RELEASE NOTES

Petrophysics

Integrated log analysis for comprehensive interpretation

Release Notes

GVERSE Petrophysics 2019.4

LMK Resources Inc. Houston
6051 North Course Drive,
Suite 300,
Houston TX 77072, USA.
Phone: +281-495-5657
FAX: +281-568-7315
Internet:
http://www.gverse.com/geographix

Contents

Introduction

We are pleased to announce the release of GVERSE® Petrophysics 2019.4.

This document provides an introduction to the GVERSE Petrophysics features and benefits. It also gives instructions on how launch this application along with a brief overview of the interface.

What is GVERSE Petrophysics?

GVERSE® Petrophysics is a 64bit petrophysical application designed to assist geoscientists and petrophysicists in analyzing and interpreting well log data and characterization of the reservoir using simple to advanced log interpretation workflows in a large multi-well multi-user environment.

GVERSE Petrophysics supports the import of digital data from numerous sources and provides you with integrated data views and analysis. Using this application you can view, edit, and analyze well log data in three different views:

- Log View
- Crossplot View
- Report View

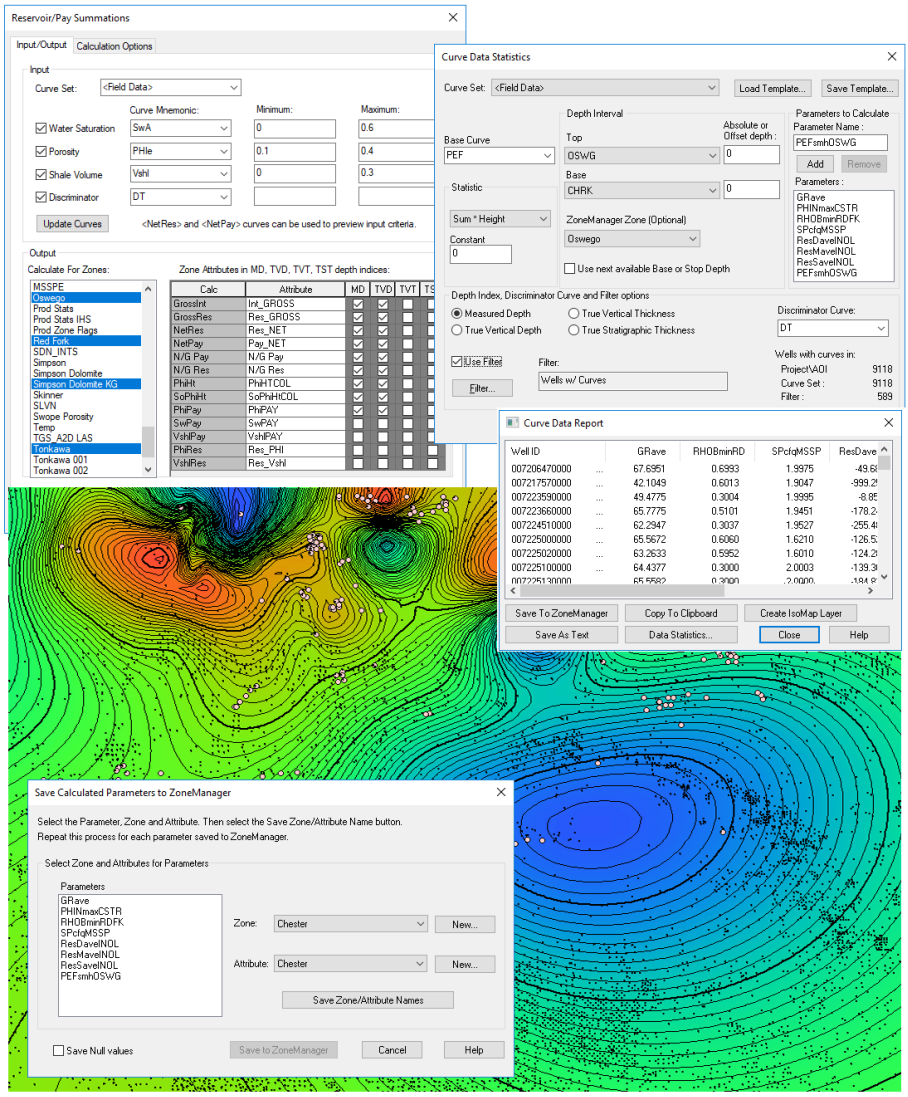
GVERSE Petrophysics enables you to quickly analyze well log data using industry standard petrophysical algorithms. In addition, the Petrophysics Development Kit allows you to write user-defined interpretive models in C, C++, and Visual Basic programming languages for application in GVERSE Petrophysics.

GVERSE Petrophysics works on the Windows platform and is integrated with the GeoGraphix Discovery Geology applications, and GVERSE Geophysics. In GVERSE Petrophysics, you work with the active GeoGraphix project (selected in ProjectExplorer), into which you import curve data and well files, and access well data directly from the database. You can use log templates created in GVERSE Petrophysics to display wells in GVERSE Geomodeling and XSection, create cross sections from wells displayed in GVERSE Petrophysics, view WellBase information for wells displayed in GVERSE Petrophysics, and create IsoMap layers from GVERSE Petrophysics curve data statistics. In addition to these integration features, when working with well data in GeoAtlas, GVERSE Geomodeling, or XSection, you can instantly view the selected wells in GVERSE Petrophysics.

Main Features

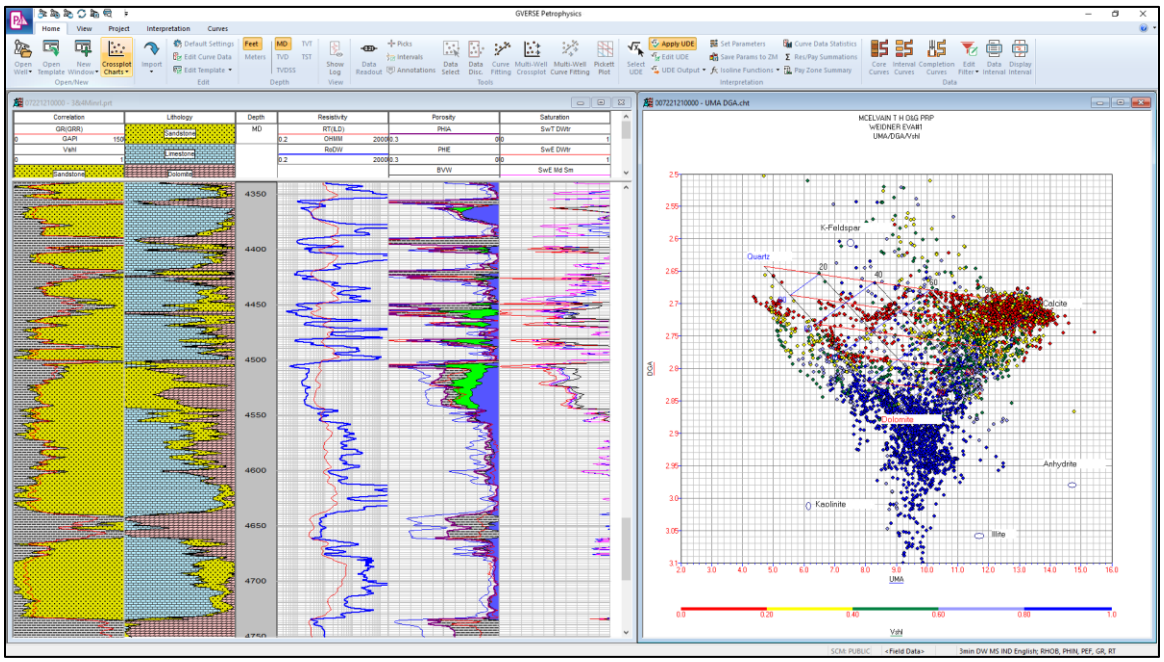
Multi-Well Interpretation

- Perform one-step reservoir pay summations for common reservoir attributes such as gross, net, net/gross, porosity feet, and hydrocarbon-filled porosity with corrections for true, vertical, and stratigraphic thickness.
- Generate virtually any statistic from curve-derived attributes over a zone or depth interval of interest with Curve Data Statistics.
- Easily confirm results using data-distribution histograms, statistics, and cross plots.
- Map directly in GeoGraphix or save results to ZoneManager attributes.
- Create proposed completion stages and perforation cluster intervals, then save as proposed completion records in the WellBase Completion table. These records are available for data posting symbology on the well log templates.



