



Geolog[®]

Formation Evaluation



Geolog®

The industry standard in advanced petrophysical innovation

Geolog minimizes the 'black box' nature of other petrophysical software by enabling the user to view and modify the modules used to compute petrophysical outputs. This allows us to run Geolog in complex wells where routine analysis is no longer routine.

Senior Petrophysicist, Super-Major

Superior Functionality and Modular Design

For close to 30 years, Geolog® has been the industry standard for advanced petrophysical analysis and formation evaluation. In operation at 90% of the top-producing oil companies around the world, Geolog is unmatched in terms of its best-in-class petrophysical and geological analysis tools, well data management, superior graphics, and robust data integration. Geolog combines technological superiority with a modern, user-friendly interface that is consistent across multiple platforms.

The easy scalability of Geolog means that it can be used for any number of applications, from log drafting to high-end petrophysics. Its modular design provides a flexible software environment that can be scaled from a single user on a laptop to a team collaborating over the network, customized to specific user requirements.

Powerful Capabilities in an Easy-to-Use Graphic Environment

The ability to effectively convey the results of an analysis is an essential component of the exploration and production life cycle. Geolog's central graphics module and user-friendly interface offer unrivalled ease of use and a short learning curve for new users. The Geolog launch platform allows the display of composite, high-quality well data presentations,

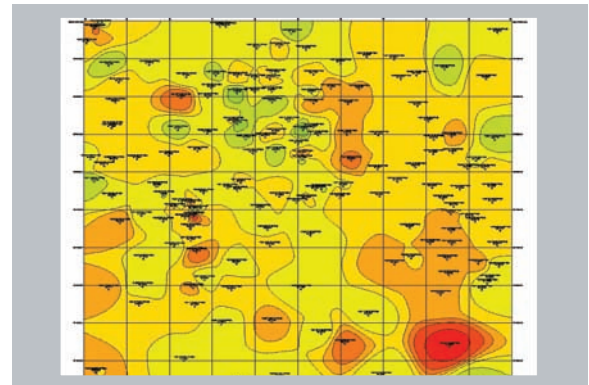
and provides comprehensive data analysis and graphic editing mechanisms for various types of borehole information.

Powerful crossplot functionality, including interactive 3D crossplots, provides input for petrophysical calculations.

Any combination of Geolog's graphic displays can be presented within a single workspace. Users can create, save and restore custom workspaces to meet their individual requirements, enabling them to increase the speed and efficiency of their processing and interpretation.

The Geolog Project data management module provides tools for the interrogation of Paradigm's powerful Epos® well database, and includes many tools for field-wide QC work. These map-based tools help maximize the returns from a study by managing pertinent information effectively and easily.

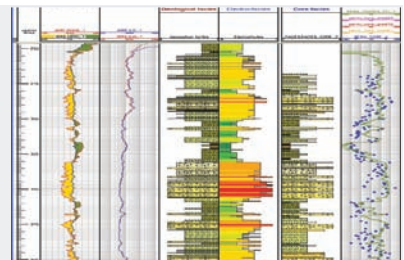
A complete audit trail enables users to query the history of any individual log.

