



# Resolver

## Formation Evaluation Analysis Software

The biggest challenge in formation evaluation is the determination of formation characteristics.

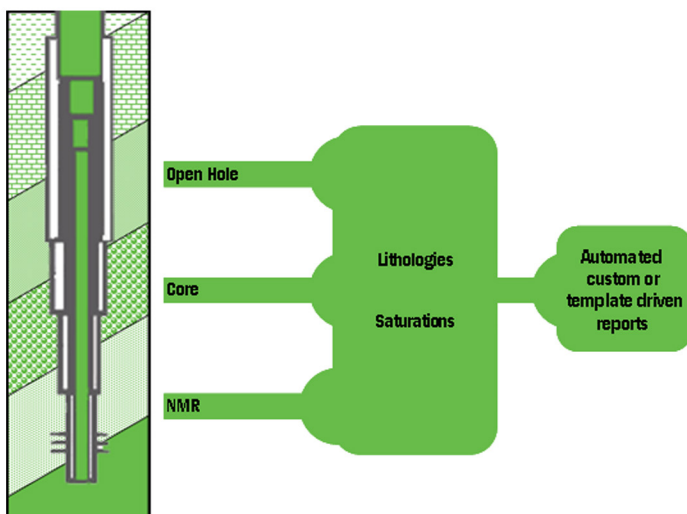
Traditionally, the analyst must determine the lithology and mineral response characteristics, a process which is both costly and time-consuming.

Resolver employs probabilistic modeling for formation evaluation. Formation characteristics are determined utilizing all available data (including core and NMR) and results are simultaneously reconciled to the measurements. Rock properties and mineral composition are determined simultaneously with the amount of hydrocarbon in place. The use of global optimization generates a data match far easier than other methods, reducing the risk of applying multiple erroneous mineral to the model. In addition, Resolver provides on screen indicators of errors and an undetermined system allowing the analyst the opportunity for correction.

Mineral composition and formation water resistivity is found by an accurate and stable optimization engine.

Resolver analyzes lithologies with any level of complexity for accurate modeling. Elemental composition and core data are combined simultaneously with traditional logs and any number of tools and/or constraints may be applied.

Resolver uses streamlined, easy-to-use workflows executed in real-time.



Probabilistic optimization technology uses all available data including core and NMR

Monte Carlo simulation of any tool set in any formation

Open system allows strict control over any aspect of the analysis and full access to all data and parameters

Easy integration of new tools and user models

Fully customizable automated report generation

Unlimited predefined or custom project templates for fast turnover

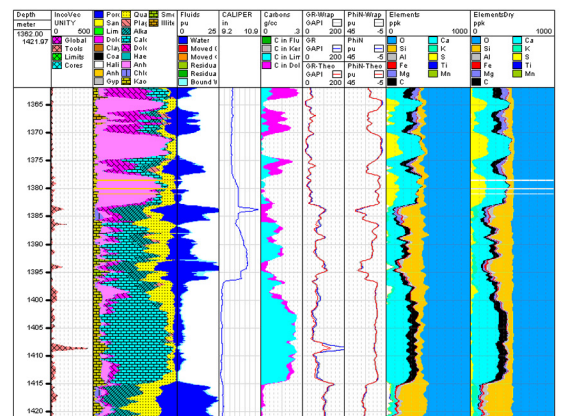
Powerful quality control

Lithologies can be very complex

Environmental corrections for most service companies

Complete mineral database of mineral parameters for all known clay, abundant and even rare minerals.

Computes multiple clays, silts and sand



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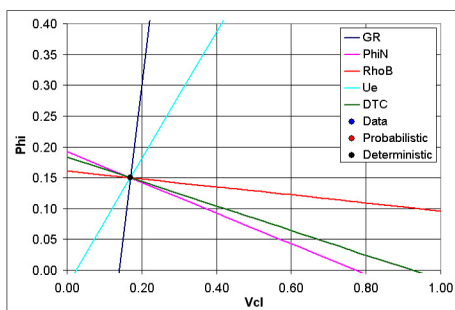
### Why use probabilistic modelling?

