

What is it?

LESA is Windows[®] based software that will provide complete deterministic log analysis and interpretation. The software is fully 32-bit compliant for 98/NT/2000/Me/XP. The following file formats are supported:

- LAS
- LBS
- LIS (through a conversion step)

Most open-hole logs may be incorporated into the interpretations, from a minimum of a single porosity log, to any combination of modern log suites. Interpretations incorporate specific tool response of the major service companies.

The software provides the user a series of templates for graphical output and gives the ability to modify these or create totally new templates as needed. Net pay and net sand calculations can be determined for any designated interval, using cutoff parameters defined by the interpreter. Sub-zones are summed for a complete reservoir appraisal.

What are its Analysis Capabilities?

Quick-Look Analysis (Preliminary)

This requires minimal choices from the interpreter. The program's expert system gives estimates of shale and fluid properties necessary for a full shaley-formation analysis. These program-determined properties can be edited as required. All standard Quick-Look interpretational procedures are incorporated, and source documents are recognized on each appropriate graphical output.

Quick-Look Analysis (Advanced)

This option allows the interpreter to zone the reservoir and input specific parameters to perform a complete shaley formation analysis.

In-Depth Analysis

Environmental corrections, porosity and matrix cross plots are available for major service company tools. A preliminary choice of clean and shale intervals is available from program-determined analyses and/or initial operator input. Detailed zonation can then be performed with complete editing capability.

Full shaley-formation analysis involves simultaneous calculations of over 10 different saturation models. A large number of cross plots can be used to help in detailed reservoir interpretation. On all cross plots, analog traces of the logs may be included, and an independent depth zonation, recognized by color differentiation, can be recognized. Any other data can be recorded as a Z plot (routinely V_{sh} is presented).

Core-log comparisons are available for all standard core measurements. Log-calculated permeability and relative permeability involves recognition of rock-typing through

porosity/irreducible water saturation relationships. User-defined equations and programs can be incorporated into the overall reservoir analysis.

Mechanical Properties

Mechanical properties can be estimated using density and sonic log input. Shear travel times are estimated (if not available) from compressional travel times.

Coalbed Methane Analysis

The software recognizes coal from analyses of density, neutron, sonic, and resistivity curves. The interpreter can choose cutoff values to distinguish coal from other rock types.

Standard analyses involve recognition of:

- Coal rank
- Carbon content
- Moisture content
- Gas in Place
- Ash content
- Volatile matter content
- Gas content
- Cumulative gas in place

Six different methods of determining gas content and gas in place are automatically calculated. Estimates of gas deliverability are included. Graphical output includes presentations similar to Schlumberger and Halliburton. Included on the output are bulk volumes of water and hydrocarbons for the non-coal intervals. This shows whether or not the coals are in close juxtaposition to wet sands. Gross and net reservoir parameters for the non-coal intervals are available.

Total Organic Carbon

Total organic carbon (TOC) and pyrolysis S_2 values are calculated using the technique of Passey et.al. AAPG December, 1990.

Multi-Mineral Analysis

LESA has the capability of using any number of open-hole logs to determine rock and reservoir components. Tables are included which define log responses to commonly occurring sedimentary minerals, reservoir liquids and gases. These tables can be edited and expanded at user discretion.

The interpreter selects the components that are expected to be present, and the program determines percentages of each component. Up to seven different components may be examined at any one time. The method requires availability of the appropriate logs (mostly porosity logs and gamma ray).

Other Features

Visual Curve Editing

The visual curve-editing feature of *LESA* allows the user to modify any well curve in a visual interface. When the interpreter selects this option, the entire display screen becomes the visual curve-editing window. The software provides several choices, including Drag Mouse Editing, Horizontal Curve Shifting, Vertical Curve Shifting, Rubberized Curve Shifting and the ability to

reset the editing. The interpreter also has the option of selecting Tagged Shifting Mode, which allows all selected curves to be in a single track and modified in unison.

Data Selection

The data selection tools allow the interactive highlighting of data on log plots, cross plots and histograms. Data selected on one type of plot are automatically highlighted on other plots. Using the montage plot capability, this technique can quickly be used to locate data based on groupings on any of the types of plots, and see where they are located on the others.

