BasinFlow® Overview

BasinFlow is a flow path modeling program (2.5-D) that combines source rock and carrier bed data with hydrodynamics to model oil and gas migration and entrapment potential at the prospect, play, or basin level.

BasinFlow:

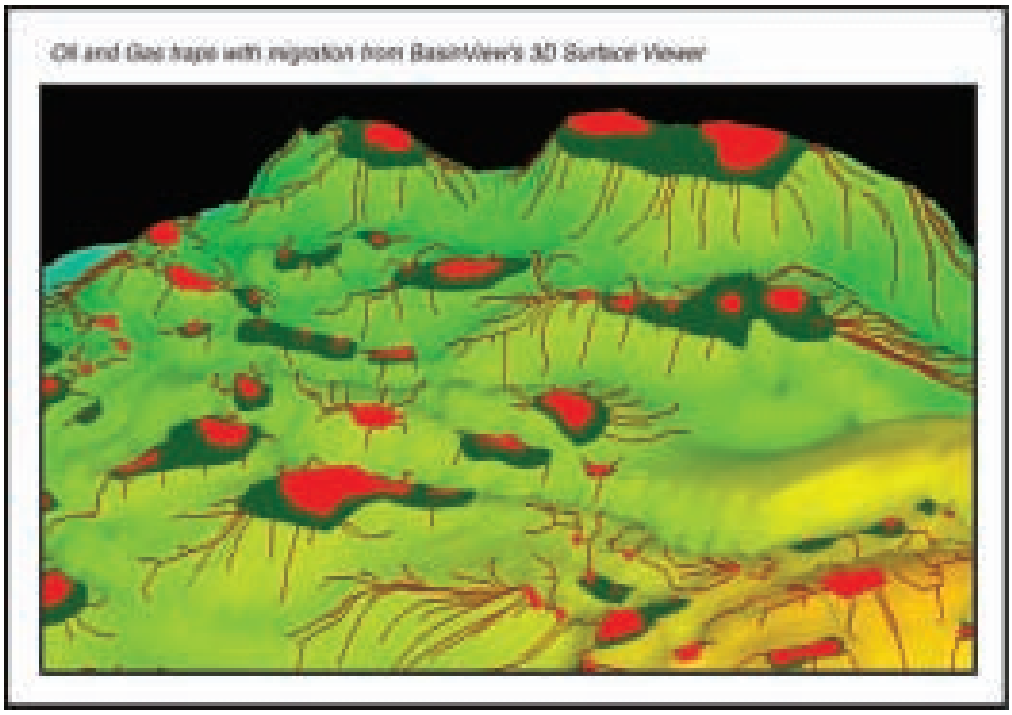
- Defines migration pathways and fetch areas.
- Identifies structural, stratigraphic, fault, hydrodynamic, and combination traps.
- Calculates oil and gas accumulation in traps.
- Models trap fill and spill.
- Models the impact of ground water recharge/discharge on migration and entrapment.
- Simulates loss of hydrocarbon during migration or though seal leakage.

Migration Dynamics:

- Buoyancy drive caused by variations in structure and the density differences between hydrocarbons and formation water - predicts structural traps.
- Capillary drive caused by variations in oil-water capillary pressure, which is a function of permeability - predicts stratigraphic and fault traps.
- Water drive caused by groundwater flow - predicts hydrodynamic traps.

Output:

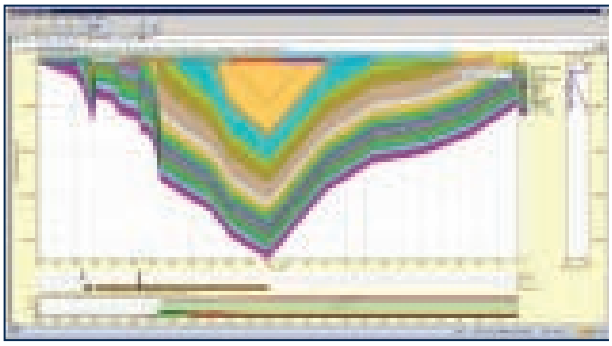
- Display BasinFlow output as maps through geologic time in BasinView.
- Draw maps of traps, migration pathways and fetch areas.
- Display vector maps of buoyancy, capillary, and hydrodynamic drive.