Petrophysical Analysis

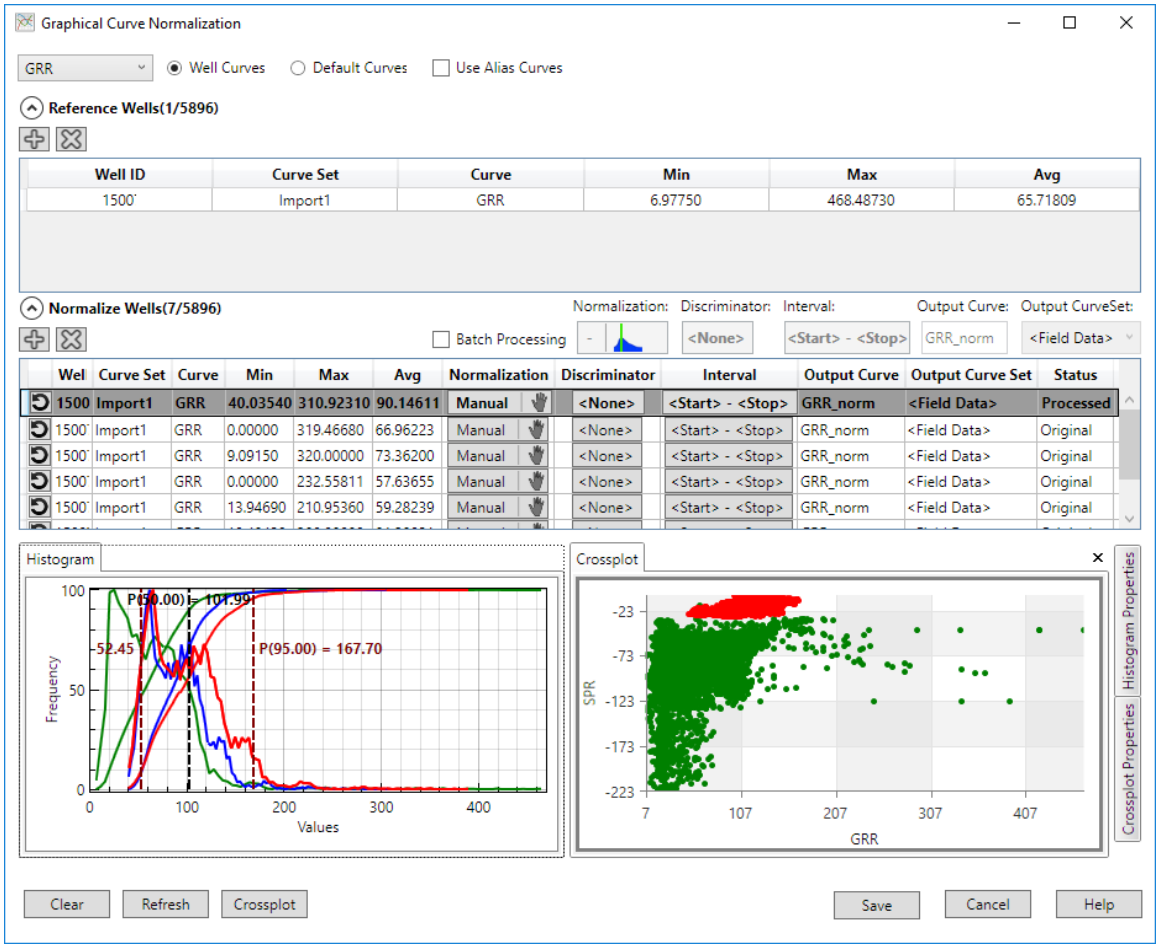
- Easily perform quick and interactive log calculations for standard interpretations and reconnaissance with user-defined equations.
- Utilize pre-written interpretations for 3 and 4-mineral determinations and Archie, Dual-Water, Indonesian, and Modified Simandoux saturation models.
- Link complex, external models written in C, C++, or Visual Basic.
- Build and save personal equations with user-defined equations comprised of over 250 pre-defined standard log analysis equations.
- Calculate Poisson's Ratio and Young's Modulus using mechanical properties/UDE Group.
- Utilize standard Halliburton, Schlumberger, and Baker Atlas charts for environmental corrections or digitize additional charts.



Curve Data Management

- Import standard LAS, LBS, ASCII, DLIS, and LIS/TIF data files.
- Automatically merge and splice curves using the curve import tool or optionally merge or splice at user defined depths.
- Benefit from project-based mnemonic inventory, mnemonic aliases, and unit conversions.
- Manually or bulk normalize curves using the graphical curve normalization utility which includes average, single, and two-point normalization methods.

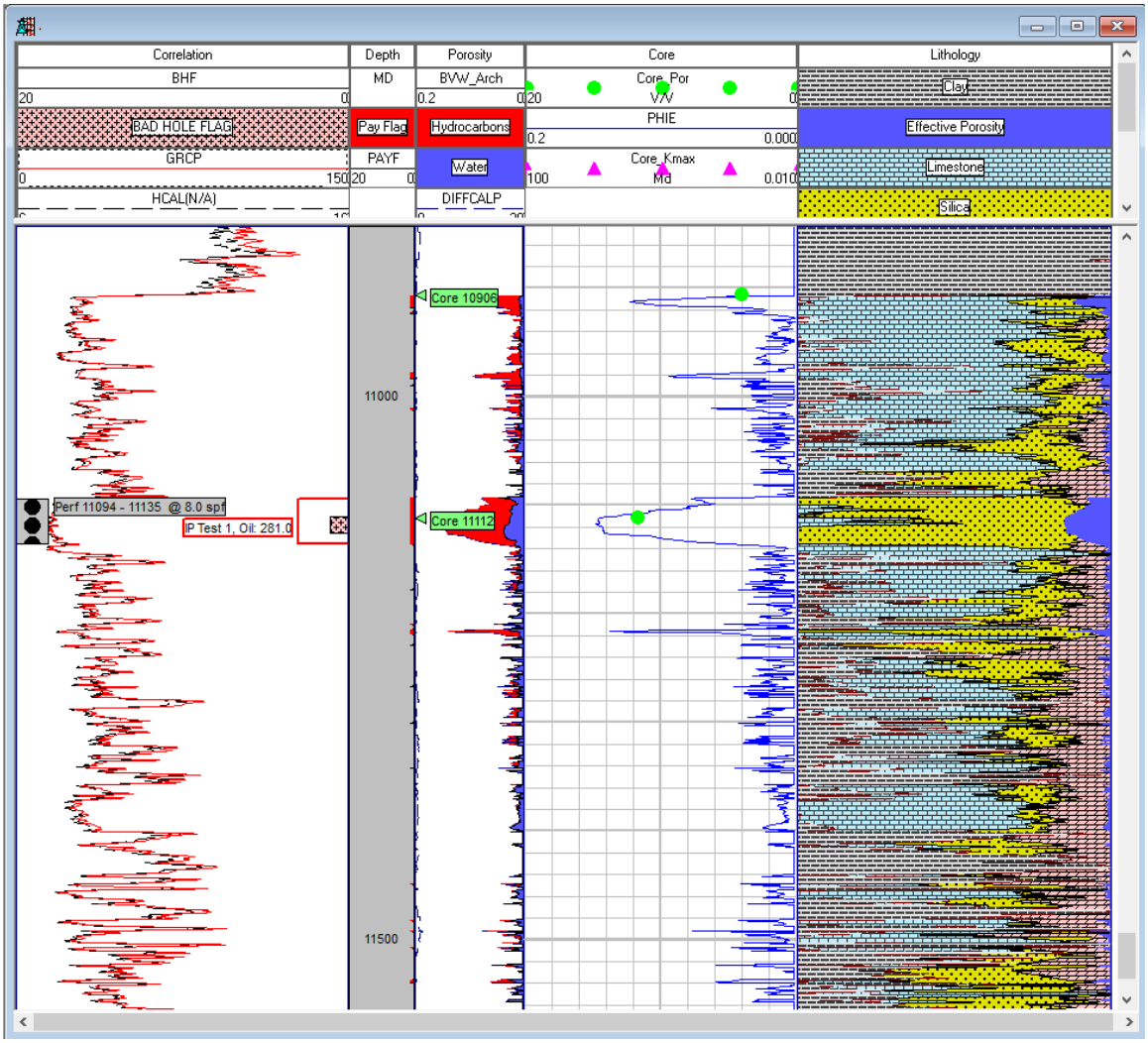
- Utilize single or multi-well curve copy, renaming, deletion, rescaling, min/max clipping and filter smoothing tools.
- View standard core curve analysis attributes plus 200 new user-defined core curves.
- Combine multiple curve mnemonics for similar curve types in hierarchical order based on a pre-determined preference.



