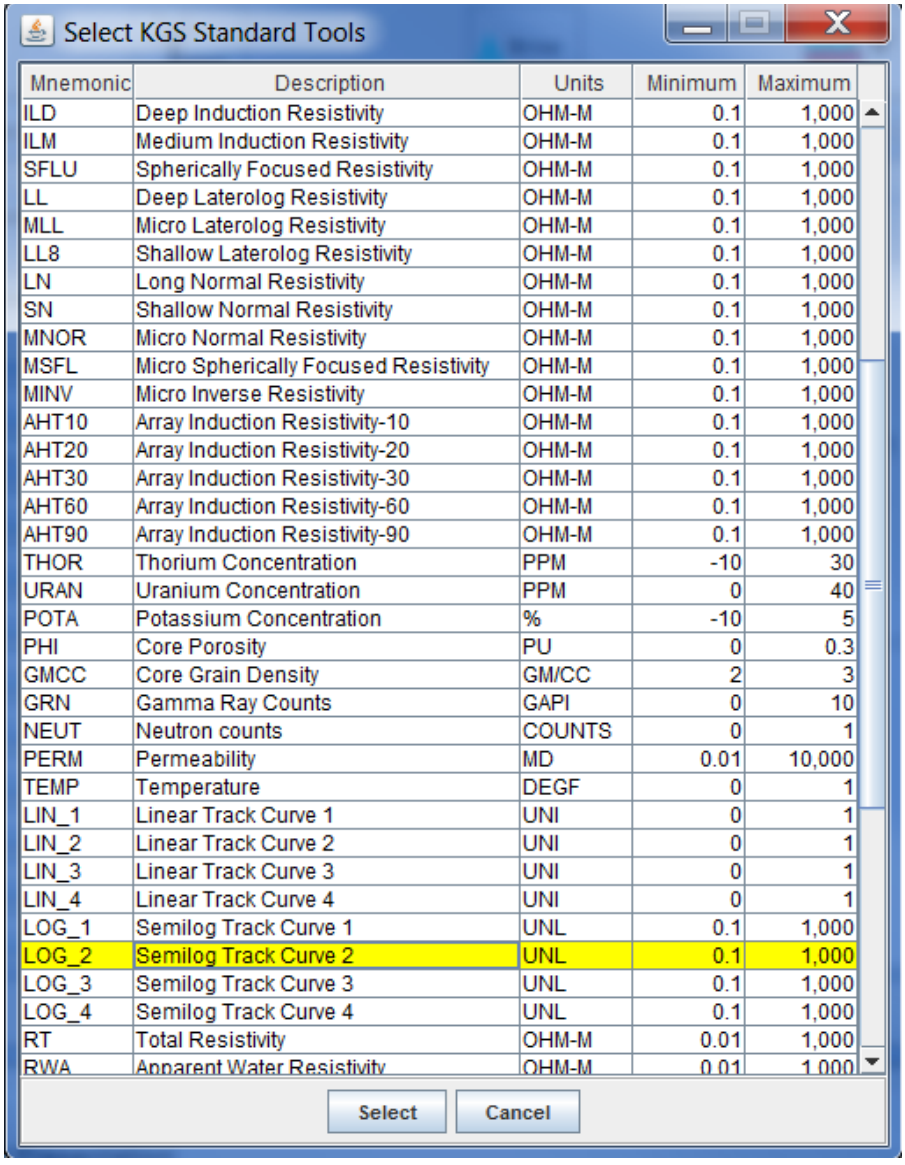
"Select KGS Standard Tools" Dialog. Slide the scroll bar down to the "LOG_1" Mnemonic – Semilog Track Curve 1 and highlight that curve. Click on the "Select" Button to map the "?(MPERM16) to the Semilog Track Curve 1.



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.

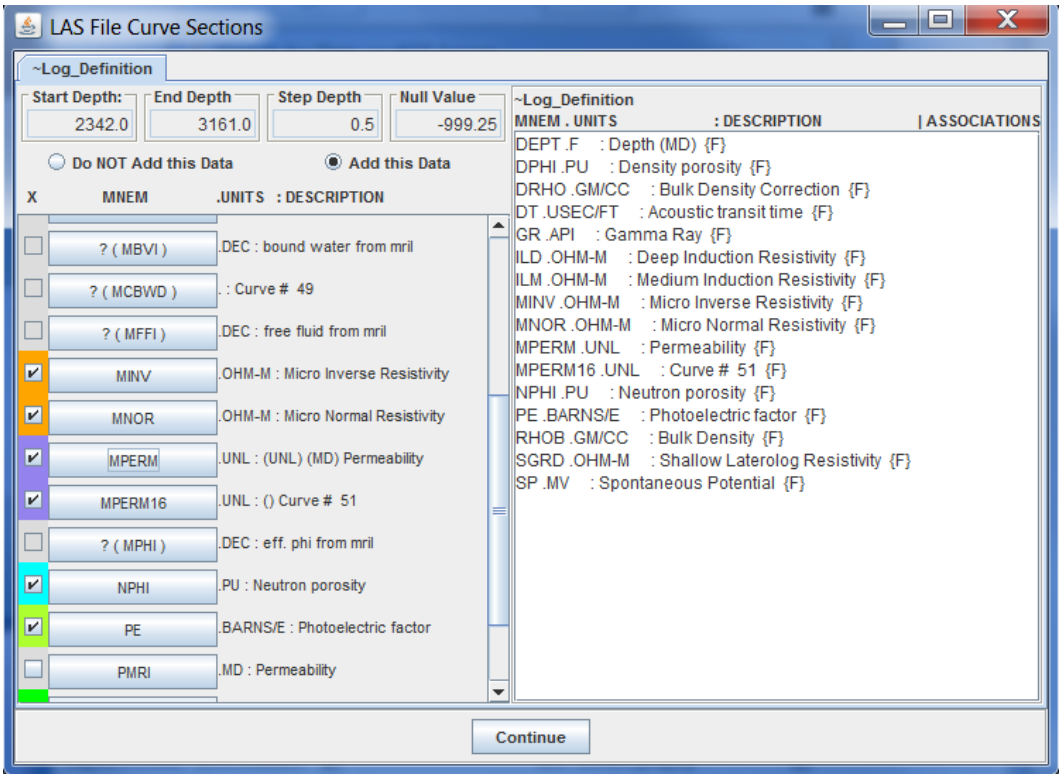


In order to plot both Permeability Curves on the same track, the MPERM must be assigned to the unknown Log Curves with MPERM16. Click on the MPERM Mnemonic Button to display the



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

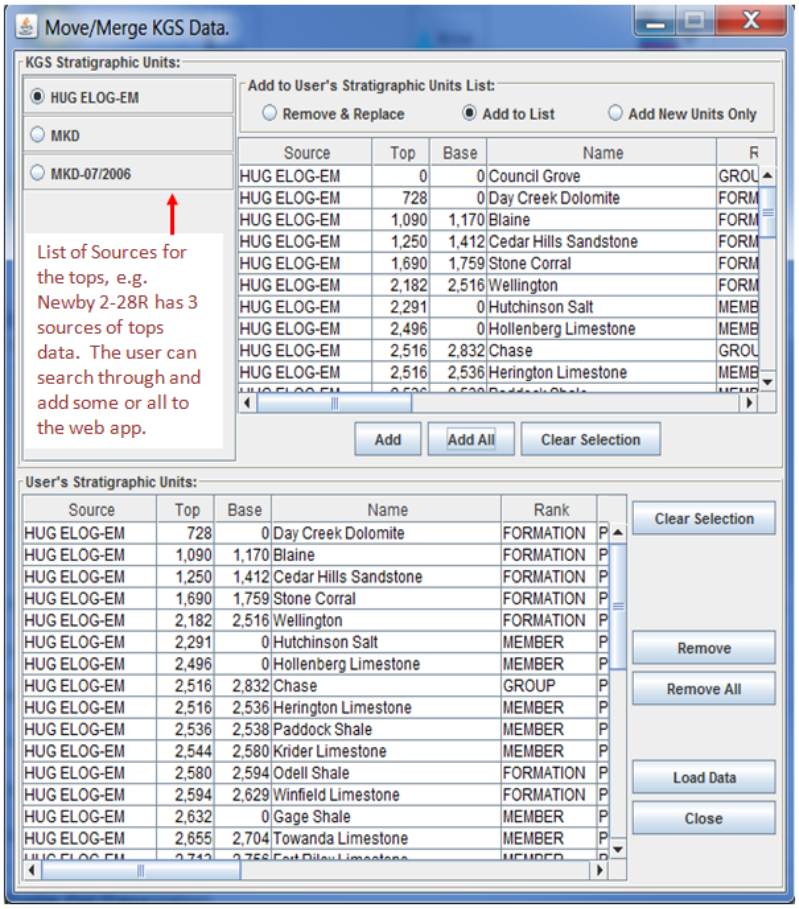
"Select KGS Standard Tools" Dialog. Slide the scroll bar down to the "LOG_2" Mnemonic – Semilog Track Curve 2 and highlight that curve. Click on the "Select" Button to map the "MPERM to the Semilog Track Curve 2.



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.



"**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

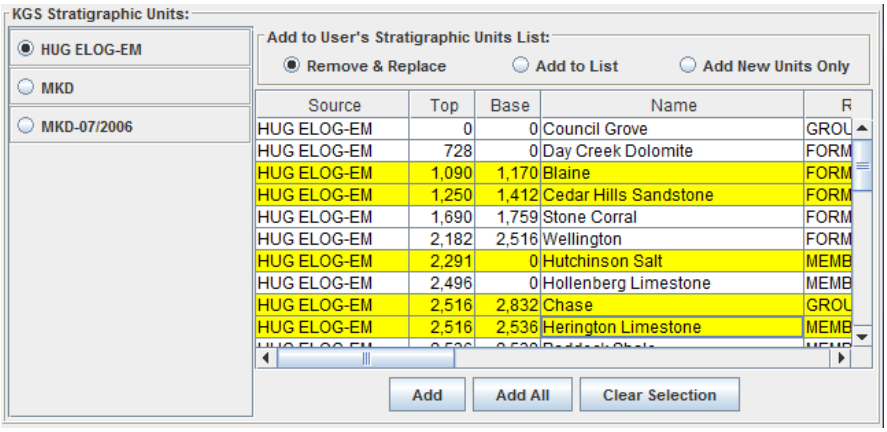
Add – add the highlighted top(s) to the "User's Stratigraphic Units" Table. Note: this table will allow the user to select multiple wells by using the "Ctrl" Key and the left click of mouse.
Add All – copy the list of tops to the "User's Stratigraphic Units" Table.
Clear Selection – remove the highlight 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

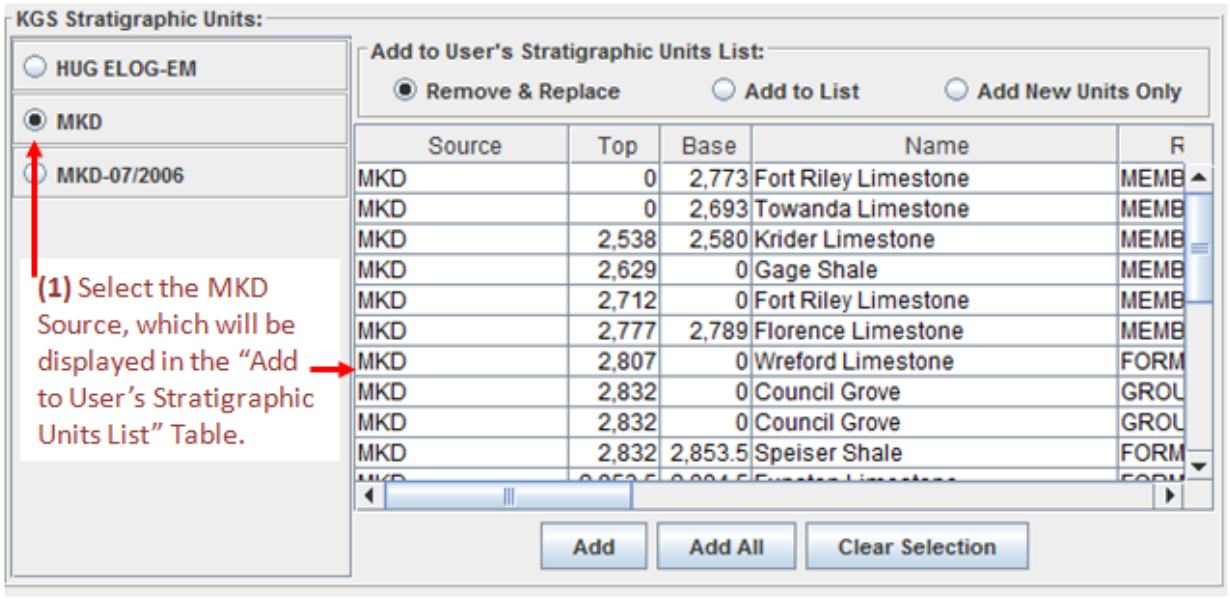
Clear Selection – remove the highlight on tops selected.
Remove – remove the highlighted top(s) from the table. Note: this table will allow the user to select multiple wells by using the "Ctrl" Key and the left click of mouse.
Remove All – remove all tops from the table.
Load Data – transfer the tops list to the web app calling.
Close – Close this dialog

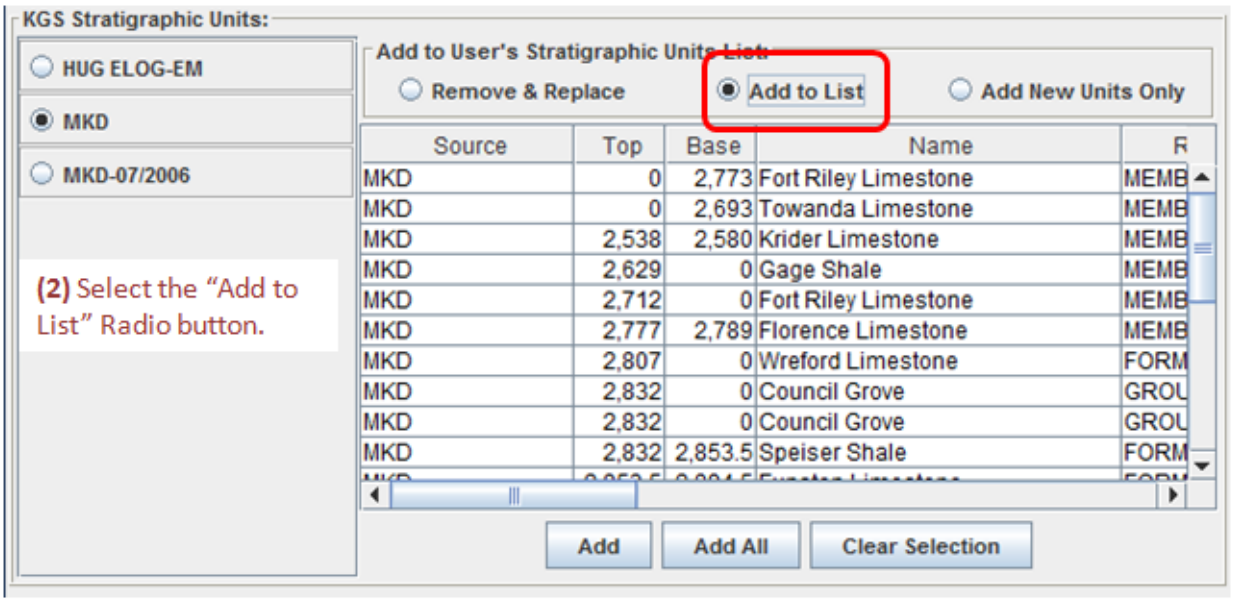
This dialog allows the user to add all or some the tops from each of the sources. Both tables are set up so the user can use the "Ctrl" Key with the left click of mouse to select multiple tops, i.e.

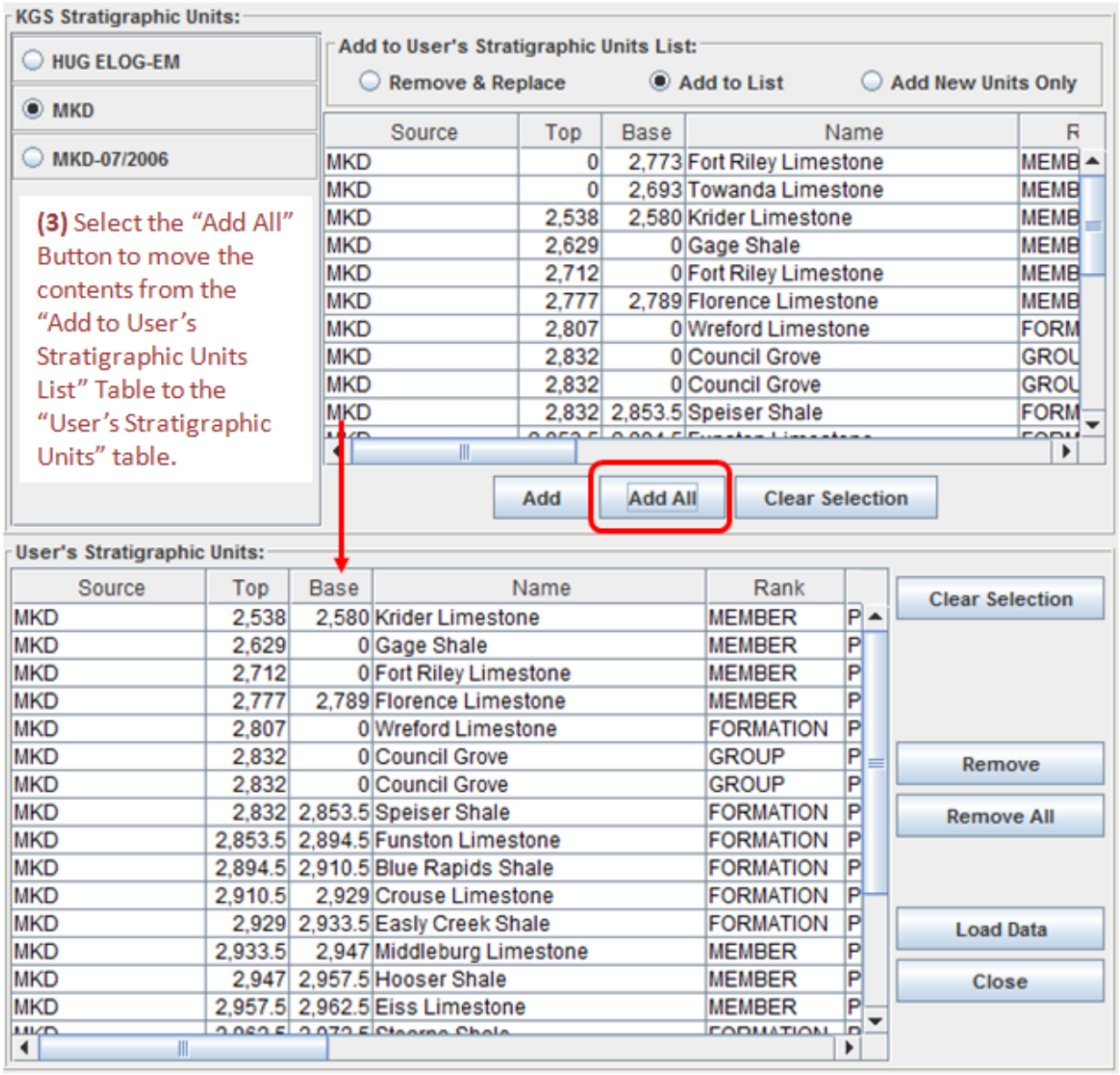


Notice that the only some of the tops are selected. You can then select the Add Button to move only the selected tops to the "User's Stratigraphic Units" Table.

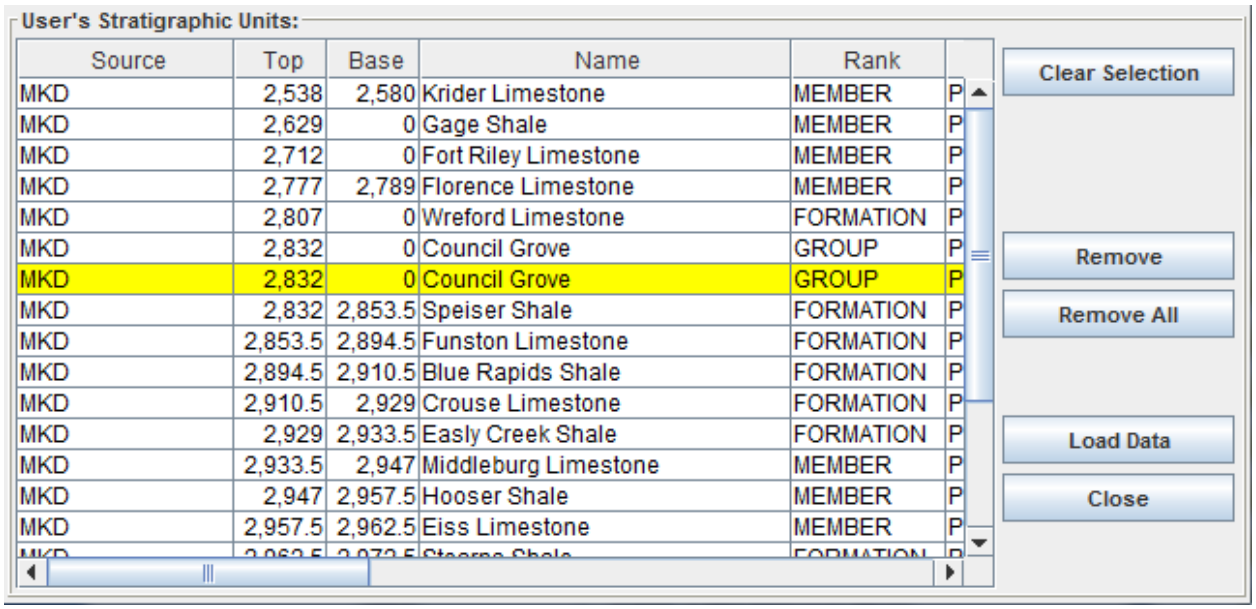
MKD Source Example:



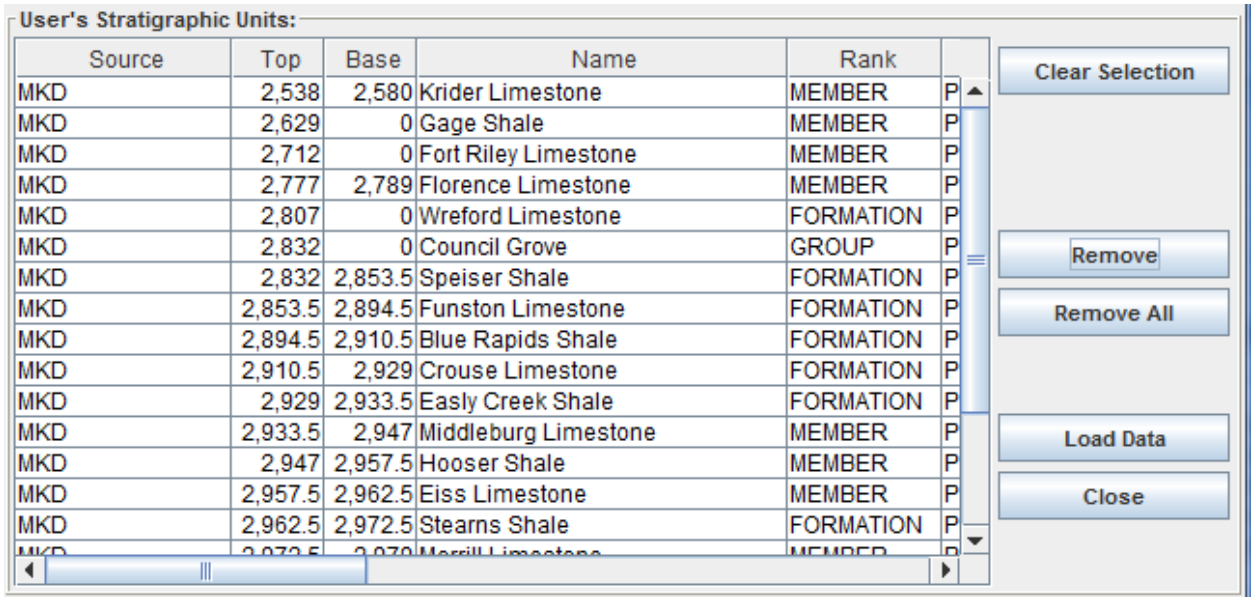




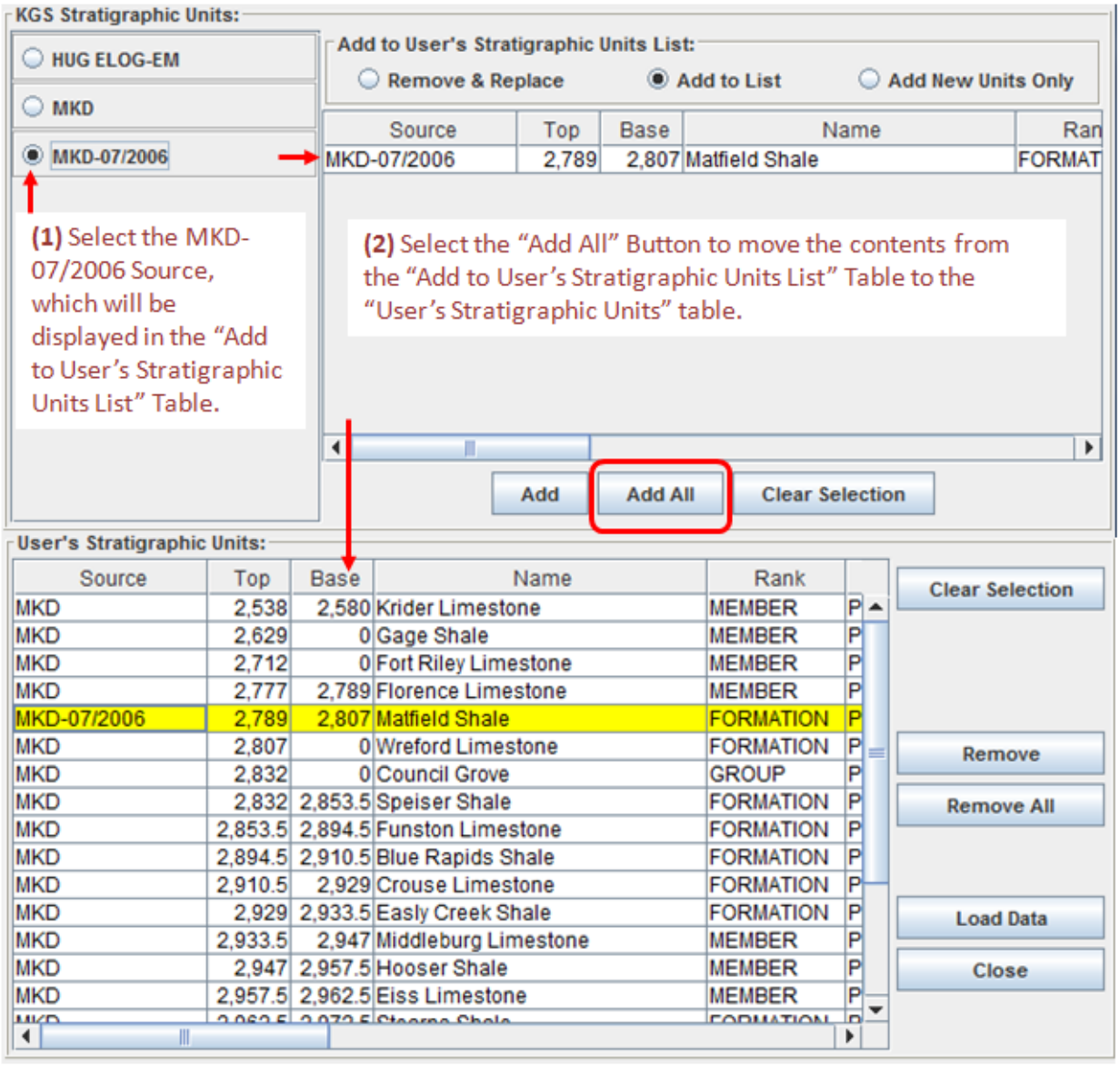
Once the list of tops are in the "User's Stratigraphic Units" Table the user can edit the list by removing any duplicate or invalid tops. Notice that the "Council Grove" Top occurs 2 times in the list. Highlight the one of the "Council Grove" tops.



Now select the “Remove” Button.



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.

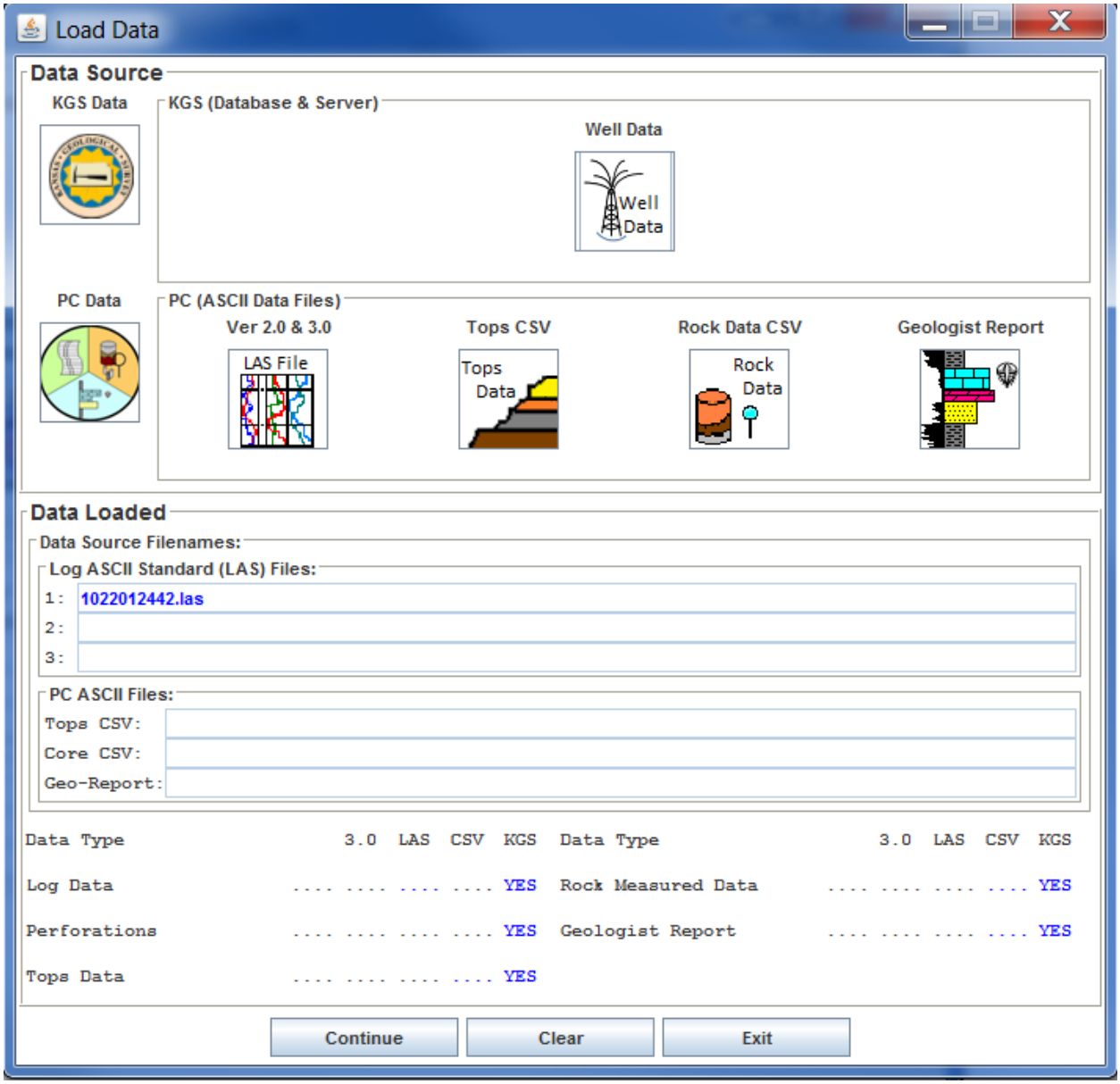


Now with the data set complete select the "Load Data" Button to import the Tops data into the web app.

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 3D Cross Plot 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, and the Geologist Report Data Type have been downloaded from KGS.



Select the “Continue” Button to open the 3D Cross Plot Dash board.

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.