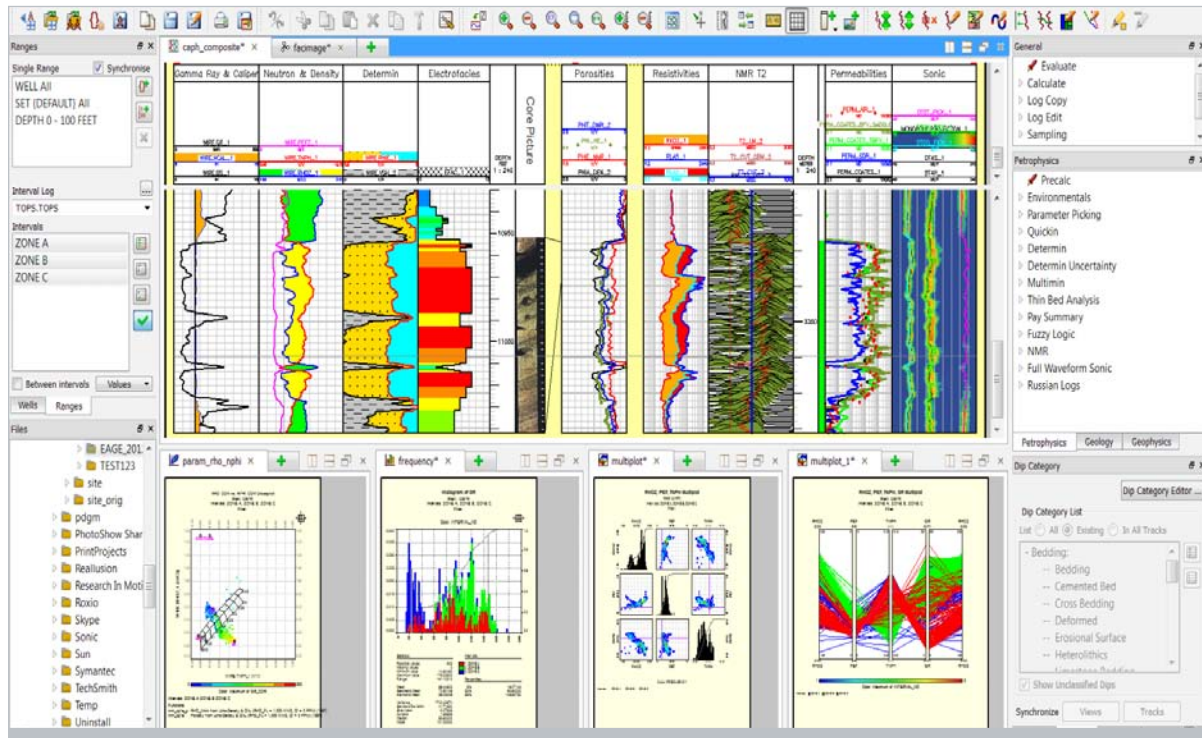


▲ Quick-look field-wide property mapping created in Geolog Project

Facimage™

Invaluable to both petrophysicists and geologists, Facimage is an advanced, field-proven, electrofacies analysis and log prediction tool kit. Consisting of a suite of routines for electro-facies analysis and core data modeling, Facimage makes Total's Multi-Resolution Graph-based Clustering (MRGC) algorithm commercially available.





▲ Geolog workspace showing log display, crossplot, frequency plot and multi-plots, with full inter-process communication between views

Better Reservoir Characterization through Shared Knowledge

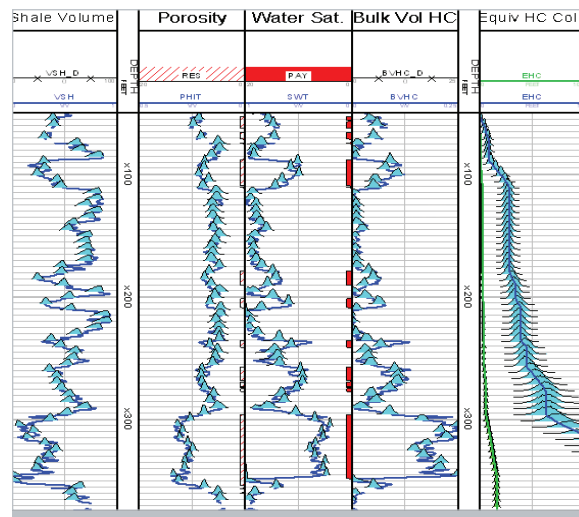
The Paradigm Epos interoperability integration framework enables our applications to access well data from a single source, creating new synergies between them. Through its common data repositories, Epos allows close collaboration between petrophysicists performing reservoir characterization and geologists working in interpretation and earth modeling.

Direct Access to Third-Party Databases Saves Time and Money

The Epos framework allows Geolog applications to work directly not only on data stored in the Epos well data repository, but also on such databases as Petrel* (two-way connectivity), Recall™, OpenWorks® and GeoFrame®, without the need for time-consuming data reformatting.

Epos offers high levels of data access control and security, and simplifies such data management activities as backup, restore, etc. It is possible to assign Read and/or Write access to different teams or individuals, thus providing IT Managers and Project Administrators with maximum control and flexibility.