Log Analysis and Display

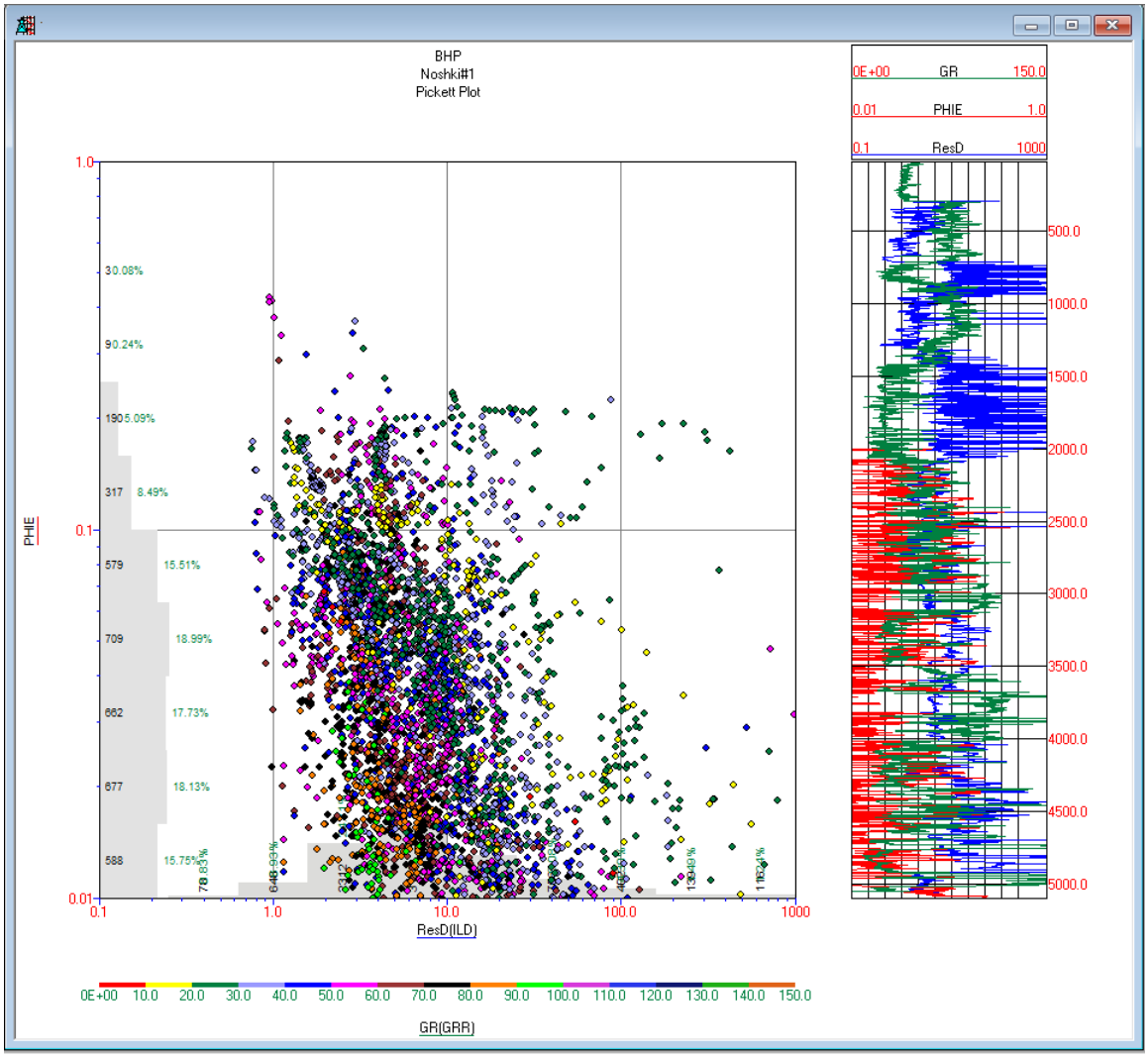
- Control presentation templates to display curve and depth-registered images with virtually unlimited tracks, curves, colors, and pattern fills.
- Display different track types including linear, logarithmic, mineral percent, depth registered images, text, core description, lithology pattern fills, tadpoles, and descriptions.
- Easily cut, copy, and paste curves between tracks using the on-screen presentation editing feature.
- Automatically post DST, core, perforation, mechanicals, IP, casing, tubing, and zone information.
- Interactively pick and display formation and fault markers and user-defined attribute intervals.

- On-screen QC editing of curves including performing simple or complex depth shifting, adjusting SP baseline shifting, and utilizing curve patch tools.