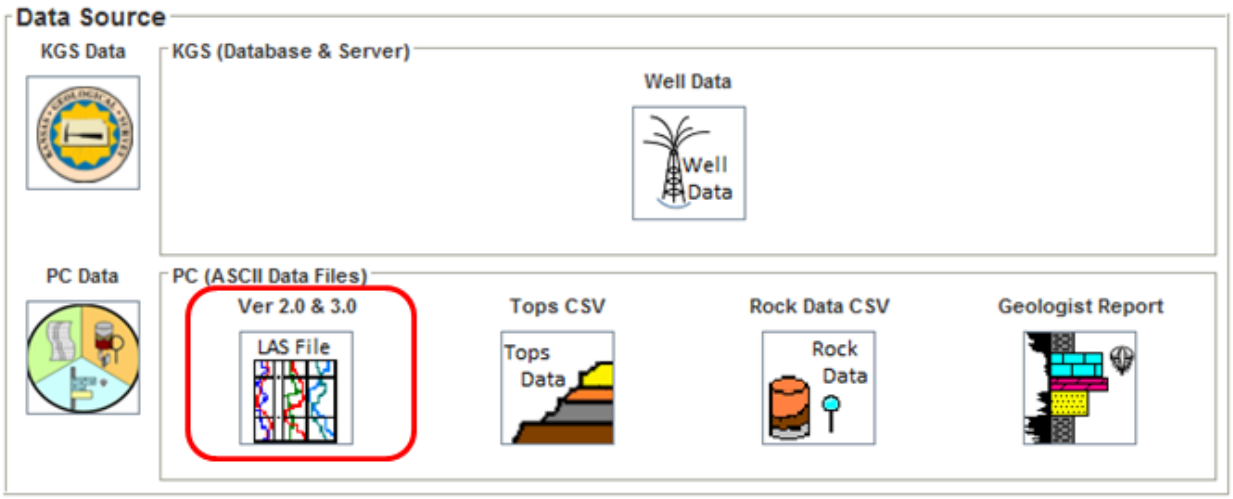
Well Data: Wellington KGS 1-32, Sumner County, Kansas

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
Report	http://www.kgs.ku.edu/Gemini/Tools/documentation/Wellington-KGS-1-32_geo.txt

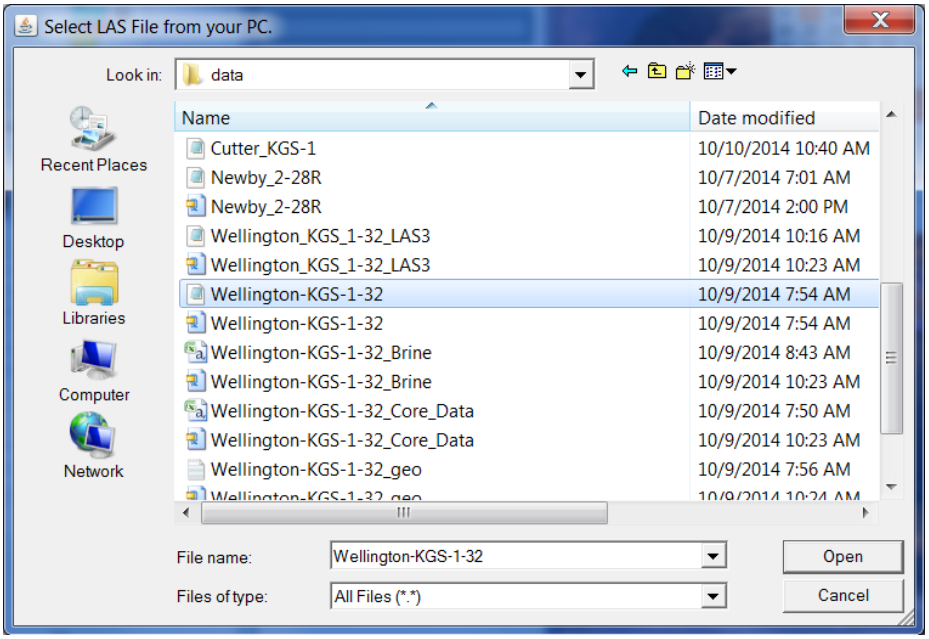
Type	Zip Files
LAS 2.0	http://www.kgs.ku.edu/Gemini/Tools/documentation/Wellington-KGS-1-32.zip
Tops	http://www.kgs.ku.edu/Gemini/Tools/documentation/Wellington-KGS-1-32_Tops.zip
Core	http://www.kgs.ku.edu/Gemini/Tools/documentation/Wellington-KGS-1-32_Core_Data.zip
Report	http://www.kgs.ku.edu/Gemini/Tools/documentation/Wellington-KGS-1-32_geo.zip

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

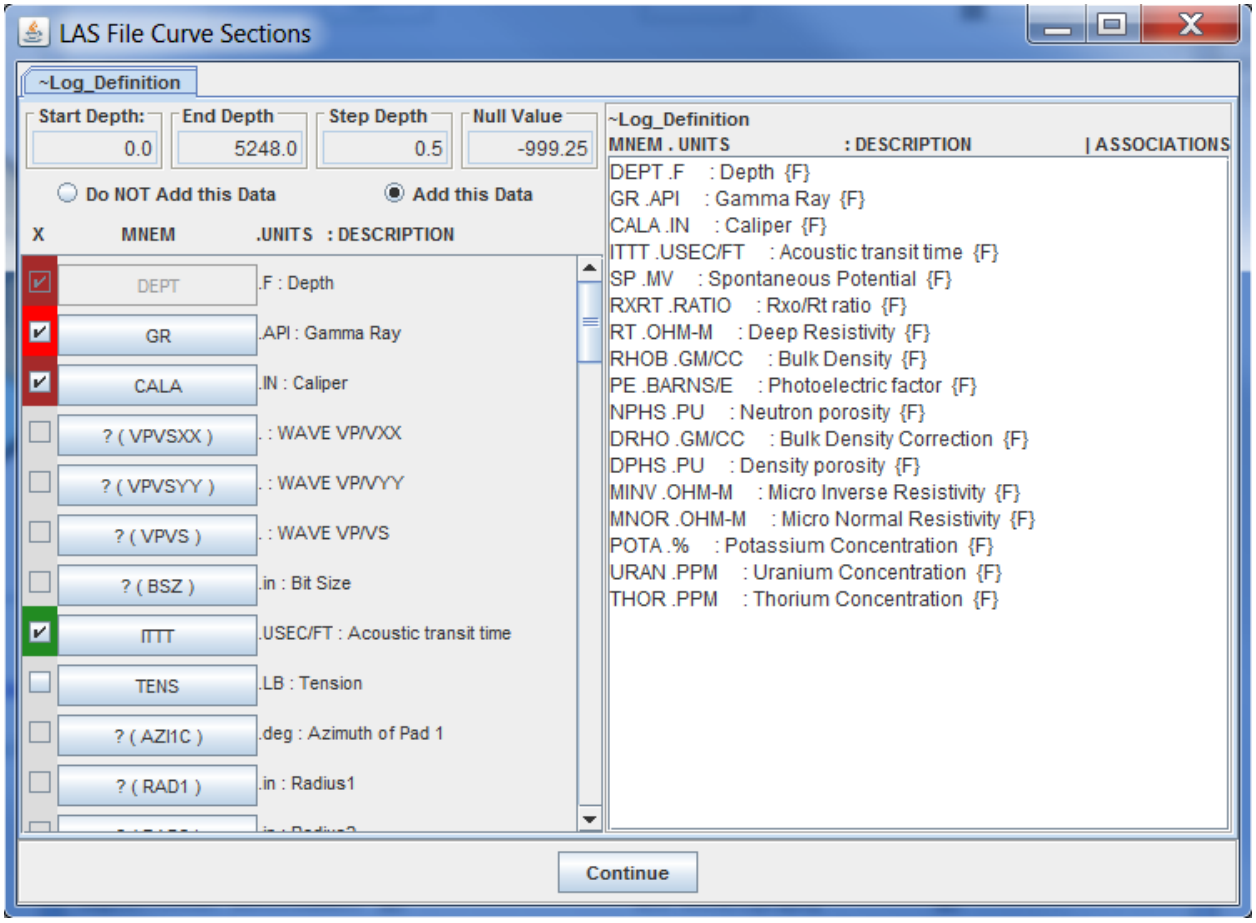
Most of the web apps will use the same input dialogs to import Log ASCII Standard (LAS) version 2.0 or 3.0 files. The Load Data Dialog is basically the same for most of the Web Apps, except they only load a subset of the total data types. In this example a LAS version 2.0 file is being imported into 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 3D Cross 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,

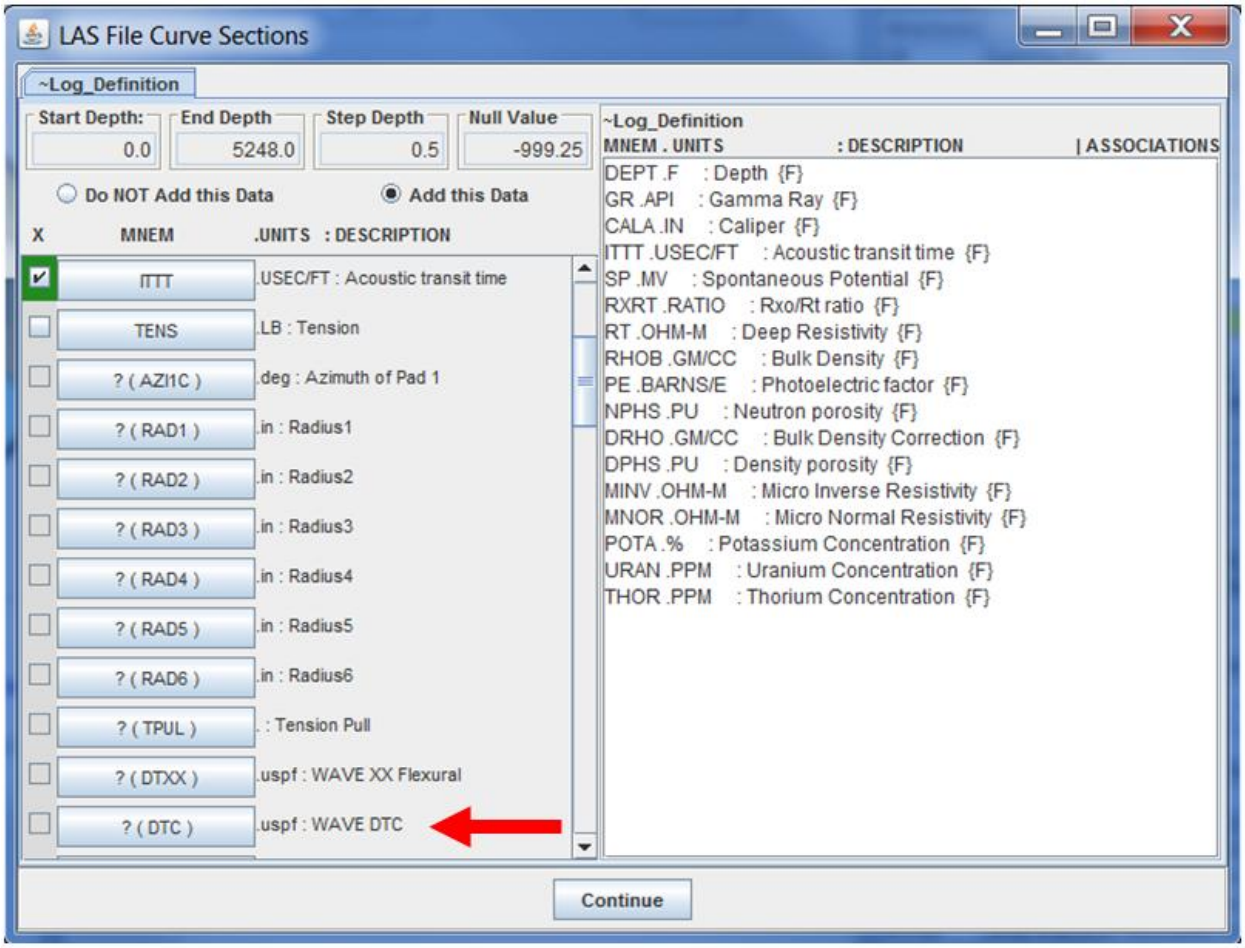
- Orange - OHM-M or Resistivity Logs
- Cyan – PU or porosity Logs, Neutron Porosity, Density Porosity, etc.
- Greenish yellow – BARNS/E or Photoelectric Factor Logs
- Green – GM/CC or Bulk Density Log
- Forest Green – USEC/FT or the Acoustic Transit Time Log

- 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.

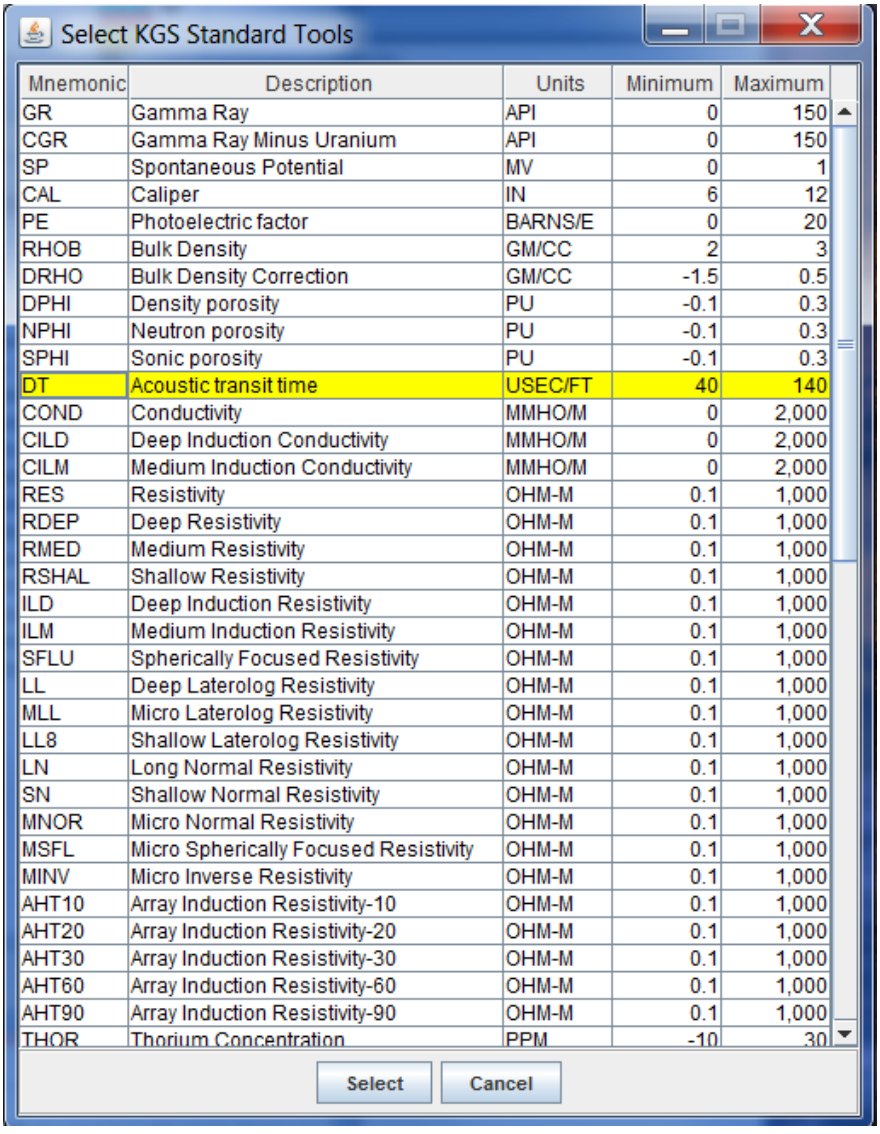
Map Curves & Change Curve Selections

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 3D CROSS PLOT web app.



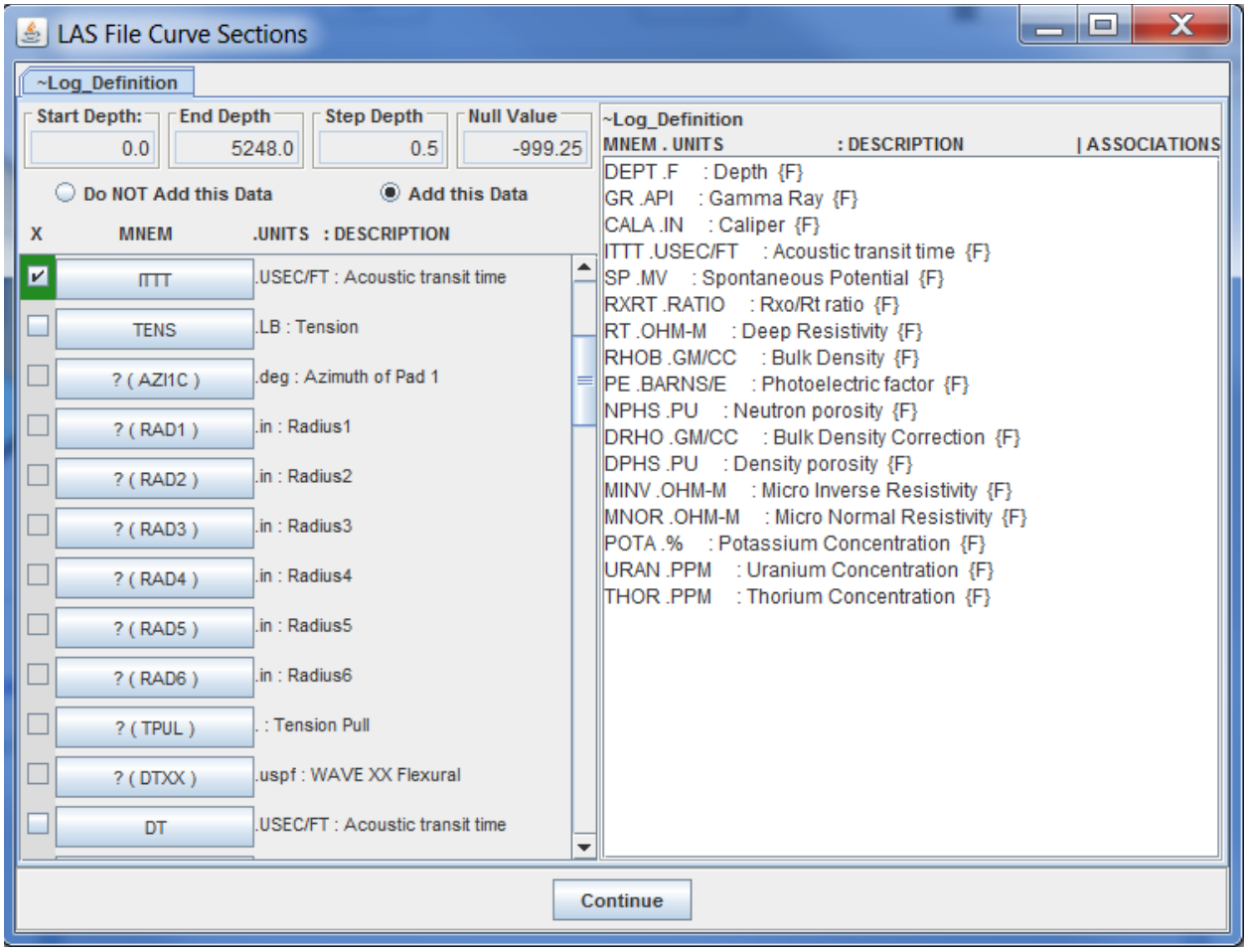
Click on the "?(DTC)" Button to display the "Select KGS Standard Tools" Dialog. This dialog provides a list of the KGS "Standard" Curve Mnemonics, from which the user can map an unrecognized log curve to one of the KGS standard curve mnemonics. The KGS "Standard" Curve Mnemonics List was created as a way to standardize the alpha bit soup of Log Mnemonics. Each logging company has their own curve mnemonics to represent similar tools. The 3D Cross Plot program is a later version of code from the GEMINI Project 3D Cross Plot 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.

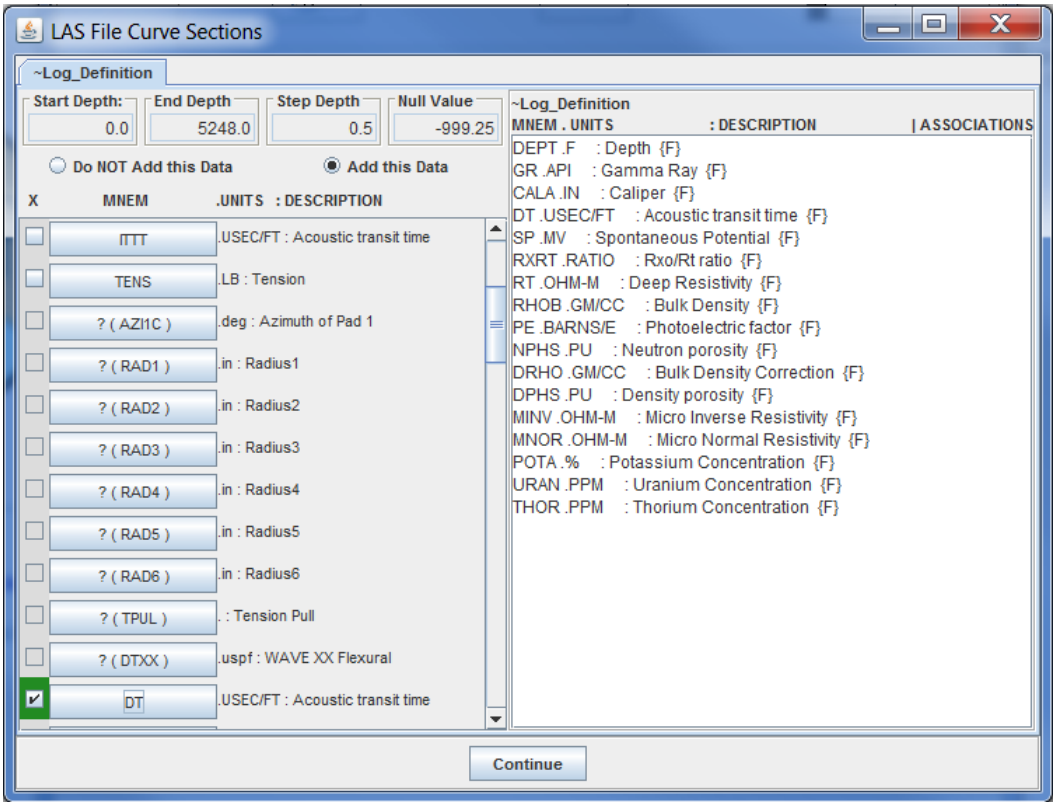


Mnemonic	Description	Units	Minimum	Maximum
GR	Gamma Ray	API	0	150
CGR	Gamma Ray Minus Uranium	API	0	150
SP	Spontaneous Potential	MV	0	1
CAL	Caliper	IN	6	12
PE	Photoelectric factor	BARNS/E	0	20
RHOB	Bulk Density	GM/CC	2	3
DRHO	Bulk Density Correction	GM/CC	-1.5	0.5
DPHI	Density porosity	PU	-0.1	0.3
NPHI	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

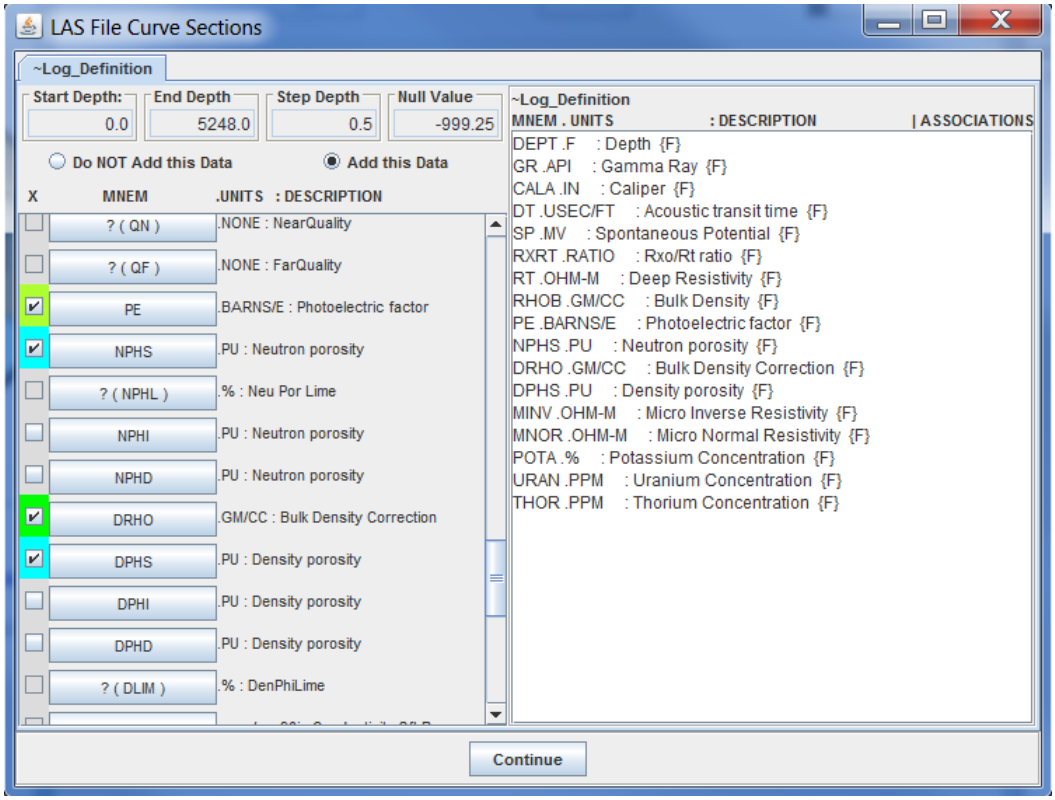
Highlight the “DT” Mnemonic Row and click on the “Select” Button to map the “?(DTC)” Curve Mnemonic to “DT” KGS Standard Curve Mnemonic.



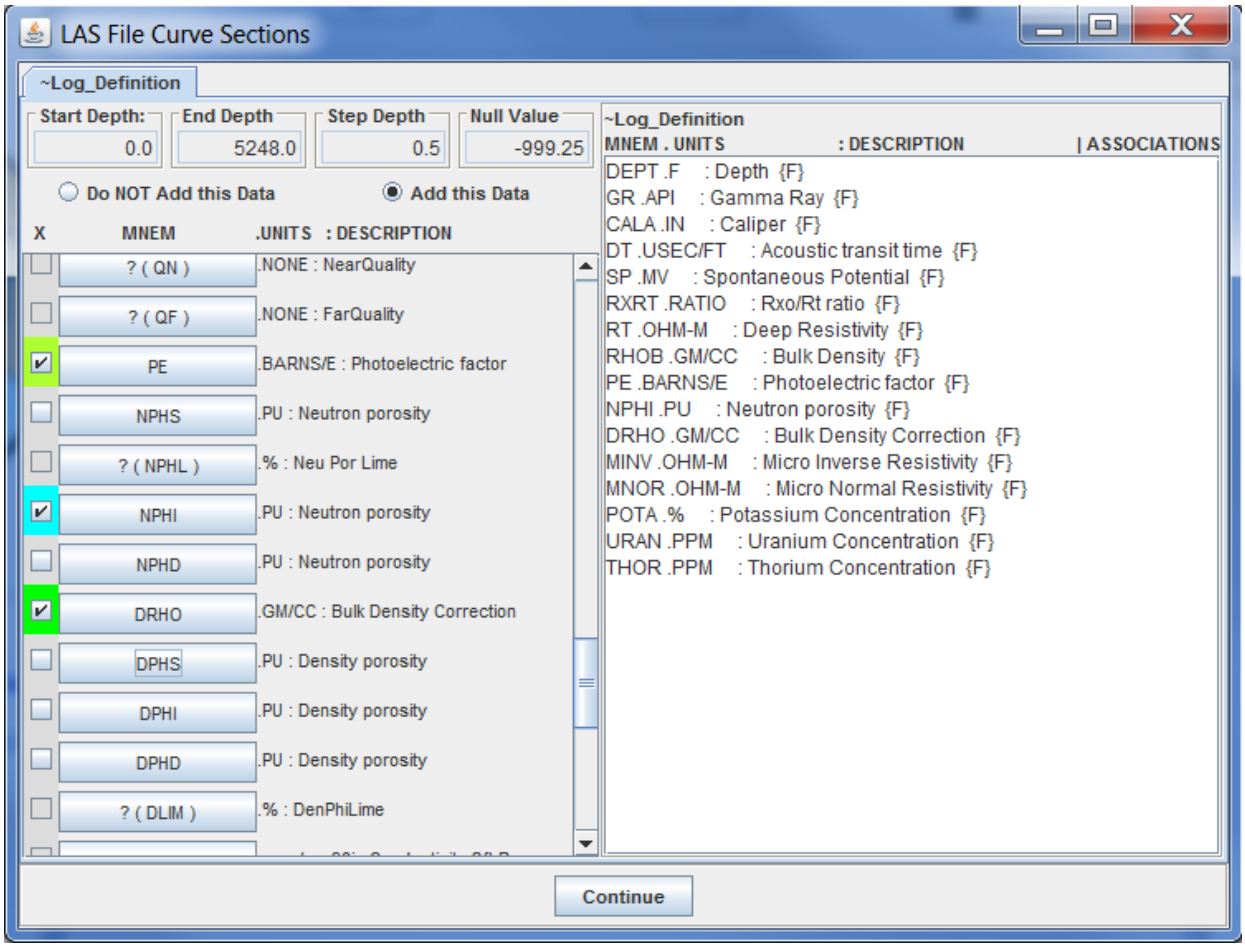
The “?(DTC). .uspf : WAVE DTC” has changed to “DT.usec/ft : Acoustic transit time”. We want to change the selected “ITTT” Log Curve to “DT” Log Curve. The reason is that “ITTT” is the wrong curve type for the Acoustic Transit Time. The program found the curve mnemonic as similar to the “DT” Standard Curve Mnemonic, but this curve will not plot correctly in the 3D Cross 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.



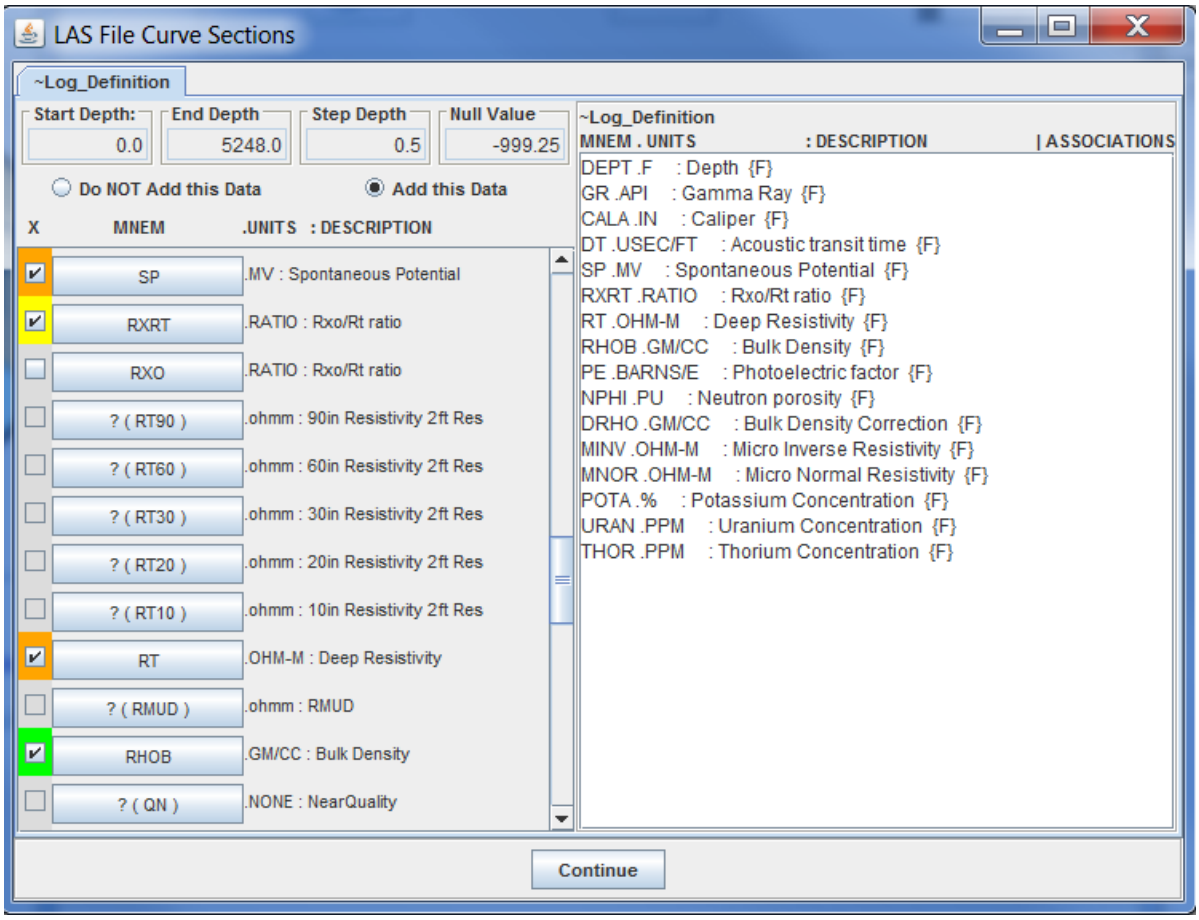
Moving the scroll bar down to the porosity curves, Neutron Porosity, and Density Porosity.



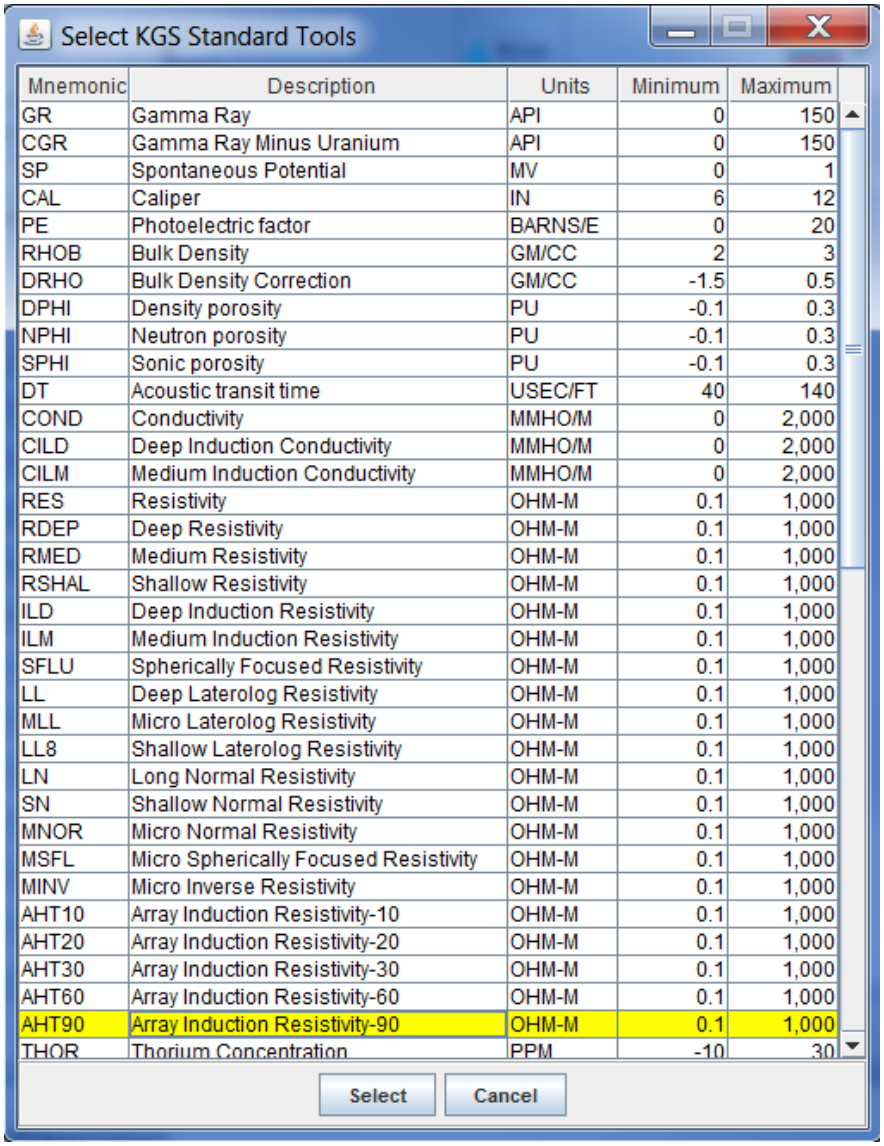
The LAS File Read will select the first curve that it recognizes and selects and color codes the curve. In this case the Neutron porosity mnemonic selected is “NPHS”, which is a valid curve, but the “NPHI” curve is desired so like the Acoustic Transit Time, you can deselect the “NPHS” and then select 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 3D CROSS PLOT 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 corectly.