* is a mark of Schlumberger

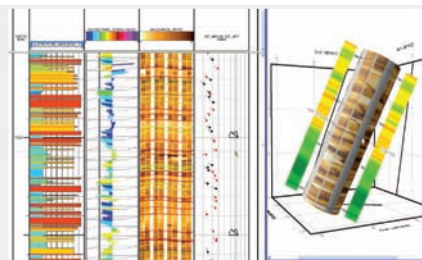


▲ Determin Uncertainty: Distributions of petrophysical curves output on a frame-by-frame basis show where uncertainty is greatest

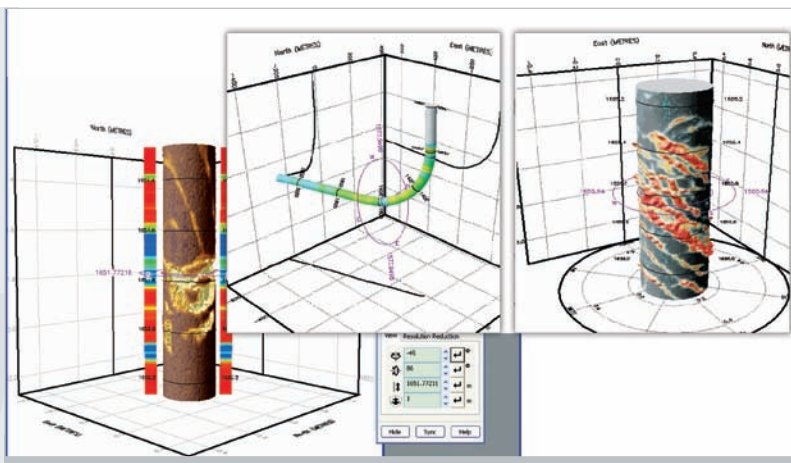
Geolog Image Log Processing & Interpretation

With the ability to handle a wide range of acoustic and electrical imaging tools, the Geolog image log processing and interpretation module provides a vendor-independent solution for the processing and interpretation of borehole image logs. Interactive dip azimuth walkout plots and stereonet provide the geologist with tools to interpret structural data.

*Incorporates technology developed by Total



Geolog handles the entire data loading, log editing, analysis and presentation workflow, so that we don't need to train our people on separate packages for each task.



▲ Views of wellbore in 3D in Geolog; tracking between views is fully interactive

Comprehensive Deterministic and Probabilistic Petrophysical Analysis Tools

Geolog petrophysical packages provide an environment for effective geological and petrophysical analysis.

Determin, a comprehensive suite of individual deterministic modules, allows analysts to apply all the major petrophysical techniques in the traditional analysis methodology, including environmental corrections, as well as:

- Vshale determination from GR, SP, Density / Neutron, Density / Sonic, Neutron / Sonic, Resistivity, Neutron or M/N plots
- Porosity calculated from Sonic, Density, Density / Neutron or Neutron / Sonic
- Saturation using Archie, Total shale, Indonesia, Simandoux, Waxman-Smiths, Dual Water or Juhasz methods

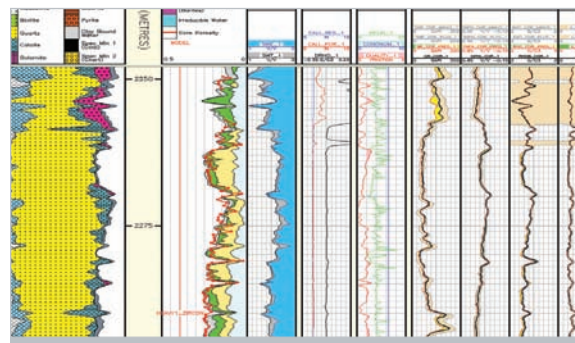
Various permeability computation methods are available. Determin modules are written in **Loglan**, Geolog's powerful programming language. This easily learned language gives log analysts the freedom to customize modules to meet their needs or incorporate local or proprietary algorithms. An option is available for work in interactive mode, enabling automatic updates of all relevant calculations when values are changed on screen.

The Determin shale unconventional module is available under license from Saudi Aramco. This module contains a number of routines for the calculation of TOC/kerogen volume from both Passey and Schmoker methods, the calculation of free and absorbed gas volumes, and a brittleness index for target identification and hydraulic fracture planning.