Program Capabilities

- User defined equations and routines.
- Scatter plots of any raw or calculated data.
- Depth plots allowing user defined panels with any raw or calculated data.
- Color filling of any data stream or between data streams on a log plot.
- Metric, English or mixed units capability.
- Program determined zonation, fully editable.
- Detailed core/log comparisons available.
- Extensive on-line help and tutorial.
- User defined toolbar for most often used commands.
- Large number of cross plots to define zone parameters.
- Variety of analog plots to illustrate log and core comparisons, rock and fluid properties, and final computed reservoir values.

Calculation Procedures

Porosity Logs

Hierarchy of porosity automatically chosen, may be overridden by user.

Logic for interpretation of density and gamma-gamma logs incorporated.

Density and neutron porosity as pressure-dependent functions.

Environmental calculations available for gamma ray, neutron and density logs.

Tool specific cross plot porosity charts for Schlumberger, Halliburton and Western Atlas tools.

GRN, SNP, and CNL (NPHI and TNPH) may be analyzed.

Total and shale-corrected (effective) porosities are automatically determined.

Sonic porosity from time-series or empirical formulas.

Porosity calculated from density/neutron, neutron/sonic, sonic/density, or individual porosity logs.

Resistivity Logs

- R_i and R_{xo} may be calculated from most commonly encountered logs, involving solution to tornado charts (Schlumberger, Halliburton and Western Atlas).
- R_i and R_{xo} available when log suites are limited.
- R_{xo} calculated from micro logs, and combined with induction and 16-inch normal to provide a pseudo dual induction – R_{xo} combination.

Fluid Saturation

- S_w from Archie, Simandoux, Total Shale, Dual Water, Waxman-Smits, Indonesian, Fertl, Modified Fertl, Fertl-Hammack, Laminated Shale or Rocky Mountain.
- Oil and Gas distinguished by detailed analysis of density / neutron / resistivity logs.
- Different saturation profiles may be assumed to determine fluid saturation variations away from the wellbore.

Matrix/Shale Identification

- MID plot for both time-series and empirical sonic log interpretation.
- Radioactive and non-radioactive shales may be distinguished.
- Matrix Identification plot.
- Program-determined matrix/shale recognition, which may be user-modified.
- V_{sh} from four different sources.

Miscellaneous

- Cased hole neutron time-lapse analysis for gas storage or reservoir depletion studies.
 - Total organic carbon using delta resistivity method.
 - Coalbed methane analytic capability.
 - Gross and net reservoir parameters by subzone and for the total reservoir.
 - Extensive visual and tabular curve-editing capability.
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***LESA* Modules**

There are three add-on modules available for *LESA* (see individual module information sheets for pricing):

Esteem

The *Esteem* module allows the user to generate data, or produce pseudo data from known good data. Using the *Esteem* module you can select multiple input curves from one or more wells to be used to predict the values of one or more output curves.

Using a neural network type approach, the input values of a “training set” are used to predict the values of the output curves within the “training set”. Once the neural network has completed training, the results can be applied to other wells with similar input curves to predict the desired outputs.

The technique may be used, for example, to predict sonic curves from other logs, such as the GR, Resistivity and Density logs. *Esteem* may also be used for rock typing. The presentation of resultant rock types on application allows quick identification of new rock types that were not provided to the training set.

Minerva

The *Minerva* module can be used to perform a simultaneous solution of a series of response equations. The technique may be applied to a series of logs to solve for mineral and fluid components using inverse modeling.

Synthetica

The *Synthetica* module creates and displays synthetic seismograms from sonic or sonic/density logs. The program gives the user the ability to specify filters and phase rotation. You can use either AGC scaling or constant scaling.

Various filters are available for cleaning up your sonic logs, including free-form editing and automatic despiking routines. Additional features include the ability to create synthetic logs deterministically from other logs. These include synthetic sonic from GR/density/neutron, and density from GR/sonic/neutron. These may be used to verify the validity of original sonic and density logs.

How to Order *LESA*

Please contact **Digital Formation, Inc.** for pricing. To order, please call **(888) 747-5372** (US & Canada), or **(303) 770-4235**.