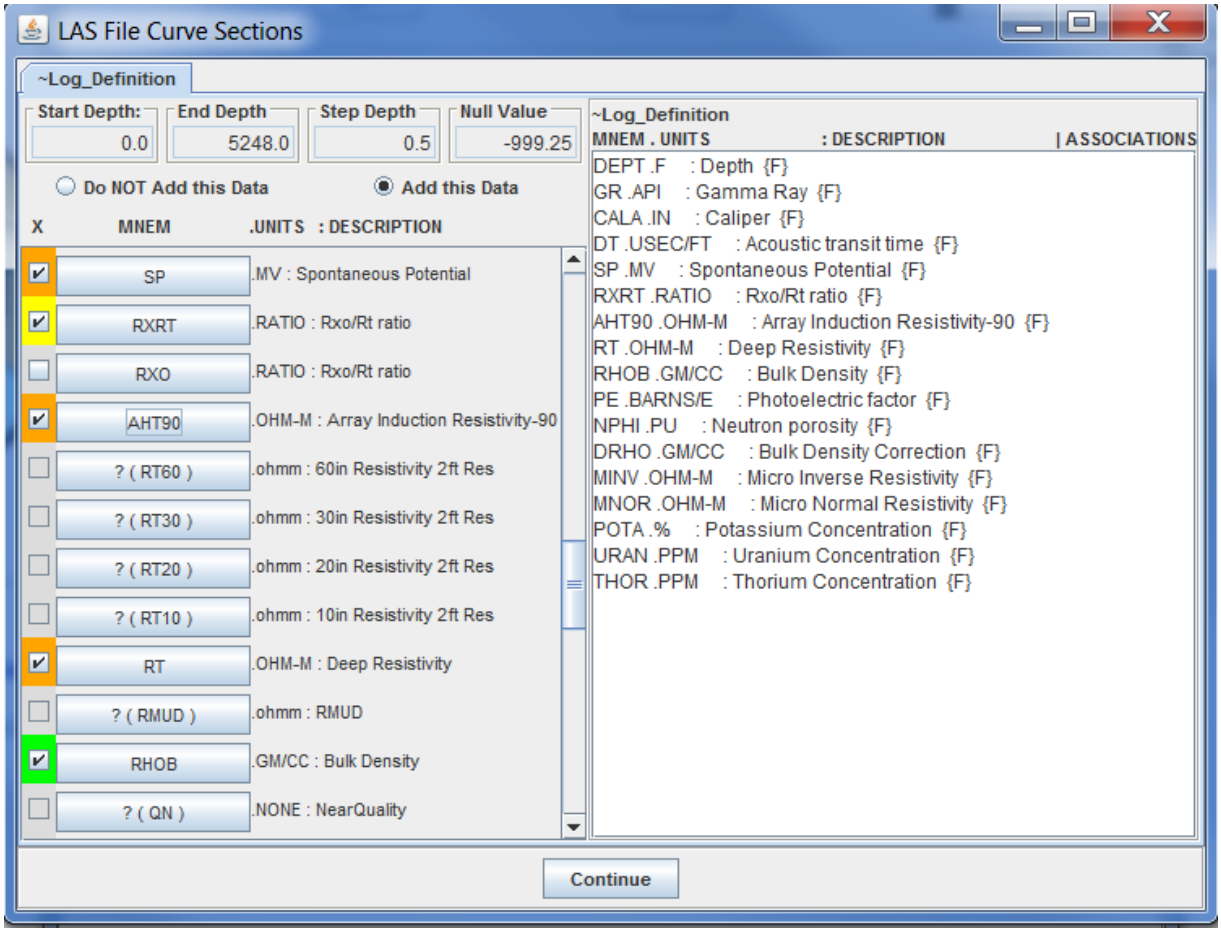
The above dialog represents the changes made for the neutron/density porosity logs. The last curves to be modified are the Array Induction Logs. Haliburton uses a different curve mnemonic for these logs. Move the scroll bar up to find the Array Induction Logs, RT90, RT60, etc.



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.

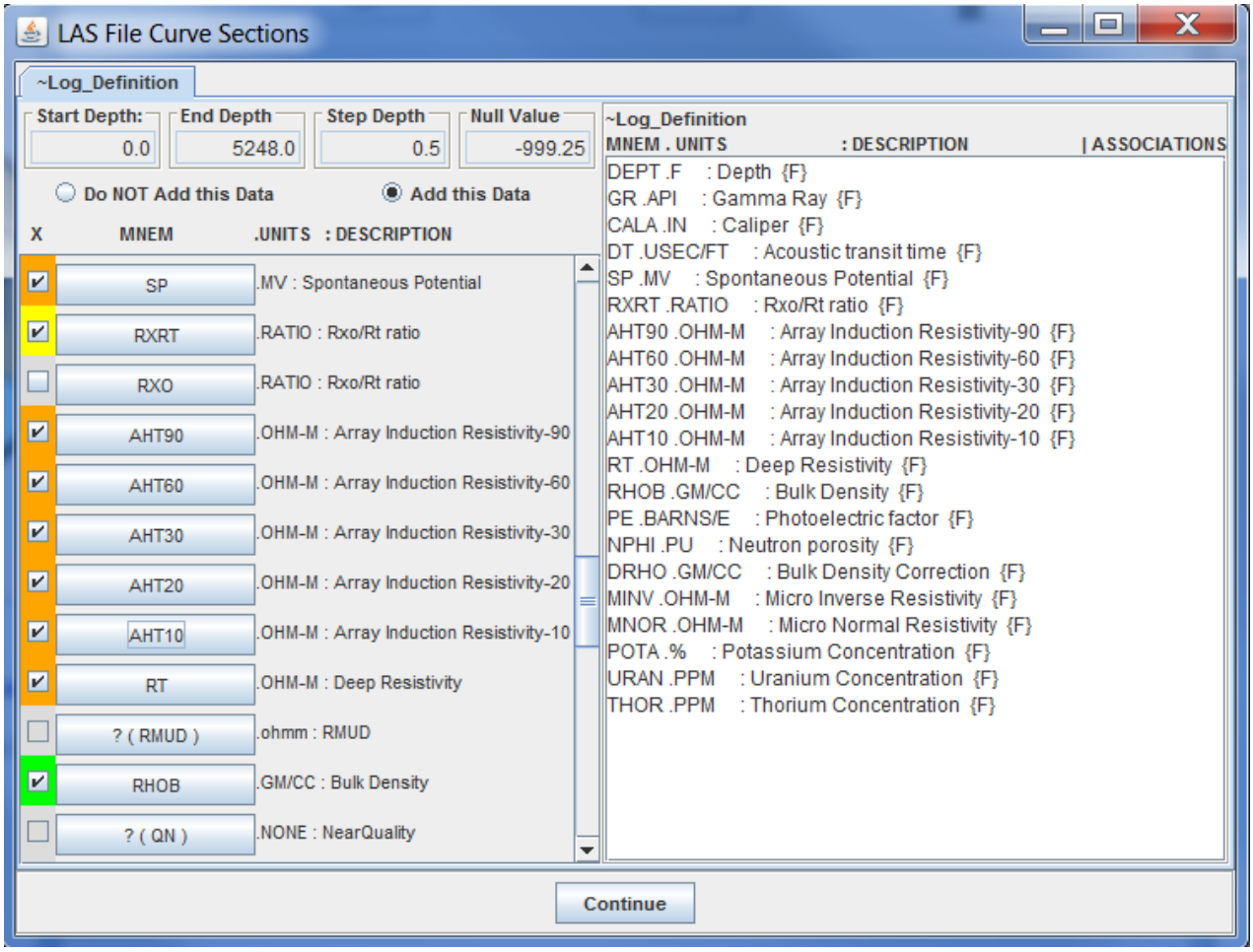


Highlight the AHT90 and click on the “Select” Button.

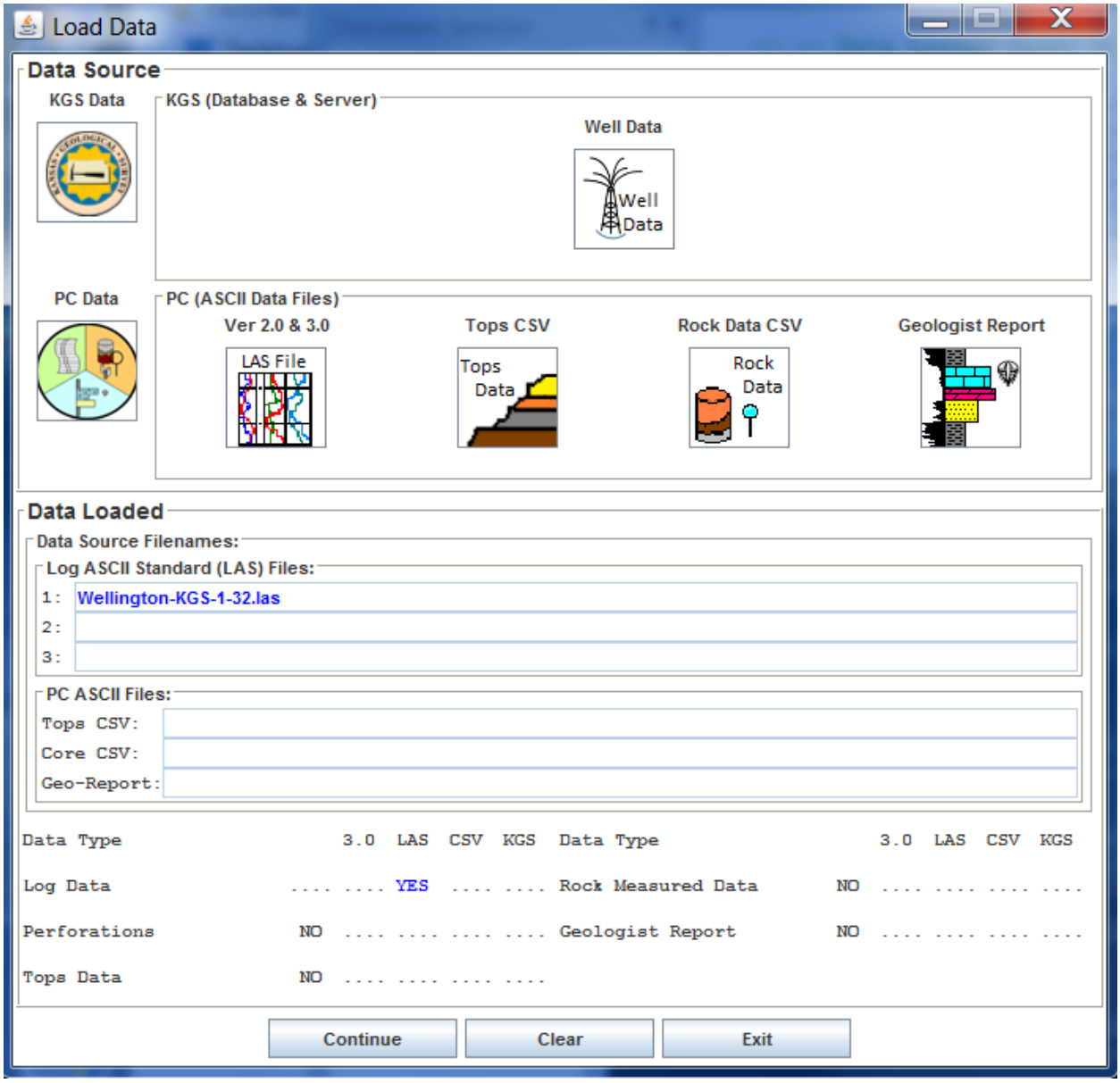


The "(?AHT90).ohmm : 90in Resistivity 2ft Res" has changed to "AHT90.OHM-M : Array Induction Resistivity-90" and the orange check box is selected. The rest of the Array Induction Log Curves each are mapped to the respective KGS Mnemonic Curve as follows,

(?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

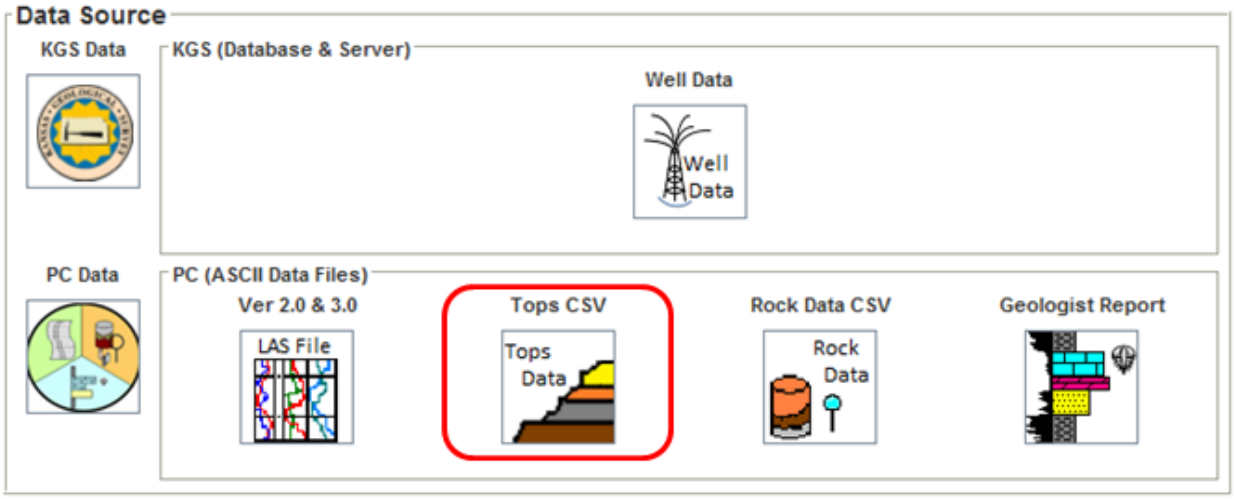

LAS File Curve Sections
~Log_Definition
Start Depth:
0.0
End Depth
5248.0
Step Depth
0.5
Null Value
-999.25
Do NOT Add this Data
Add this Data
X
MNEM
.UNITS
: DESCRIPTION
SP
.MV : Spontaneous Potential
RXRT
.RATIO : Rxo/Rt ratio
RXO
.RATIO : Rxo/Rt ratio
AHT90
.OHM-M : Array Induction Resistivity-90
AHT60
.OHM-M : Array Induction Resistivity-60
AHT30
.OHM-M : Array Induction Resistivity-30
AHT20
.OHM-M : Array Induction Resistivity-20
AHT10
.OHM-M : Array Induction Resistivity-10
RT
.OHM-M : Deep Resistivity
? (RMUD)
.ohmm : RMUD
RHOB
.GM/CC : Bulk Density
? (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 .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

Select the Continue Button to read and parse the LAS log curves selected into the 3D CROSS PLOT 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.

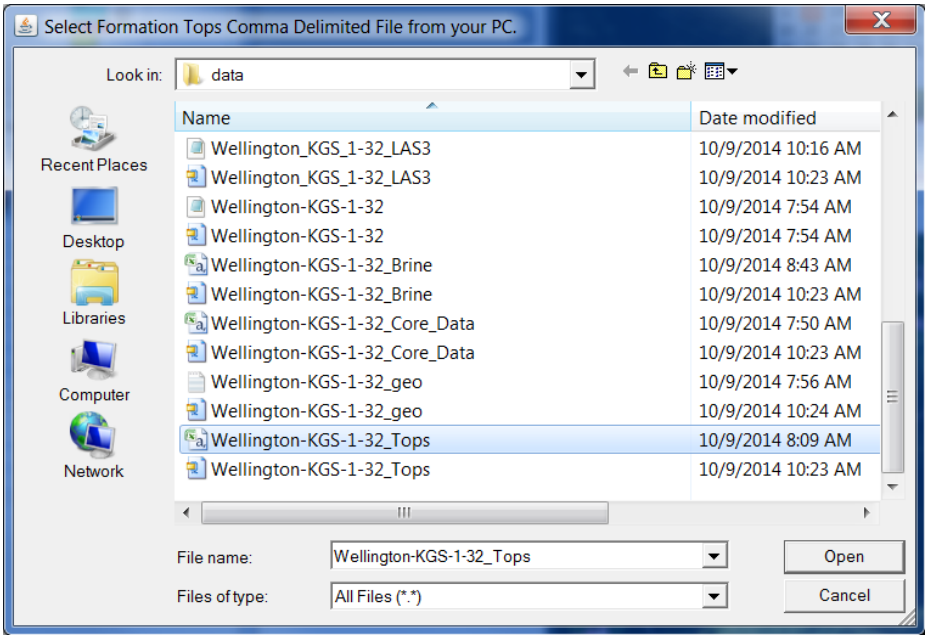


Importing PC Data – Tops CSV (Comma Separated Values) File.

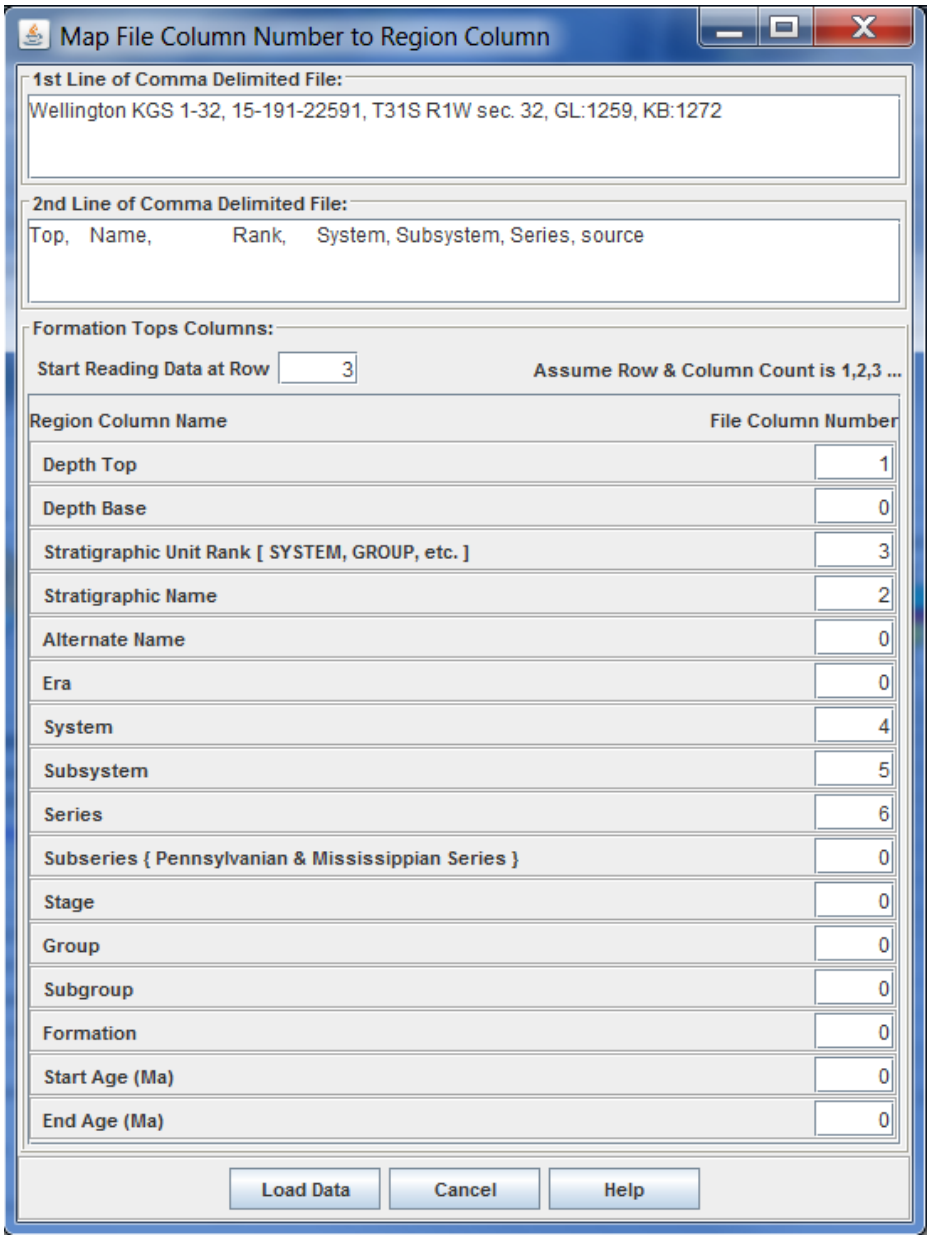
Most of the web apps will use the same input dialogs to import tops CSV (Comma Separated Values) file. The Load Data Dialog is basically the same for most of the Web Apps except they only load a subset of the total data types. In this example a Tops CSV file is being imported into the web app.



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.



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.

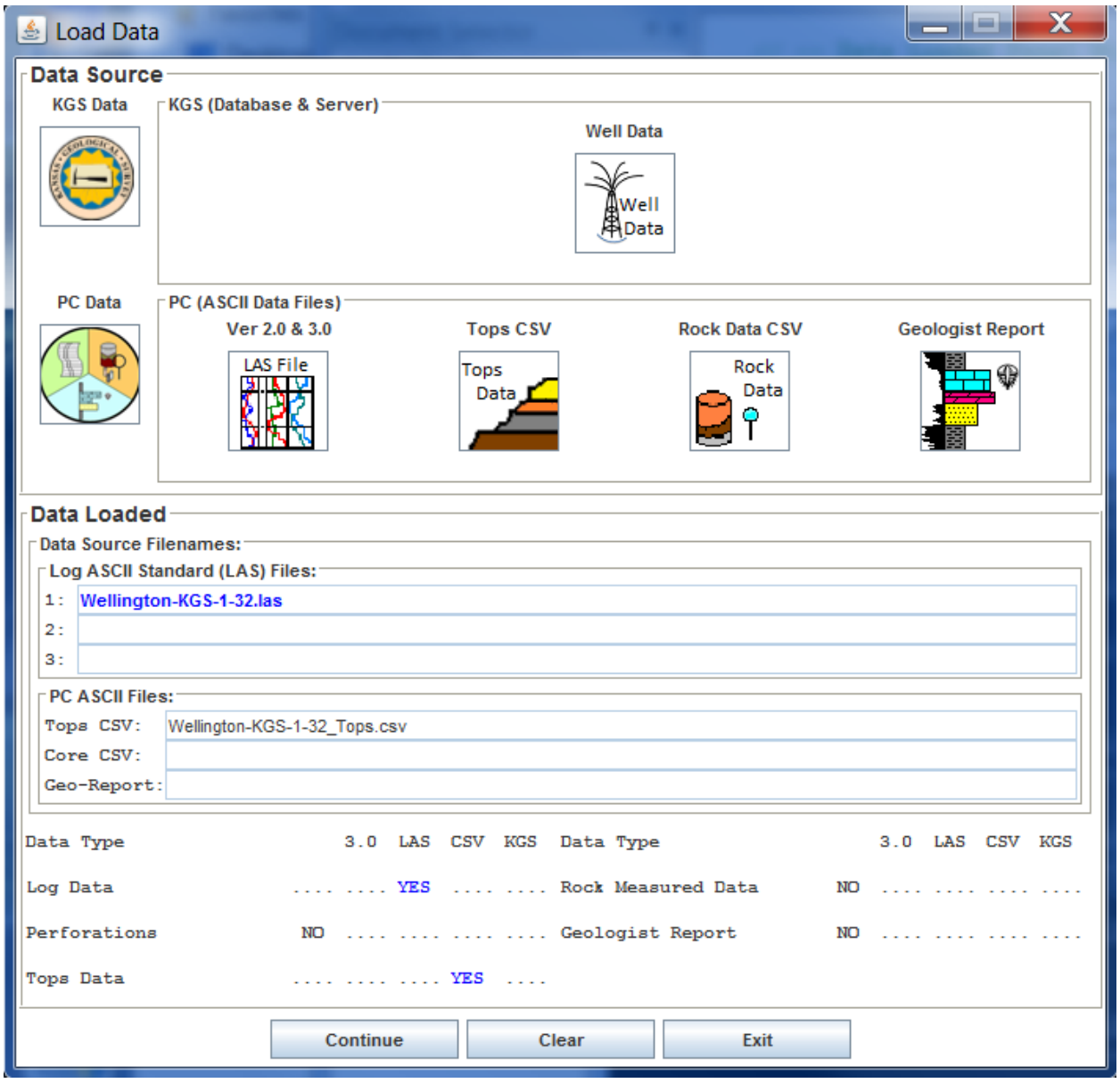
The "Map File Column Number to Region Column" Dialog allows the user to map the data in the Tops CSV File to the web app data structure variables. The program first reads the first and second line of the CSV File looking for the data column headers. The lines are each parsed to single out the data column 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.

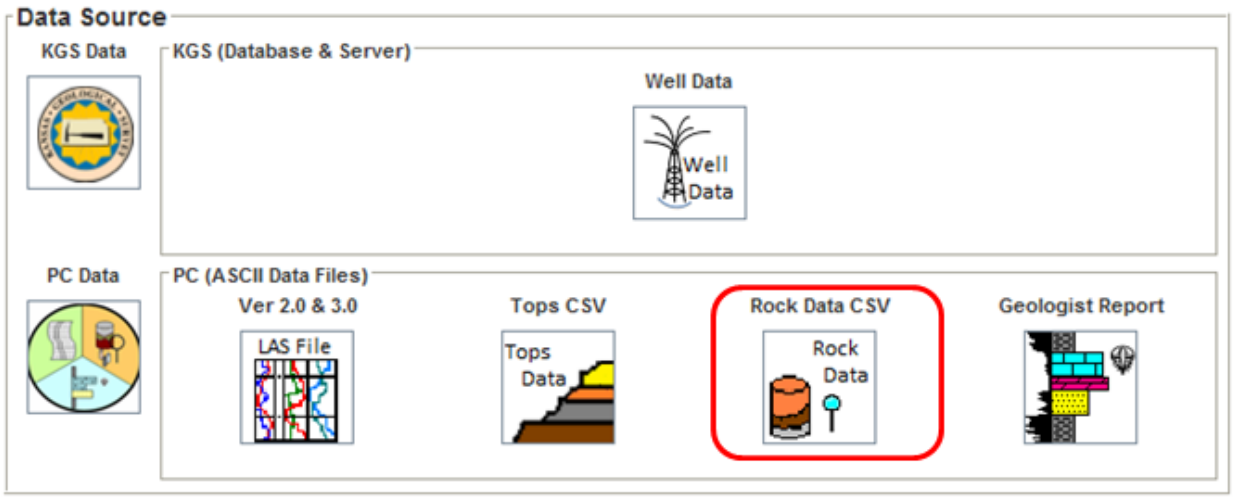
Column	File Column Label	Tops Data Name
1	Top	Depth Top
2	Name	Stratigraphic Name
3	Rank	Stratigraphic Unit Rank
4	System	System
5	Subsystem	Subsystem
6	Series	Series
7	Source	

When the user selects the “Load Data” Button on the “Map File Column Number to Region Column” Dialog the data is parsed into the 3D Cross Plot Program, where the Tops CSV file name is entered into the “PC ASCII Files:” Panel as well as the data type source.

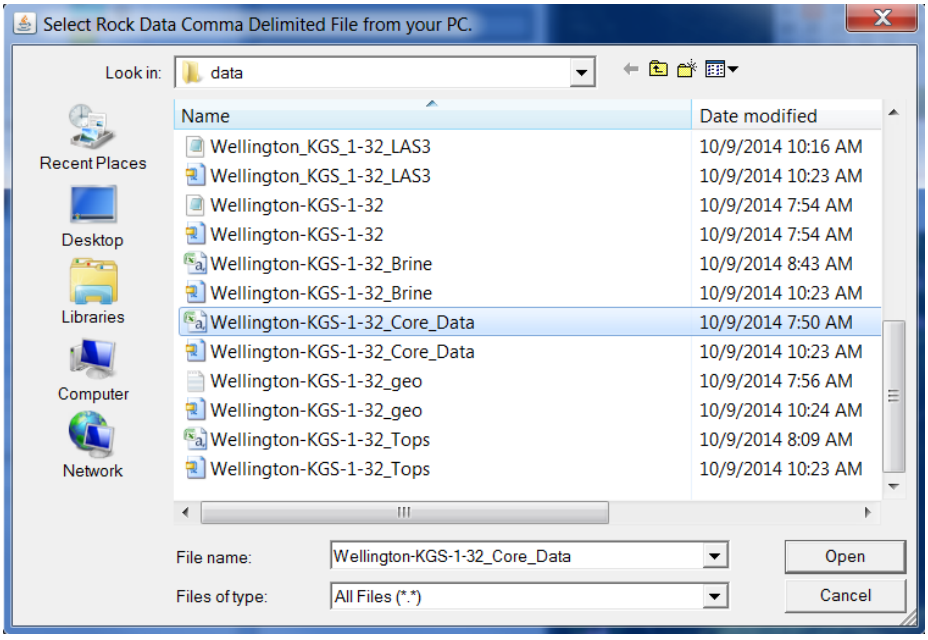


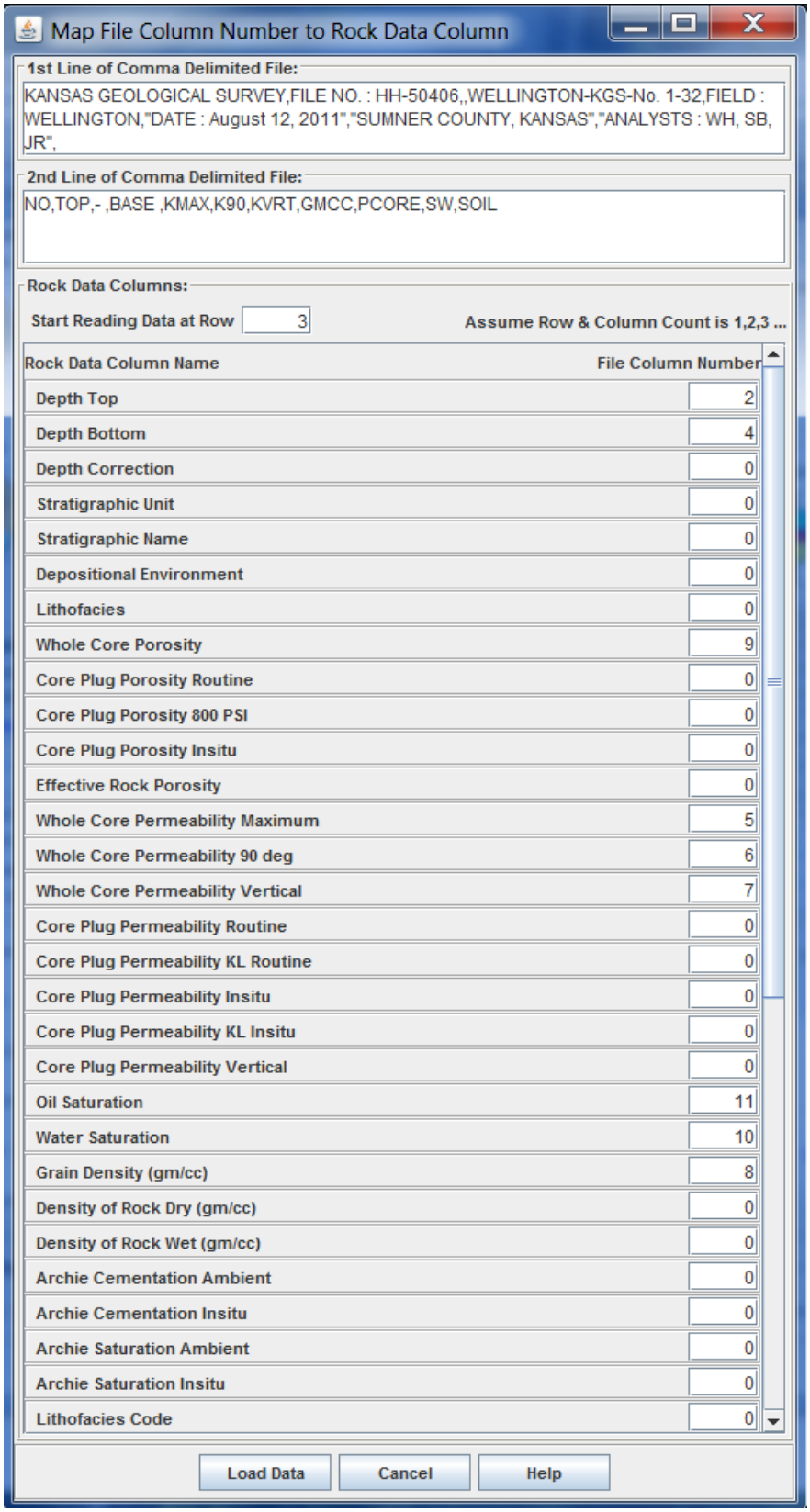
Importing PC Data – Core CSV (Comma Separated Values) File.

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.





