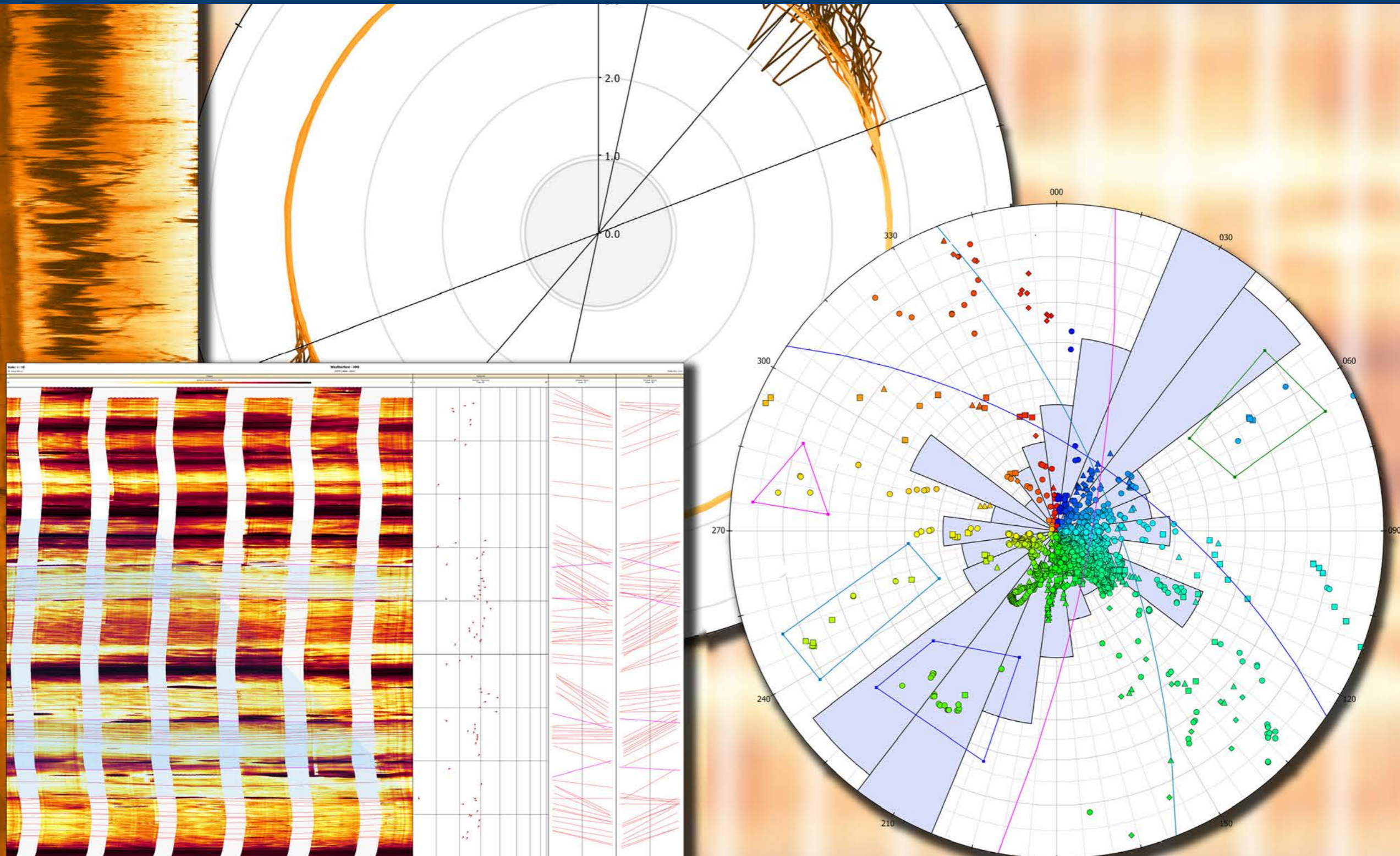


IP™ Modules



Mineral solver

Our premier tool for non-deterministic assessment. Integrate all of your wellbore logs and core data into one solution for Lithology, Porosity and Saturation.

Mineral solver is perfect for handling Carbonate wells with complex diagenetic histories, mixed-clay wells or even handling heavy-mineral effects in Sandstones.

Mineral solver is also ideal for Unconventional Reservoir analysis using TOC as an input to solve for Kerogen volume. Any mineral can be included in a

rock-model and any data which is a curve data can be included to help you build a full picture of the down-hole lithology.

Curve / Val	Equation	Eq. Mode	Use	Confidence	Inv. Fact.	Result	V _{Lime}	V _{Sand}	V _{Pyrite}	V _{clay}	V _{water}	V _{oil}	V _{BWater}
1.0	Unity	Model	✓	0.01	1.0		1	1	1	1	1	1	1
RHOB	Density	Model	✓	0.02	1.0		2.71	2.65	4.99	2.78	Auto	0.8	1
Nphi_Corr	Neutron	Model	✓	0.02	1.0		Auto	Auto	0.01	0.25	Auto	0.8	1
DTLN	Sonic	Model	✓	3.	1.0		47	55	39.2	70	189	200	189
SGR	GammaRay	Model	✓	5.	1.0		20	20	15	150	20	20	20
0.0	BoundWater	Model	✓	0.01	1.0		0	0	0	0.15	0	0	-1
0	Constant	Model	✓	0.01	1.0		0	0.03	-1	0	0	0	0

Operate with confidence at every stage

01 Custom modelling and zonation

02 Integrate your data

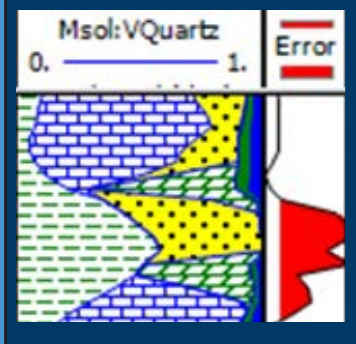
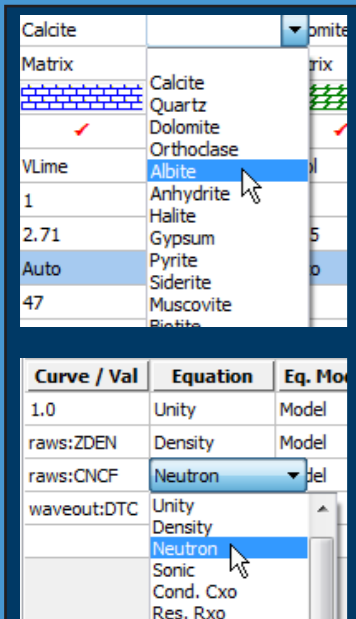
03 Interact with the solution

04 Assess your assumptions

05 Handle the hard stuff

06 Refine. Review. Replicate.

Take control of your assessment



Build your own rock-models without relying on a Sand-Lime-Dolomite model. Derive a best estimate of Porosity based on what is actually there.

Our default Mineral listing can create more than ten thousand rock models and it's easy to add your own. Easily create the models you need; save, import, export and share across your organization.

Meet the Challenge of Formation Complexity. Zoning a well is only one way to begin handling how different lithology can be.