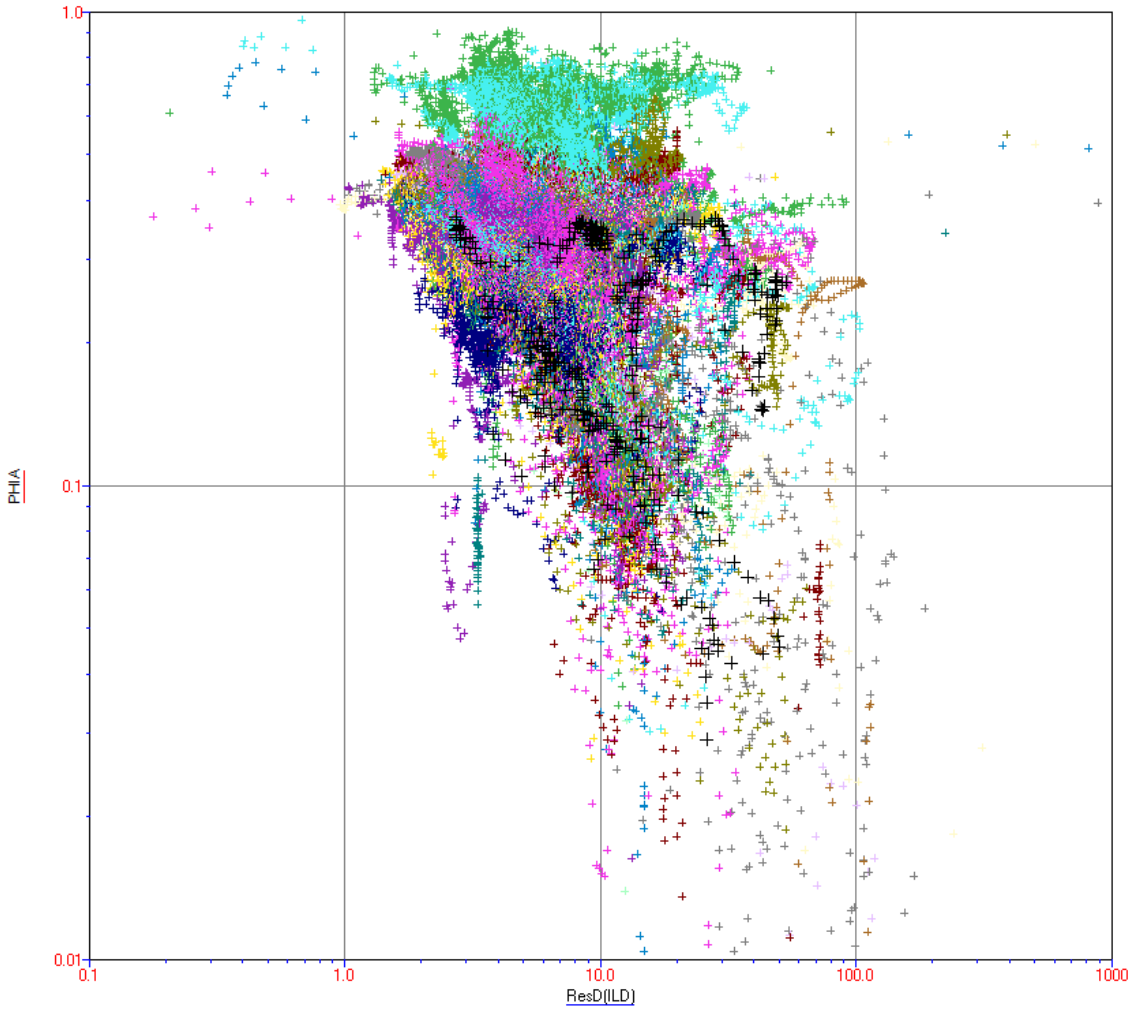
Cross Plot Analysis and Display

- Display data relationships over total well depths, user-specified depth range, or one or more zone(s)
- Create three-axis display with linear or logarithmic scale, user-controlled symbols, size and color, Z-axis color spectrum, and X and Y axis histograms



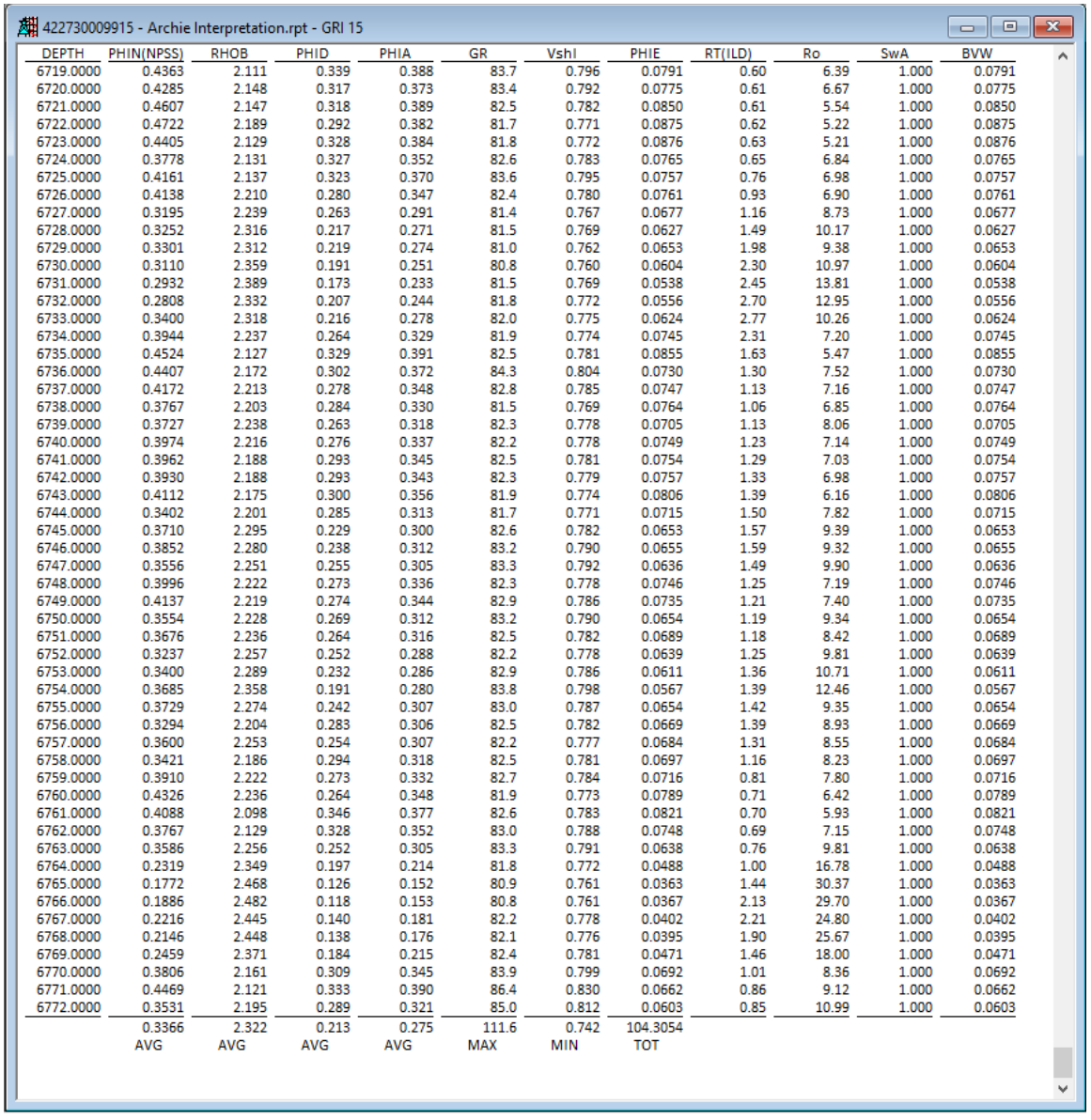
Multi-Well Cross Plots

- Benefit from multi-level discrimination with user-drawn polygon capabilities
- Differentiate between wells by assigning colors to individual wells for better analysis
- Fit curves using linear regression, reduced to major axis, and polynomial regression capabilities
- Interactively determine the Formation Water Resistivity (Rw), Bound Water Resistivity (Rwb) and Cementation Exponent (m) using the Pickett plot



Customizable Reports

- Create user-defined well reports such as net pay, average porosity, water saturation, total porosity feet, or hydrocarbon-filled porosity
- Define curve choices, sample rates, depth interval, or zone selection using the provided tabular list
- Export to tab or comma delimited text files, or copy results to the Microsoft® Windows® clipboard