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
Line 2 Data Column Labels
Line 3 Data Start

```
KANSAS GEOLOGICAL SURVEY,FILE NO. : HH-50406,,WELLINGTON-KGS-No. 1-32,FIELD : WELLINGTON,
NO,TOP,- ,BASE ,KMAX,K90,KVRT,GMCC,PCORE,SW,SOIL
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,

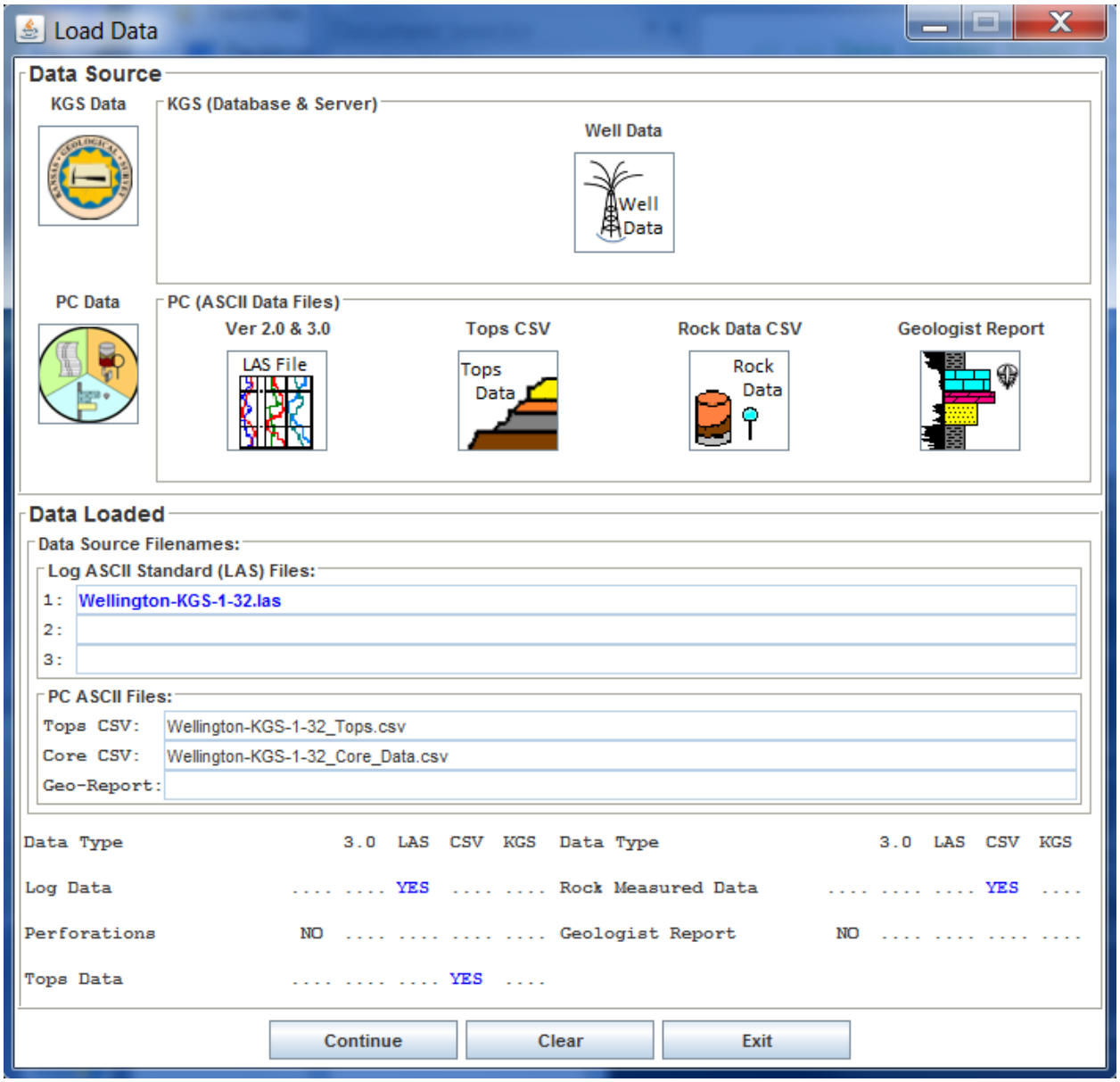
Mnem	Description	Mnem	Description
Depth Data		**Density Data**	
TOP	Depth Top	GMCC	Grain Density (gm/cc)
BASE	Depth Bottom	RHOD	Density of Rock Dry (gm/cc)
CORR	Depth Correction	RHOW	Density of Rock Wet (gm/cc)
Stratigraphic & Environment Descriptions		**Permeability Data**	
STU	Stratigraphic Unit	KMAX	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.

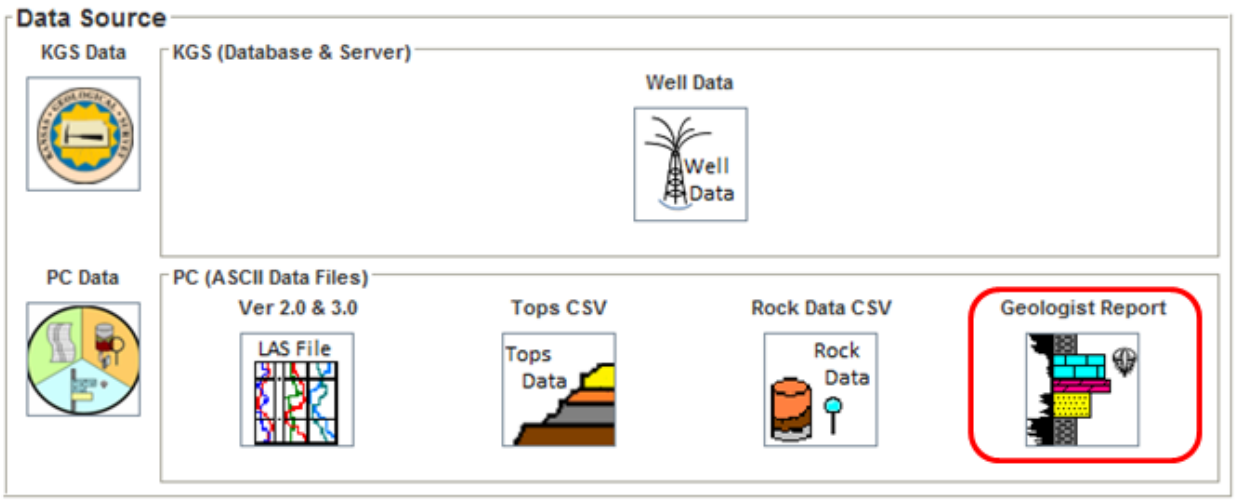
Column	File Column Label	Core Data Name
1	NO	
2	TOP	Depth Top
3	-	
4	BASE	Depth Bottom
5	KMAX	Whole Core Permeability Maximum
6	K90	Whole Core Permeability 90 deg
7	KVRT	Whole Core Permeability Vertical
8	GMCC	Grain Density (gm/cc)
9	PCORE	Whole Core Porosity
10	SW	Water Saturation
11	SOIL	Oil Saturation

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 3D Cross Plot Program, where the Core Data CSV file name is entered into the “PC ASCII Files:” Panel as well as the data type source.



Importing PC Data – Geologist Report (Cuttings/Core Descriptions, Measured Sections) ASCII Delimited File.

Some of the web apps will use the same input dialogs to import Geologist Report ASCII Delimited 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 Geologist Report ASCII Delimited file is being imported into the web app.

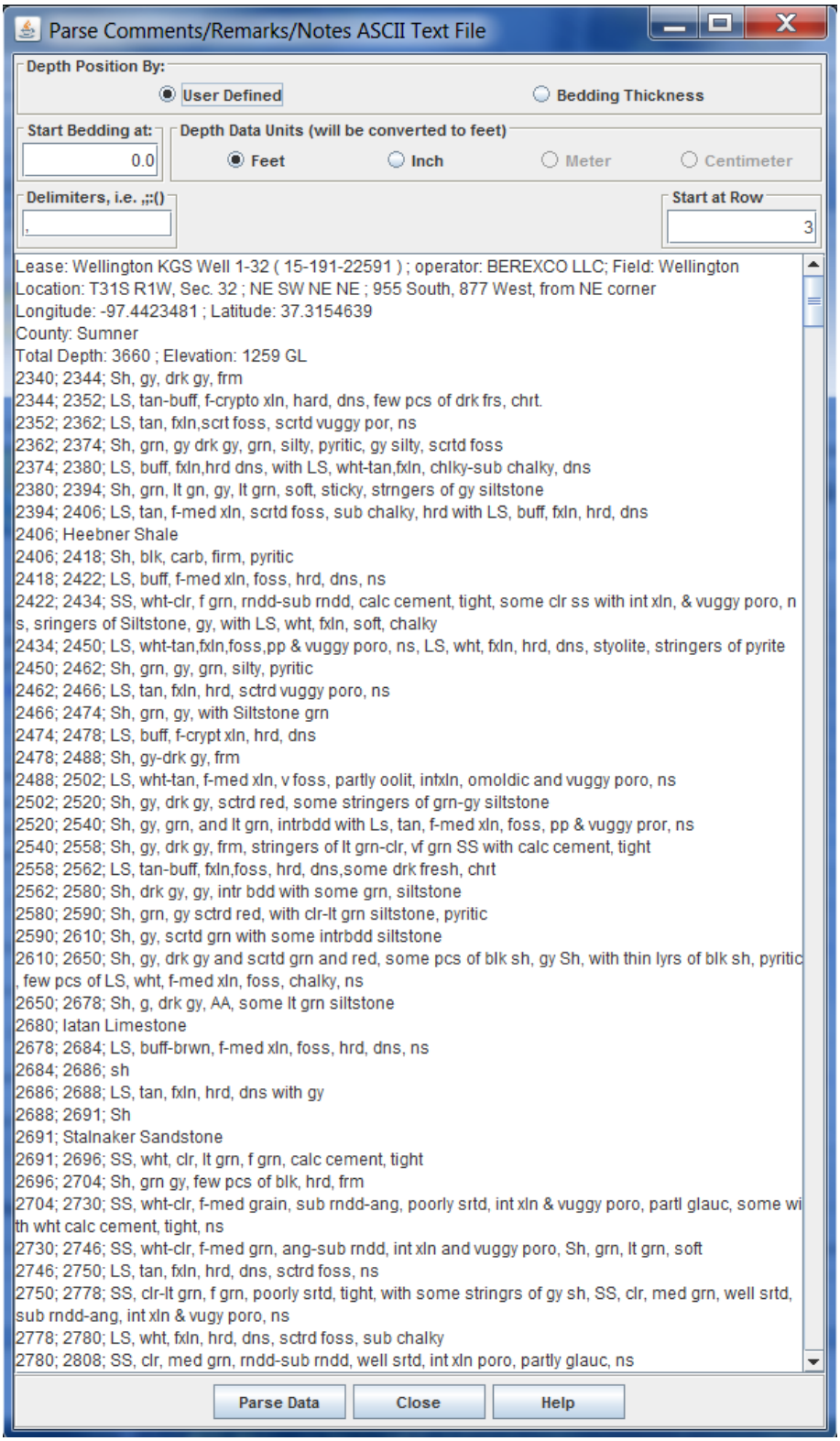


Left Click on the "Geologist Report" Icon Button in the Data Source Panel of the Load Data Dialog. This will display the "Select Comments/Remarks/Notes Delimited File from your PC" Dialog. This dialog allows the user to search their PC for the file of interest. In this example it is the Geologist Delimited file Wellington-KGS-1-32_geo.txt, highlighted below. Select the Open button to display the "Parse Comments/Remarks/Notes ASCII Text File" Dialog.

The Select Comments/Remarks/Notes Delimited File from your PC Dialog allows the user to import the geologist report into the web app. The data is parsed into the one of number of rock description data structures, i.e. Rock Color, Rock Lithology, Porosity, Sedimentary Structure, and General Fossils.

There are two sections to this dialog the Top controls how the depth data is found and interpreted. The "User defined" Depth assumes that the first two columns will be the start and stop depth followed by the text as this example below shows. The "Bedding Thickness" Depth assumes that there is one depth with the description. The user should take care to use a delimiter that does not appear in the description if the bedding thickness follows the bed descriptions.

The "Delimiters, i.e. ,;:()" text field has default ',' by default, which for the example below, showed be changed to ';' to match the depth data separation delimiter shown. And the "Start at Row" text field should be changed to 6 since the data starts at line 6. The default depth is in feet, but it is possible that a measured section would be measured in inches, note this setting is for all depths in the file. This panel allows the user to see all the data and to edit the Depth Delimiter, Starting point of the Data and Bedding Depth Start text fields to match the data and then select the "Parse Data" to parse the text into the rock data structures.


Parse Comments/Remarks/Notes ASCII Text File
Depth Position By:
User Defined
Bedding Thickness
Start Bedding at:
0.0
Depth Data Units (will be converted to feet)
Feet
Inch
Meter
Centimeter
Delimiters, i.e. ,;:()
,
Start at Row
3
Lease: Wellington KGS Well 1-32 (15-191-22591) ; operator: BEREXCO LLC; Field: Wellington
Location: T31S R1W, Sec. 32 ; NE SW NE NE ; 955 South, 877 West, from NE corner
Longitude: -97.4423481 ; Latitude: 37.3154639
County: Sumner
Total Depth: 3660 ; Elevation: 1259 GL
2340; 2344; Sh, gy, drk gy, frm
2344; 2352; LS, tan-buff, f-crypto xln, hard, dns, few pcs of drk frs, chrt.
2352; 2362; LS, tan, fxln,scrt foss, scrtd vuggy por, ns
2362; 2374; Sh, grn, gy drk gy, grn, silty, pyritic, gy silty, scrtd foss
2374; 2380; LS, buff, fxln,hrd dns, with LS, wht-tan,fxln, chlky-sub chalky, dns
2380; 2394; Sh, grn, lt gn, gy, lt grn, soft, sticky, strngers of gy siltstone
2394; 2406; LS, tan, f-med xln, scrtd foss, sub chalky, hrd with LS, buff, fxln, hrd, dns
2406; Heebner Shale
2406; 2418; Sh, blk, carb, firm, pyritic
2418; 2422; LS, buff, f-med xln, foss, hrd, dns, ns
2422; 2434; SS, wht-clr, f grn, rndd-sub rndd, calc cement, tight, some clr ss with int xln, & vuggy poro, n
s, sringers of Siltstone, gy, with LS, wht, fxln, soft, chalky
2434; 2450; LS, wht-tan,fxln,foss,pp & vuggy poro, ns, LS, wht, fxln, hrd, dns, styolite, stringers of pyrite
2450; 2462; Sh, grn, gy, grn, silty, pyritic
2462; 2466; LS, tan, fxln, hrd, sctrd vuggy poro, ns
2466; 2474; Sh, grn, gy, with Siltstone grn
2474; 2478; LS, buff, f-crypt xln, hrd, dns
2478; 2488; Sh, gy-drk gy, frm
2488; 2502; LS, wht-tan, f-med xln, v foss, partly oolit, intxln, omoldic and vuggy poro, ns
2502; 2520; Sh, gy, drk gy, sctrd red, some stringers of grn-gy siltstone
2520; 2540; Sh, gy, grn, and lt grn, intrbdd with Ls, tan, f-med xln, foss, pp & vuggy pror, ns
2540; 2558; Sh, gy, drk gy, frm, stringers of lt grn-clr, vf grn SS with calc cement, tight
2558; 2562; LS, tan-buff, fxln,foss, hrd, dns,some drk fresh, chrt
2562; 2580; Sh, drk gy, gy, intr bdd with some grn, siltstone
2580; 2590; Sh, grn, gy sctrd red, with clr-lt grn siltstone, pyritic
2590; 2610; Sh, gy, scrtd grn with some intrbdd siltstone
2610; 2650; Sh, gy, drk gy and scrtd grn and red, some pcs of blk sh, gy Sh, with thin lyrs of blk sh, pyritic
, few pcs of LS, wht, f-med xln, foss, chalky, ns
2650; 2678; Sh, g, drk gy, AA, some lt grn siltstone
2680; Iatan Limestone
2678; 2684; LS, buff-brwn, f-med xln, foss, hrd, dns, ns
2684; 2686; sh
2686; 2688; LS, tan, fxln, hrd, dns with gy
2688; 2691; Sh
2691; Stalnaker Sandstone
2691; 2696; SS, wht, clr, lt grn, f grn, calc cement, tight
2696; 2704; Sh, grn gy, few pcs of blk, hrd, frm
2704; 2730; SS, wht-clr, f-med grain, sub rndd-ang, poorly srtd, int xln & vuggy poro, partl glauc, some wi
th wht calc cement, tight, ns
2730; 2746; SS, wht-clr, f-med grn, ang-sub rndd, int xln and vuggy poro, Sh, grn, lt grn, soft
2746; 2750; LS, tan, fxln, hrd, dns, sctrd foss, ns
2750; 2778; SS, clr-lt grn, f grn, poorly srtd, tight, with some stringrs of gy sh, SS, clr, med grn, well srtd,
sub rndd-ang, int xln & vugy poro, ns
2778; 2780; LS, wht, fxln, hrd, dns, sctrd foss, sub chalky
2780; 2808; SS, clr, med grn, rndd-sub rndd, well srtd, int xln poro, partly glauc, ns
Parse Data
Close
Help

Geologist Report ASCII Delimited File Structure.

By Depth Range:

The Wellington KGS 1-32 Geologist Report Delimited file example has a more relaxed format. The well header information is at the top of the file with as many lines needed. The data starts immediately after the header section. The Geologist Report Example for the Wellington KGS 1-32 well is as follows,

Line 1 to Line 5: Well Header Information

Line 6 Data Start

Line 13 Tops Pick Depth example, if there are no other tops sources then the geologist report will be parsed for tops.

```
Lease: Wellington KGS Well 1-32 ( 15-191-22591 ) ; operator: BEREXCO LLC; Field: Wellington
Location: T31S R1W, Sec. 32 ; NE SW NE NE ; 955 South, 877 West, from NE corner
Longitude: -97.4423481 ; Latitude: 37.3154639
County: Sumner
Total Depth: 3660 ; Elevation: 1259 GL
2340; 2344; Sh, gy, drk gy, frm
2344; 2352; LS, tan-buff, f-crypto xln, hard, dns, few pcs of drk frs, chrt.
2352; 2362; LS, tan, fxln,scrt foss, scrtd vuggy por, ns
2362; 2374; Sh, grn, gy drk gy, grn, silty, pyritic, gy silty, scrtd foss
2374; 2380; LS, buff, fxln,hrd dns, with LS, wht-tan,fxln, chlky-sub chalky, dns
2380; 2394; Sh, grn, lt gn, gy, lt grn, soft, sticky, strngers of gy siltstone
2394; 2406; LS, tan, f-med xln, scrtd foss, sub chalky, hrd with LS, buff, fxln, hrd, dns
2406; Heebner Shale
2406; 2418; Sh, blk, carb, firm, pyritic
2418; 2422; LS, buff, f-med xln, foss, hrd, dns, ns
2422; 2434; SS, wht-clr, f grn, rndd-sub rndd, calc cement, tight, some clr ss with int xln, & vuggy poro, ns,
2434; 2450; LS, wht-tan,fxln,foss,pp & vuggy poro, ns, LS, wht, fxln, hrd, dns, styolite, stringers of pyrite
2450; 2462; Sh, grn, gy, grn, silty, pyritic
2462; 2466; LS, tan, fxln, hrd, sctrd vuggy poro, ns
2466; 2474; Sh, grn, gy, with Siltstone grn
2474; 2478; LS, buff, f-crypt xln, hrd, dns
2478; 2488; Sh, gy-drk gy, frm
```

Figure: Partial contents of the Wellington-KGS-1-32_geo.txt File.

In this example the depth range information is separated by semicolons (;) and is in the front of each description, e.g. “2340; 2344; Sh, gy, dark gy, frm”. The depth range parse engine assumes that there will be two numbers at the beginning of each description. The semicolon is not necessarily unique in the line, but the program expects to find two number fields at the front of the line. The program will separate the description from the depth range using the delimiter ‘;’. Using an example line from above,

“2340; 2344; Sh, gy, dark gy, frm”

The parse engine will determine which part is the description and which is the depth information. The depths are then cleaned of any other non-numeric characters leaving the numbers, e.g. 2340 and 2344. The parse engine sets the starting depth and ending depths for the description and computes the thickness and adds to the cumulative total depth. The description is parsed later (Lithology, Rock Color, Porosity, Sedimentary Structure, Fossils and Fossil Genera/Species Names) when the user selects the “Parse Data” Button.

By Bedding Thickness:

The next example is a measured section done in Riley County, Kansas, see image below. Only the bedding thickness is available for each layer and is placed at the end of the description in parenthesis, e.g. “Shale, gray, red zone near top (10.8)”. The user must chose the “Bedding Thickness” radio button in the “Depth Position By” Panel for this type of example. The bedding

thickness parse engine assumes that the line can be divided in two strings. In this example the parenthesis is the unique delimiter separating the text from the bedding description. The program will separate the text from the bedding thickness using the delimiter '('. Using the example above,

"Shale, gray, red zone near top (10.8)"

The parse engine will determine which part is the bedding description and which is the bedding thickness. The bedding thickness is then cleaned of any other non-numeric characters leaving the number, e.g. 10.8. The parse engine adds the thickness to the cumulative total depth and sets the starting depth and ending depth of the bed. The description is parsed later (Lithology, Rock Color, Porosity, Sedimentary Structure, and Fossils when the user selects the "Parse Data" Button.

Line 1 Location Information
Line 3 Data Start

Note the Tops Picks Depth will be grouped with the next valid lithology description.

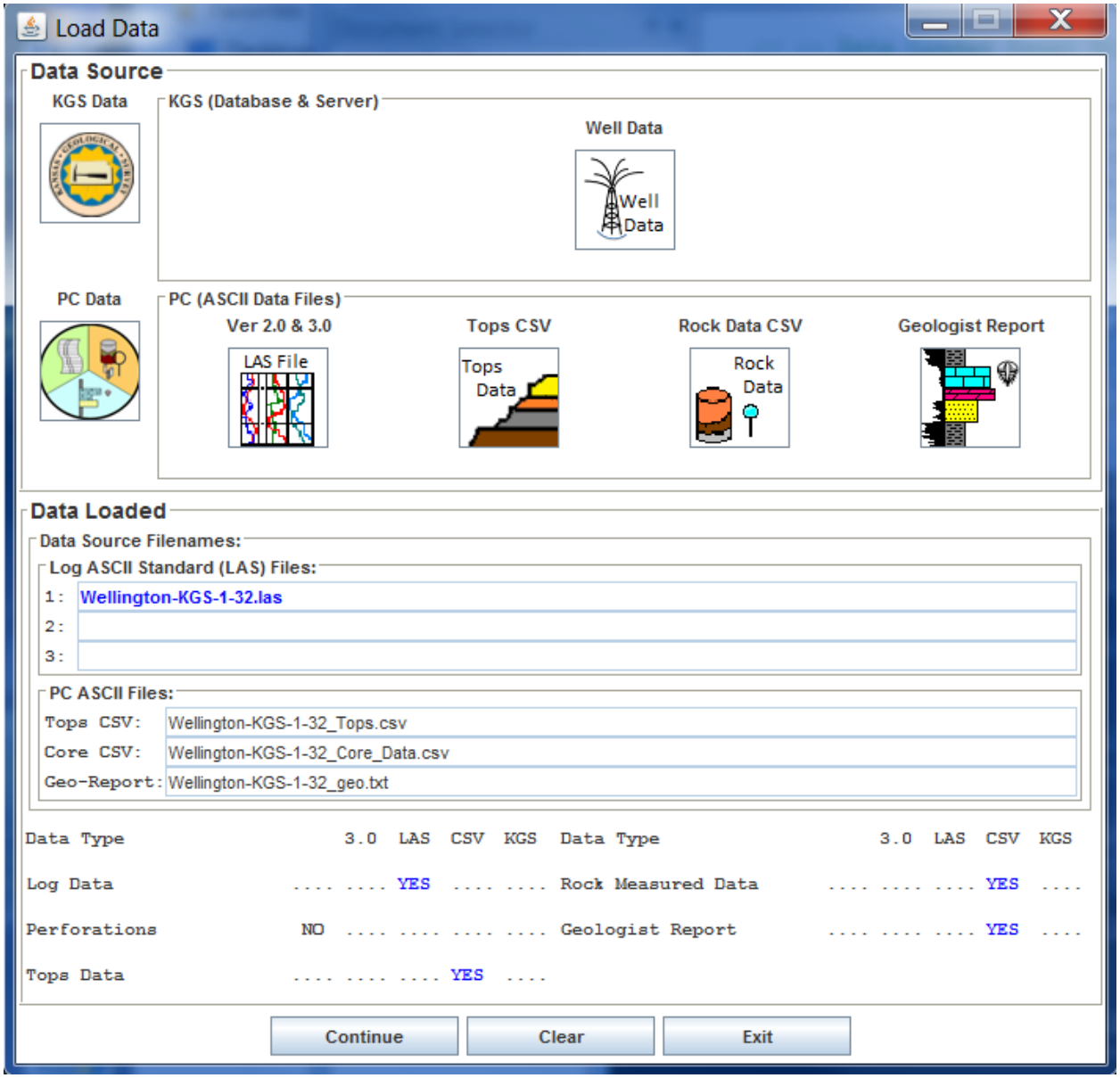
```
C S line sec. 10, T. 6 S, R. 7 E.