BasinMod® 2012 and Modules

BasinMod 2012

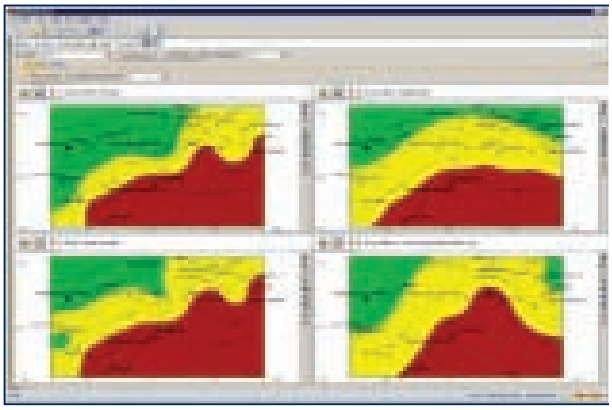
- Maps of all Calculated Values
- Trigger Maps – Depth to or age of a specified occurrence
- Mineral mixes
- Erosion Estimator
- Pore pressure predictions and excess pressure
- TOC, Initial TOC, HI, TMax,
- Porosity, generated hydrocarbon volumes
- Expanded Heat Flow Data Base
- Log cross-plots
- Improved log display/selection



PETROLEUM SYSTEMS GRAPH

CRS+ Module 2012

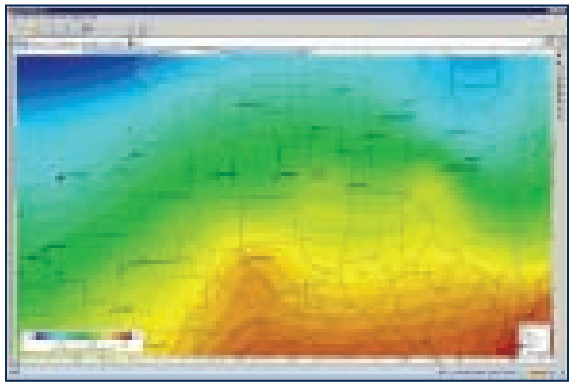
- Common Risk Segment maps for BasinMod-calculated values
- Set thresholds for low, moderate, and high uncertainty



COMMON RISK SEGMENT MAPS

BasinMod Bridge Module 2012

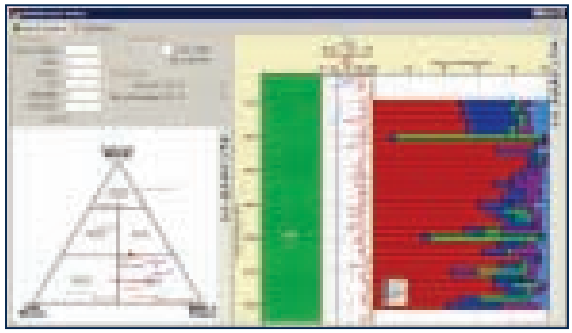
- Import data from industry-standard data bases, such as Petra® or IHS® 297, to create models
- Enhance input with Data “Globalizers”



SURFACE MAP

Unconventional Resource Module 2012

- Methane adsorption using Langmuir isotherms
- Nanoporosity due to organic matter degeneration
- Oil generation pressure
- Gas expansion pressure ("uplift excess pressure")
- Brittleness Index – from logs or mineralogy
- Organic matter volume ratio
- Compositional kinetics
- New shale lithologies
- Sequence Stratigraphy Module 2012



ROCK BRITTLENESS INDEX – MINERAL COMPOSITION

Sequence Stratigraphy Module 2012

- Helps identify organic rich interval
- Extensive library of systems tract examples