Mineral Solver allows you to integrate any curve-derived logical method to alternate between your rock models.

Integrate Electrofacies, core assessment or even just gamma to make the switch. We make it easy to handle blocks of Coal, Anhydrite or Salt, ensuring they're on the right side of Net-to-Gross.

Data defines your interpretation, and Mineral Solver allows you to include everything that feasibly adds value.

Join up your data. Each model can independently use any input:

- Standard Density/Neutron/ Gamma/Resistivity/ Acoustic
- Spectral Gamma
- TOC & Heavies
- Magnetic Resonance
- Neutron Spectroscopy
- Mineral Weight-Percent
- Sigma logs
- RCA and XRD data

Define your assumptions. Some solvers leave mineral volume to chance or add minerals where there is no geological reason.

Mineral Solver allows you to set the relationships that govern when minerals may appear and to what amount they can occur in. You can also add weighting to valuable data, adapting your model to depend on the reliable and relax on the noisy.

Deriving trends from the available data is at the core of all of IP's interpretation modules.

Mineral Solver allows you not just to see, but to alter your assumptions using industry-standard crossplot techniques.

The Tools you Expect

- Interactive Pickett plots for trending R_w and R_{mf}
- Neutron-Density
- Neutron-Sonic

 But you can crossplot any input against any other input and see how Sonic Trends with Gamma and then interactively alter your interpretation.

Define your assumptions. Some solvers leave mineral volume to chance or add minerals where there is no geological reason.

Mineral Solver allows you to set the relationships that govern when minerals may appear and to what amount they can occur.

Our Solver is driven to reduce reconstruction error: It's not probability and it's not statistical chance.

Based on your inputs, the Cambridge University math engine builds the best outputs that match the log curves, and shows you the reliability of your model.

The output makes it clear. A single curve shows you the reconstruction error, and generally, less is better: it's that simple.

The reconstructed log curves are what Mineral Solver calculates based on the determined Mineral and Fluid volumes guiding you in reviewing your model.

Examine your individual models or the entire system and assess the finished product so you can direct your work.

There's no substitute for a good R_{xo} and Sonic rock models can produce very different results. So what do you do when Clay is changing, not just in water content but in mineral content as well?

Explore Advanced Models. Non-conductive muds require special logic and Mineral Solver delivers. S_{xo} is always handled separately from S_w and you can use all of the popular Equations or let the solver decide fluids as well as minerals.

Dry Clay models are easy to construct and you are free to separate treatment of Clay-Bound water from Pore-water, yet still combine them when needed.

Gas-effects on logs are handled effortlessly: we keep the parameters simple so Neutron and Density always reconstruct right.

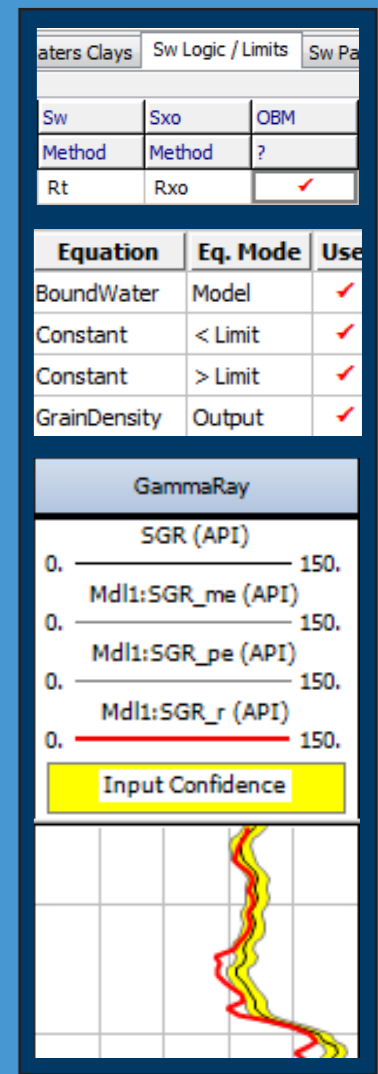
Mineral Solver also lets you compensate for Invasion: giving you the power to add multiple fluid (invasion and formation based)

Take your own path with Multi-Well interpretation. Our module requires no additional licensing to fully interpret multiple wells simultaneously or to pivot from a key well.

Mineral Solver is just one part of our 3D Petrophysics package, where you can start from first principles, deriving Models, Parameters and an interpretation with one process.

As easy as it should be. Different curve names from different wells are not an issue for any of our Multi-Well packages and verification is easy, even after the interpretation has been run.

Engaging common Zone-sets and driving interpretations using crossplots with all data from all wells has never been so simple.



Add value

Create and customize your own minerals, defaults and values.

High value logs deserve preferential treatment.

Create and customize your own minerals, defaults and values.

Control the error in your assessment

Drive your models with data alternatives and different methodology

Build once, run everywhere.

Request a demo at <http://info.lr.org/ip-demo>

Monte carlo sensitivity

Complete workflow analysis

Petrophysics workflow can be deeply complex, using hundreds of inputs, and every one of them affecting Net-to-Gross. Our true Monte Carlo analysis cuts through the complexity, isolating the key curves and parameters affecting your bottom line, allowing you to focus your work on a defensible and robust interpretation.

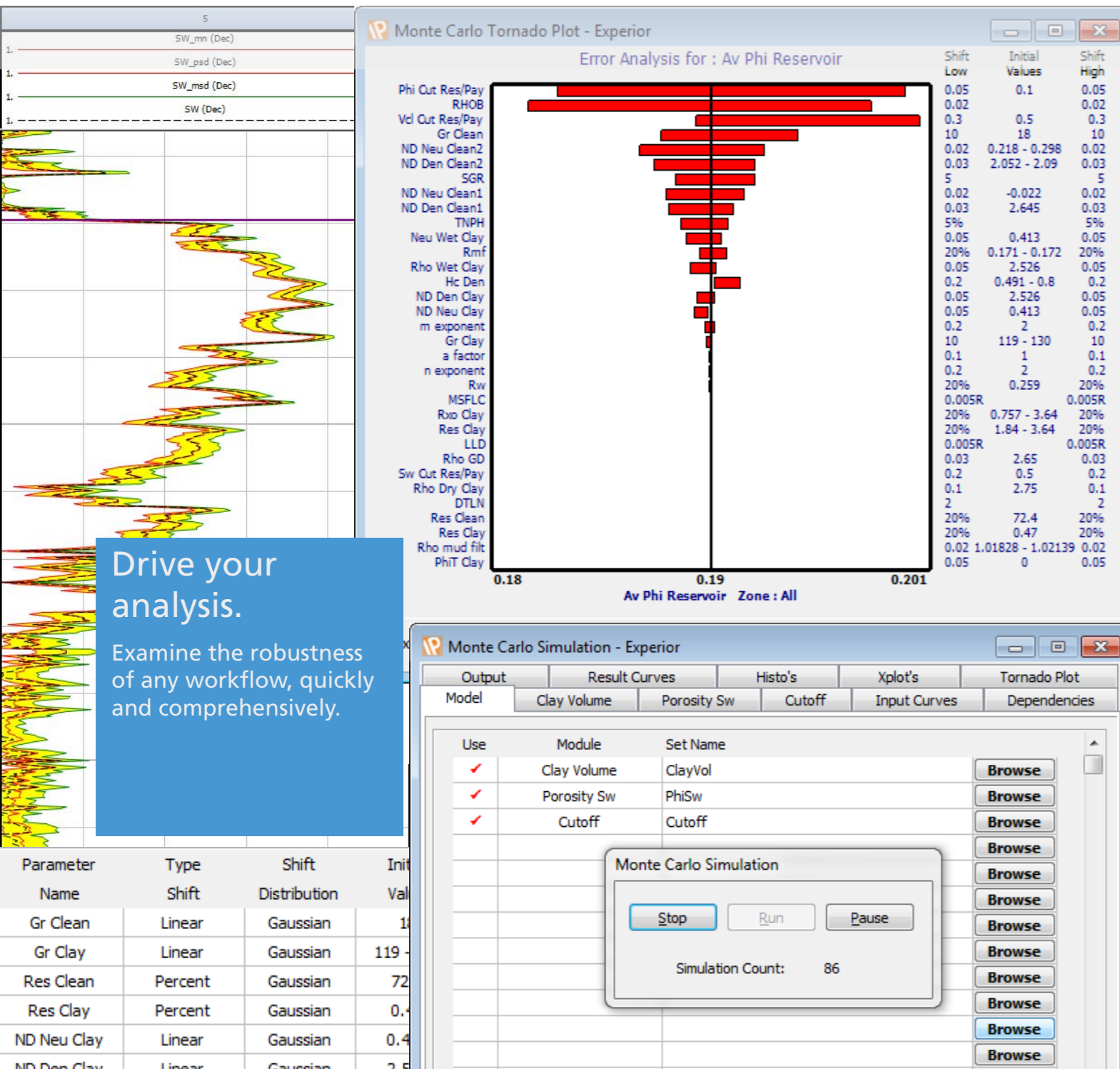
Developed during the Manhattan Project, Monte Carlo Analysis is a proven technique for finding the input-sensitivities in any multi-variate system.