Barneston limestone Feet
 Florence limestone member
  Limestone, flinty (15)
Matfield shale 62.45 feet
 Blue Springs shale member 41.15 feet
  Shale, mostly variegated, gray and platy in upper part (15)
  Limestone, red soft (1.6 )
  Shale, gray, red zone near top (10.8 )
  Limestone, yellow to gray, massive (1.85 )
  Shale, green (0.4 )
  Limestone, chocolate-color, weathers red (0.5 )
  Shale, upper part green and purple, lower part gray ( 11 )
 Kinney limestone member
  Limestone, light-gray massive, earthy in texture (1.3)
  Wymore shale member
  Shale, upper part gray, mostly red, lower 5 feet gray (20 )
Wreford limestone 32.5 feet
 Schroyer limestone member
  Limestone, gray, granular to crystalline, porous (2 )
  Shale, gray (3 )
  Limestone, gray flinty (3 )
```

Figure: Partial contents of the Measured Section in Riley County, Kansas ASCII Text File.

The Measured Section Example can be downloaded from the server to the user's PC. Note that downloading the file directly, web page will insert HTML into the text and change the structure of the document. The URL Links are as follows,

ASCII Text: http://www.kgs.ku.edu/Gemini/Tools/documentation/C_S_line_S10-T6S-R7E.txt
Zip File: http://www.kgs.ku.edu/Gemini/Tools/documentation/C_S_line_S10-T6S-R7E.zip

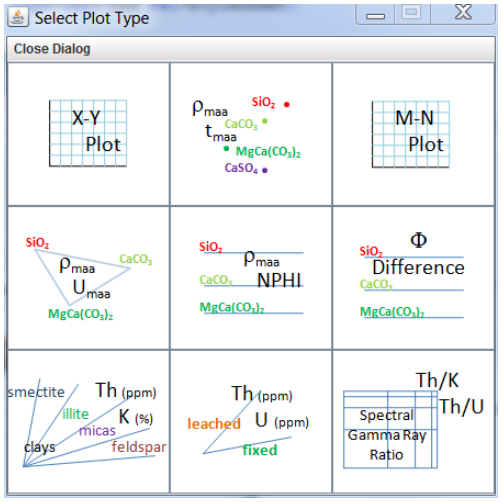
When the user selects the “Parse Data” Button on the “Parse Comments/Remarks/Notes ASCII Text File” Dialog the data is parsed into the 3D Cross Plot Program, where the Geologist Report Delimited file name is entered into the “PC ASCII Files:” Panel as well as the data type source.



Select the “Continue” Button to open the 3D Cross Plot Dash board.

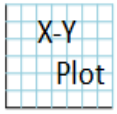
3D Cross Plot Dash Board

The Cross Plot Dash Board was set up to provide a number of standard log curve plot presentations. Each button except for the X-Y Plot button is very dependent on the log curve type, i.e. M-N Plot depends on the Neutron Porosity (NPHI), Bulk Density (RHOB), Acoustic Transit Time (DT) and Gamma Ray (GR). If any of the necessary curves are not present then the button is disabled. The X-Y Plot button allows the user to select available log curves as well as measured core data to plot. Each button displays the Cross Plot Control Dialog, with a Histogram Plot, 3D Cross Plot and a Profile Plot. Any filter action that is performed on one button will be reflected in the other buttons if the user selects another button.

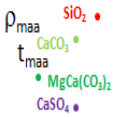


The following matrix defines the Cross Plot Buttons and the log curves that must be present.

Cross Plot Selection Panel Icon Buttons



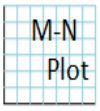
User Define XY Cross Plot
Log ASCII Standard (LAS) Log Data & Core Data
This button allows the user to select what data they wish to plot, i.e. LAS Gamma Ray Log Curve versus Measured Whole Core Porosity Data.



Rhomaa-Tmaa Cross Plot
The following Log ASCII Standard (LAS) Log Data Curves must be present,

Mnemonics	Description	Units
NPHI	Neutron Porosity	PU
RHOB	Bulk Density	gm/cc
or DPHI	Density Porosity	PU
DT	Acoustic transit time	usec/ft
or SPHI	Sonic Porosity	PU
GR	Gamma Ray	API

in order for the icon button to be enabled.

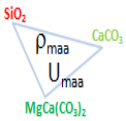


MN Litho-Porosity Cross Plot

The following Log ASCII Standard (LAS) Log Data Curves must be present,

Mnemonics	Description	Units
NPHI	Neutron Porosity	PU
RHOB	Bulk Density	gm/cc
or DPHI	Density Porosity	PU
DT	Acoustic transit time	usec/ft
or SPHI	Sonic Porosity	PU
GR	Gamma Ray	API

in order for the icon button to be enabled.

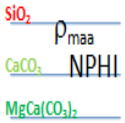


Rhomaa-Umaa Cross Plot

The following Log ASCII Standard (LAS) Log Data Curves must be present,

Mnemonics	Description	Units
NPHI	Neutron Porosity	PU
RHOB	Bulk Density	gm/cc
or DPHI	Density Porosity	PU
PE	Photoelectric Factor	barns/e
GR	Gamma Ray	API

in order for the icon button to be enabled.

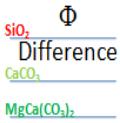


Rhomaa-NPHI Cross Plot

The following Log ASCII Standard (LAS) Log Data Curves must be present,

Mnemonics	Description	Units
NPHI	Neutron Porosity	PU
RHOB	Bulk Density	gm/cc
or DPHI	Density Porosity	PU
GR	Gamma Ray	API

in order for the icon button to be enabled.

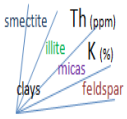


Porosity Difference Cross Plot

The following Log ASCII Standard (LAS) Log Data Curves must be present,

Mnemonics	Description	Units
NPHI	Neutron Porosity	PU
RHOB	Bulk Density	gm/cc
or DPHI	Density Porosity	PU
GR	Gamma Ray	API

in order for the icon button to be enabled.



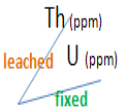
Thorium (Th) - Potassium (K) Cross Plot

The following Log ASCII Standard (LAS) Log Data Curves must be present,

Mnemonics	Description	Units
THOR	Thorium Concentration	PPM
URAN	Uranium Concentration	PPM

POTA	Potassium Concentration	%

in order for the icon button to be enabled.

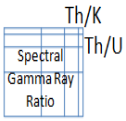


Thorium (Th) - Uranium (U) Cross Plot

The following Log ASCII Standard (LAS) Log Data Curves must be present,

Mnemonics	Description	Units
THOR	Thorium Concentration	PPM
URAN	Uranium Concentration	PPM
POTA	Potassium Concentration	%

in order for the icon button to be enabled.



Spectral Gamma Ray Cross Plot

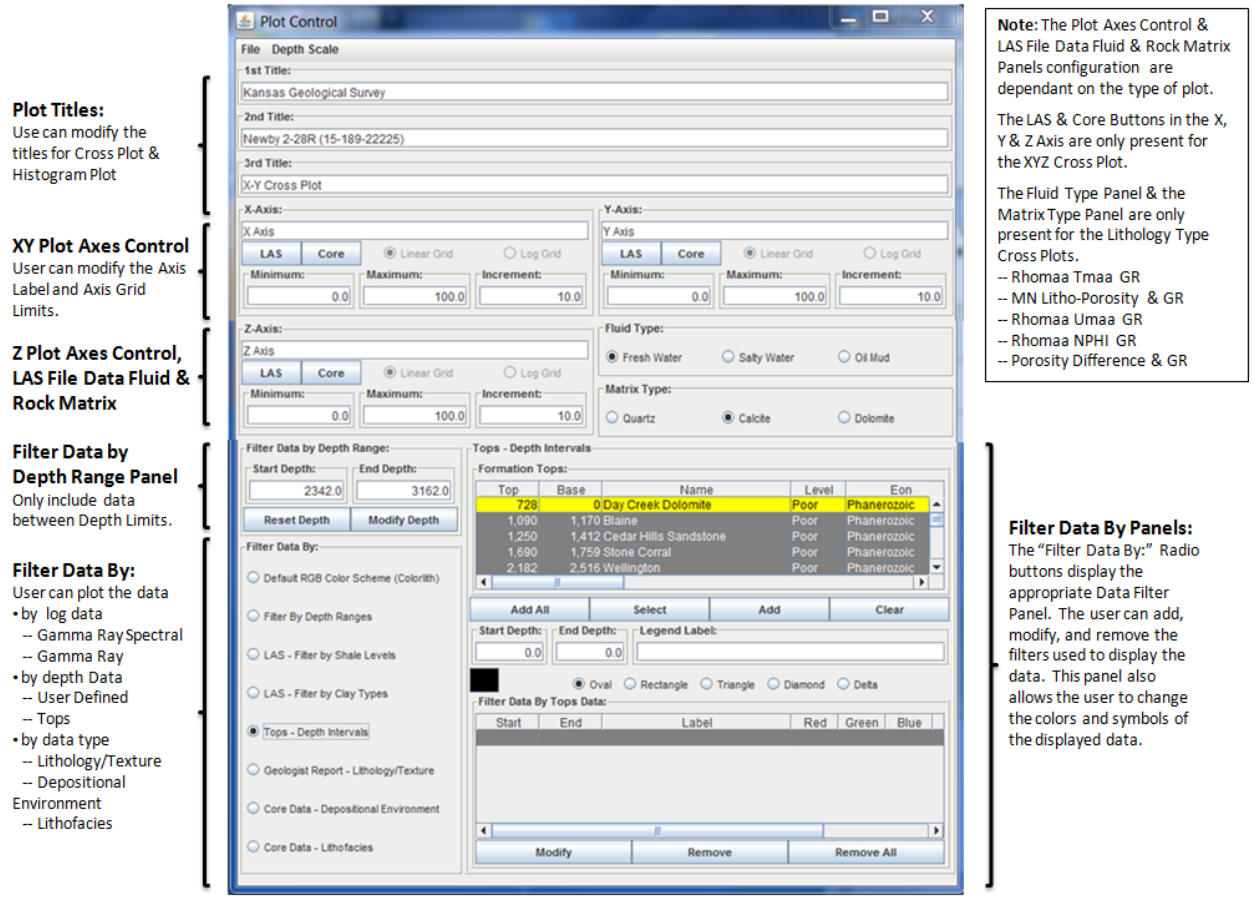
The following Log ASCII Standard (LAS) Log Data Curves must be present,

Mnemonics	Description	Units
THOR	Thorium Concentration	PPM
URAN	Uranium Concentration	PPM
POTA	Potassium Concentration	%

in order for the icon button to be enabled.

3D Cross Plot Control & Plot Dialogs

The Cross Plot Control Dialog loads the curves necessary to reflect the icon button selected in the Cross Plot Dash Board except for the X-Y Plot Button will, which will allow the user to choose from available log curves and measured core data. The user can modify the titles, the X-Y-Z axes and in some cases the Fluid & Matrix Type as well as filter the data by colors using the Tops, Primary Lithology in the Geologist Report, Clay Types, Shale Levels, etc.



Filter Data By

The initial "Filter Data By" radio button selection is the "Default RGB Color Scheme (Colorlith)", which for all the Cross Plot Dash Board Buttons has the minimum and maximum value for each Red Green and Blue Color value pre-selected except the X-Y Plot Button, which is determine by the units when the user loads each of the axes.

Depth Range: Start Depth & End Depth

The user can exclude data from the plots by setting the Starting Depth and Ending Depth on the Cross Plot Control Panel. This is the top filter and will be considered first before the other filters are added.

Depth Ranges

This allows the user to add depth ranges to the filter list and the program will automatically add the log data to the Cross Plot, Histogram Plot and mark the colors on the Profile Plot.

Tops – Depth Intervals

If the tops data is present the program will automatically build a list the user can select from. As the user selects the tops the program will automatically add the log data to the Cross Plot, Histogram Plot and mark the colors on the Profile Plot.

Geologist Report (Rock Description)

Lithology/Texture is parsed from the description of the rock or core. The program will automatically build a list of primary lithologies from the rock/core descriptions, which the user can select from.

Core Data – Depositional Environment

If the curve type Depositional Environment is present the program will automatically build a list the user can select from. This LAS Log Data will only be selected over the depth range the core data is present.

Core Data – Lithofacies