A **reservoir flow unit characterization** workflow allows petrophysicists and engineers to estimate reservoir flow properties from log data, to help estimate their production capacity.

The **Determin Uncertainty** add-on tool, a full Monte Carlo deterministic log analysis module, allows the uncertainty associated with a petrophysical analysis to be accurately quantified. The consideration of parameter inter-dependencies ensures that uncertainties are correctly carried throughout the analysis.

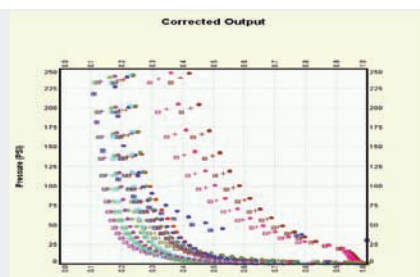
The full distribution of the petrophysical curves can be transferred from Geolog to the Paradigm SKUA-GOCAD™ system for integration into a reservoir uncertainty analysis using the **Reservoir Uncertainty** (Jacta®) module.



▲ The reliability of Multimin outputs can be assessed using the quality curve

Core Analysis & Saturation Height Modeling

This module provides a comprehensive suite of algorithms for interpreting and integrating routine and special core analysis data, allowing effective correlation with conventional and NMR log data. It features a highly interactive graphical workflow for rapidly loading, correcting and analyzing special core analysis data for saturation height modeling, enabling seamless integration of this data with other petrophysical measurements, for more accurate reservoir characterization.



Multimin is an optimizing tool for statistically determining mineral and fluid characteristics and volumes from petrophysical data, such as logs, cores, XRD and petrographic data. Multi-well simultaneous analysis capabilities result in substantial gains in productivity and quality, even in the most challenging analytical environments.

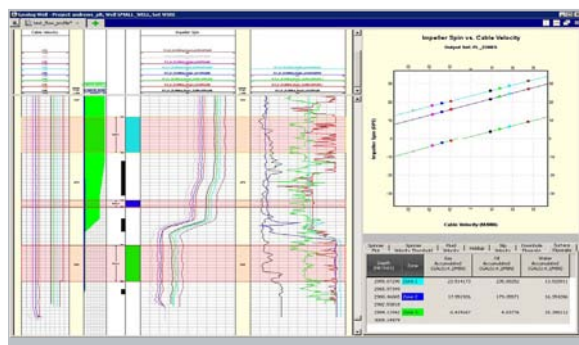
Synseis, Geolog's module for borehole geophysics, enables comprehensive data processing in both vertical and deviated wells. Working with other Geolog modules, Synseis is a flexible toolkit for depth-to-time conversions, synthetic seismogram generation, Gassman substitution and AVO analysis.

Engineering Modules Expand Geolog's Reach into Additional Phases of the Production Cycle

Geolog includes technologies aimed at engineers working on wells that are already deep into the production stage, including:

- Well schematics: Users can visualize wellbore mechanicals in conjunction with all other data gathered from the wellbore, providing critical input to cased hole logging applications.
- Well integrity: An independent means of assessing the mechanical condition of casing in a wellbore, ensuring safe well operations and ultimate abandonment of a well.
- Production logging: Assists with post-production formation evaluation.

Together with the system's proven technologies for petrophysical and geological analysis, these make Geolog an essential tool for petrophysicists, geologists and engineers alike.

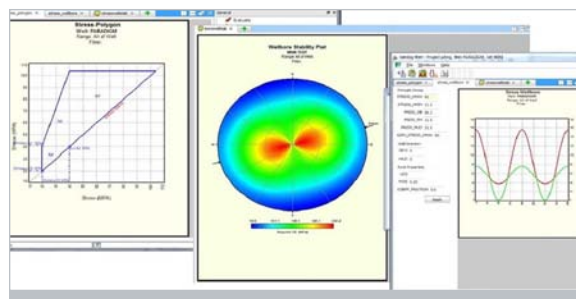


- ▲ Production logging allows users to process and interpret spinner and fluid tools to identify volumes of fluid produced in their wells

Geomechanics Minimizes Drilling Costs while Ensuring Safety

Geolog offers a geomechanics module comprising a comprehensive series of calculations and interactive tools for assessing mechanical conditions around the wellbore. These result in a better understanding of the reservoir, leading to improved recovery and reduced exploitation costs. The geomechanics package includes:

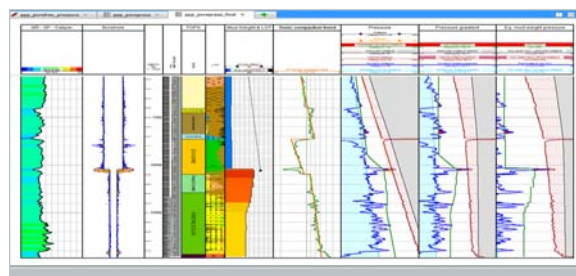
- Pore Pressure Prediction
- Dynamic and static elastic properties
- Unconfined compressive strength
- In-situ stress estimation (multiple methods)
- Wellbore stability plots: Mud window, stress plot, stereonet plot



- ▲ Geomechanics tools and interactive displays enable a detailed assessment of mechanical conditions around the wellbore

Pore Pressure Prediction from Logs

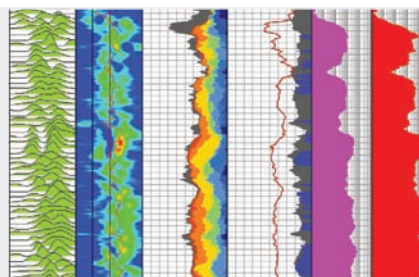
A comprehensive suite of tools is available for the calculation of log derived normal, overburden, pore and fracture pressures. The pore pressure prediction module includes dedicated routines for initial data preparation and shale compaction trend analysis. Layouts displaying results at each stage are automatically generated, aiding QC throughout the workflow.



- ▲ Pore pressure prediction outputs include results in pressure gradient and equivalent mud weight

NMR

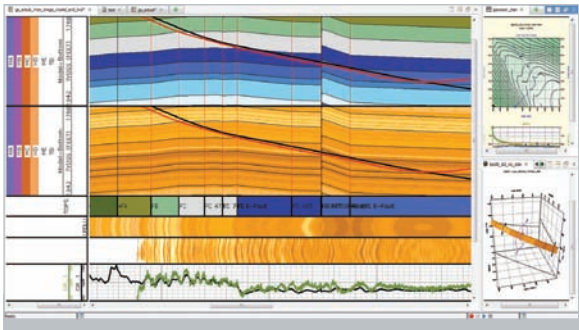
The NMR add-on module enables vendor-independent, high-end processing, quality control, interpretation and modeling of NMR logs, including 2D NMR. With multiple inversion options, users are free to investigate relationships between the measured data and their reservoir.



Geolog's user-defined algorithms let us integrate our proprietary analytical routines into a package that exactly fits our requirements.

Independent Geosteering Enables Real-Time Well Modeling

Geolog Geosteer® works in collaboration with the Paradigm Epos-based product suite, as well as with Sysdrill® drilling applications. These provide a powerful log-scale interpretation capability that integrates petrophysical, geological, geophysical and drilling workflows. This integrated application group provides a well planning environment in which complex well paths may be designed and engineered for optimal placement in the reservoir based on a combination of seismic, geological or reservoir data. Geolog Geosteer gives users the independent ability to model, monitor and interactively modify a well in real time as it is being drilled.



- ▲ Geolog Geosteer allows an independent comparison of real-time log responses with a pre-drilling model, enabling monitoring of well progress and well plan modification if required

Comprehensive Packages Tailored to Every Need

Several Geolog packages are offered, adapted to the varying needs of geologists, geophysicists, petrophysicists and engineers:

Aimed at the generalist, **GeologBasic** provides exceptional flexibility and ease of use for data loading, editing and display. Data from contractor formatted or ASCII files can be loaded into