Customizing your analysis is easy: you specify your workflow and every element, every input or parameter you need to test.

Monte Carlo performs hundreds or even thousands of iterations of your entire workflow, stress-testing every aspect, then collates the results of how the outputs change to all input variance.

Like every Module in IP, Multi-Well analysis comes as standard, so you can employ this powerful technique to readily assess sensitivity across the field.

Our module lets you output a statistically valid report on error quantification for use in risk assessments and best-worst case considerations.



Drive your analysis.

Examine the robustness of any workflow, quickly and comprehensively.

Crossplots and histograms are built in for analysing the distribution of the Sensitivity results and every Summary Result gives the zonal listings, sorting results by up to 5 user-defined percentiles.

Our reports allow you to quantitatively show the error involved in the interpretation and rather than reporting just net pay thickness and average porosity, our statistics report lets you more accurately estimate the errors in the reserves.

Features:

- Imports all raw data and parameters from your existing interpretations, in any number of wells
- You define the Error to apply for each input, quantifying every uncertainty
- Choose the statistical method for the distribution of error for each parameter
- Running thousands of variations to the inputs, IP qualifies every error, collating the data graphically to show you workflow sensitivity
- Generate reports with results for each zone along with the 10, 50 and 90 percentiles
- Tornado plots assist you to readily identify which parameters or input curves have the biggest effect on the final results

Request a demo at <http://info.lr.org/ip-demo>

Hydraulic flow units

Unravelled

Classify reservoir rock into grades based on production potential, especially in carbonates where the relationship between porosity and permeability frequently non-linear. Identify with zones with similar flow potential across multiple wells.

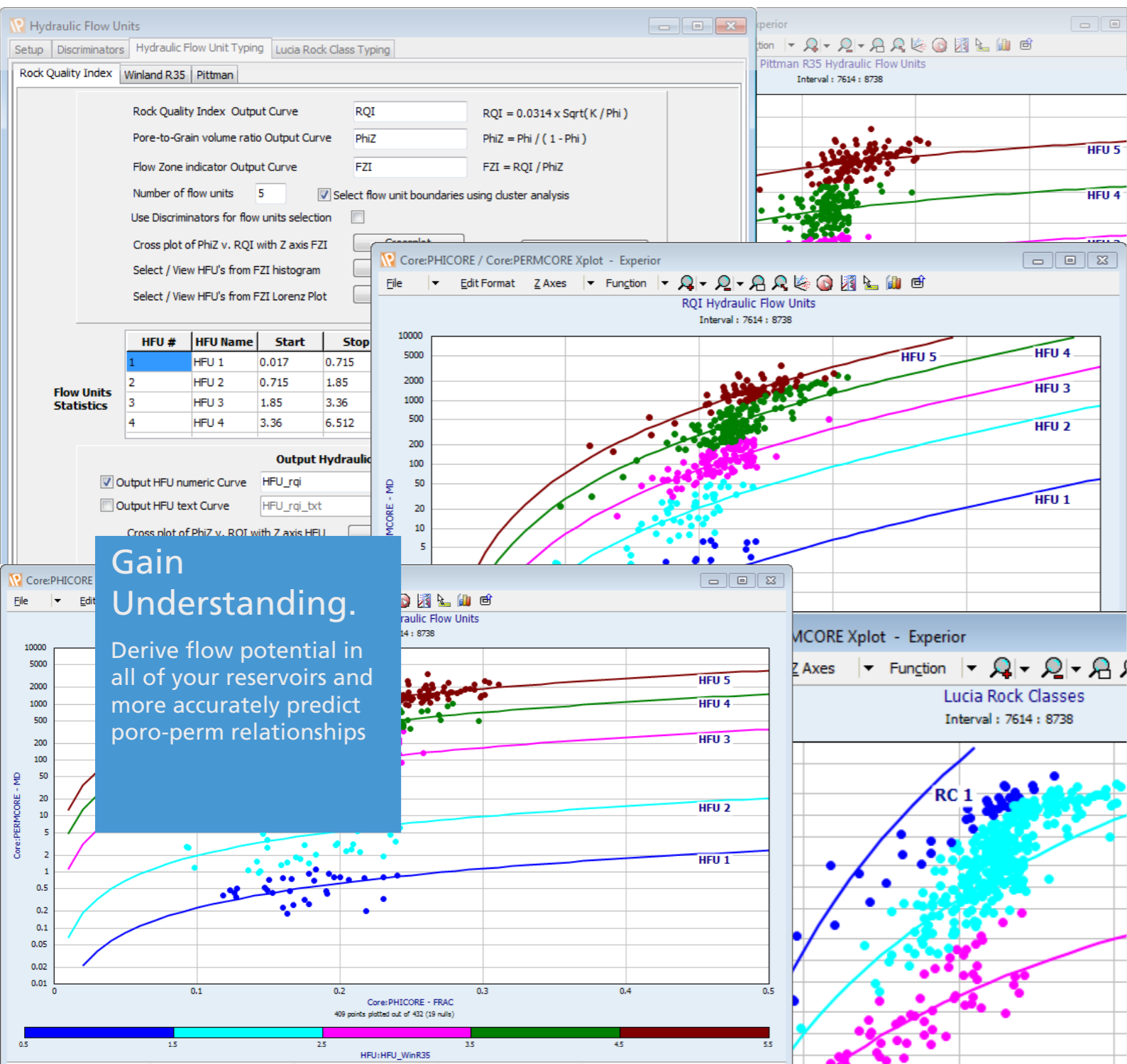
Create HFU models using data from single or multiple wells which have log or core data available. Each model relates permeability and porosity data to the flow potential of the rock.