If the curve type Lithofacies is present the program will automatically build a list the user can select from. This LAS Log Data will only be selected over the depth range the core data is present.

Log Data – Shale Levels (Gamma Ray API Levels)

The program automatically separates the log data by Gamma Ray API Levels into Default Shale Levels as follows,

- Clean Formation 0.0 to 60.0 API
- Shaly Formation 60.0 to 70.0 API
- Shale Formation 70.0 API to 100.0 API
- Hot Shale Formation 100.0 API to 150.0 API
- Beyond Maximum greater than 150.0 API

These values can be edited by the user to reflect what the user perceives as the natural API range.

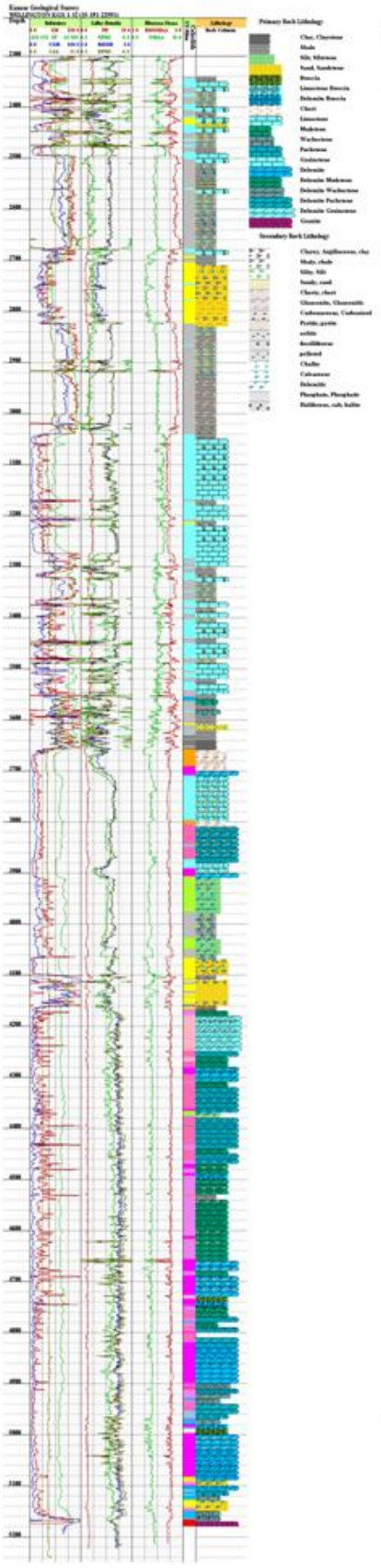
Log Data – Clay Minerals (Th/K Ratio Levels)

The program automatically separates the Th/K Ratio Levels into Clay Minerals as follows,

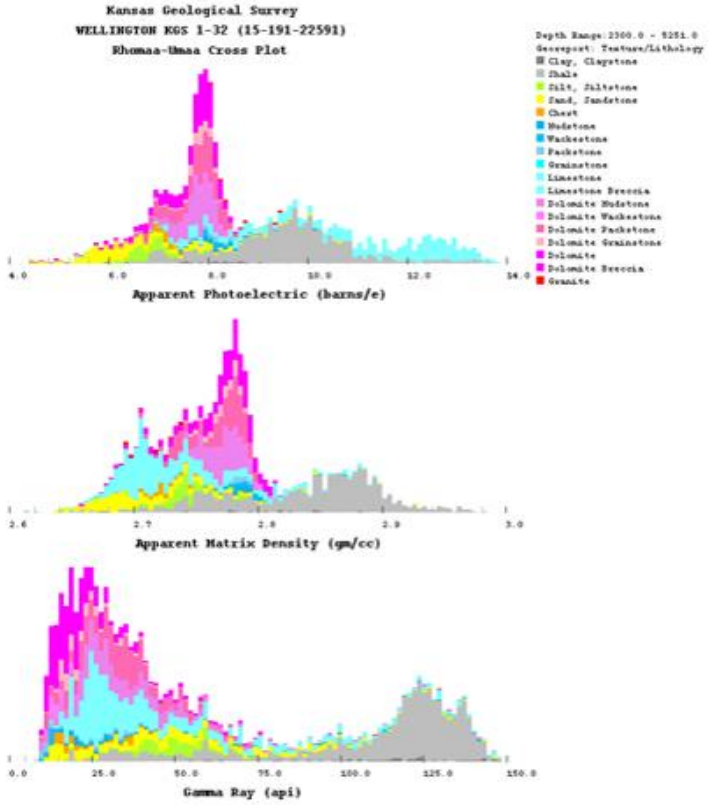
- Potassium Evaporates 0.0 to 0.5
- Feldspar 0.5 to 0.8
- Glauconite 0.8 to 1.33
- Micas 1.33 to 2.0
- Illite 2.0 to 3.5
- Smectite 3.5 to 12.0
- Heavy Thorium Bearing Minerals 28.0 to 100.0

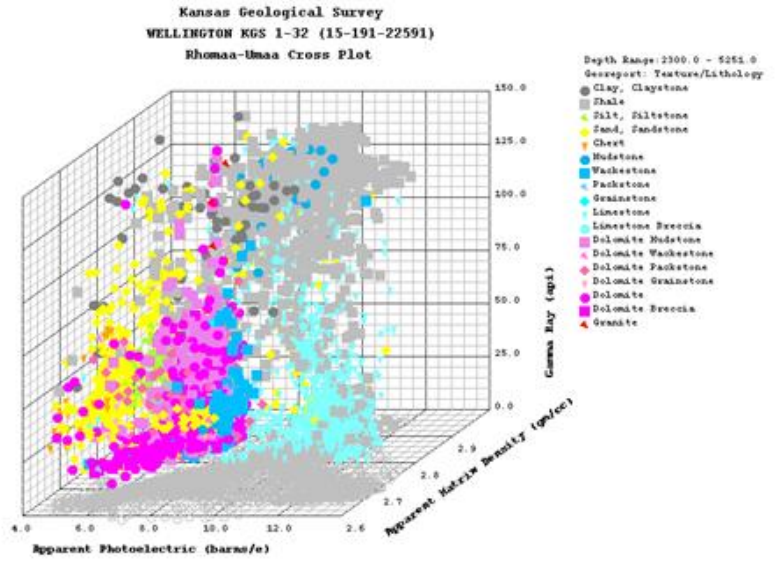
The user can set up all the "Filter Data By" plots for selected Cross Plot Dash Board Icon Button and if the user switches to another icon button the "Filter Data By" selections will automatically be transferred to the new selection, i.e. the user does not have to go through the process of setting the colors, depth ranges, etc. for every icon button. The user can move from Cross Plot Icon Button to Icon Button to view the data presentation and the "Filter Data By" for each selection.

The Profile Plot will present the log curves and core data points by depth to reflect the for each Cross Plot Icon Button selected and the "Filter Data By" will also be represented as another track, i.e. if the user selects the "Geologist Report – Lithology/Texture" radio button then a rock column will be plotted to illustrate the possible lithologies and the color choices selected in a plot track next to it, see image below.



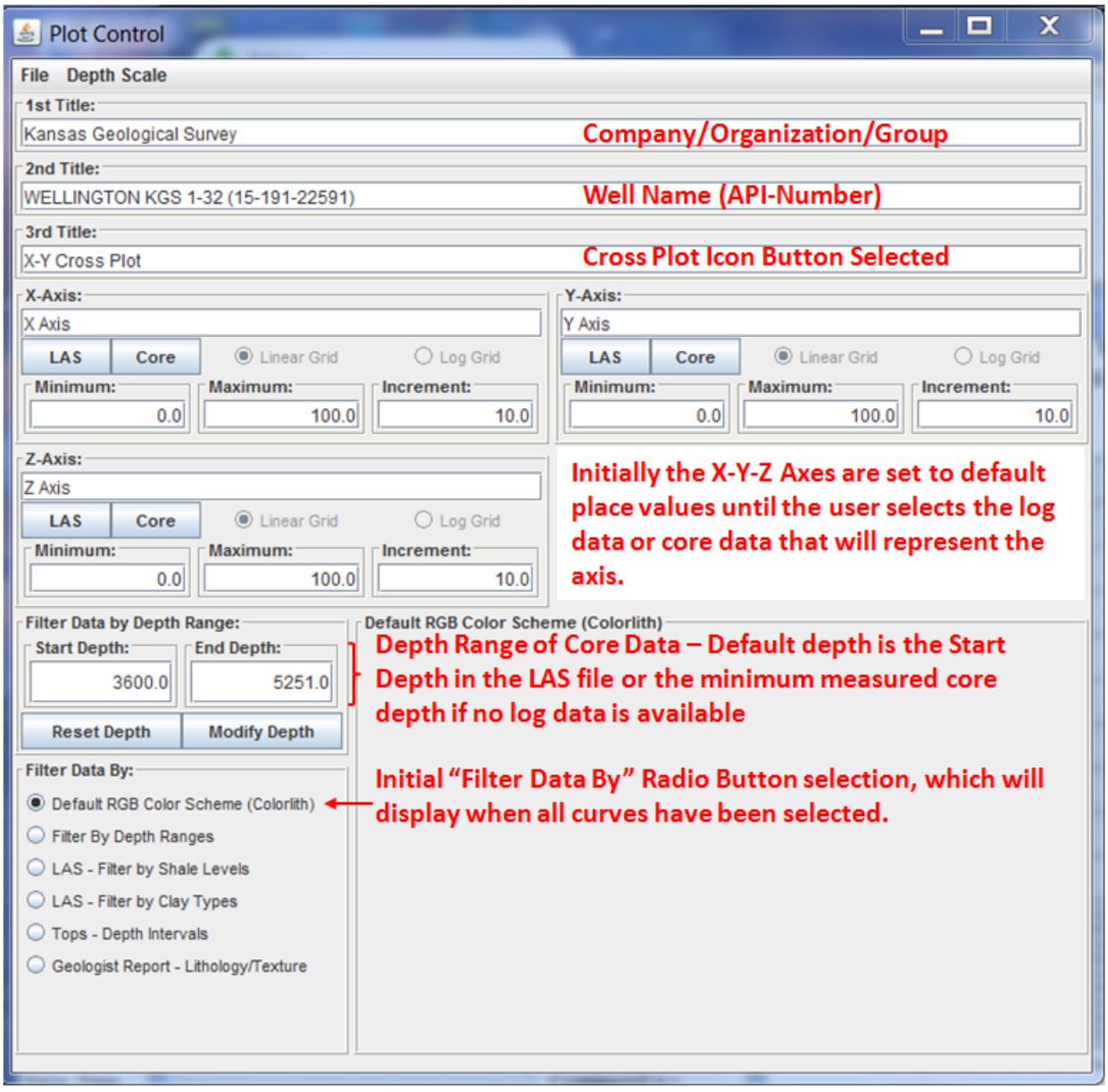
Wellington KGS 1-32
RHOmaa – Umaa – GR Cross Plot
Filtered by Geologist Primary Lithology Description

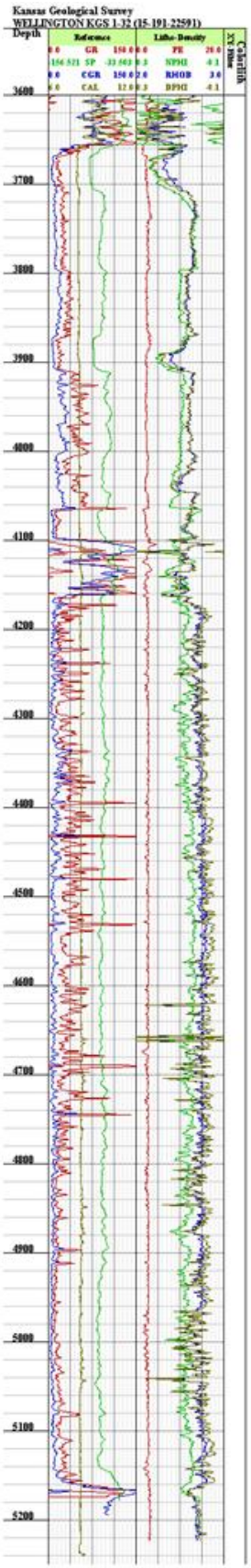


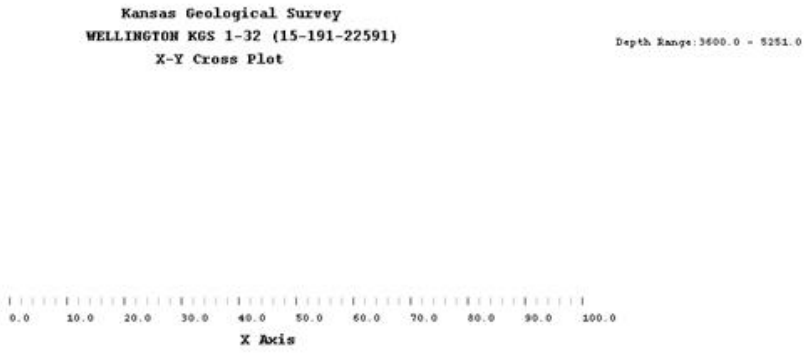


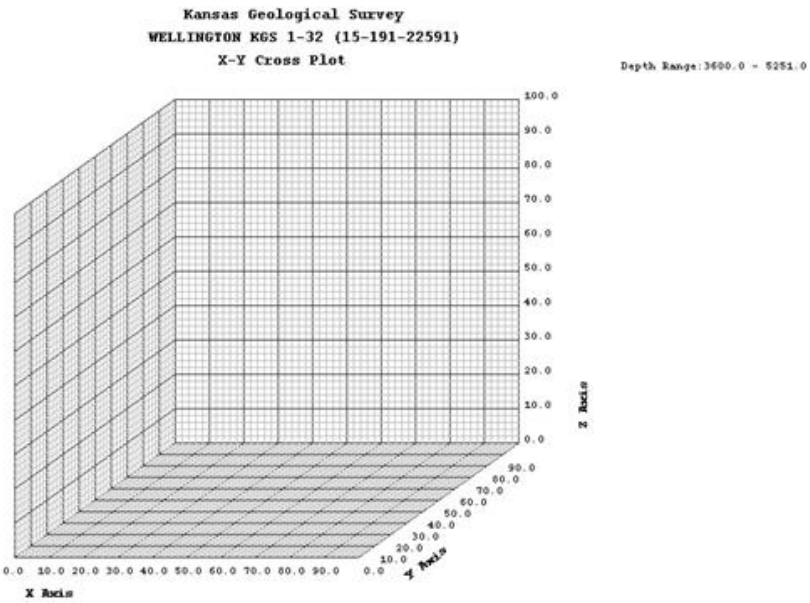
X-Y Dash Board Icon Button Control Dialog

The X-Y Plot Icon Button allows the user to plot any available log curve and/or core data against each other and in any direction, the user can plot two measured core data in the X-Y direction and the gamma ray log curve in the Z direction. This button is the only button that does not preselect the X-Y-Z curves to be plotted. The three plots, histogram and cross plot are empty until the user selects the curves. The profile plot will display default plot tracks depending on the data available by a hierarchy of log curves, i.e. Litho-Density Log Curves first, Resistivity Log Curves if Litho-Density is not present, etc. As the user selects each curve that curve is reflected in the histogram first and the cross plot when all the curves are present.



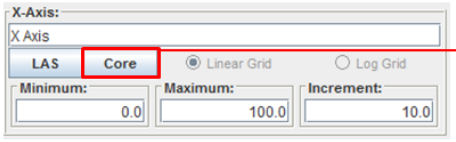




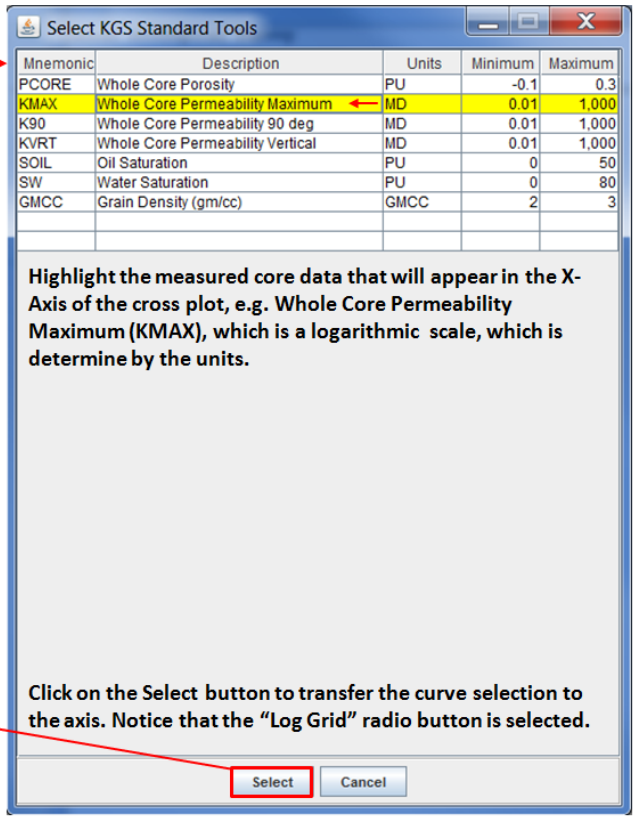


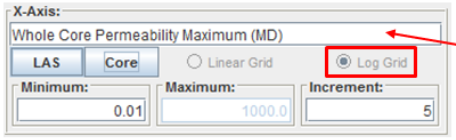
Initially the Histogram & Cross Plots are empty until the user selects the curve. The Profile Plot displays default log curves until all the axes are selected.

Select X-Axis Curve

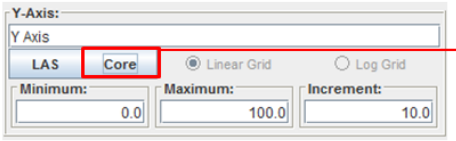


Select the Core Button to display the "Select KGS Standard Tools" Dialog. This dialog will list all the available measured core data that was imported into the Cross Plot Program.

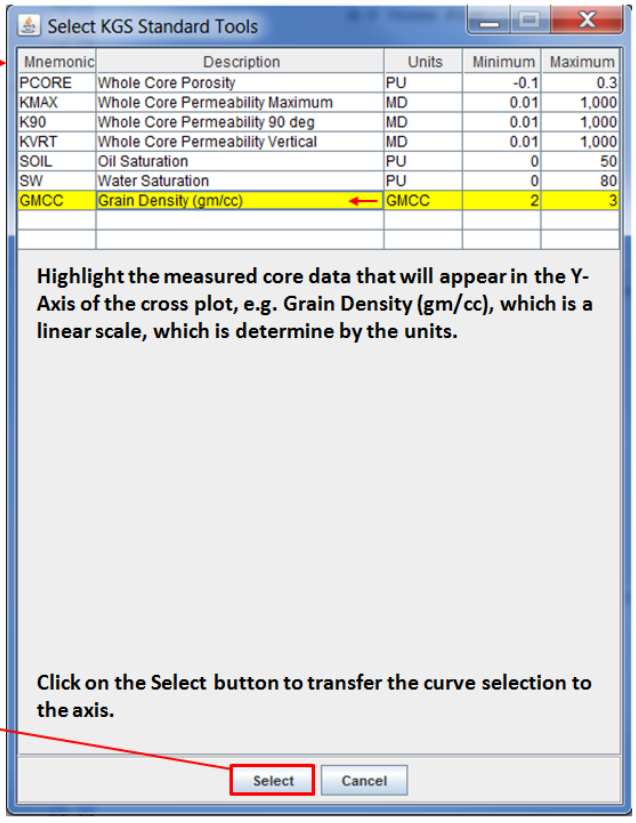


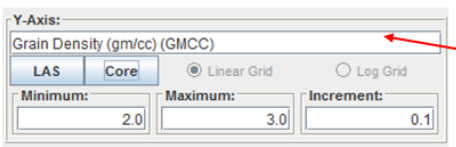


Select Y-Axis Curve

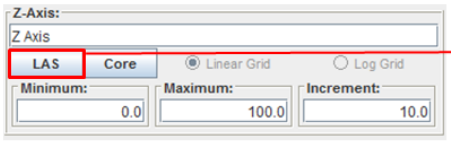


Select the Core Button to display the "Select KGS Standard Tools" Dialog. This dialog will list all the available measured core data that was imported into the Cross Plot Program.

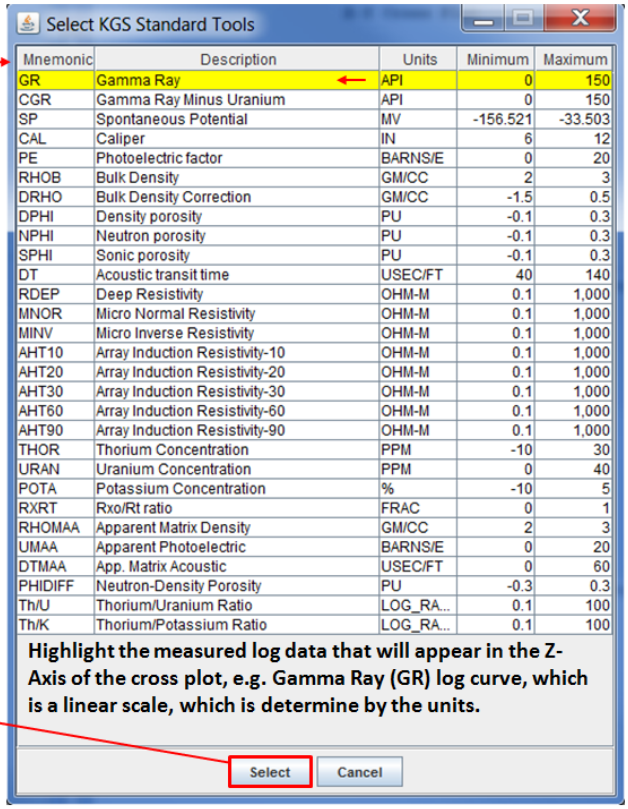


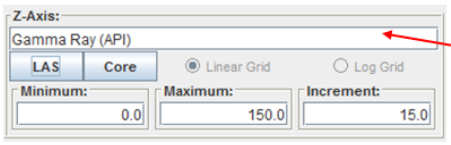


Select Z-Axis Curve

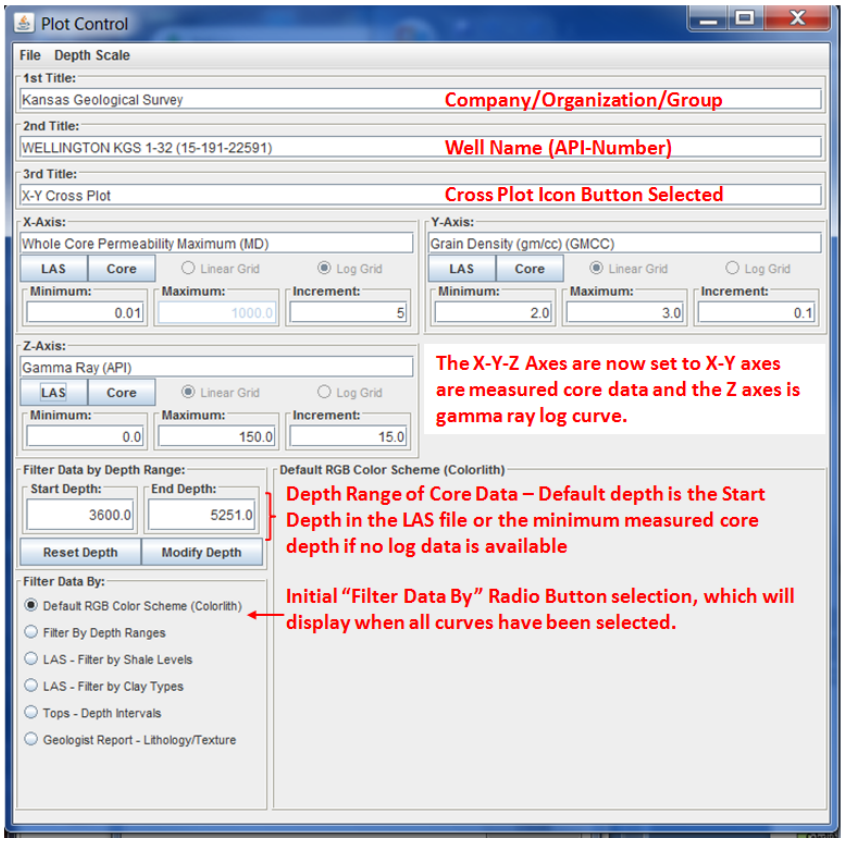


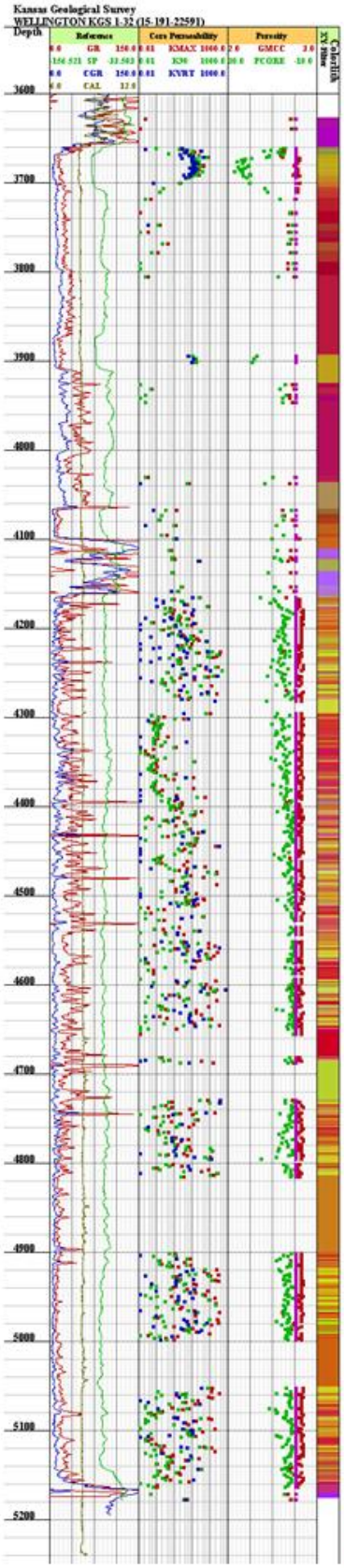
Select the Core Button to display the "Select KGS Standard Tools" Dialog. This dialog will list all the available measured core data that was imported into the Cross Plot Program.

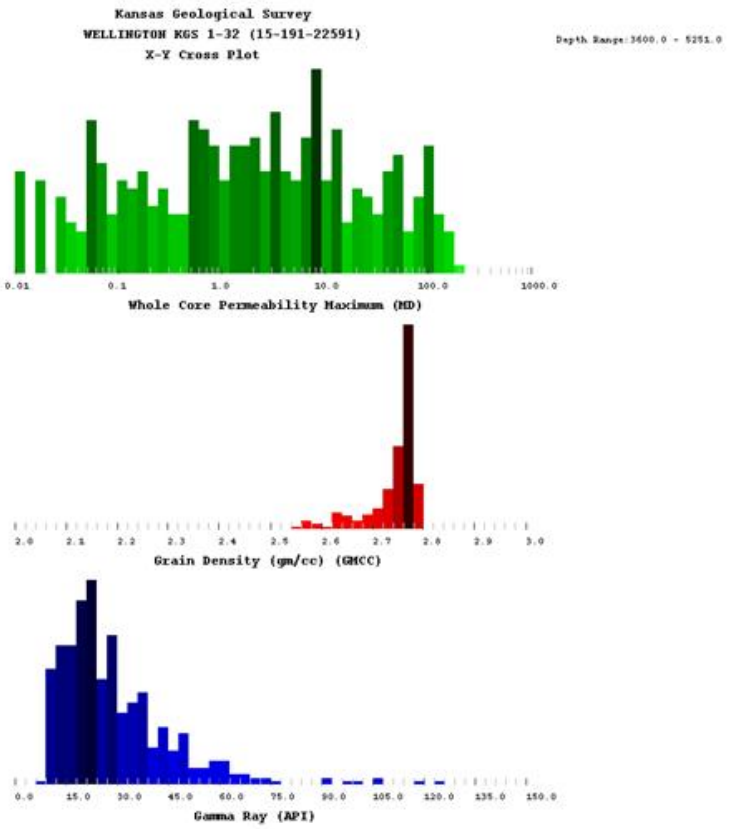


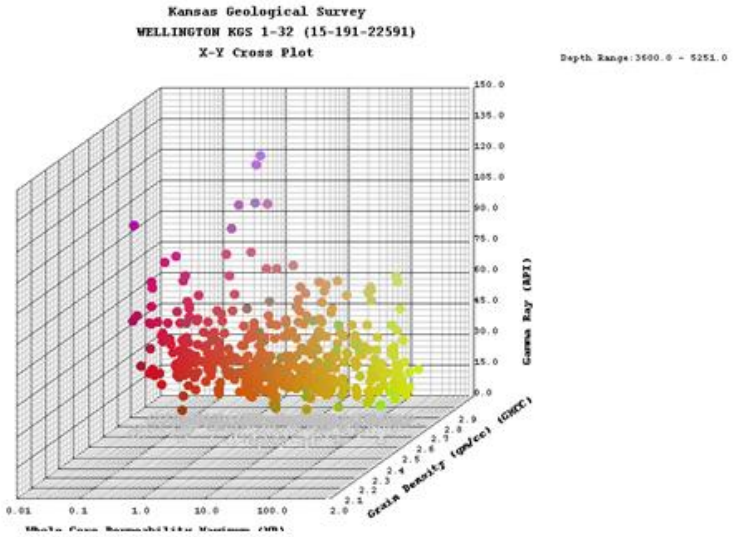


Click on the Select button to transfer the curve selection to the axis.



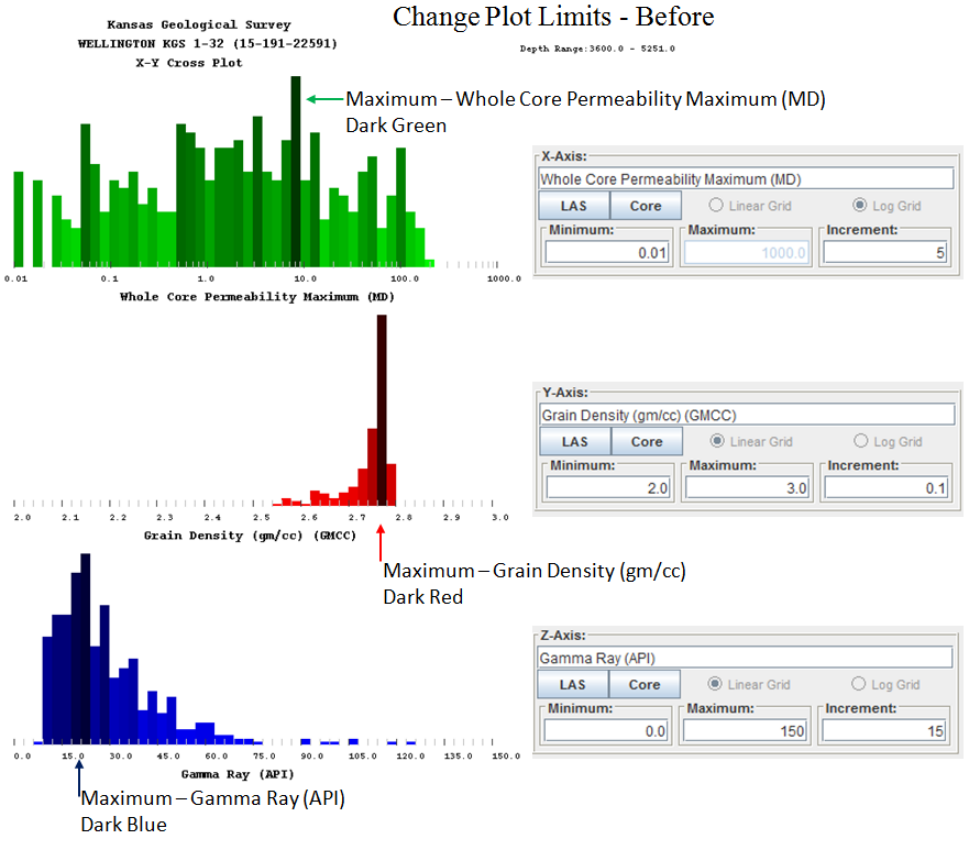




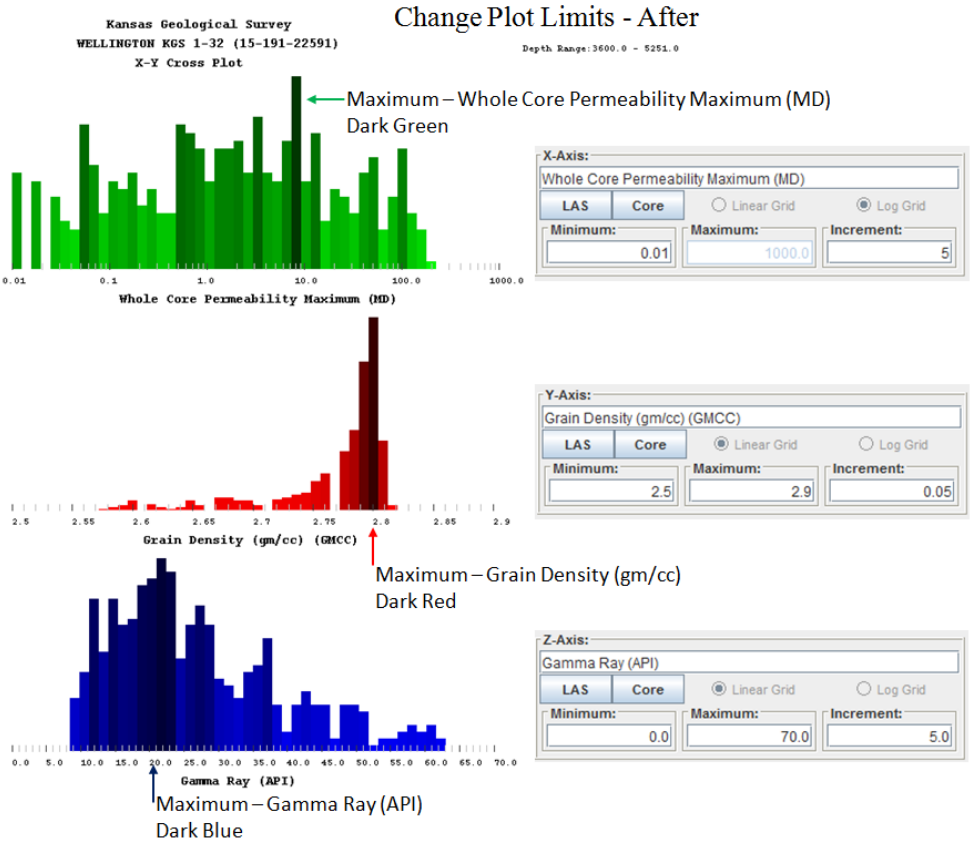


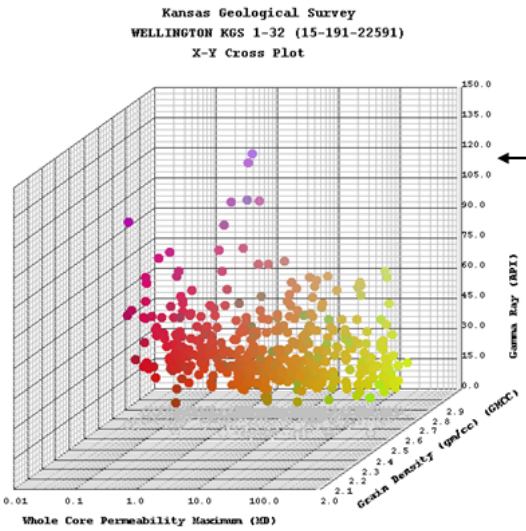
The Histogram and Cross Plot now display the core & log data as well as the Profile plot displays the plot tracks of the selected data.

Change Plot Limits - Before

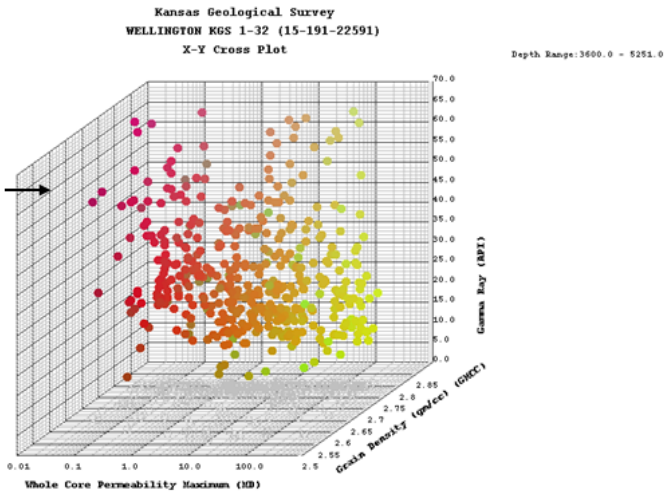


Change Plot Limits - After





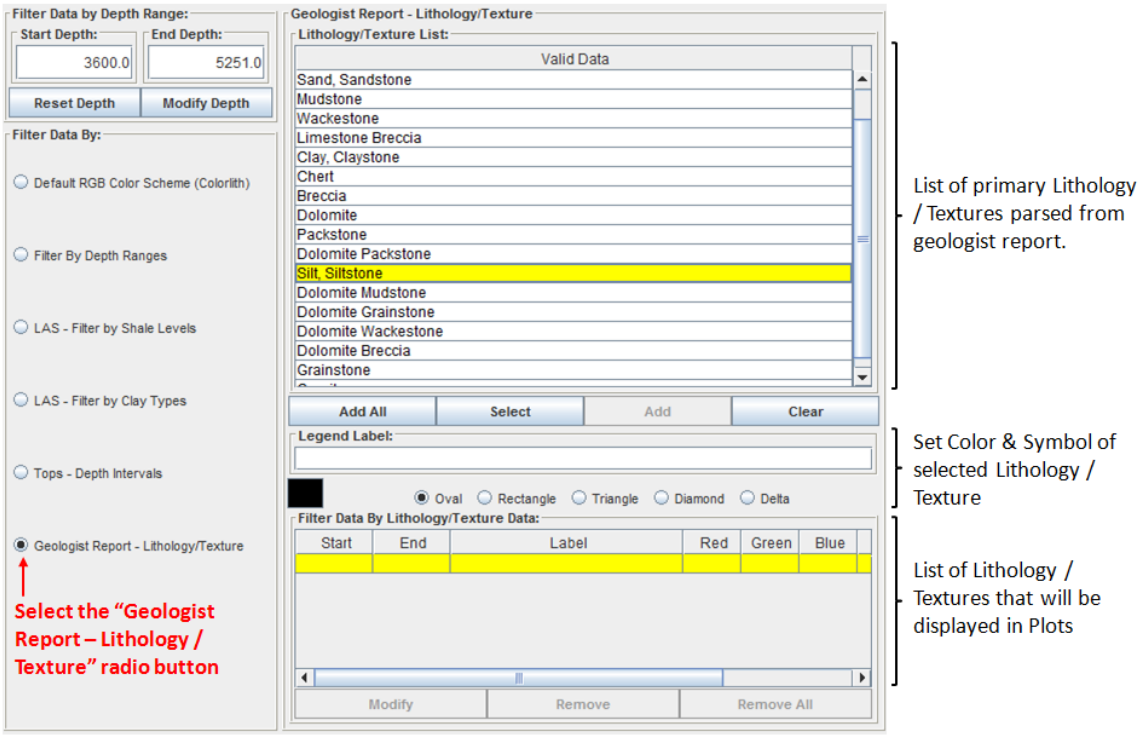
Cross Plot Before Axes Change – Default X-Y-Z Limits
X Axis: 0.01 to 1000.0 (MD) - Default
Y Axis: 2.0 to 3.0, increment 0.1 (gm/cc)
Z Axis: 0.0 to 150.0, increment 15.0 (API)



Cross Plot After Axes Change
X Axis: 0.01 to 1000.0 (MD) - Default
Y Axis: 2.5 to 2.9, increment 0.05 (gm/cc)
Z Axis: 0.0 to 70.0, increment 5.0 (API)

X-Y Dash Board Icon Button – Geologist Report – Lithology/Texture

The "Geologist Report – Lithology/Texture" radio button allows the user to filter the log and core data by color and symbols. The cross plot program parses the geologist cuttings / core descriptions into a list of primary lithologies and in some cases with limestone and dolomite by textures. The user can select the "Add All" button to move every lithology into the "Filter Data By Lithology/Texture Data" table with each lithology being assigned a default color and symbol automatically. There are 43 possible colors from reds, oranges, yellows, etc. in that order being assigned to each lithology from the top of the list to the base with the plot symbols being assigned in a rotating manner, i.e. the first lithology are assigned an Oval symbol the second lithology a Rectangle symbol, etc.



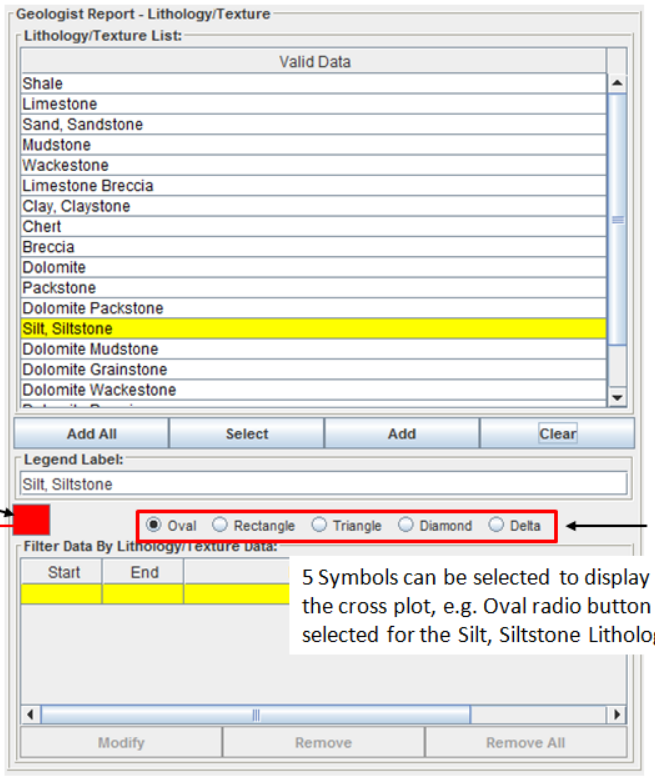
Valid Data Buttons

Add All – Select all Lithology / Textures and automatically assign colors and symbols
Select – Allows the user to assign color and symbol individual
Add – Add Lithology / Texture to the "Filter Data By Lithology/Texture Data" Table

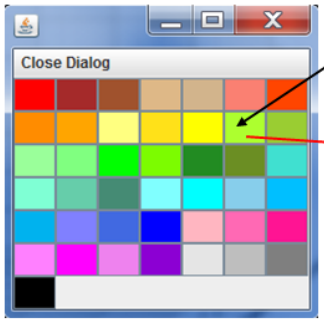
The "Add All" button is quick, but may not give an insight into the distribution of the lithology type with respect to other types since the color scheme starts with the top of the color wheel and moves successively to the base assigning the each lithology in the list above. The color schema will look more red and yellow and distinguishing one lithology from another would be problematic. The user can add the lithologies in the order they wish to see and assign color and symbols to group of lithology types, i.e. silt, sand with green, yellow respectively, limestone with shades of blues, dolomite with shades of violets. This way the lithologies will stand out more clearly. Start from the "Silt, Siltstone" and using the color green.

43 possible colors to select

Click on the color button to display color dialog

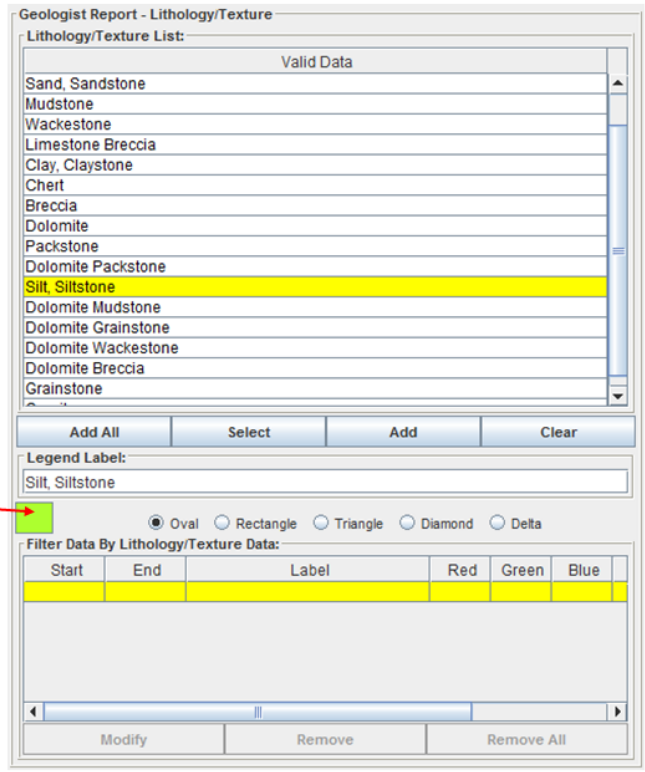


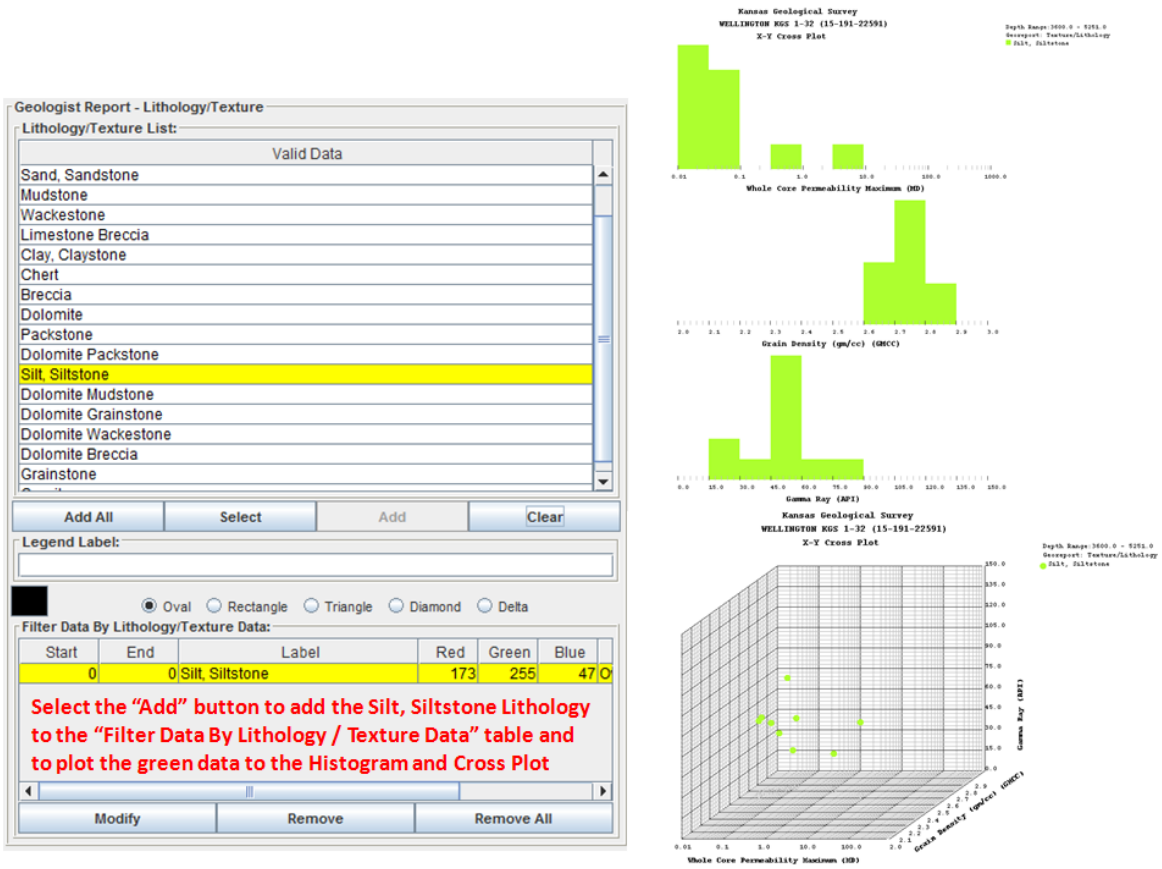
5 Symbols can be selected to display on the cross plot, e.g. Oval radio button is selected for the Silt, Siltstone Lithology



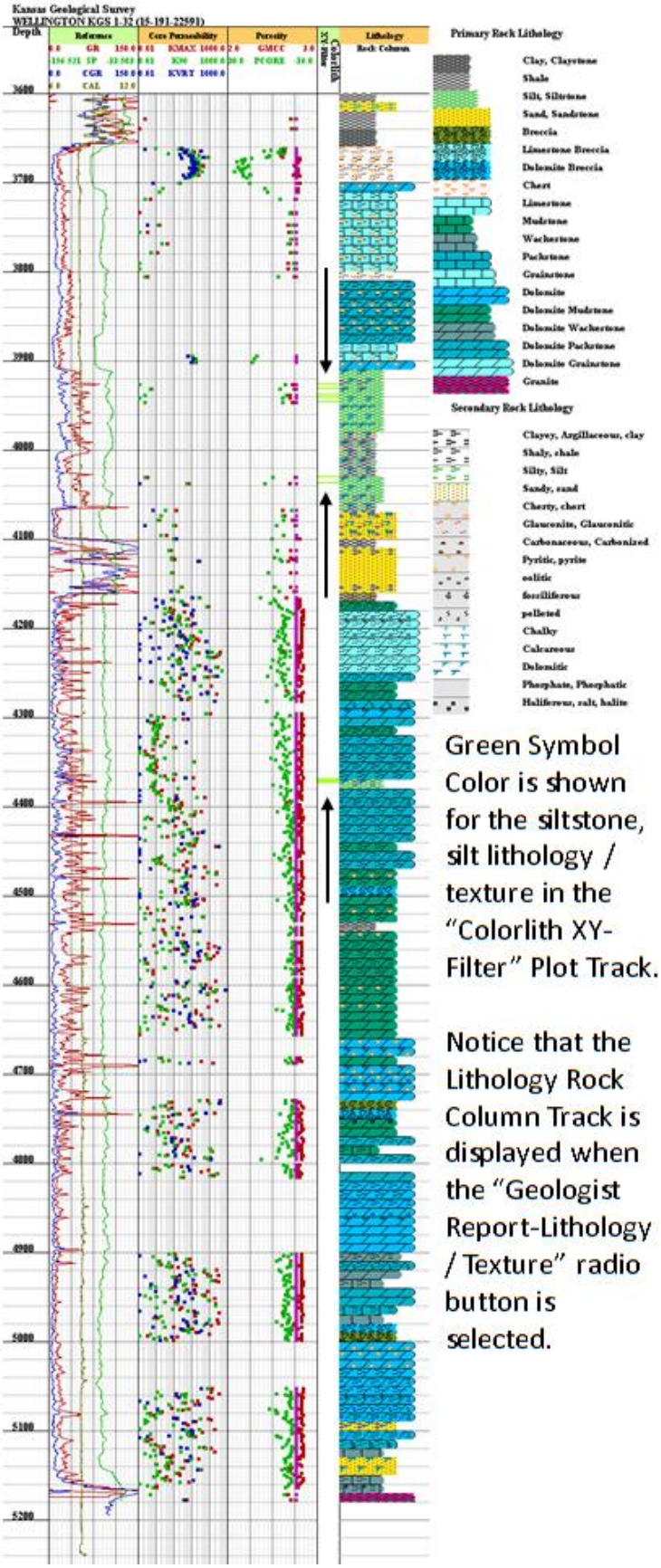
43 possible colors to select

Click on the color button to select color for Lithology symbol





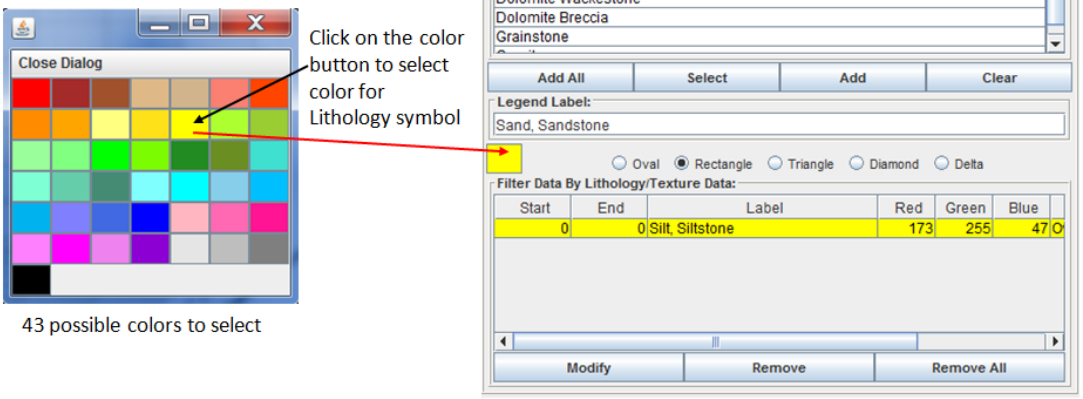
