Nonlinear petrophysical optimization

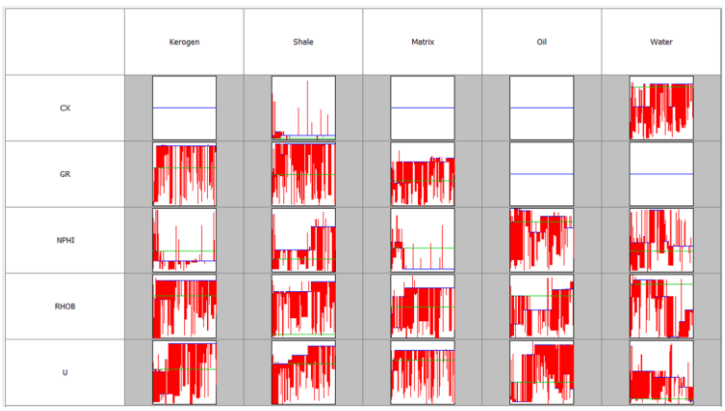
iMineralysis™ is a powerful nonlinear petrophysical modeling and optimization tool designed to estimate mineral and fluid compositions in the most complex geological settings of rock and fluid properties.

Main features:

- Allows the estimation of the mineral coefficients (end-points) when performing multimineral analysis in areas where the coefficients are uncertain.
- Uses a genetic algorithm to optimize the coefficients within possible ranges of values.
- Generates a multimineral solution that predicts the input logs and outputs the fractions of fluids and minerals present in the rock.
- Automates the time-consuming, manual trial-and-error process of estimating mineral constants.
- Allows the petrophysicist to explore different types of analyses and even the estimation of spatial variations in important parameters such as water resistivity, kerogen maturity, and clay composition.

Example of the coefficient matrix showing the starting coefficient for the optimization process and the allowed ranges for each coefficient.

5 Constituents 5 Logs & Constraints	**Kerogen** Color : Mineral	**Shale** Color : Mineral	**Matrix** Color : Mineral	**Oil** Color : Fluid	**Water** Color : Fluid
CX = Tolerance = 0.005	Constant **0.0**	Max = 2.0 Coeff = 0.04085 Min = 0.0	Constant **0.0**	Constant **0.0**	Max = 12.0 Coeff = 11.30753 Min = 6.0
GR = Tolerance = 5.0	Max = 900.0 Coeff = 873.99212 Min = 400.0	Max = 250.0 Coeff = 237.09665 Min = 50.0	Max = 30.0 Coeff = 20.80775 Min = 5.0	Constant **0.0**	Constant **0.0**
NPHI = Tolerance = 0.01	Max = 0.55 Coeff = 0.2732 Min = 0.25	Max = 0.4 Coeff = 0.22125 Min = 0.15	Max = 0.03 Coeff = -0.04516 Min = -0.05	Max = 1.0 Coeff = 0.88831 Min = 0.75	Max = 1.0 Coeff = 0.87571 Min = 0.85
RHOB = Tolerance = 0.01	Max = 1.7 Coeff = 1.67342 Min = 1.1	Max = 5.0 Coeff = 3.40737 Min = 2.6	Max = 2.8 Coeff = 2.77788 Min = 2.6	Max = 1.0 Coeff = 0.94656 Min = 0.7	Max = 1.15 Coeff = 0.9608 Min = 0.8
U = Tolerance = 0.3	Max = 1.5 Coeff = 1.42905 Min = 0.15	Max = 12.0 Coeff = 11.94038 Min = 6.5	Max = 14.0 Coeff = 11.93517 Min = 4.0	Max = 0.2 Coeff = 0.02143 Min = 0.0	Max = 1.1 Coeff = 0.51472 Min = 0.0



Different coefficients tested by the genetic algorithm (red) and the best solution for each iteration (blue). The initial coefficient is indicated in green.

SEISPETRO Geosoftware — iMineralysis™ (cont.)