Each depth level with input poro-perm data is given an HFU grading; the number of gradings and the division value between the gradings can be adjusted by the user.

The HFU model can then be applied as an input to IP's statistical modules for nearby wells and define a continuous flow unit curve across the full data interval of the target well.

Using Flow Units, Reservoir Engineers can refine their static reservoir models and enhance Saturation Height calculation, leading to better estimates of Hydrocarbon Saturation.

Take advantage of all the popular industry standards and unlock a powerful application for all of the core data across any field.



Gain Understanding.
Derive flow potential in all of your reservoirs and more accurately predict poro-perm relationships

Our HFU module implements all three industry recognised methods for calculating flow potential: Rock Quality Index (RQI), Winland R35 and the Pittman methods. All three methods are available to the user and expanded to have multiple equations for selection depending on Capillary Pressure.

- Using HFU you can:
- Predict the potential production value of a well prior to completion
 - Obtain consistent results across multiple wells
 - Use the results to improve accuracy of the Saturation Height analysis and static reservoir models

- Features:**
- Our Module:
- Works equally well with core data or log data
 - Uses Interactive histograms to adjust flow unit boundaries
 - Provides results already formatted for easy importing into our Saturation Height Module, enabling you to compare and contrast with Capillary Pressure data.
 - Has statistical prediction modules ready to import HFU results.
 - Additional features to define Carbonate rocks into different classes using the Lucia method

Request a demo at <http://info.lr.org/ip-demo>

Saturation height modelling

Bypass the routine

Create the strongest comparison of RCA data to continuous well logs with an industry standard. Saturation Height Modelling creates an entire-well water saturation model based on any same-well or offset-well information you have.

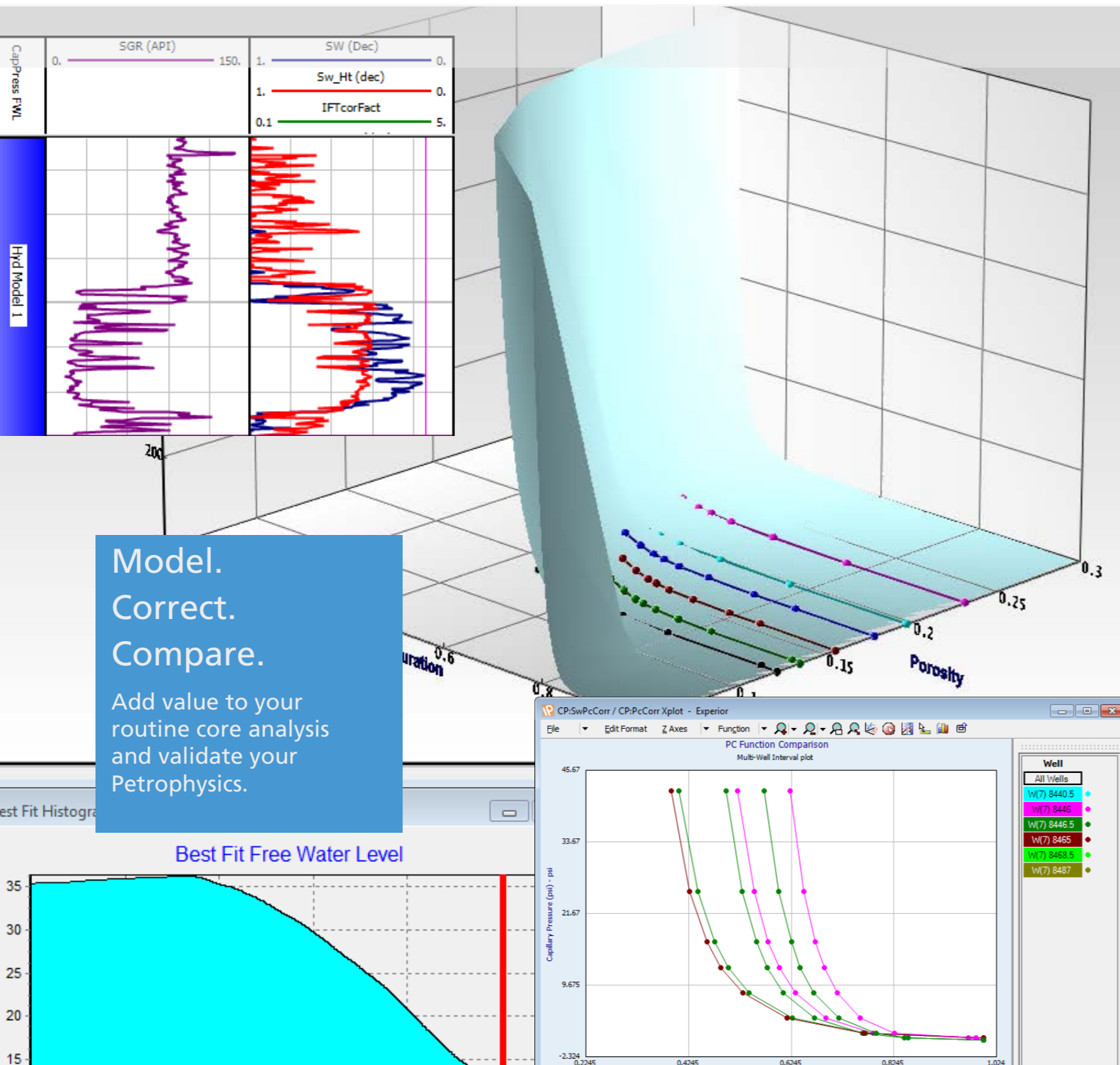
Set up Capillary pressure data the easy way, grade and assess core analysis information based on comparison then, enable or disable data, visually and intuitively.

Perform standard and custom regressions to capillary data and create functions that demonstrate how porosity, permeability and fluid pressure relate.

Optionally add stress-correction or clay-bound water correction to apply and integrate any Hydraulic Flow Unit information to discriminate further and refine your outlook.

Integrate multi-well data sources easily, without tedious imports or exports. Our tool gets you to the business of making decisions.

Comparison to standard log-based petrophysics is built in and you can easily integrate multiple Saturation Height functions into a joined up analysis with our Function Mixing tool that switches on any customizable logical condition.



Model.
Correct.
Compare.

Add value to your routine core analysis and validate your Petrophysics.

Best Fit Free Water Level

Request a demo at <http://info.lr.org/ip-demo>

Our Saturation Height module offers over 30 different functions types, as well as custom options. Use any discriminator logic to select the data and build confidence into your evaluation. Our module give you the option to use different functions for each unit in a reservoir.

Changes in fluid density can be fully accounted for, like a simple gas cap or a more complicated oil compositional gradient, as long as the contacts and densities are known, you're good to go.