As the user looks at the profile plot below in the "Colorlith XY Filter" plot track the color does not go across all of the depth range of the zones that are described as silt. They only seem to line up with the measured core data depth range as thin lines. The depth range of the data defines the width of the color band and the core data unlike the log data is over a very short depth ranges. The log data will generally look more filled in because the zones are in half to quarter foot intervals connecting one depth to the next so the color will fill across the full depth range. So if the user only uses log data then the zone across the silt zone should reflect very closely the geologist description of the depth range on the profile plot.

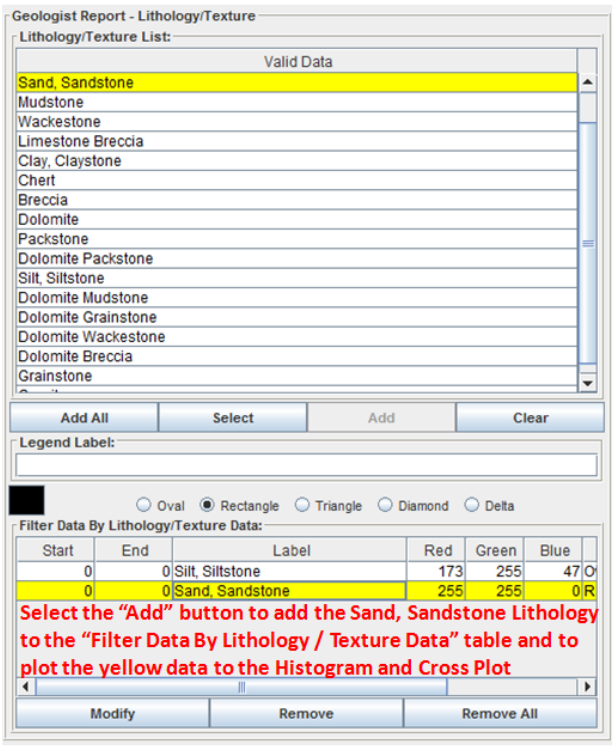


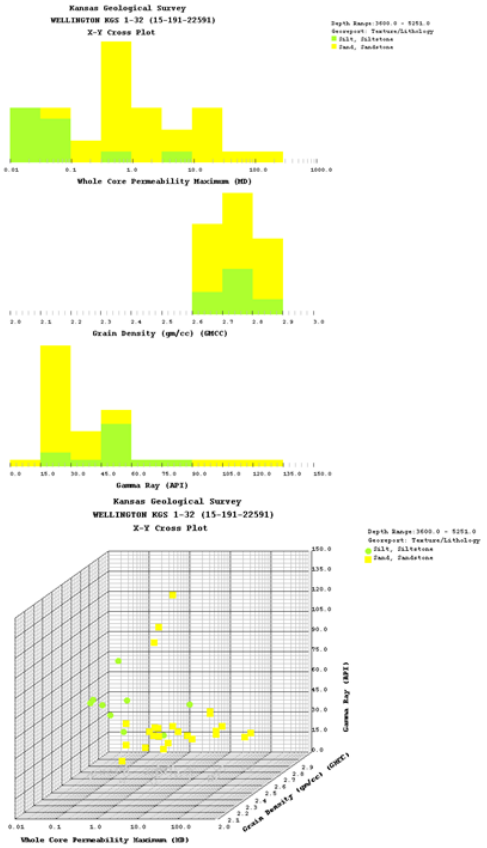
Green Symbol Color is shown for the siltstone, silt lithology / texture in the "Colorlith XY-Filter" Plot Track.

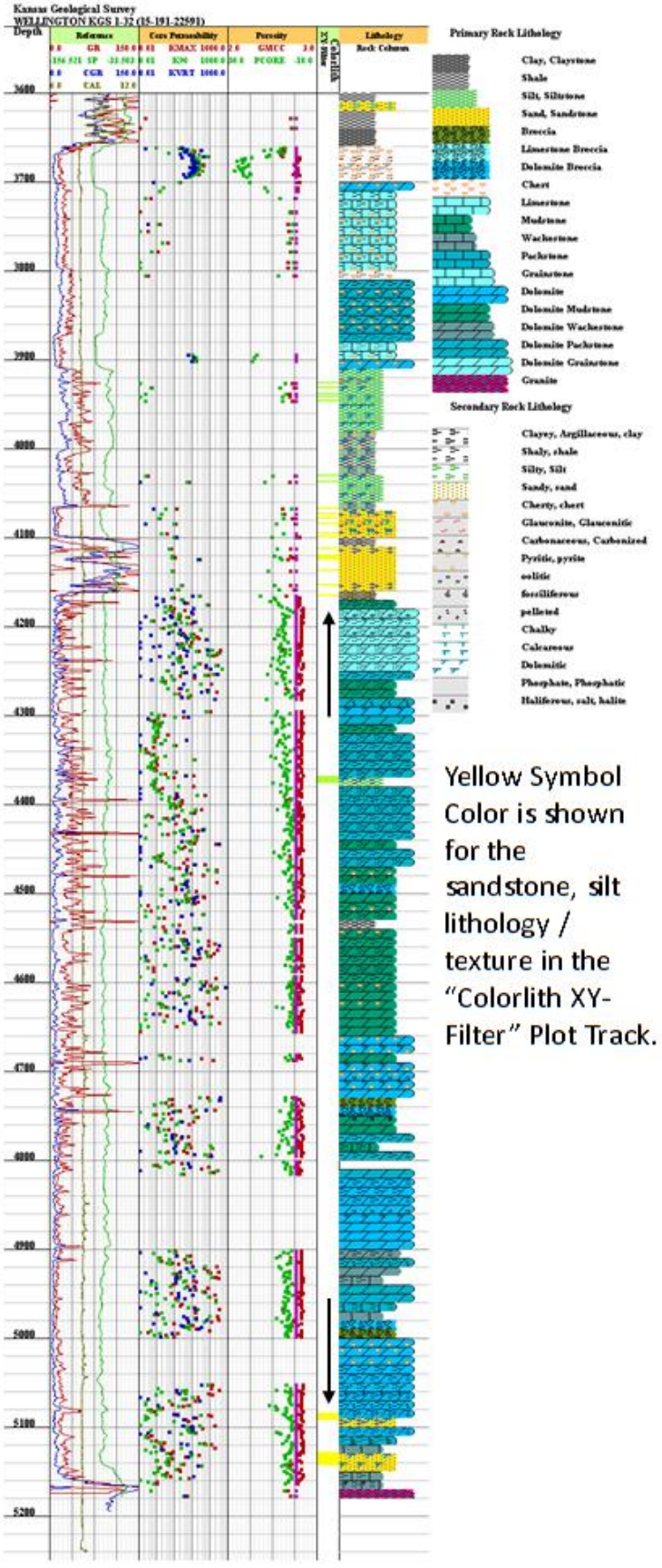
Notice that the Lithology Rock Column Track is displayed when the "Geologist Report-Lithology / Texture" radio button is selected.

The next lithology is “Sand, Sandstone” select the yellow color, if the user looks at the profile the symbols so far matches the background colors that are being selected.



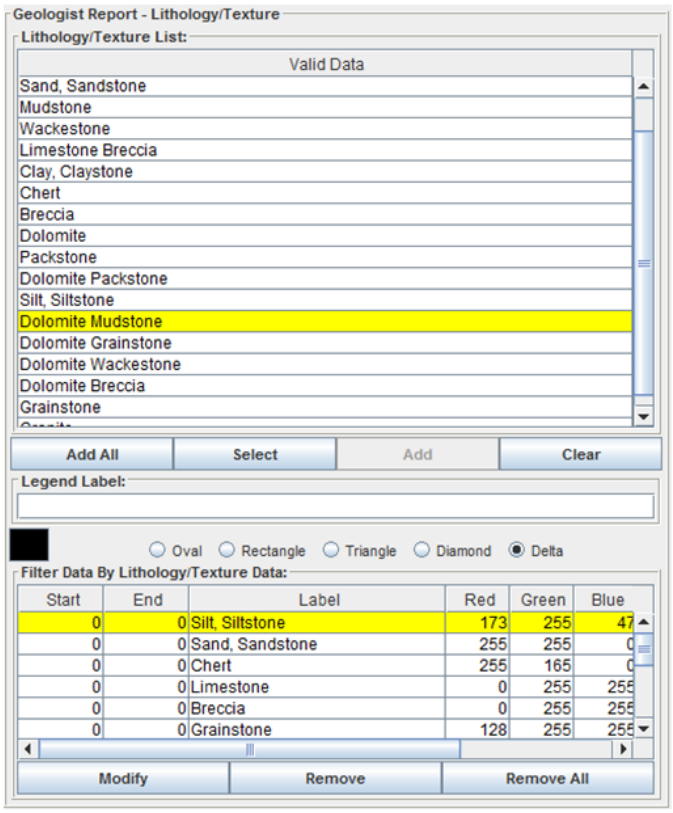




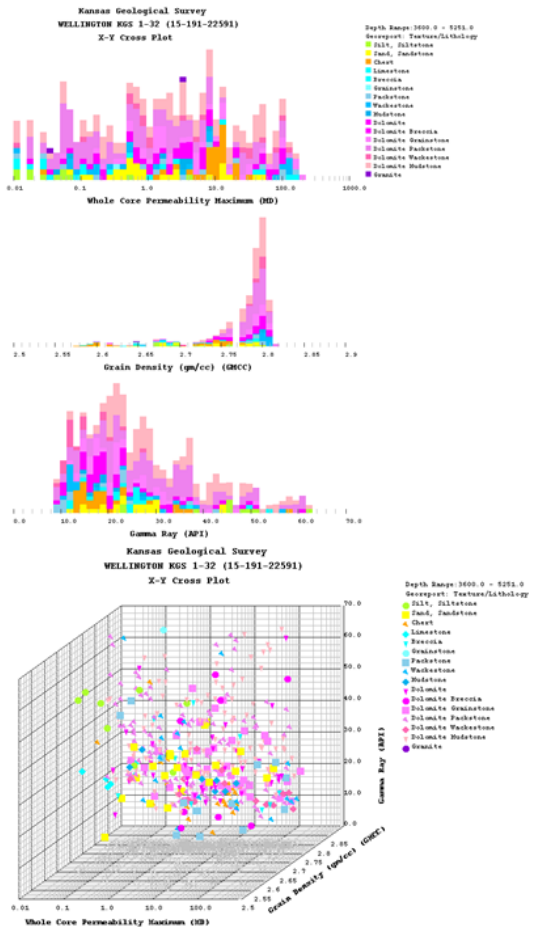


Yellow Symbol Color is shown for the sandstone, silt lithology / texture in the "Colorlith XY-Filter" Plot Track.

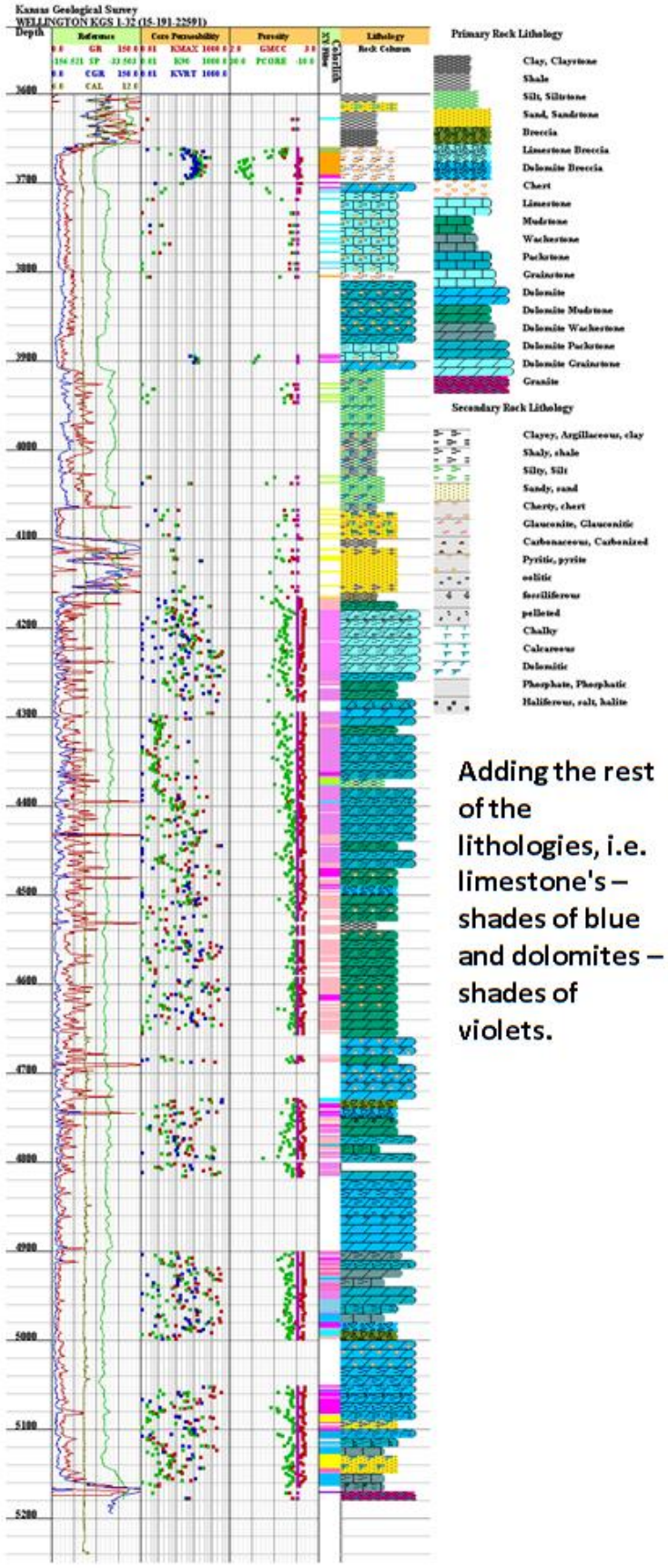
Continue adding each group of lithology / texture in reverse order, i.e. Grainstone, Packstone, Wackestone then Mundstone limestone as shades of blues going from light to darker blue. Then with Grainstone, Packstone, Wackestone then Mundstone dolomite as shades of violets from dark to lighter shades, this way the lithologies will stand out more clearly. As the user looks at the histogram, cross plots and the profile plot you can see the color schema better to identify the lithology differences at a glance.



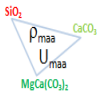
Adding the rest of the lithologies, i.e. limestone's – shades of blue and dolomites – shades of violets.



The profile plot will show white background gaps in the colors in the "Colorlith XY Filter" plot track with only color bands lining up with the core data.

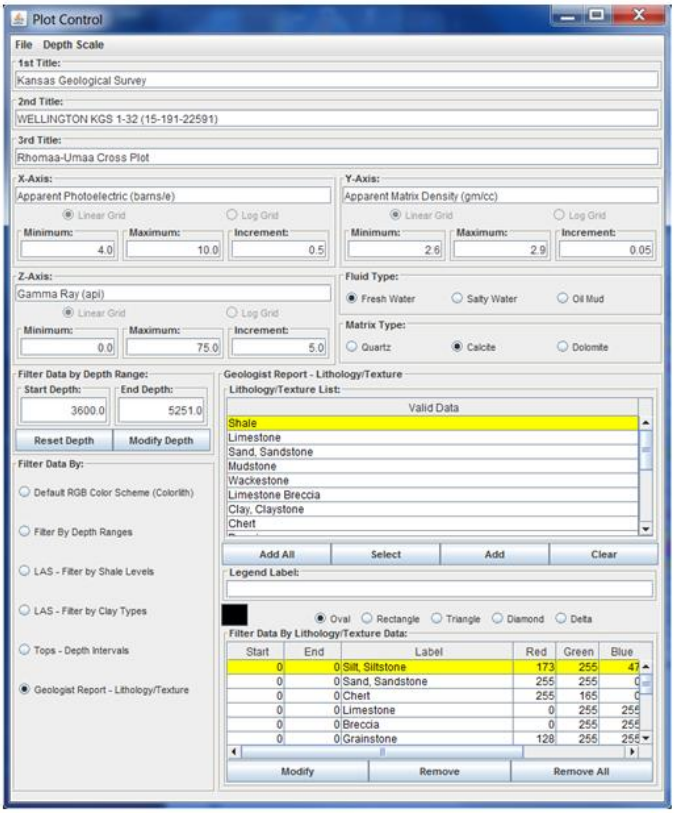


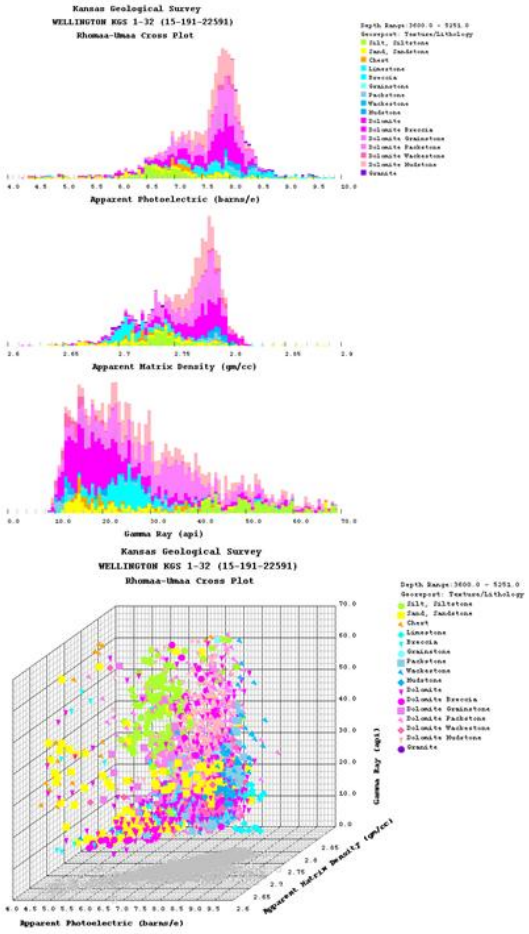
Adding the rest of the lithologies, i.e. limestone's – shades of blue and dolomites – shades of violets.



RHOmaa-Umaa-GR Dash Board Icon Button – Geologist Report Lithology/Texture

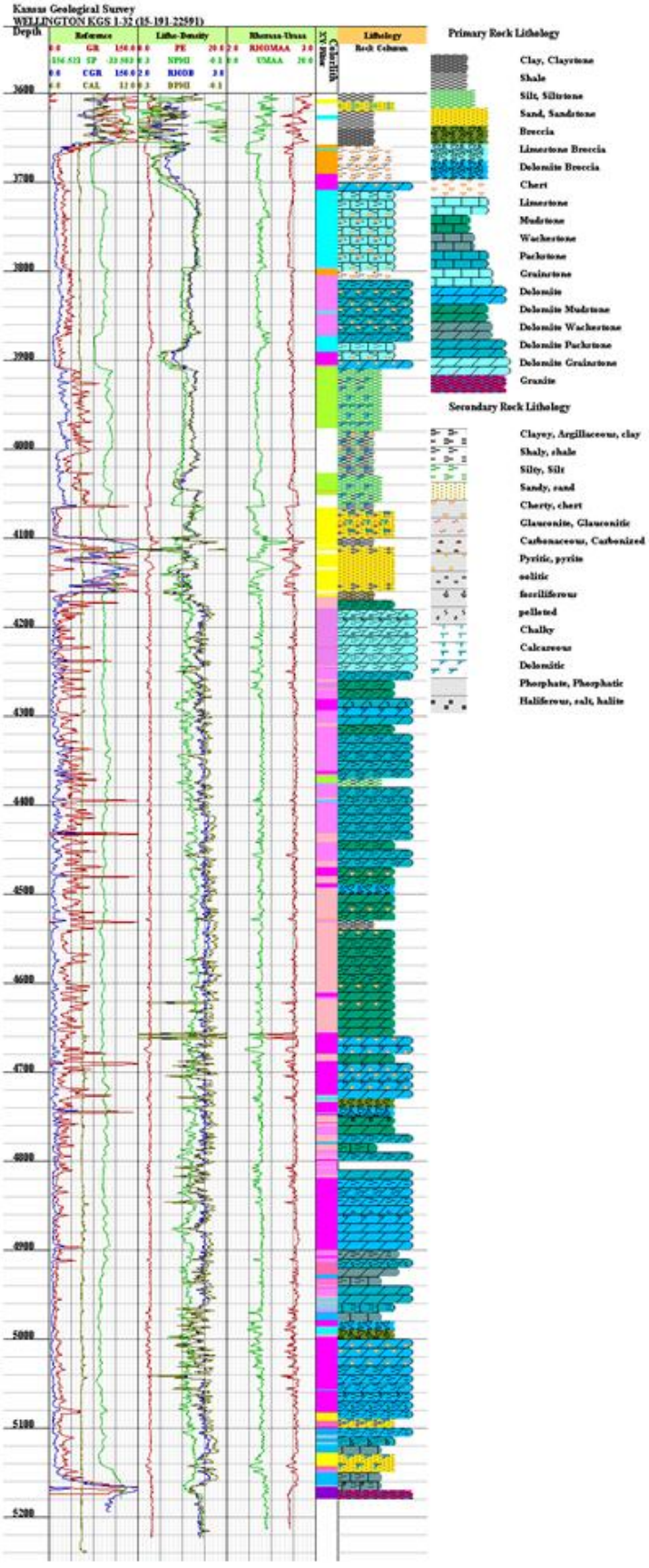
Exiting the X-Y Dash Board Icon Button Control Dialog and selecting the RHOmaa-Umaa-GR Dash Board Icon Button and selecting the "Geologist Report – Lithology/Texture" radio button will automatically display the color schema the user does not have to re-enter the color choices for the primary lithologies. The user needs to set the depth range starting depth to 3600.0 to reflect the same depth interval as the core data and changing the X-Y-Z limits to tighten the limits around the data distribution to better visualize the different lithology zones.





RHOmaa-Umaa-GR Log Curves
X Axis: 4.0 to 10.0, increment 0.5 (barns/e)
Y Axis: 2.6 to 2.9, increment 0.05 (gm/cc)
Z Axis: 0.0 to 70.0, increment 10.0 (API)

The profile plot will only show white background gaps in the colors in the "Colorlith XY Filter" plot track for lithologies that have not been defined, i.e. the shale and clay zones. As stated above since this profile plot, see image below, was on log data only notice that the color across the lithology matches the geologist description depth range much closer.



Primary Rock Lithology

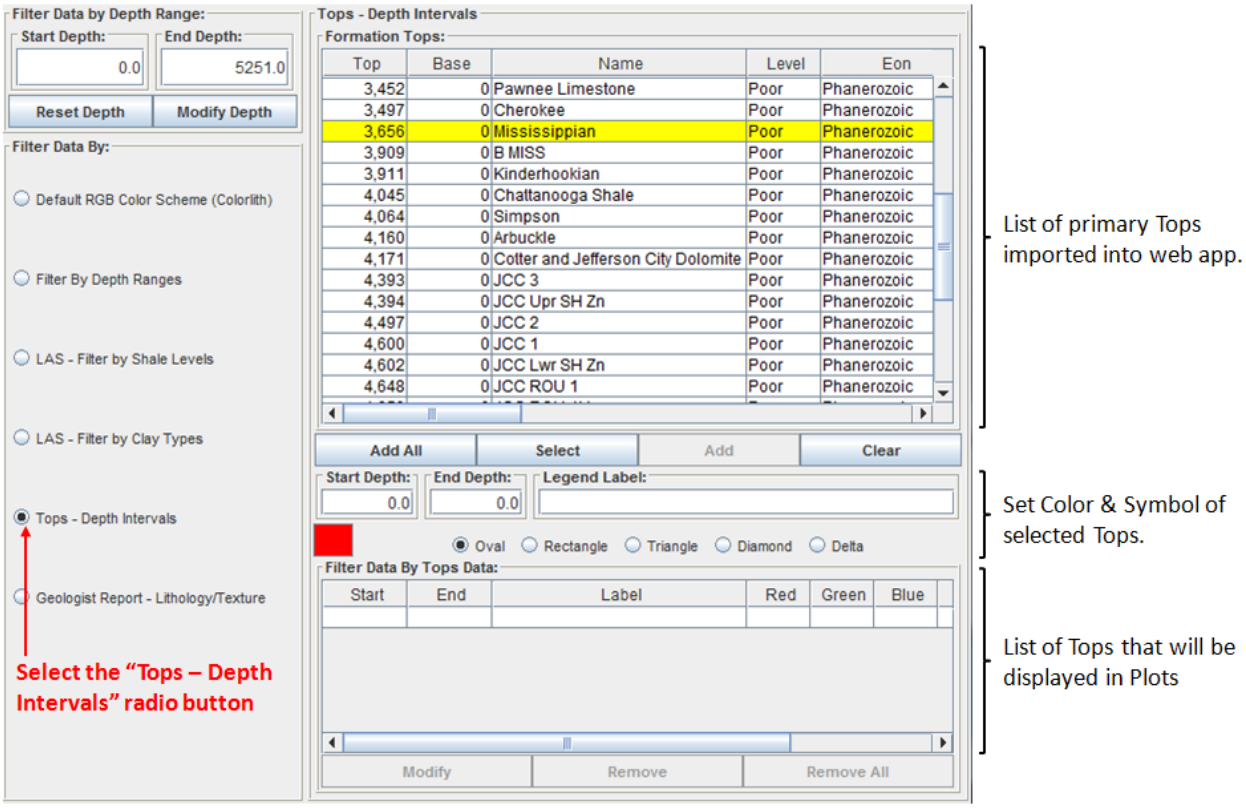
- Clay, Claystone
- Shale
- Silt, Siltstone
- Sand, Sandstone
- Breccia
- Limestone Breccia
- Dolomite Breccia
- Chert
- Limestone
- Mudstone
- Wackestone
- Packstone
- Grainstone
- Dolomite
- Dolomite Mudstone
- Dolomite Wackestone
- Dolomite Packstone
- Dolomite Grainstone
- Granite

Secondary Rock Lithology

- Clayey, Argillaceous, clay
- Shaly, shale
- Silty, Silt
- Sandy, sand
- Cherty, chert
- Glauconite, Glauconitic
- Carbonaceous, Carbonized
- Pyritic, pyrite
- oolitic
- fossiliferous
- pelleted
- Chalky
- Calcareous
- Dolomitic
- Phorphate, Phosphatic
- Haliferous, salt, halite

X-Y Dash Board Icon Button – Tops – Depth Intervals

The "Tops – Depth Intervals" radio button allows the user to filter the log and core data by color and symbols. The cross plot program displays the tops in the "Tops – Depth Intervals" table with the Top, Base Depths, and Name of the Top and other Stratigraphic Unit Names. The user can select the "Add All" button to move every Top into the "Filter Data By Tops Data" table with each top being assigned a default color and symbol automatically, if the top has a base with the top depth. There are 43 possible colors from reds, oranges, yellows, etc. in that order being assigned to each top from the beginning of the list to the base with the plot symbols being assigned in a rotating manner, i.e. the first top are assigned an Oval symbol the second top a Rectangle symbol, etc.



Valid Data Buttons

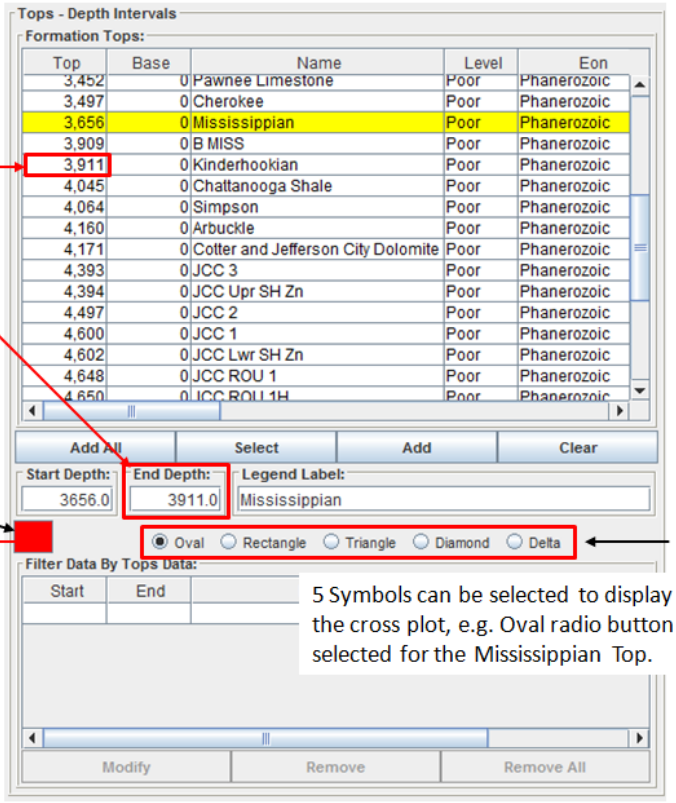
Add All – Select all Tops and automatically assign colors and symbols
Select – Allows the user to assign color and symbol individual
Add – Add Top to the "Filter Data By Tops Data" Table

The "Add All" button is quick, but may not give an insight into the distribution of the tops with respect to other tops since the color scheme starts with the top of the color wheel and moves successively to the base assigning the each top in the list above. The color schema will look more red and yellow and distinguishing one top from another would be problematic. The user can add the tops in the order they wish to see and assign color and symbols to group of tops.

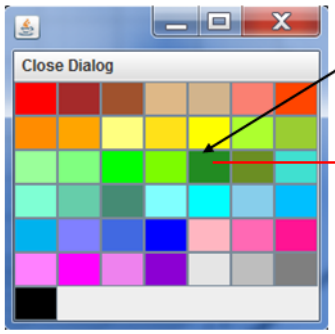
In order for the tops to plot you must have both a Top and Base for each top in the "Filter Data By Tops Data" Table when the top is selected, e.g. B MISS is the base of the Mississippian, but for this example we will use the Kinderhookian as the base although the real base should be the top of the Chattanooga Shale (Top of the Devonian).

43 possible colors to select

Click on the color button to display color dialog

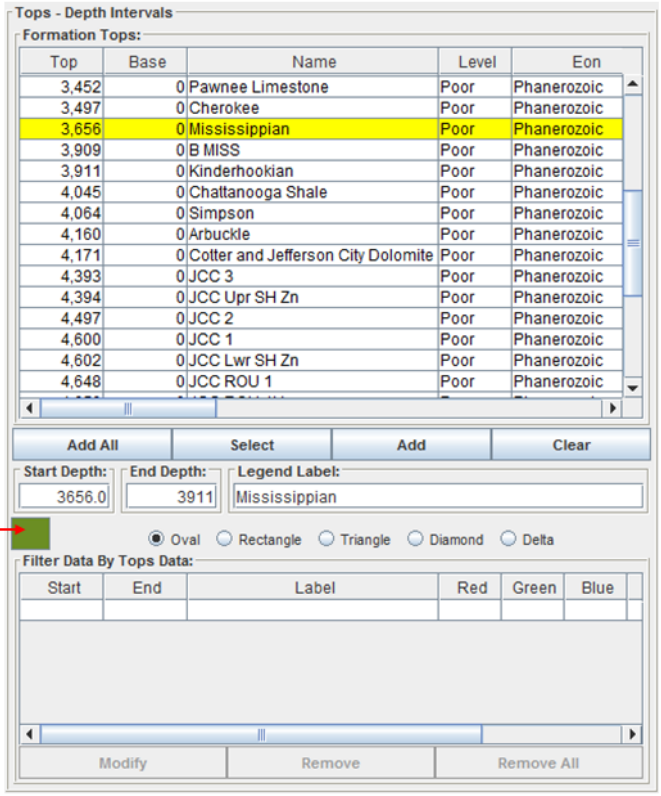


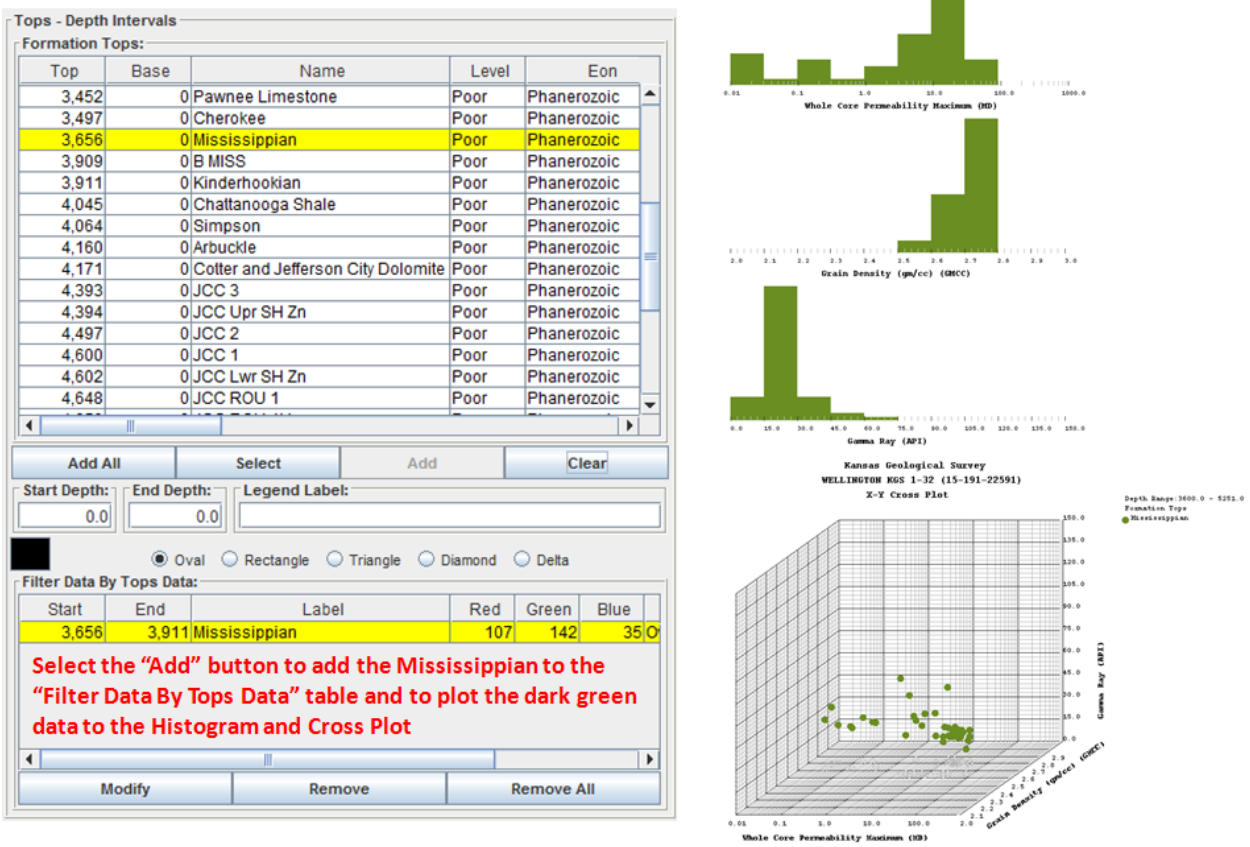
5 Symbols can be selected to display on the cross plot, e.g. Oval radio button is selected for the Mississippian Top.



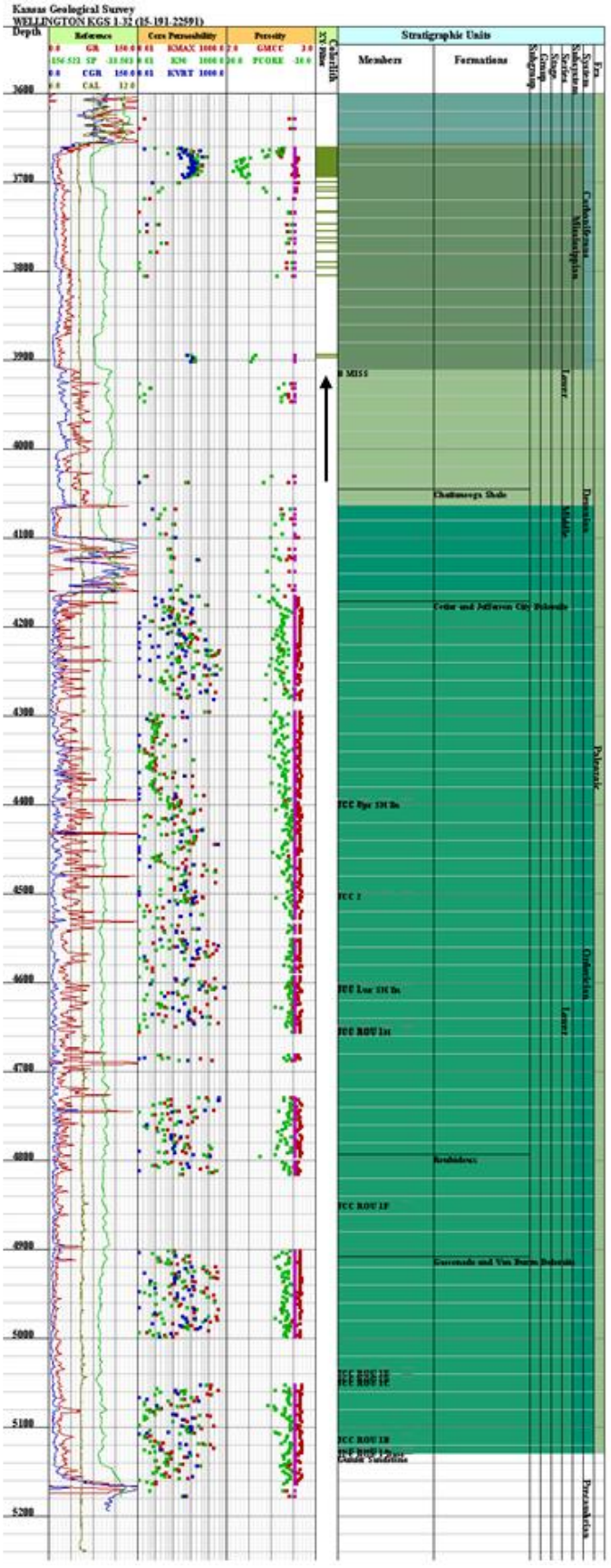
43 possible colors to select

Click on the color button to select color for Mississippian symbol





As the user looks at the profile plot below in the "Colorlith XY Filter" plot track the color does not go across all of the depth range of the zones that are described as Mississippian. They only seem to line up with the measured core data depth range as thin lines. The depth range of the data defines the width of the color band and the core data unlike the log data is over a very short depth ranges. The log data will generally look more filled in because the zones are in half to quarter foot intervals connecting one depth to the next so the color will fill across the full depth range. So if the user only uses log data then the zone across the Mississippian zone should reflect very closely the Mississippian depth range on the profile plot.

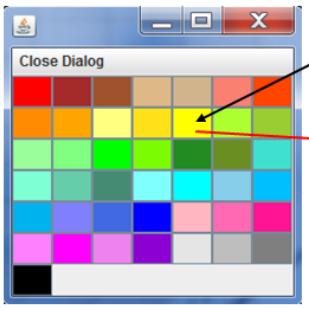


Green Symbol Color is shown for the Mississippian Top in the "Colorlith XY-Filter" Plot Track.

Notice that the Stratigraphic Unit Plot Track is displayed when the "Tops – Depth Interval" radio button is selected.