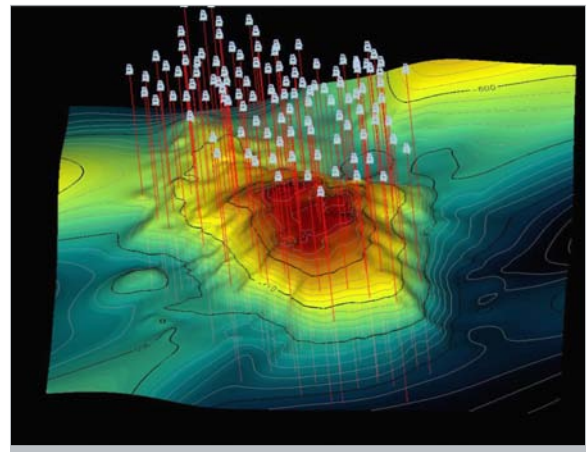
Geolog using drag and drop, and all tools needed to prepare log data for analysis are included in the package. Highest-quality presentations can be created using a wide variety of graphical elements, which can easily be customized by the user.

GeologELP includes extensive deterministic petrophysical analysis capabilities, while **GeologFE**, the tool of choice for petrophysicists, contains all GeologELP functionality, plus an advanced programming environment for the ultimate in user customization.

GeologGold, the most comprehensive Geolog package, adds optimizing petrophysical functionality and borehole geophysics.

For geologists and engineers, Geolog offers discipline-specific packages that extend the use of Geolog further into the production cycle. The **Geolog for Geologists** bundle aims at improving geologists' understanding of the 3D architecture of the reservoir. It adds geological correlation and cross-section creation to the basic package, as well as mapping and 3D visualization, though tight integration with Epos-based visualization solutions.

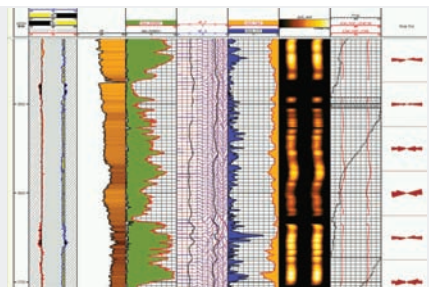
The **Geolog for Engineers** package includes cased hole and geomechanics modules as well as Loglan, allowing engineers to incorporate their own calculations and visualize the results using Geolog's high-quality display capabilities.