Features:

- The ability to easily analyse, QC and correct capillary pressure data
- Multiple workflows and methods for creating robust and accurate regressions on your data.
- 'One Equation for all Pc curves' option - Find a single equation which fits all (or a subset) of the data
- 'Separate equation for each Pc curve' option - Fit each individual Pc curve and then combine the parameters into a 'Combined equation'. Discriminators can be applied to allow for functions based on porosity range litho-type and more.
- Interactive - pick both FWL and IFT correction on the log plot interactively to fit your Sw calculation.
- Carry your regression functions to other wells and correlate FWL at the field level.

Rock typing without the stress

Create Electro-facies from log and core data with our premium statistical analyses tools. Embedding both Cluster and Self-Organizing Map methods, our Rock-typing leaves no stone unturned.

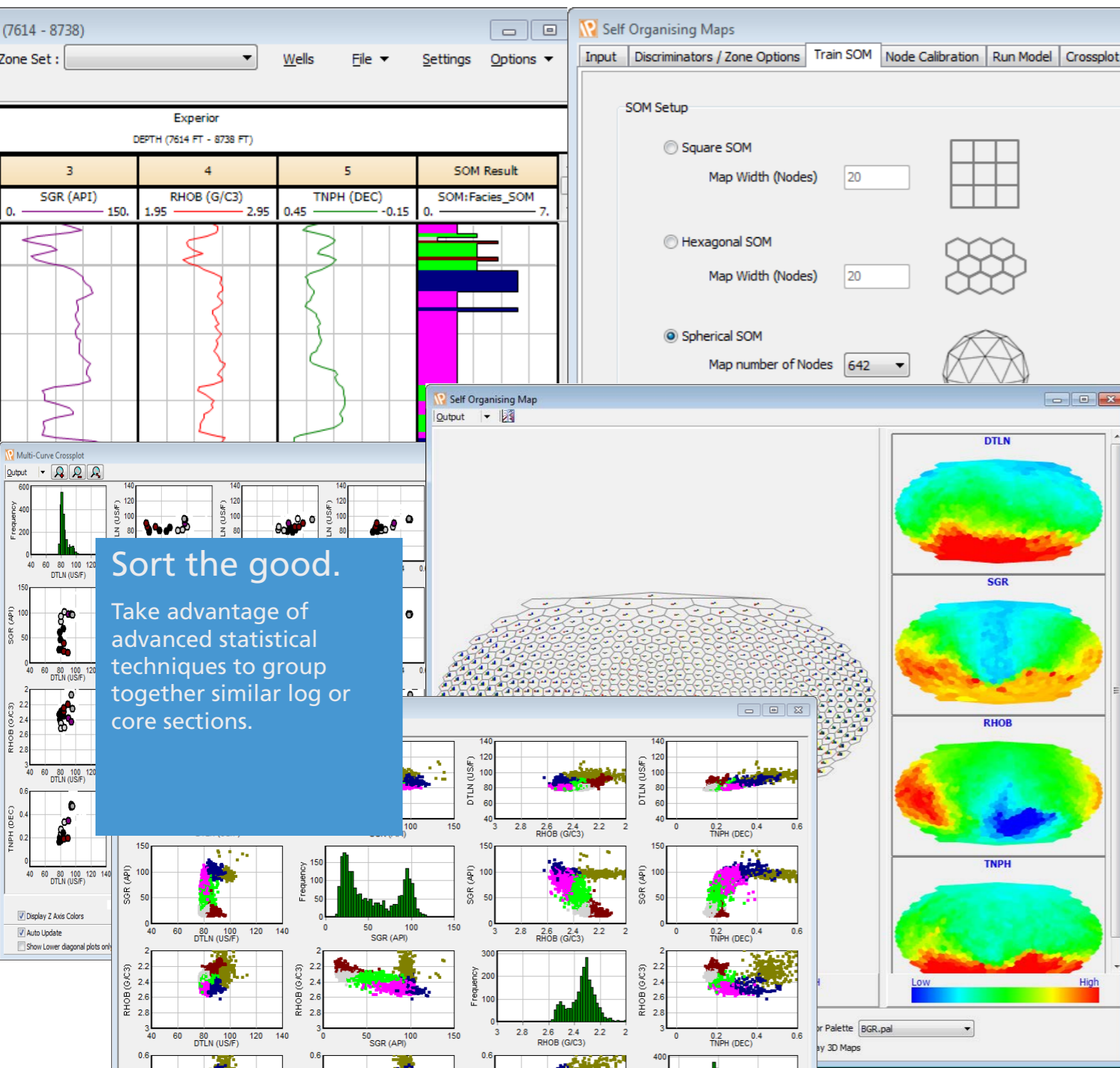
Including two modules: Cluster Analysis and Self Organising Maps, Rock typing is easy to set up and uses powerful classification algorithms allowing for repeatable and accurate facies classifications.

Used with core or raw logs, there is no requirement for a full petrophysical interpretation, allowing you to cluster, zone and focus on the best approach to Lithology, Porosity and Saturation.

Both Cluster Analysis and Self-Organizing Maps accept a wide range of Linear or Logarithmic input curves and input-tables created in one module can easily be loaded into the other (as well as any of our Curve Prediction modules).

Building a Facies model can be done with any number of wells and the facies results applied to the same or other wells.

Getting you to the key parameters of your model, our Cross-plots and Star-plots show you graphically how data inputs differentiate Facies selection and our Contingency Table allows you to compare any Rock Typing models, including core data and manual picks.



Sort the good.
Take advantage of advanced statistical techniques to group together similar log or core sections.

A powerful Clustering tool, Rock Typing can predict curves as well, giving you two powerful functions in one.

Using Rock Typing you can:

- Train your model using any log or core data as input
- Group data single or multi-well using powerful clustering techniques
- Calibrate models to any input
- Cluster data free-hand or to a Calibrated input
- Predict data, using any correlated additional input
- Examine individual clusters and re-assign Facies

Features:

Our Module is:

- Fast and powerful, with rock typing options based on your preference
- Cluster once, Calibrate often: Self-Organising Maps do not require trained input curves. Your data is sorted into natural groups/clusters of similar data and calibrations applied after
- Discriminates data easily, applying any limits to data used in creating or running the model.
- Interactive, with cross plots of all log data used as inputs. This can be used to simply illustrate the locations of the clusters with respect to each input.