422730009915 - Archie Interpretation.rpt - GRI 15

DEPTH	PHIN(NPSS)	RHOB	PHID	PHIA	GR	Vshl	PHIE	RT(ILD)	Ro	SwA	BVW
6719.0000	0.4363	2.111	0.339	0.388	83.7	0.796	0.0791	0.60	6.39	1.000	0.0791
6720.0000	0.4285	2.148	0.317	0.373	83.4	0.792	0.0775	0.61	6.67	1.000	0.0775
6721.0000	0.4607	2.147	0.318	0.389	82.5	0.782	0.0850	0.61	5.54	1.000	0.0850
6722.0000	0.4722	2.189	0.292	0.382	81.7	0.771	0.0875	0.62	5.22	1.000	0.0875
6723.0000	0.4405	2.129	0.328	0.384	81.8	0.772	0.0876	0.63	5.21	1.000	0.0876
6724.0000	0.3778	2.131	0.327	0.352	82.6	0.783	0.0765	0.65	6.84	1.000	0.0765
6725.0000	0.4161	2.137	0.323	0.370	83.6	0.795	0.0757	0.76	6.98	1.000	0.0757
6726.0000	0.4138	2.210	0.280	0.347	82.4	0.780	0.0761	0.93	6.90	1.000	0.0761
6727.0000	0.3195	2.239	0.263	0.291	81.4	0.767	0.0677	1.16	8.73	1.000	0.0677
6728.0000	0.3252	2.316	0.217	0.271	81.5	0.769	0.0627	1.49	10.17	1.000	0.0627
6729.0000	0.3301	2.312	0.219	0.274	81.0	0.762	0.0653	1.98	9.38	1.000	0.0653
6730.0000	0.3110	2.359	0.191	0.251	80.8	0.760	0.0604	2.30	10.97	1.000	0.0604
6731.0000	0.2932	2.389	0.173	0.233	81.5	0.769	0.0538	2.45	13.81	1.000	0.0538
6732.0000	0.2808	2.332	0.207	0.244	81.8	0.772	0.0556	2.70	12.95	1.000	0.0556
6733.0000	0.3400	2.318	0.216	0.278	82.0	0.775	0.0624	2.77	10.26	1.000	0.0624
6734.0000	0.3944	2.237	0.264	0.329	81.9	0.774	0.0745	2.31	7.20	1.000	0.0745
6735.0000	0.4524	2.127	0.329	0.391	82.5	0.781	0.0855	1.63	5.47	1.000	0.0855
6736.0000	0.4407	2.172	0.302	0.372	84.3	0.804	0.0730	1.30	7.52	1.000	0.0730
6737.0000	0.4172	2.213	0.278	0.348	82.8	0.785	0.0747	1.13	7.16	1.000	0.0747
6738.0000	0.3767	2.203	0.284	0.330	81.5	0.769	0.0764	1.06	6.85	1.000	0.0764
6739.0000	0.3727	2.238	0.263	0.318	82.3	0.778	0.0705	1.13	8.06	1.000	0.0705
6740.0000	0.3974	2.216	0.276	0.337	82.2	0.778	0.0749	1.23	7.14	1.000	0.0749
6741.0000	0.3962	2.188	0.293	0.345	82.5	0.781	0.0754	1.29	7.03	1.000	0.0754
6742.0000	0.3930	2.188	0.293	0.343	82.3	0.779	0.0757	1.33	6.98	1.000	0.0757
6743.0000	0.4112	2.175	0.300	0.356	81.9	0.774	0.0806	1.39	6.16	1.000	0.0806
6744.0000	0.3402	2.201	0.285	0.313	81.7	0.771	0.0715	1.50	7.82	1.000	0.0715
6745.0000	0.3710	2.295	0.229	0.300	82.6	0.782	0.0653	1.57	9.39	1.000	0.0653
6746.0000	0.3852	2.280	0.238	0.312	83.2	0.790	0.0655	1.59	9.32	1.000	0.0655
6747.0000	0.3556	2.251	0.255	0.305	83.3	0.792	0.0636	1.49	9.90	1.000	0.0636
6748.0000	0.3996	2.222	0.273	0.336	82.3	0.778	0.0746	1.25	7.19	1.000	0.0746
6749.0000	0.4137	2.219	0.274	0.344	82.9	0.786	0.0735	1.21	7.40	1.000	0.0735
6750.0000	0.3554	2.228	0.269	0.312	83.2	0.790	0.0654	1.19	9.34	1.000	0.0654
6751.0000	0.3676	2.236	0.264	0.316	82.5	0.782	0.0689	1.18	8.42	1.000	0.0689
6752.0000	0.3237	2.257	0.252	0.288	82.2	0.778	0.0639	1.25	9.81	1.000	0.0639
6753.0000	0.3400	2.289	0.232	0.286	82.9	0.786	0.0611	1.36	10.71	1.000	0.0611
6754.0000	0.3685	2.358	0.191	0.280	83.8	0.798	0.0567	1.39	12.46	1.000	0.0567
6755.0000	0.3729	2.274	0.242	0.307	83.0	0.787	0.0654	1.42	9.35	1.000	0.0654
6756.0000	0.3294	2.204	0.283	0.306	82.5	0.782	0.0669	1.39	8.93	1.000	0.0669
6757.0000	0.3600	2.253	0.254	0.307	82.2	0.777	0.0684	1.31	8.55	1.000	0.0684
6758.0000	0.3421	2.186	0.294	0.318	82.5	0.781	0.0697	1.16	8.23	1.000	0.0697
6759.0000	0.3910	2.222	0.273	0.332	82.7	0.784	0.0716	0.81	7.80	1.000	0.0716
6760.0000	0.4326	2.236	0.264	0.348	81.9	0.773	0.0789	0.71	6.42	1.000	0.0789
6761.0000	0.4088	2.098	0.346	0.377	82.6	0.783	0.0821	0.70	5.93	1.000	0.0821
6762.0000	0.3767	2.129	0.328	0.352	83.0	0.788	0.0748	0.69	7.15	1.000	0.0748
6763.0000	0.3586	2.256	0.252	0.305	83.3	0.791	0.0638	0.76	9.81	1.000	0.0638
6764.0000	0.2319	2.349	0.197	0.214	81.8	0.772	0.0488	1.00	16.78	1.000	0.0488
6765.0000	0.1772	2.468	0.126	0.152	80.9	0.761	0.0363	1.44	30.37	1.000	0.0363
6766.0000	0.1886	2.482	0.118	0.153	80.8	0.761	0.0367	2.13	29.70	1.000	0.0367
6767.0000	0.2216	2.445	0.140	0.181	82.2	0.778	0.0402	2.21	24.80	1.000	0.0402
6768.0000	0.2146	2.448	0.138	0.176	82.1	0.776	0.0395	1.90	25.67	1.000	0.0395
6769.0000	0.2459	2.371	0.184	0.215	82.4	0.781	0.0471	1.46	18.00	1.000	0.0471
6770.0000	0.3806	2.161	0.309	0.345	83.9	0.799	0.0692	1.01	8.36	1.000	0.0692
6771.0000	0.4469	2.121	0.333	0.390	86.4	0.830	0.0662	0.86	9.12	1.000	0.0662
6772.0000	0.3531	2.195	0.289	0.321	85.0	0.812	0.0603	0.85	10.99	1.000	0.0603
	0.3366	2.322	0.213	0.275	111.6	0.742	104.3054				
	AVG	AVG	AVG	AVG	MAX	MIN	TOT				

Benefits

Intuitive Language: GVERSE Petrophysics uses a simple and intuitive scripting language. With little effort, users create sophisticated petrophysical models. These models can then be applied to individual wells for detailed analysis or to thousands of wells to generate reservoir-to-regional scale formation characterizations. Utilizing log template displays and petrophysical interpretations, users then multi-dimensionally view the petrophysical models from single-well log templates to multi-well cross sections to 3D fence diagrams.

Scalable Functionality: GVERSE Petrophysics includes over 250 predefined standard log analysis equations as well as several predefined water saturation, lithology, and coal bed methane (CBM) models. The equations are grouped into easy-to-understand families of calculations that can be copied and edited into a script to solve most formation-analysis problems. For the more sophisticated user, GVERSE Petrophysics can be linked to external models created in Visual Basic, C, or C++ code. External models offer unlimited analytical complexity as well as integration with presentation, attribute extraction, and mapping utilities.

Seamless Petrophysical Analysis, Attribute Extraction, and Mapping: Users can extract attributes generated in the petrophysical models within formation zones of interest and/or filtered well-sets for direct map layer creation, statistical analysis, or export. GVERSE Petrophysics easily links to ZoneManager, GeoGraphix attribute analysis application, to support well-by-well/zone-by-zone parameters for petrophysical models or read/write parameters for Pickett Plot analysis.