Starting:

	Kerogen	Shale	Matrix	Oil	Water
CX	0	0.03	0	0	11
GR	700	150	15	0	0
NPHI	0.35	0.2	-0.02	0.95	0.9
RHOB	1.5	2.75	2.7	0.9	1.1
U	0.9	10	11	0.07	0.1

Final: Results_Demo_i_OO_PP

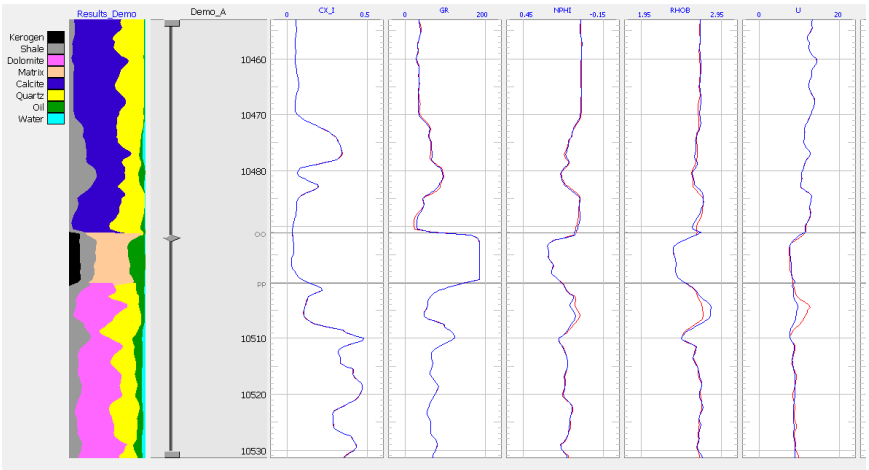
	Kerogen	Shale	Matrix	Oil	Water
CX	0	0.13742	0	0	11.297
GR	874.85	246.87	23.962	0	0
NPHI	0.30207	0.32915	-0.04595	0.92561	0.91105
RHOB	1.6464	4.7498	2.7588	0.93272	0.95668
U	1.4501	11.591	12.504	0.04799	0.06749

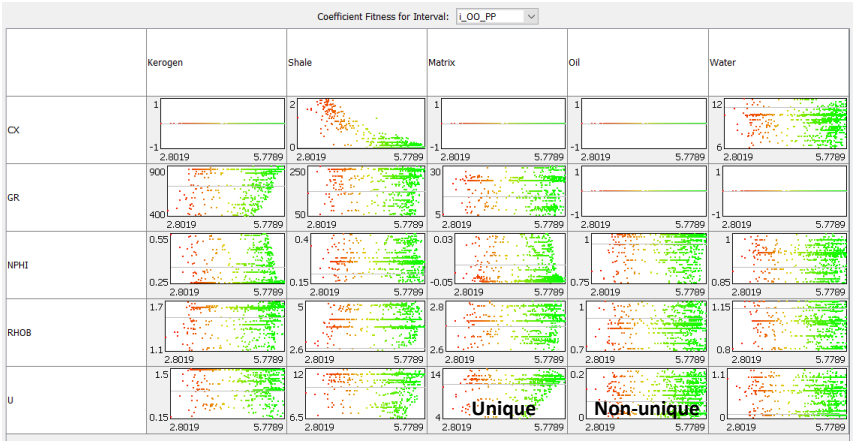
Matrix of coefficients for the different constituents before (above) and after (below) optimization.

Powerful petrophysical tool to help you solve the most challenging mineral and fluid compositions

Multimineral solution performed using the optimized variables. Mineral solution is shown in the left, and raw data (red) vs. predicted logs (blue) is shown on the right.

The output of iMineralysis™ consists of the predicted logs, fractions of minerals and fluids, and optimized coefficients.





Analysis of the coefficients fitness can help to assess their non-uniqueness. Vertical axis is the coefficient range; horizontal axis is the fitness. Each dot represents a tested coefficient colored by fitness, from poor (red) to good (green).

For more information or to download your free demo license go to www.seispetro.com