Request a demo at
<http://info.lr.org/ip-demo>

Geosteering

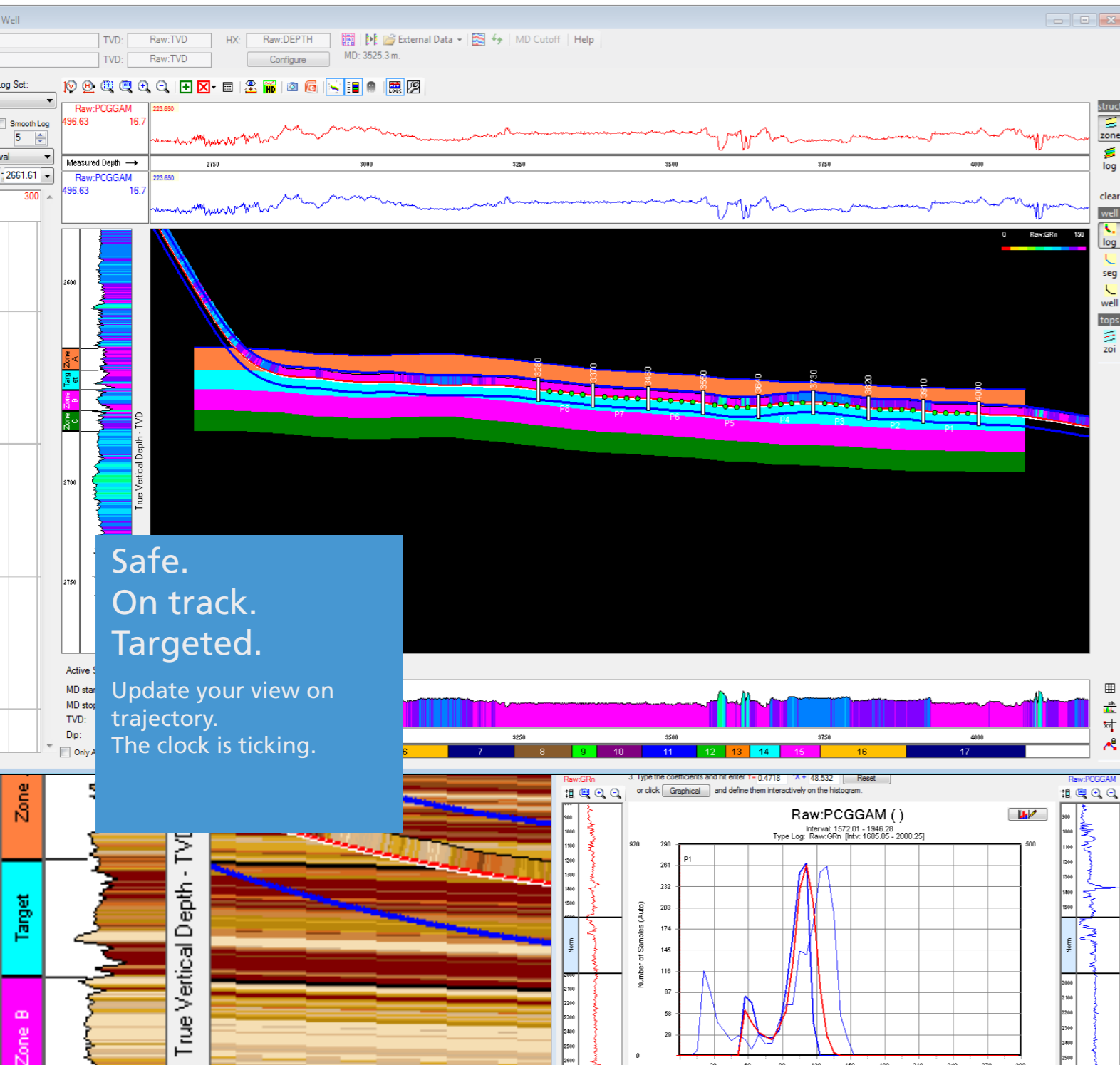
Precision and direction

Direct any well whilst drilling, based on geological knowledge and the logging measurements sent uphole in real time. Place your wells effectively, maximising exposure to the reservoir and avoiding geohazards.

Combine your Real-time logging data and geological models from offset wells (or even the same well) to constantly update well trajectory and stay on target.

With new logs and interpretations you can bring the full power of a complete petrophysics package to your Geosteering, enabling all rock-science disciplines to work in unison.

Wells that have been used with geosteering have a designated target, which may change as the model changes. The well must remain within the formation and the geosteering module helps predict the upcoming formations in order to make a decision for the borehole placement and subsequent production. This module is able to incorporate geomechanical data as well as production data.



Safe.
On track.
Targeted.

Update your view on trajectory.
The clock is ticking.

Geosteering uses offset well data (or the same well when drilling back into the same formation) and projects curves to find correlation as you drill ahead. Geosteering can straddle many disciplines including Petrophysics to Geology, Engineering (Production and Drilling).

- Geosteering helps you:
- Get real-time decision making and well steering – stay in the formation when you need to
 - Integrate your workflow with IP's interpretations suite – all in one package
 - Effectively placement of a well
 - Maximise reservoir exposure
 - Identify geohazards and minimize Rig downtime

Features:

Key to the process is normalization of the offset well data, and IP delivers with its interactivity.

- Pan in the graph views
- Guiding lines can be activated between the offset well and projected well
- Easy to add new segments, change dips and match GR
- Display zones, or log data throughout the viewing window
- Drape seismic images

Request a demo at <http://info.lr.org/ip-demo>

SandPit 3D

Optimize production

Maximize formation productivity with the safest pressure drawdown and best perforation pattern, while minimizing the risk of formation failure and sand production. Integrate key rock-physics principles into your bottom line.

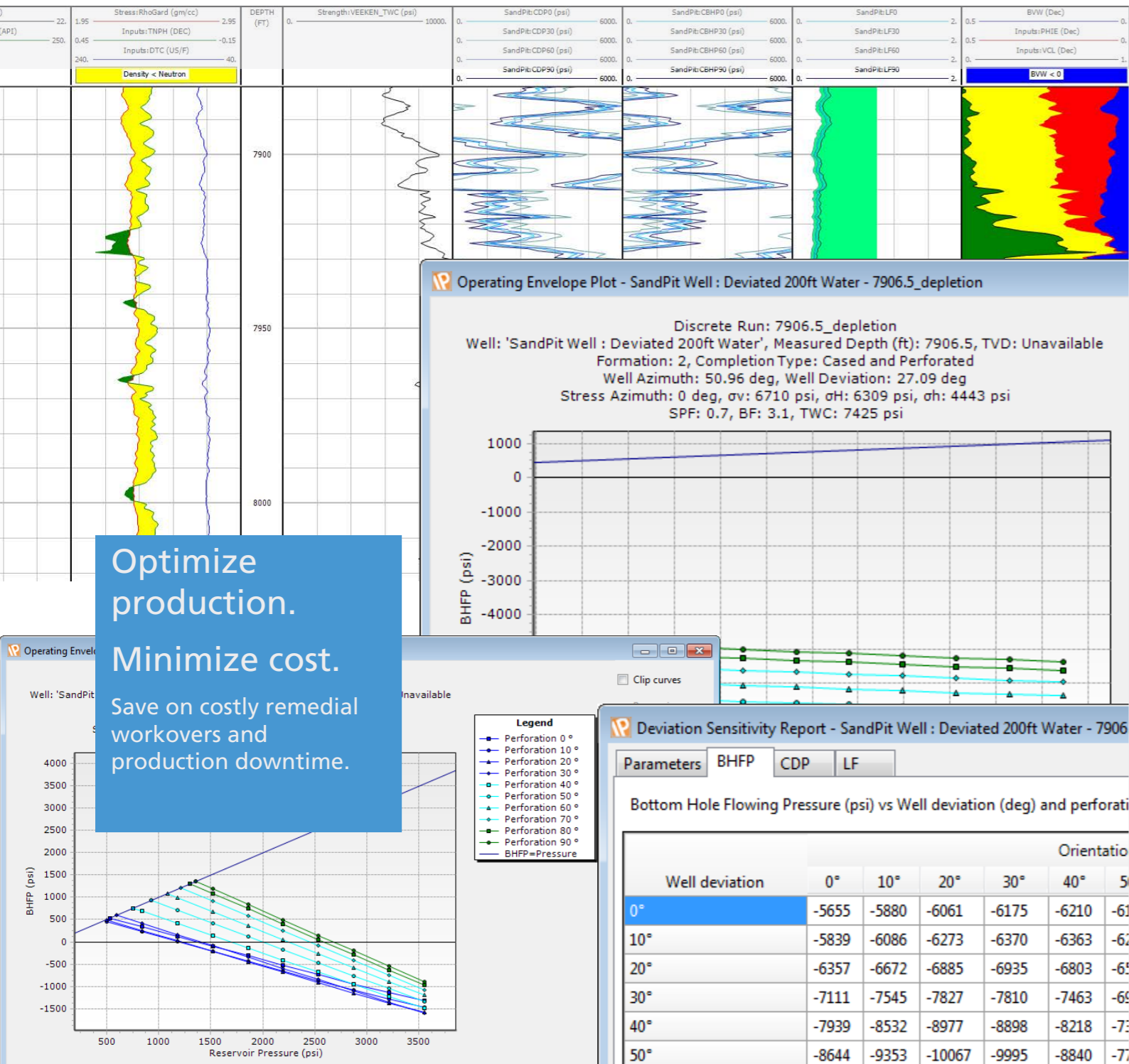
Drawing-down pressure at the well-head is a classical method of increasing production, but how much is too much?