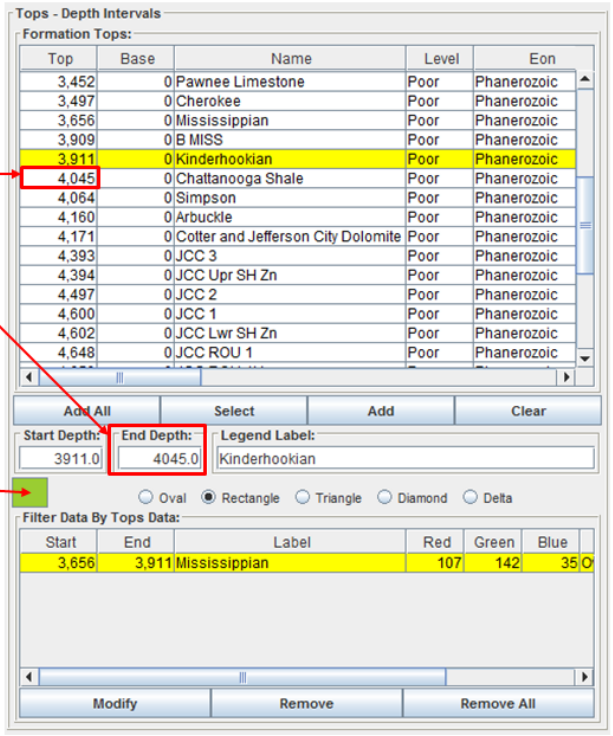
The next top is “Kinderhookian” select the light olive green color, if the user looks at the profile the symbols so far matches the background colors that are being selected.

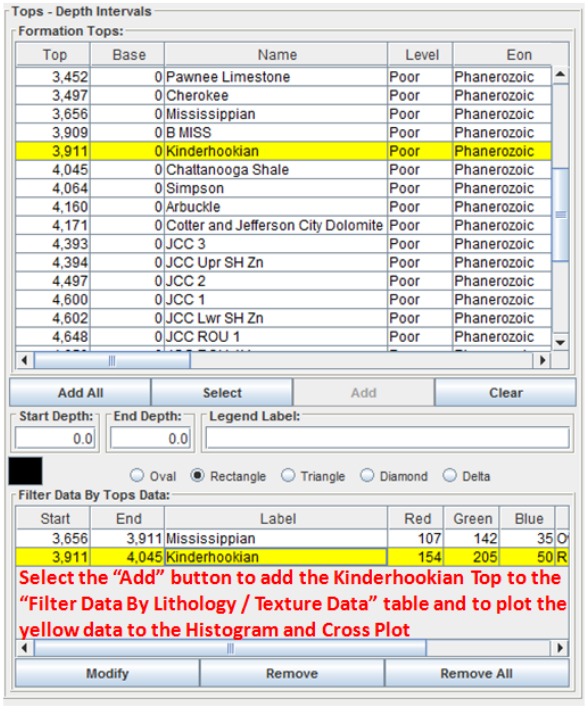
In order for the tops to plot you must have both a Top and Base for each top in the “Filter Data By Tops Data” Table when the top is selected, e.g. the top of the Chattanooga Shale (Top of the Devonian).

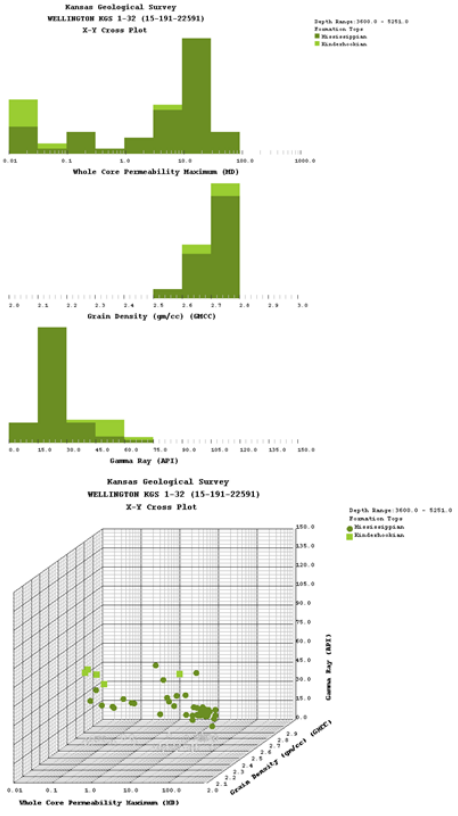


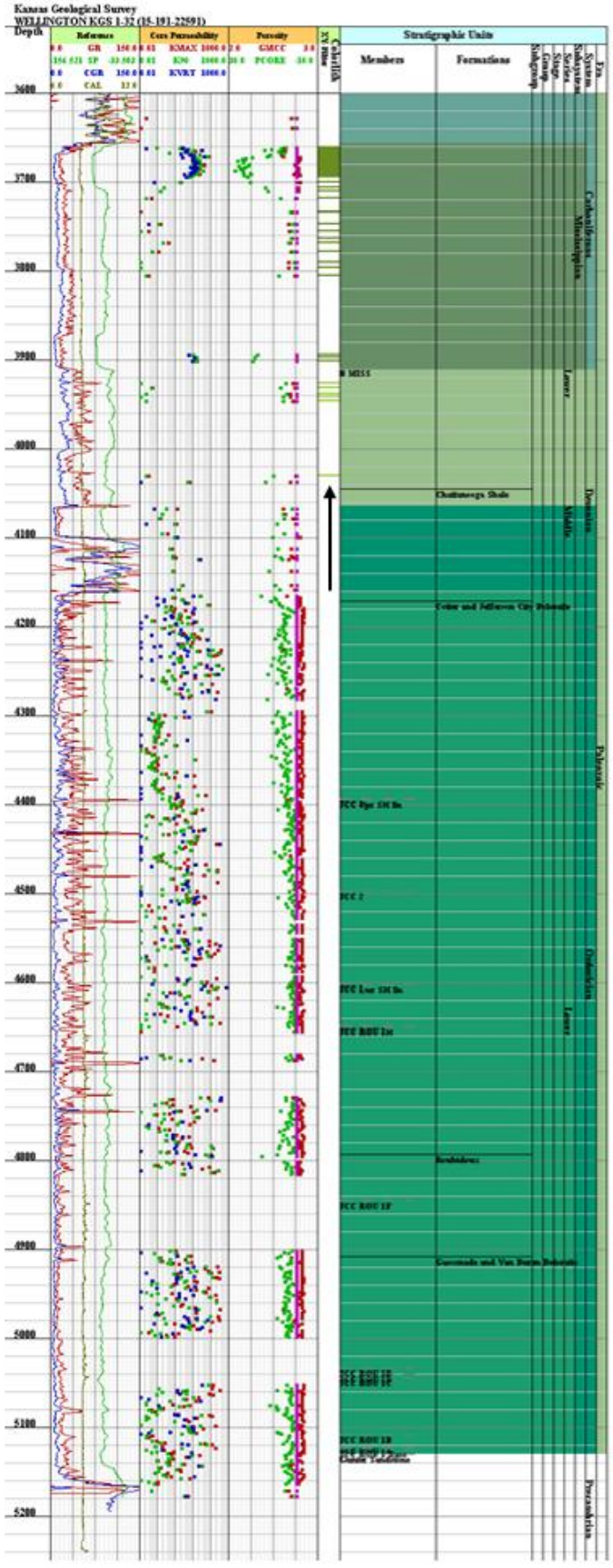
Click on the color button to select color for Lithology symbol

43 possible colors to select



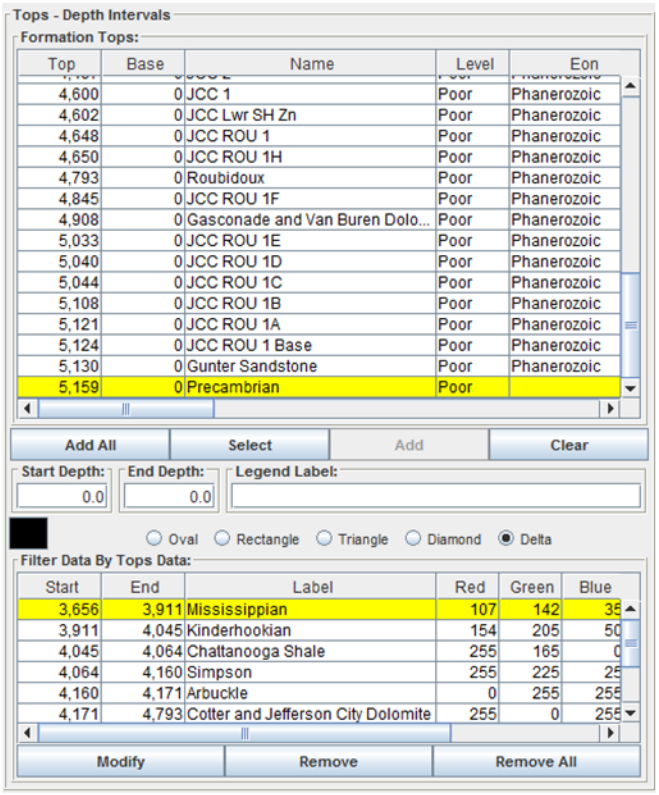




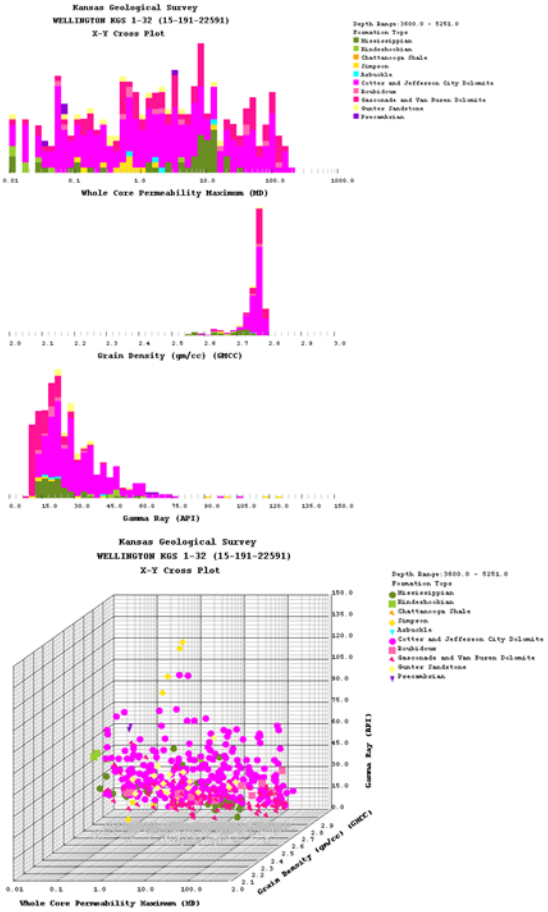


Light Olive Green Symbol Color is shown for the Kinderhookian Top in the "Colorlith XY-Filter" Plot Track.

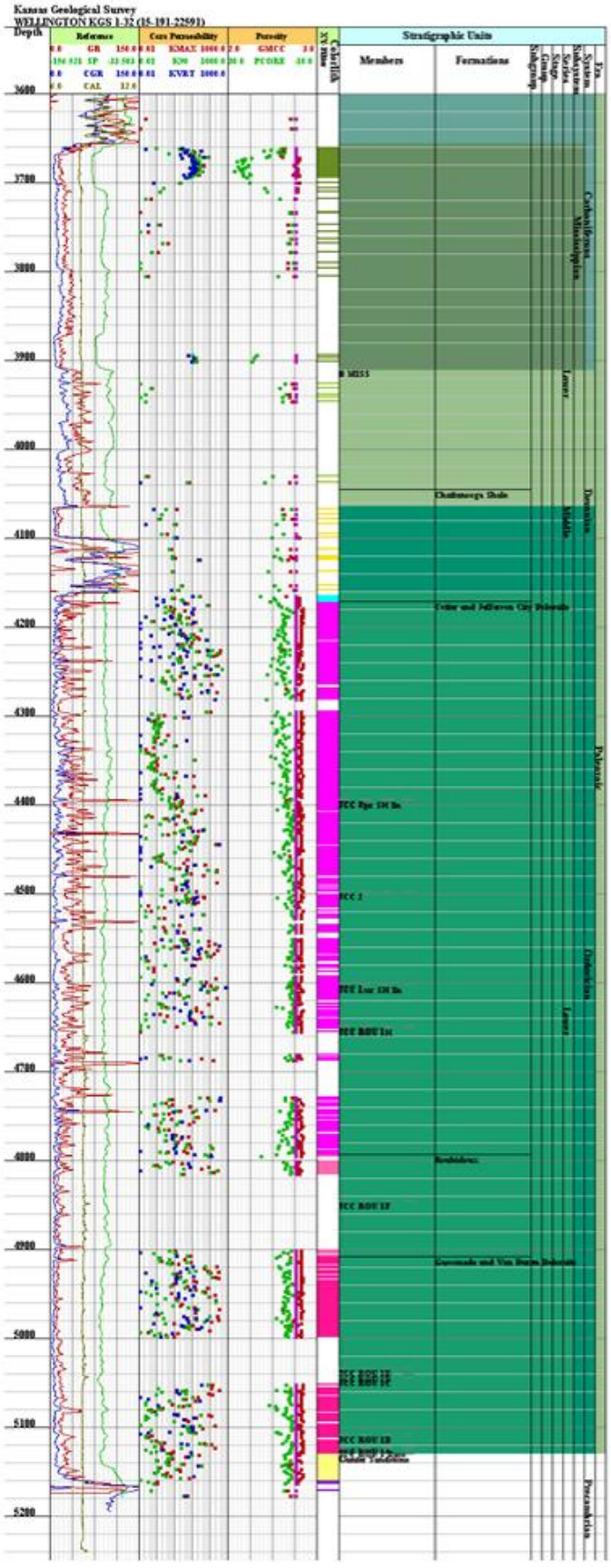
Continue adding each top in descending order, i.e. Chattanooga Shale as Orange, Simpson as medium yellow, Arbuckle as cyan, etc., this way the lithologies will stand out more clearly. As the user looks at the histogram, cross plots and the profile plot you can see the color schema better to identify the lithology differences at a glance.



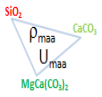
Adding the rest of the lithologies, i.e. sandstone tops – shades of yellow, limestone tops – blue and dolomite tops – shades of violet, etc.



The profile plot will show white background gaps in the colors in the "Colorlith XY Filter" plot track with only color bands lining up with the core data.

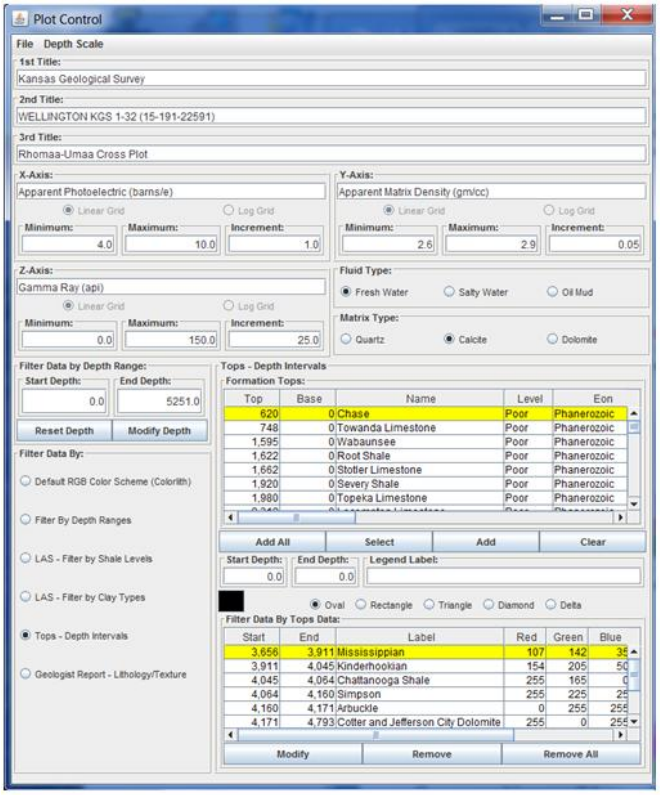


Adding the rest of the lithologies, i.e. sandstone tops – shades of yellow, limestone tops – blue and dolomite tops – shades of violet, etc.

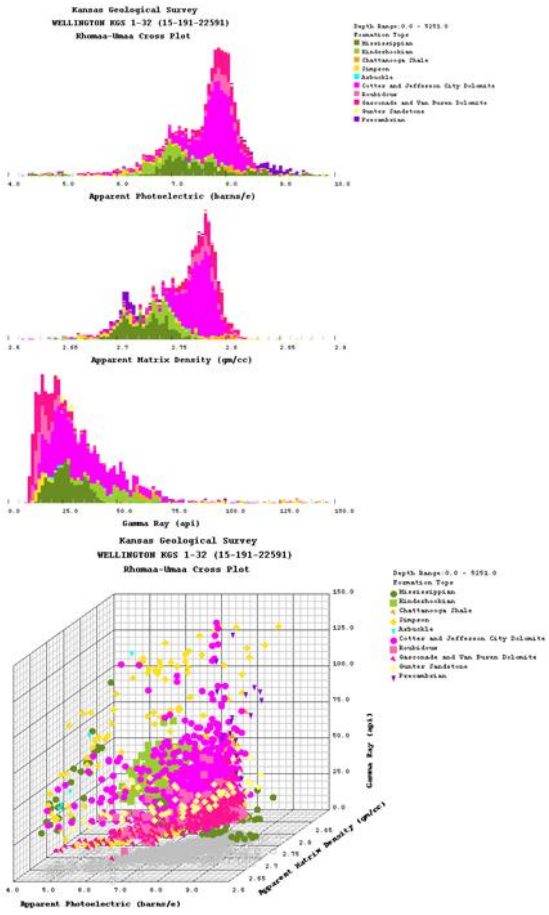


RHOmaa-Umaa-GR Dash Board Icon Button – Tops – Depth Intervals

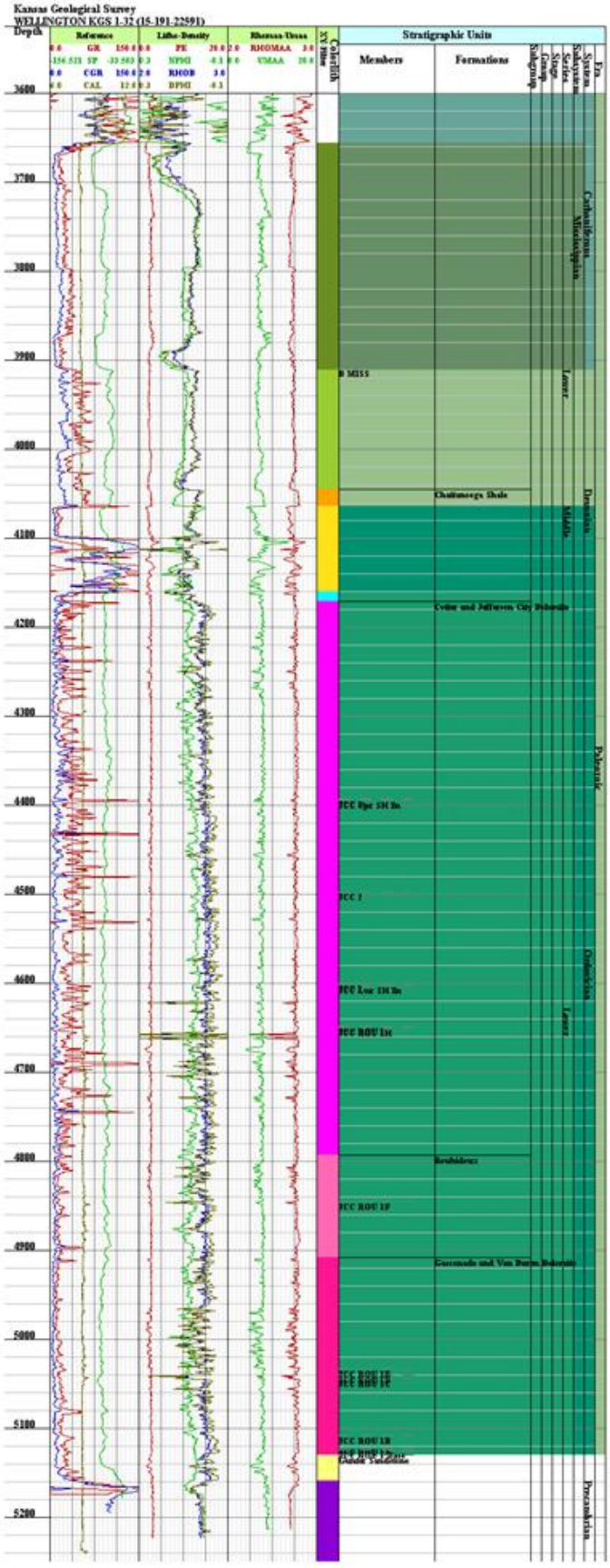
Exiting the X-Y Dash Board Icon Button Control Dialog and selecting the RHOmaa-Umaa-GR Dash Board Icon Button and selecting the "Tops – Depth Intervals" radio button will automatically display the color schema the user does not have to re-enter the color choices for the primary lithologies. The user needs to set the depth range starting depth to 3600.0 to reflect the same depth interval as the core data and changing the X-Y-Z limits to tighten the limits around the data distribution to better visualize the different lithology zones.

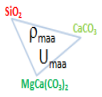


RHOmaa-Umaa-GR Log Curves
X Axis: 4.0 to 10.0, increment 0.5 (barns/e)
Y Axis: 2.6 to 2.9, increment 0.05 (gm/cc)
Z Axis: 0.0 to 150.0, increment 25.0 (API)



The profile plot will only show white background gaps in the colors in the "Colorlith XY Filter" plot track for lithologies that have not been defined. As stated above since this profile plot, see image below, was on log data only notice that the colors mark the different tops selected.


Kansas Geological Survey
WELLINGTON KGS 1-32 (15-191-22591)
Depth
Reference
Litho-Density
Rhomaa-Umaa
Colorlith
Stratigraphic Units
Members
Formations
Sub-group
Group
Stage
Series
Subsystem
System
Era
3600
3700
3800
3900
4000
4100
4200
4300
4400
4500
4600
4700
4800
4900
5000
5100
5200
B MISS
Chattanooga Shale
Cotter and Jefferson City Dolomite
Reubidoux
Gasconade and Van Buren Dolomite
Carboniferous
Mississippian
Lower
Middle
Devonian
Paleozoic
Ordovician
Lower
Precambrian

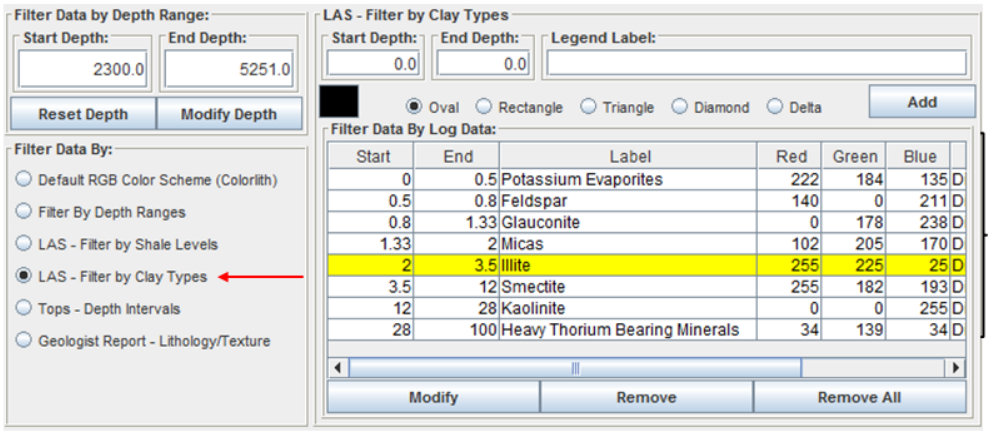


RHOmaa-Umaa-GR Dash Board Icon Button – LAS – Filter by Clay Types

The Clay Types Filter button requires the Spectral Gamma Ray Thorium/Potassium Ratio to filter the log data plot. The Mineral definitions for specific Thorium/Potassium Ratio ranges are defined by The Dakota Aquifer Program Annual Report, FY89 Kansas Geological Survey, Open-File Rept. 90-27 Annual Report, FY89-Appendix B (http://www.kgs.ku.edu/Dakota/vol3/fy89/app_b.htm). Thorium may be associated with an increase of terrigenous clays and high Potassium may be caused by the presence of potassium feldspars or micas. The following is list displays the Mineral and Thorium/Potassium Ratio,

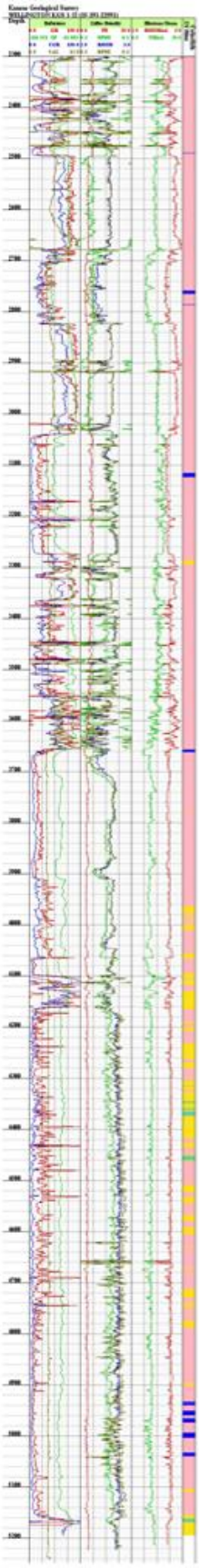
Mineral	Thorium/Potassium Ratio Start	End
• Potassium Evaporates	0.0	0.5
• Feldspar	0.5	0.8
• Glauconite	0.8	1.33
• Micas	1.33	2.0
• Illite	2.0	3.5
• Smectite	3.5	12.0
• Kaolinte	12.0	28.0
• Heavy Thorium Minerals	28.0	100.0

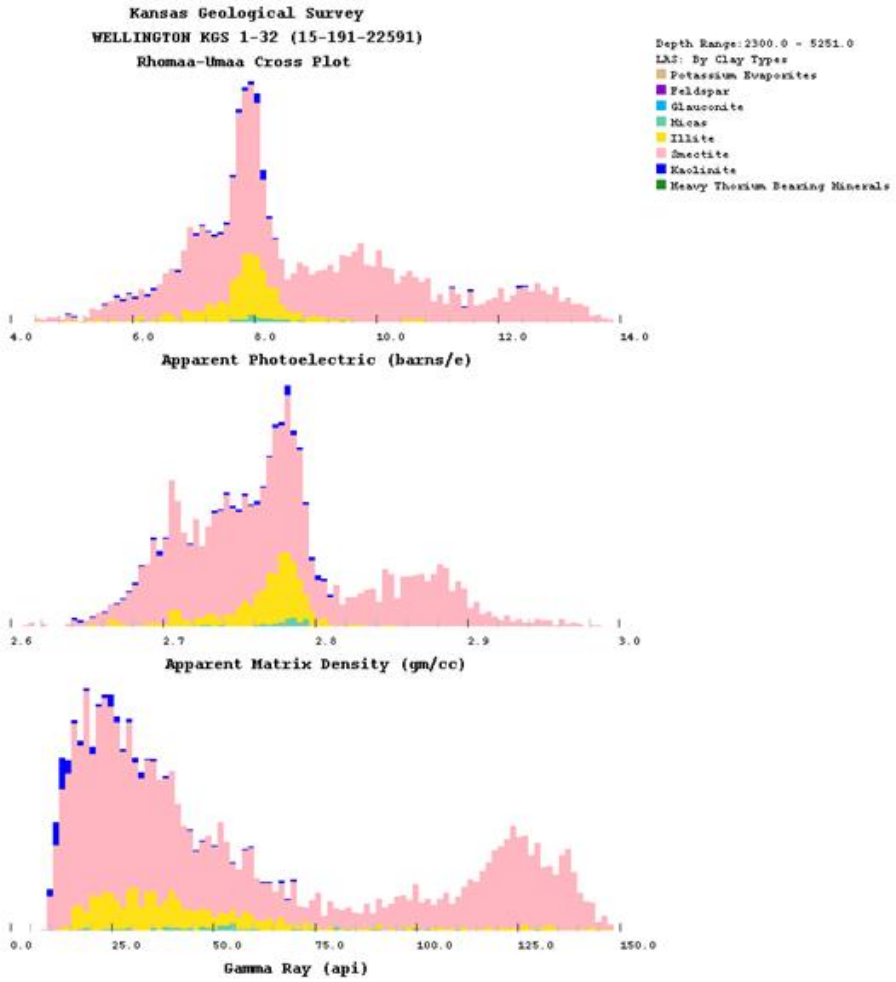
The Clay Type plots, see images below, imply Potassium Evaporates for most of the well, which is not possible. The plot data only reflects that the Thorium/Potassium Ratio is very low or Thorium level is very low. The user can remove the Potassium Evaporates from the list of Minerals in the "Filter Data By Log Data" table to reflect that it does not exist. The user can modify the colors as well as the plot symbols for the histogram & cross plots. The user can also modify the Start and End Thorium/Potassium Ratio ranges to define their view of the clay minerals present.

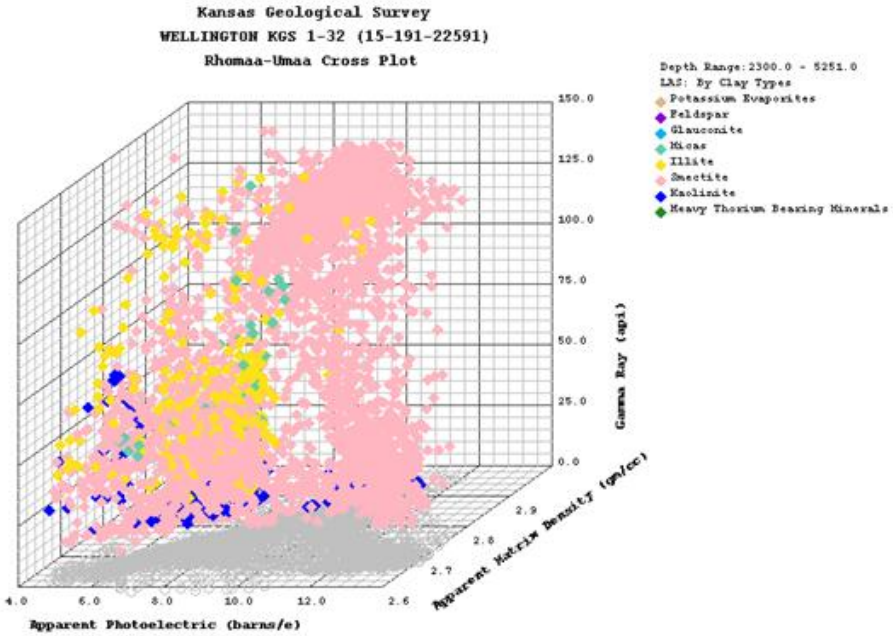


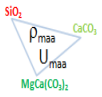
List of Clay Minerals, with the Start and End Thorium/Potassium Ratio Ranges.

The user can edit the colors & symbols as well as change the levels.




Kansas Geological Survey
WELLINGTON KGS 1-32 (15-191-22591)
Rhomaa-Umaa Cross Plot
Depth Range:2300.0 - 5251.0
LAS: By Clay Types
Potassium Evaporites
Feldspar
Glauconite
Micas
Illite
Smectite
Kaolinite
Heavy Thorium Bearing Minerals
4.0
6.0
8.0
10.0
12.0
14.0
Apparent Photoelectric (barns/e)
2.6
2.7
2.8
2.9
3.0
Apparent Matrix Density (gm/cc)
0.0
25.0
50.0
75.0
100.0
125.0
150.0
Gamma Ray (api)


Kansas Geological Survey
WELLINGTON KGS 1-32 (15-191-22591)
Rhomaa-Umaa Cross Plot
Depth Range:2300.0 - 5251.0
LAS: By Clay Types
Potassium Evaporites
Feldspar
Glauconite
Micas
Illite
Smectite
Kaolinite
Heavy Thorium Bearing Minerals
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Gamma Ray (api)
2.6
2.7
2.8
2.9
Apparent Matrix Density (gm/cc)
4.0
6.0
8.0
10.0
12.0
Apparent Photoelectric (barns/e)

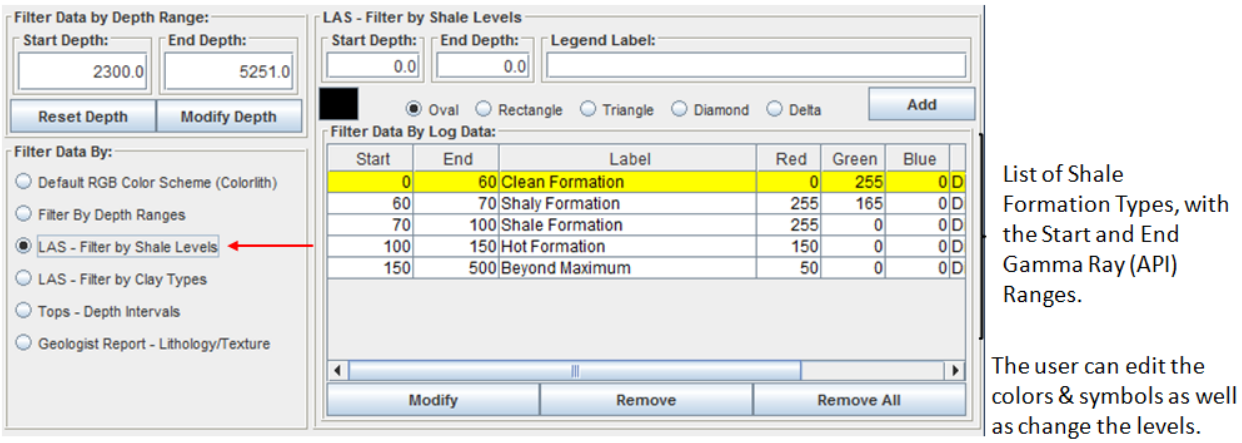


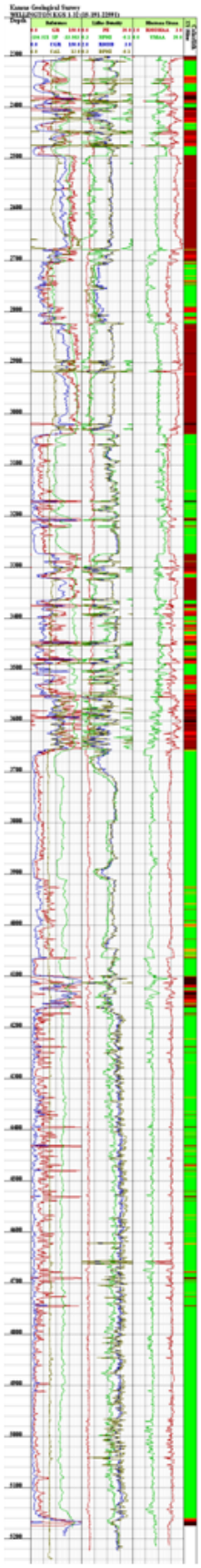
RHOmaa-Umaa-GR Dash Board Icon Button – LAS – Filter by Shale Types

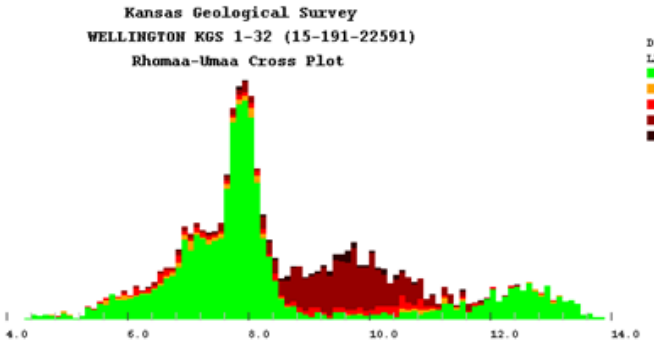
The Shale Types Filter button requires the Gamma Ray API levels to filter the log data plot. The Formation Type levels are defined for specific Gamma Ray API level ranges are defined as follows,

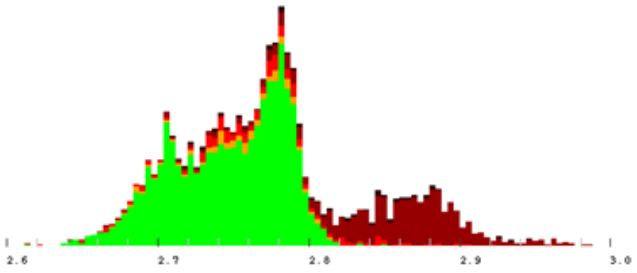
Formation Type	Gamma Ray API Start	End
• Clean Formation	0.0	60.0
• Shaly Formation	60.0	70.0
• Shale Formation	70.0	100.0
• Hot Shale Formation	100.0	150.0
• Beyond Maximum API	150.0	500.0

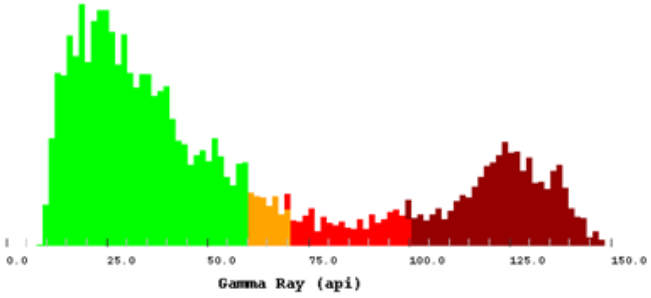
The user can modify the colors as well as the plot symbols for the cross plot. The user can also modify the Start and End API levels to define the formation types that best fit the measured well log data.

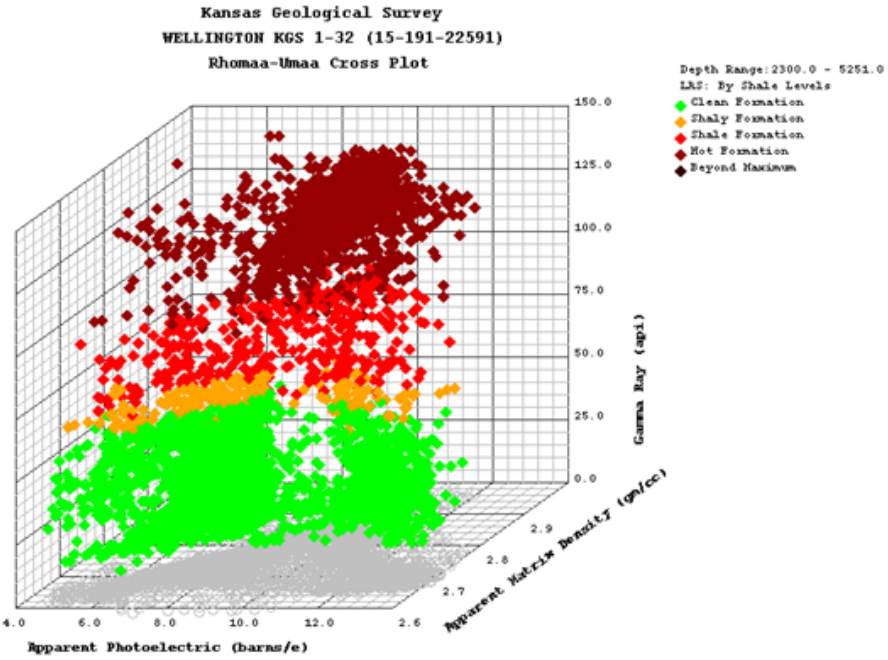





Kansas Geological Survey
WELLINGTON KGS 1-32 (15-191-22591)
Rhomaa-Umaa Cross Plot
Depth Range:2300.0 - 5251.0
LAS: By Shale Levels
Clean Formation
Shaly Formation
Shale Formation
Hot Formation
Beyond Maximum
4.0
6.0
8.0
10.0
12.0
14.0
Apparent Photoelectric (barns/e)


2.6
2.7
2.8
2.9
3.0
Apparent Matrix Density (gm/cc)


0.0
25.0
50.0
75.0
100.0
125.0
150.0
Gamma Ray (api)


Kansas Geological Survey
WELLINGTON KGS 1-32 (15-191-22591)
Rhomaa-Umaa Cross Plot
Depth Range:2300.0 - 5251.0
LAS: By Shale Levels
Clean Formation
Shaly Formation
Shale Formation
Hot Formation
Beyond Maximum
150.0
125.0
100.0
75.0
50.0
25.0
0.0
Gamma Ray (api)
2.9
2.8
2.7
2.6
Apparent Matrix Density (gm/cc)
4.0
6.0
8.0
10.0
12.0
Apparent Photoelectric (barns/e)