Probabilistic methods employ all available data and provide validation of the formation model which guides the analyst to find the formation characteristics. Probabilistic methods are intuitive, highly stable and the optimization engine in Resolver enables a higher degree of accuracy than in any other tool.

Deterministic method	Resolver - Probabilistic method
Cannot merge data of different types. Problems must be broken up into simpler units and each model and dataset requires a different solution.	Resolver uses all logs including core data and NMR simultaneously, reconciling the results to the measurements. For accurate modeling, lithologies with any level of complexity can be used. Through interactive verification, Resolver shows that the model and tool response constants match all individual logs. Erroneous assumptions are highlighted.
No simulation capabilities.	Constants such as $m$ , $n$ and $R_w$ are optimized simultaneously with fluid and mineral volumes over multiple zones. Rock properties as well as reservoir characteristics are calculated. Resolver automatically adjusts to any log configuration, works with project templates, user interfaces and reports, and performs analysis as well as Monte Carlo simulation.
Formation characteristics are manually calculated by the analyst.	Streamlined, easy-to-use workflows executed in real time guide the user through the analysis. A rapid optimization engine calculates formation characteristics as well as fluid and mineral volumes.
'Black box' feedback only with no validation.	Intuitive, easily interpreted validation feedback. Probabilistic methods are based on a comparison of the data with a theoretical model, therefore, users can evaluate the effect of changes to the formation model on the tool response. This comparison is visualized and guides the user to more accurate characterization of the formation.

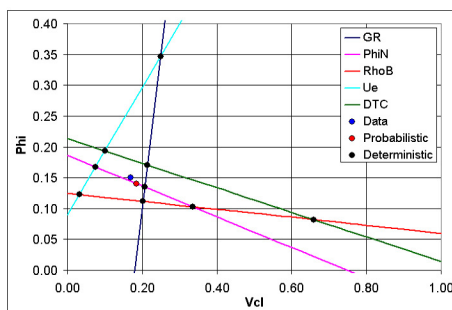
Any change in formation model will lead to changes in the results. However, because probabilistic methods use redundant data they are less affected by changes and are more stable than deterministic methods. In the three figures, a simple shaly-sand formation is analyzed. For each tool a measurement was made, which reduces the solutions to a line segment in the  $V_{cl}$ - $\Phi_{cl}$  space. To solve the problem at least two tools must be used and the cross-point gives the solution obtained by the tools. The deterministic method uses a user-selected combination of two tools. The probabilistic method uses all tools.

**No measurement errors**



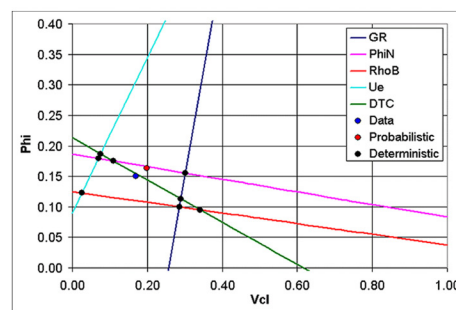
Multiple deterministic solutions and probabilistic method both return the true solution.

**Small measurement errors**



Substantial differences between the multiple deterministic solutions. Probabilistic method returns an answer close to the true solution.

**Small measurement /parameter errors**



Large differences between the multiple deterministic solutions. Probabilistic method returns an answer close to the true solution.

Even with high quality data the solution provided by each tool combination will be different. When only two tools are used, solutions vary significantly and some solutions are incorrect. Users must use their experience to select a reasonable answer. The best answer is obtained with the probabilistic method. Moreover, the visual feedback will unambiguously show which tool had the largest error. With error free data but incorrect clay characterization the disparity is further evident. Nevertheless, the probabilistic method still provides a reasonable answer. However, with Resolver the clay characteristics will be optimized to obtain the best possible solution.