SandPit3D examines the key rock physics parameters in your well and gives your Reservoir Engineers tools to assess sand production likelihood for various scenarios over the lifetime of the well.

SandPit3D also gives you clarity on the optimum perforating pattern in your well, examining formation anisotropies and empowering you to make informed decisions.

Consisting of separate Discrete Depth and Multi-depth analyses, SandPit3D enables you to run the failure analysis for any deviation or azimuth and integrates lifetime depletion conditions.

As part of our Geomechanics modules, SandPit3D lets you take charge of production and failure risk.



Optimize production.
 Minimize cost.
 Save on costly remedial workovers and production downtime.

SandPit 3D calculates the effective stress acting on the walls of a perforation tunnel or wellbore. If the effective stress is greater than the effective strength of the rock, the rock will fail, producing sand.

Any Production and Completion Engineers involved in sand face completion design need to know sand production risk.

Features:

- Assess the risk and extent of sand production over the life of a well.
- Assists with selecting the right equipment to avoid sand production
- Optimise your completion design method to avert loss of production.
- Flexibility in input (stress and rock strength) and output formats.
- Provides answers in a format easily understood by production engineers and geoscientists.
- A very rapid tool which enables numerous sensitivities to be run and reported quickly and easily, important where data are sparse or constrained.

Request a demo at <http://info.lr.org/ip-demo>

Wellbore stability

No pressure

Build your Geomechanics model and assess safety before you drill. Our module integrates popular Rock Strength and Pore Pressure models to help you determine margins for mud weight, keeping your crew safe and drilling smooth.

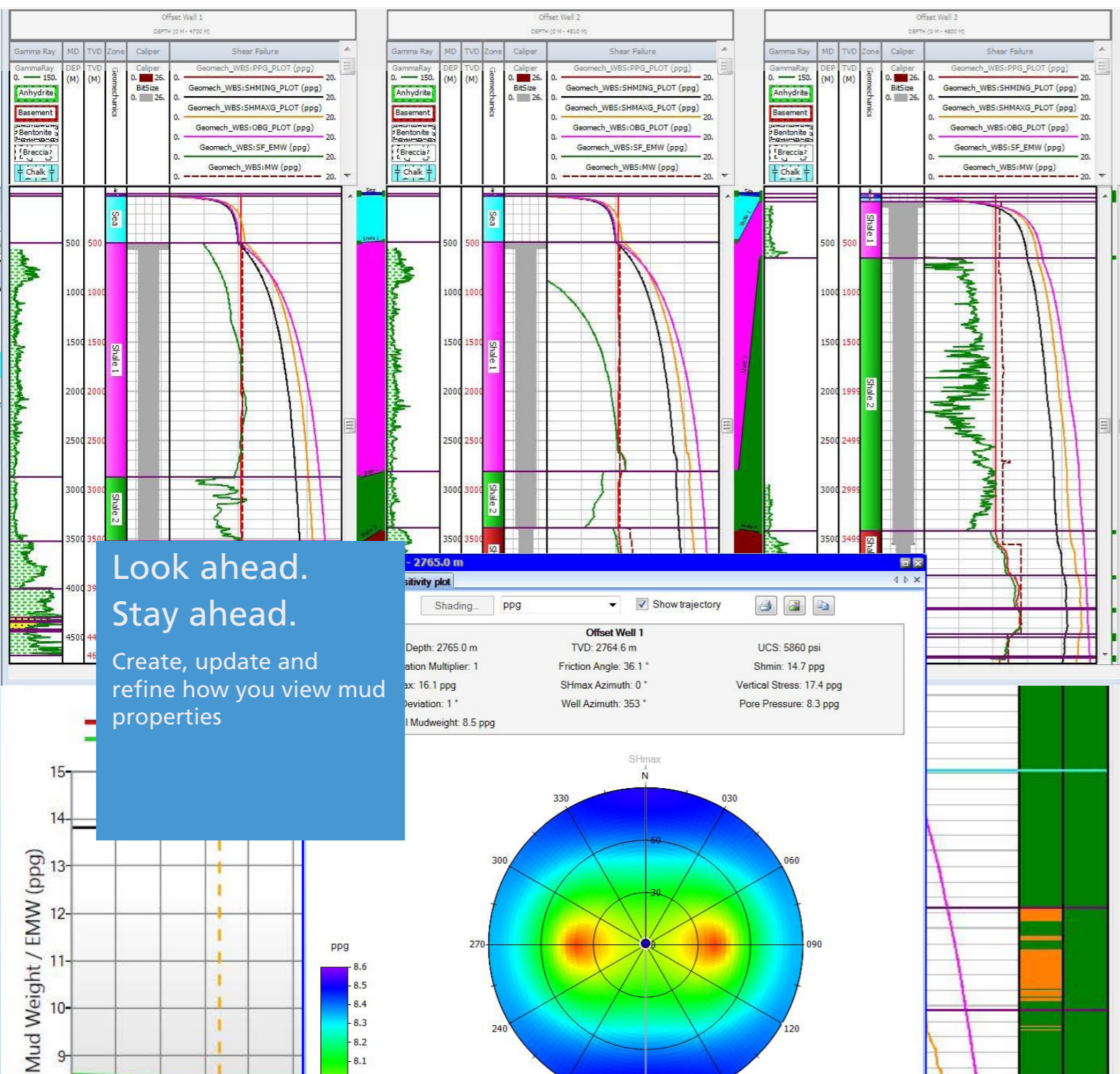
A key tool for any pre-drill strategy, our Wellbore Stability module is designed for Geomechanics Engineers to determine the failure conditions at the rock-face, taking the guesswork out of predicting a mud weight to use for safe, stable drilling.