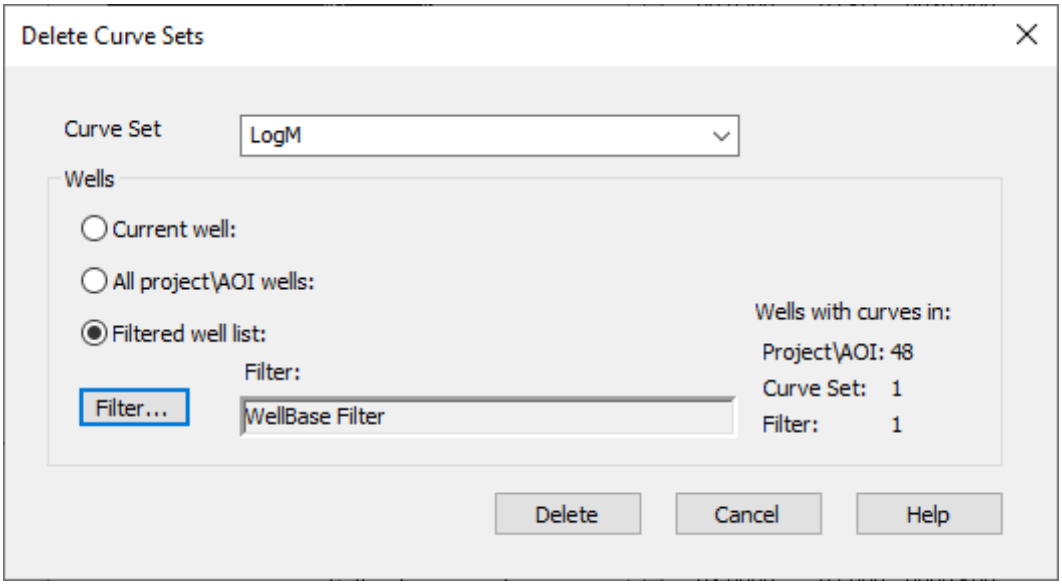
Installing GVERSE Petrophysics

GVERSE Petrophysics is installed seamlessly as part of the GeoGraphix installation. For system prerequisites and installation instructions, refer to the GeoGraphix Installation Guide on the GVERSE GeoGraphix Support Portal > Knowledge Center > Release Notes and Installation Guides page.

What's New in GVERSE Petrophysics 2019.4

Delete Curve Sets from a Filtered Set of Wells

Curve sets can be deleted from a filtered set of wells to clean the data set. Deletion does not apply to Field data.



UDE Output Curves to Default List

Generated curves using User Defined Equations (UDEs) can be saved to the default curves list, which makes them readily available to be used in templates and various workflows easily.

Exporting Log Curves for Single and Multiple Wells

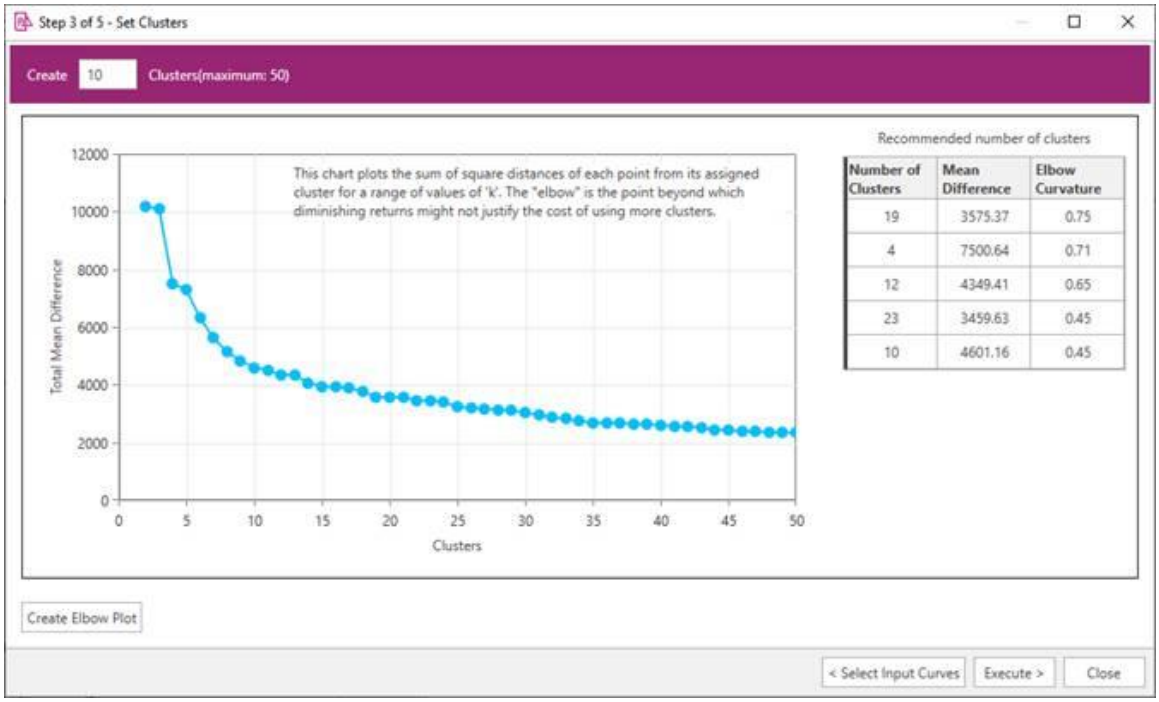
You can now export log curves with different depth index and depth units using the Export Curves option.

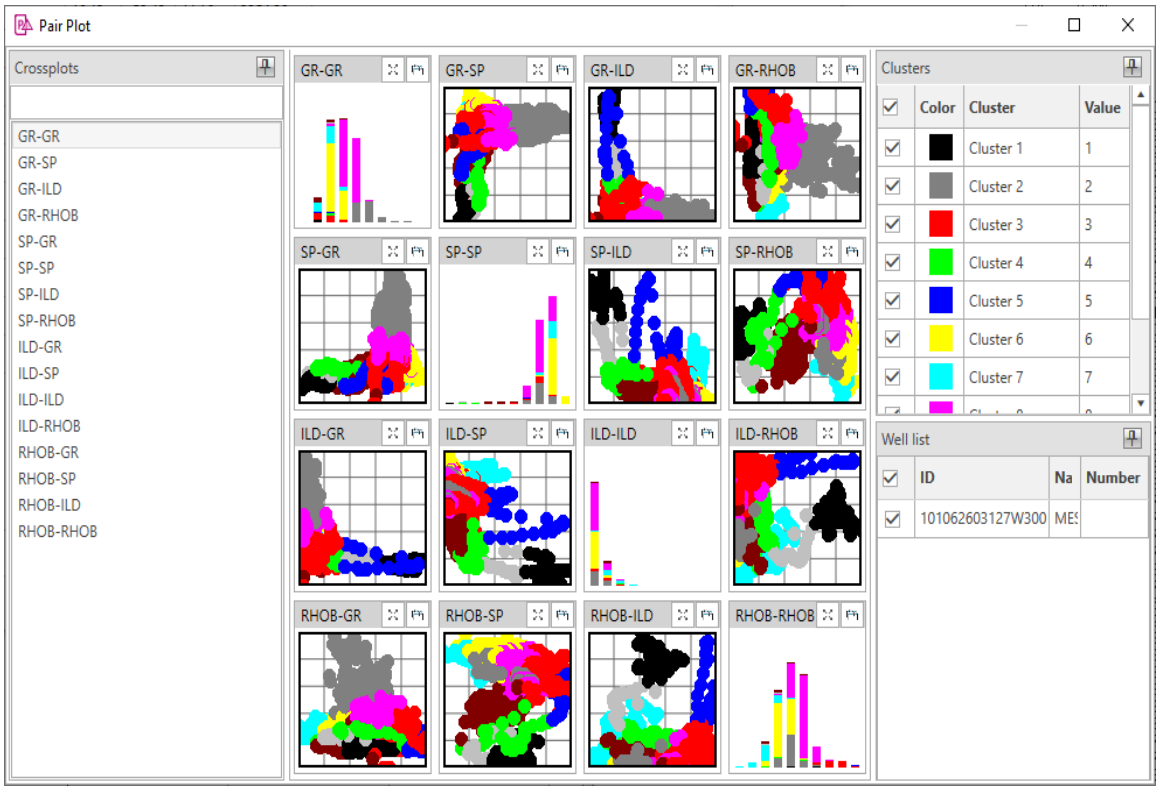
Multiple UI Improvements

Multiple UI improvements to help the user perform actions for the petrophysical interpretations.