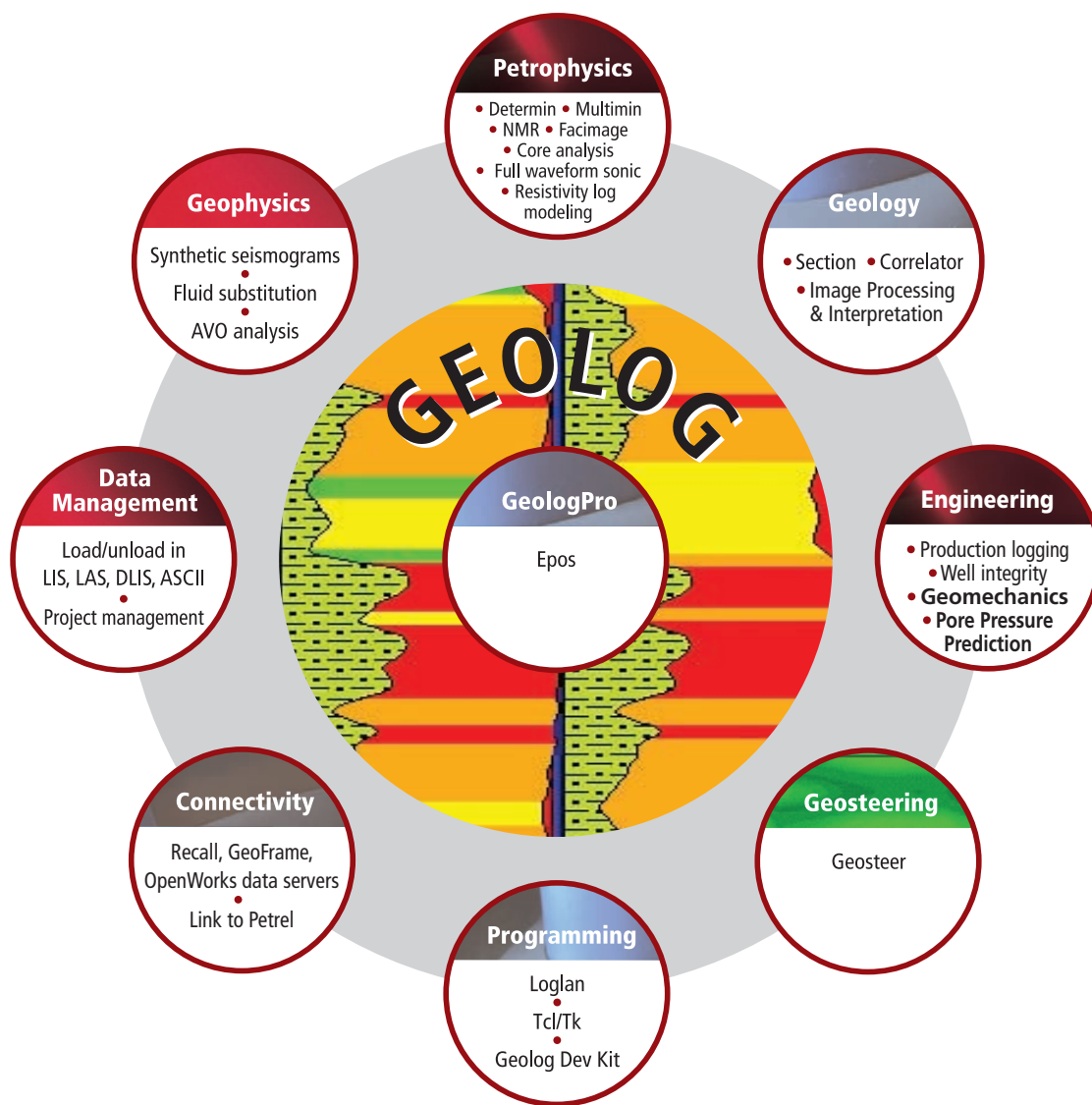


- ▲ Comprehensive mapping and 3D visualization are available in the Geolog FE, GeologGold, and Geolog for Geologists bundles.

Full Waveform Sonic

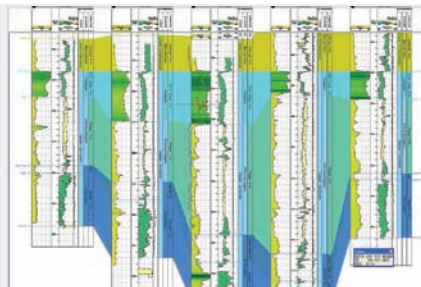
The full waveform sonic processing module is used to process and interpret array sonic logs, from raw data to results, including anisotropy processing. This enables maximum stress direction determination for the calculation of geomechanical properties.





Geolog Correlator

The Geolog Correlator is an advanced, log-based tool for geological correlation, fault and zonal correlation in Geolog. It is particularly useful in complex, high-angle/horizontal wells. Geolog Correlator is available as part of the Geolog for Geologists bundle.





Features

- Flexible data import/export
- Easy-to-use environment for log editing and interpretation, including user-defined workspace
- Presentation-quality graphical output
- Consistent look and feel for Linux and Windows users
- Interface ergonomically optimized for use with multiple large computer screens
- Powerful crossplotting, providing input for petrophysical calculations
- Comprehensive petrophysical processing tools
- Multi-well, multi-zone data management
- Audit trail, with the ability to query the history of any individual log
- Petrophysical analysis of unconventional shale fields
- Cross-section creation tools
- Log-based pore pressure and fracture pressure prediction
- Epos integration framework and well data servers

Interoperability

- OpenWorks® R5000
- GeoFrame® 2012
- Petrel* seismic-to-simulation software (* a mark of Schlumberger)
- Landmark Recall™

System specifications

- All 64-bit, for x64 architecture processors
- Microsoft® Windows® 7, 8.1, 10
- Red Hat® Enterprise Linux® 6.5 and above, 7.0 and above

The Paradigm Advantage

- Vendor independence gives users the freedom to choose the best tools for each task, with no conflict of interest.
- Fully scalable and customizable, Geolog meets the needs of users from generalist geologists, to expert petrophysicists, to engineers working in field development.
- An intuitive, interactive, Windows-style interface optimizes usability and ensures a short learning curve.
- Integration with other Paradigm products provides access to a full range of industry-leading E&P software.

www.pdgm.com

Facimage and the Geolog Image Log Processing and Interpretation module are based on Total technology.

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