Used pre-drill, Engineers can create and validate a mud-weight plan, from first principles or based on offset wells.

During drilling, take advantage of real-time data to update mud weight requirements, control pore-pressure and ensure the risk of kicks, washouts and breakouts are minimised.

Interactive plots appear throughout, enabling you to easily call up an azimuthally sensitive breakout-risk assessment and more.

Part of our Geomechanics suite, Wellbore Stability seamlessly integrates with SandPit 3D, providing a whole-life tool for detailed rock mechanics and formation integrity.



The Wellbore Stability module allows the Engineer to create a Geomechanical model covering a field of wells. Our model allows you to calibrate against data in offset wells easily and apply your model to any new or proposed well and predict mud weight for stable, safe drilling.

Features:

- An integrated Geomechanics workflow, estimating mechanical properties, horizontal and vertical stresses, pore pressure and wellbore stability
- Creation and calibration of a custom Geomechanics model in both individual wells and across a field of offset wells
- Detailed result plots for each well and field wide multi-well correlation plots
- Seamless integration of interactive single depth sensitivity analysis plots
- An extensive suite of mechanical property models (for sands, shales, dolomites, carbonates, friction angles and elastic moduli)

Request a demo at <http://info.lr.org/ip-demo>

Image analysis

Made simple

The Image Analysis module provides a complete workflow for processing and interpreting any Wireline or LWD image log, and uses state of the art proprietary techniques and unique technology patented by LR.

A full image processing, correction and interpretation package and fully integrated into your petrophysics package.

Take control of your data and interpretation – remove the reliance on service companies.

Significantly reduce the costs of running image tools by handling the processing and interpretation yourself.

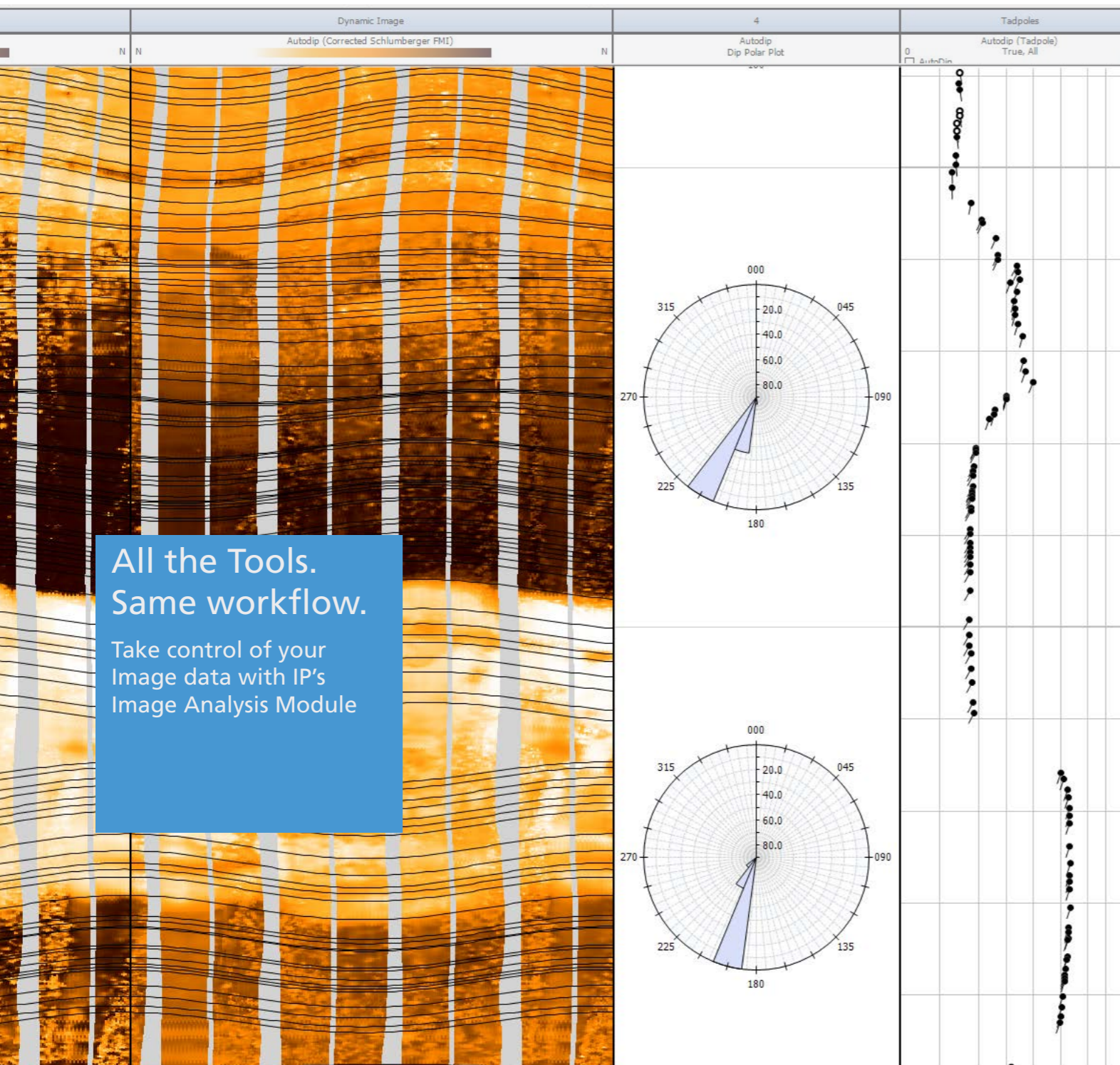
Reinterpret and share your results at any time, with all disciplines and teams.

Brand new, state-of-the-art tools for fast interpretation and powerful image corrections.

Intelligently designed interpretation tools to make Image Interpretation as efficient and easy as possible.

The IP Image Analysis module is designed to be approachable by any discipline. Geologists and Petrophysicists alike will feel at home making complex interpretations of the wellbore and regional geology.

Our interpretation tools are very accessible and coupled with our tailor-made training courses on the module and Image Analysis Interpretation we can turn every team member into an Image Analysis Expert.



All the Tools.
Same workflow.

Take control of your
Image data with IP's
Image Analysis Module

Request a demo at
<http://info.lr.org/ip-demo>

Raw images often need corrections and enhancements applied to them before an interpretation of the image can be made. The resulting image created from the data is used to identify bed boundaries and lithological features as displayed on the interpreted image. The module is designed to allow the user to step through the complete image analysis workflow to give full control over the whole interpretation.

Features:

- Load any raw data file
- Creation/editing image tools or choose from our extensive collection
- Correcting the data for various sampling effects (such as speed, streak, button-offset and more)
- Dip picking (manual, automatic and semi-automatic)
- Identify and categorize geological and drilling related features in the borehole
- Identify trends, boundaries, patterns and define relationships
- Hugely customisable plots, including: Dip Polar Plots, Walkout Plots, Cumulative Plots, Dip Scatter Plots and Stereonets to interpret the image log data
- Fracture analysis
- A 3D wellbore display to help visualize your interpreted image features.