Electrofacies Analysis

An extensive tool is introduced to run K-Means clustering on a set of input log curves for a selection of wells, which helps in identifying electrofacies curves using the log curve data.





Extracting Petrophysical Attributes from Faults/Formations

You can now calculate curve data statistics over an interval around a fault or formation pick. This helps you in extracting petrophysical attributes around the markers.

Control Decimal Places for Logs

The readability of logs display has improved by allowing the user to control the number of decimal places of log values to display.

Post Chamber Recovery Information on Presentation Templates

You can now post chamber recovery information on presentation templates, which enables users to view information on logs and perform insightful analysis.

Show Formation Tops/Fault Cuts on Log Presentation in Crossplot View

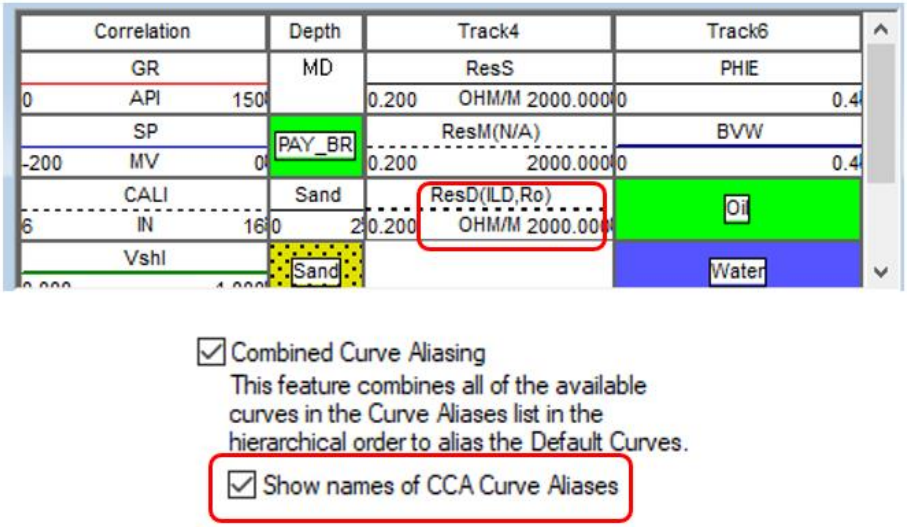
Formation tops and fault cuts can be displayed with log presentation in Crossplot view, which helps you in quickly identifying intervals of interest on the crossplot view log presentation.

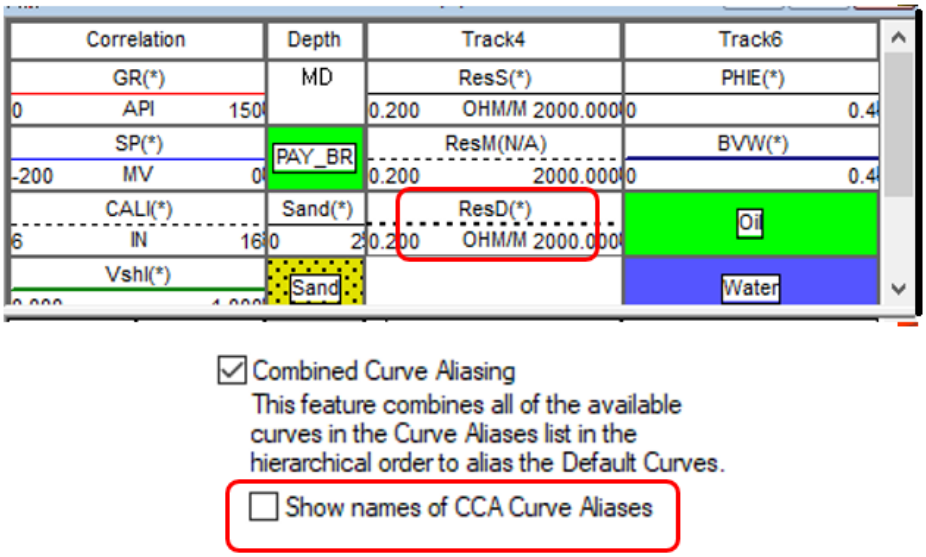
Filter Curves while Importing LAS Files

You can now choose not to import unwanted curves while importing a LAS file by filtering curves.

Toggle Display of Aliased Curve Names in Curve Headers while Applying Combined Curve Aliasing

You can choose whether to display all the aliased curve names in the respective curve header or not, while applying Combined Curve Aliasing (CCA).





Ability to Lock Zone Column while Scrolling

In the Set Parameters dialog box, the Zone column is frozen and does not hide from view while scrolling towards the right side.

Improved Formatting while Using Copy to Clipboard Option

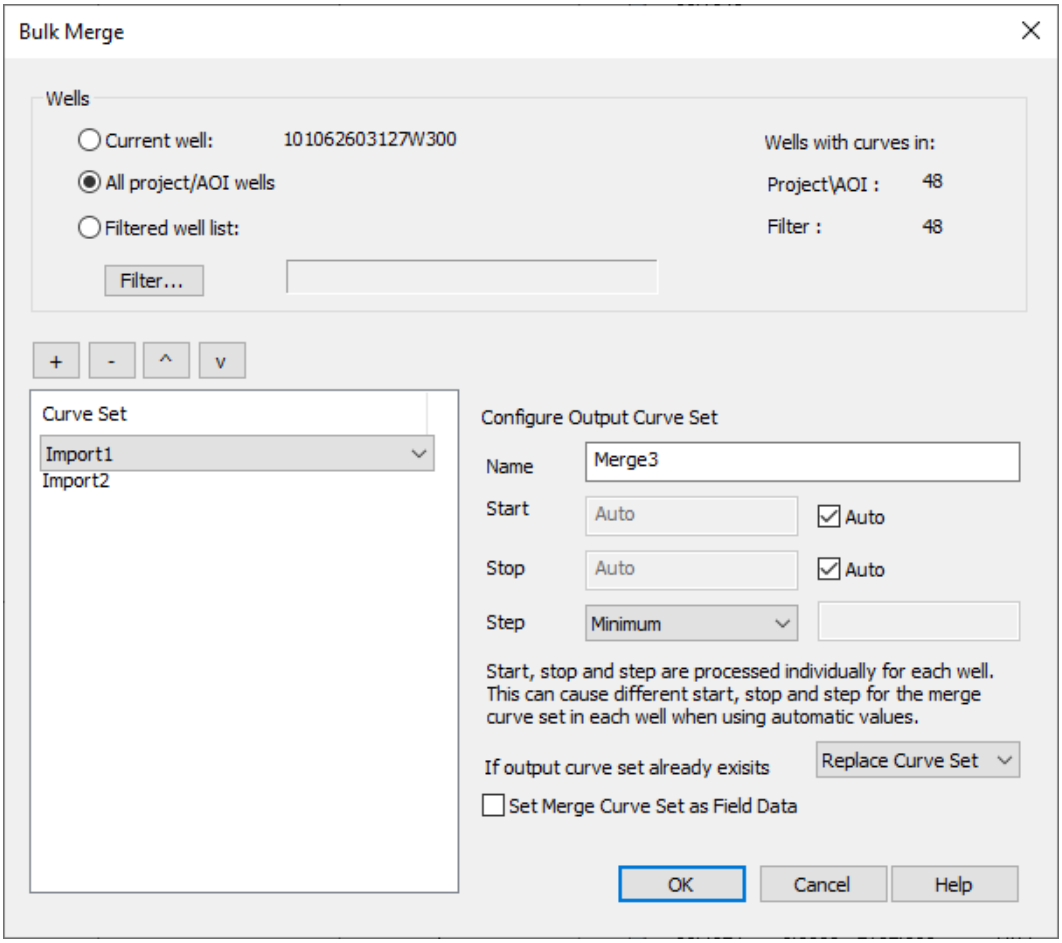
Formatting has significantly improved while using the 'Copy to Clipboard' option in Curve Set Inventory.

Add Curves to an Existing Curve Set while Importing LAS Files

Curves can now be added to an existing curve set while importing LAS files for a single well.

Merge Curve Sets in Multiple Wells

Curve sets can be merged in multiple wells, which allows users to organize and manage curve data easily in larger projects.



Curve Name Mnemonics Length Increased

You can now add the curve name mnemonics up to 40 characters in the database.

Third Party Acknowledgements

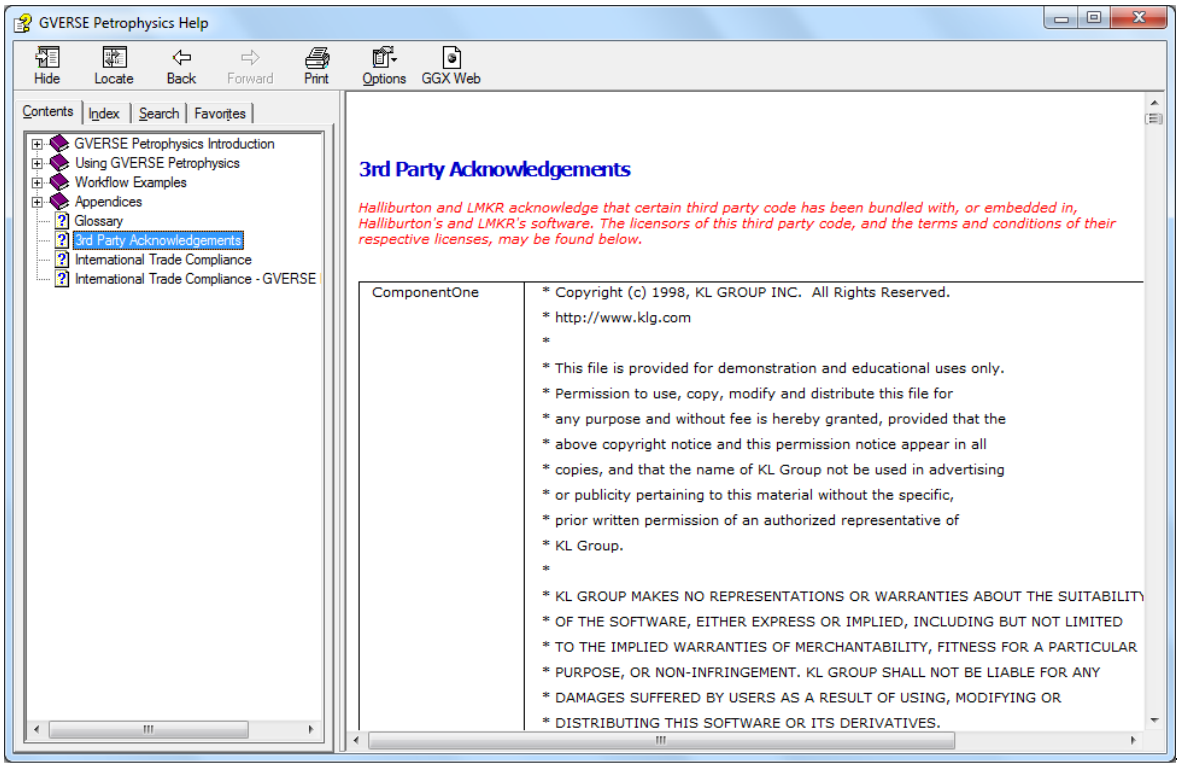
We acknowledge that certain third party code has been bundled with, or embedded in, our software. The licensors of this third party code, and the terms and conditions of their respective licenses, may be found in the help file.

To access the 3rd party license agreements:

1. To access the online help, click the **help** tab located on the tab commands bar.

   The Help window displays.

2. In the **Contents** pane, locate the **Third Party Acknowledgements** help topic as shown in the image below.



International Trade Compliance

This application is manufactured or designed using U.S. origin technology and is therefore subject to the export control laws of the United States. Any use or further disposition of such items is subject to U.S. law. Exports from the United States and any re-export thereafter may require a formal export license authorization from the government. If there are doubts about the requirements of the applicable law, it is recommended that the buyer obtain qualified legal advice. These items cannot be used in the design, production, use, or storage of chemical, biological, or nuclear weapons, or missiles of any kind.

The ECCNs provided here (if available) represent our opinion of the correct classification for the product today (based on the original software and/or original hardware). Classifications are subject to change. If you have any questions or need assistance please contact us at support@lmkr.com.

Under the U.S. Export Administration Regulations (EAR), the U.S. Government assigns your organization or client, as exporter/importer of record, responsibility for determining the correct authorization for the item at the time of export/import. Restrictions may apply to shipments based on the products, the customer, or the country of destination, and an export license may be required by the Department of Commerce prior to shipment. The U.S. Bureau of Industry and Security provides a website to assist you with determining the need for a license and with information regarding where to obtain help.

The URL is: http://www.bis.doc.gov.

Definitions

ECCN - Export Control Classification Number - The ECCN is an alpha-numeric code, e.g., 3A001, that describes a particular item or type of item, and shows the controls placed on that item. The CCL (Commerce Control List) is divided into ten broad categories, and each category is further subdivided into five product groups. The CCL is available on the EAR Website.

EAR - Export Administration Regulation - The EAR is a set of regulations that are administered by the Bureau of Industry and Security, which is part of the US Commerce Department. In general, the EAR govern whether a person may export a thing from the U.S., re-export the thing from a foreign country, or transfer a thing from one person to another in a foreign country. The EAR apply to physical things (sometimes referred to as "commodities") as well as technology and software.

The EAR number and the License type for this product are included in the table below. Also included is the date the table was last updated.

Product/Component/R5000	EAR Number	License	Last Updated On
GVERSE Petrophysics	EAR99	EAR	07/22/2019

Contacting GVERSE GeoGraphix Support

We are committed to providing the highest level of technical customer support in the industry. With an average tenure of more than thirteen years, our highly trained and experienced staff of technical analysts is comprised of geoscientists, engineers, land professionals, petrophysicists, and system specialists.

Please refer to our Customer Support timings mentioned below to ensure that you have access to our support analysts assigned to your region. When getting in touch with GVERSE GeoGraphix support, please remember that real-time support will not be available during bank holidays or after office hours. If you do get in touch with GVERSE GeoGraphix Support outside of work hours, please leave a voice message with a brief description of the issue that you are facing. Your voice message will be used to automatically create a support case for you. This will enable our analysts to attend to your issue and provide you with a resolution as soon as possible

North and South America	**Europe, Middle East & Africa**
Monday – Friday 8 am-6 pm CST* Toll Free (US/Canada) : +1 855 449 5657 **Colombia:** +57 1381 4908 **United States:** +1 303 295 0020 **Canada:** +1 587 233 4004 **Excluding bank holidays*	**UK:** Monday - Friday 8 am – 5 pm* +44 20 3608 8042 **UAE:** Sunday - Thursday (Dubai GMT+4) 8 am – 5 pm* +971 4 3727 999 **Excluding bank holidays*
Asia Pacific & Australian Continent	**Southwest Asian countries**
Malaysia: Monday - Friday (Kuala Lumpur GMT+8) 9 am – 6 pm* +60 32 300 8777 **Excluding bank holidays*	**Pakistan:** Monday - Friday (Islamabad GMT+5) 9 am – 6 pm* +92 51 209 7400 **Excluding bank holidays*

Helpful Links

Name	Website Address
GVERSE GeoGraphix Homepage	http://www.gverse.com/geographix