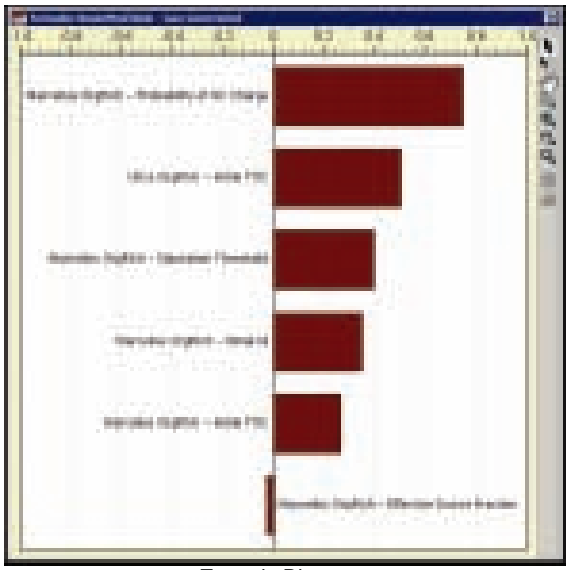
Coming Soon! BasinMod Risk

BasinMod Risk addresses the uncertainty associated with elements of the petroleum system by using a stochastic approach to modelling which produces a range, or probability distribution, of results.

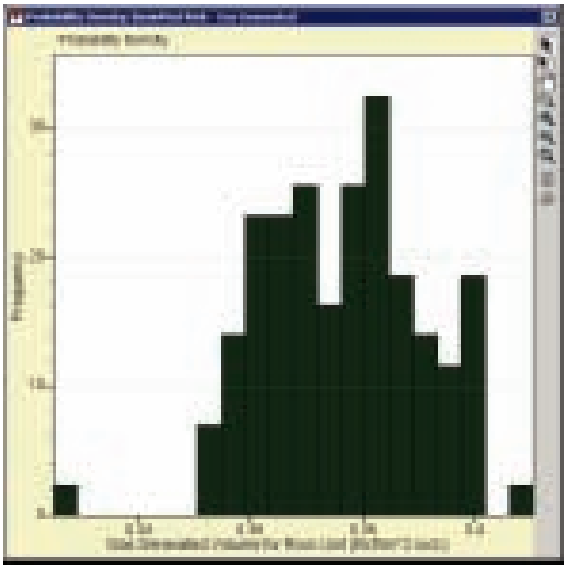
Uncertainty is assigned to model parameters, such as saturation threshold, TOC, initial HI, using the BetaPERT probability distribution.

The results of a simulation run for the wells in a project are maps of P1, P10, P50, … P99 of oil or gas generated, expelled or retained, or may include maps of free gas or methane adsorption potential.

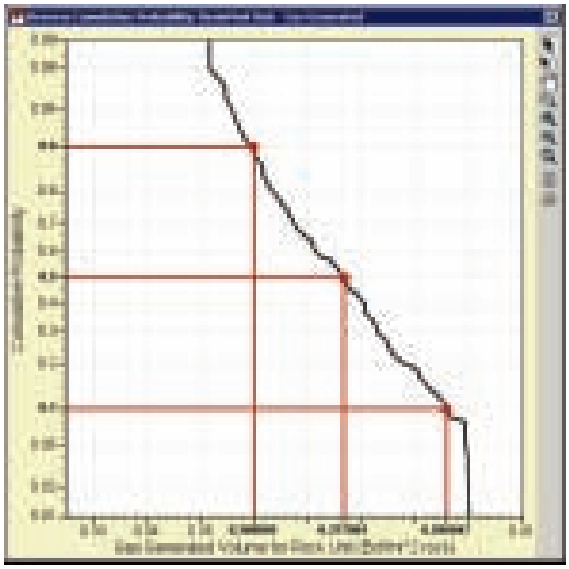
Additionally, for each of the parameters with uncertainty, probability density histograms, cumulative probability plots, and rank correlation ("tornado" diagrams) are provided.



Tornado Diagram



Probability Density



Reverse Cumulative Probability Curve

BasinMod® 2012

BasinMod® 2012 Overview

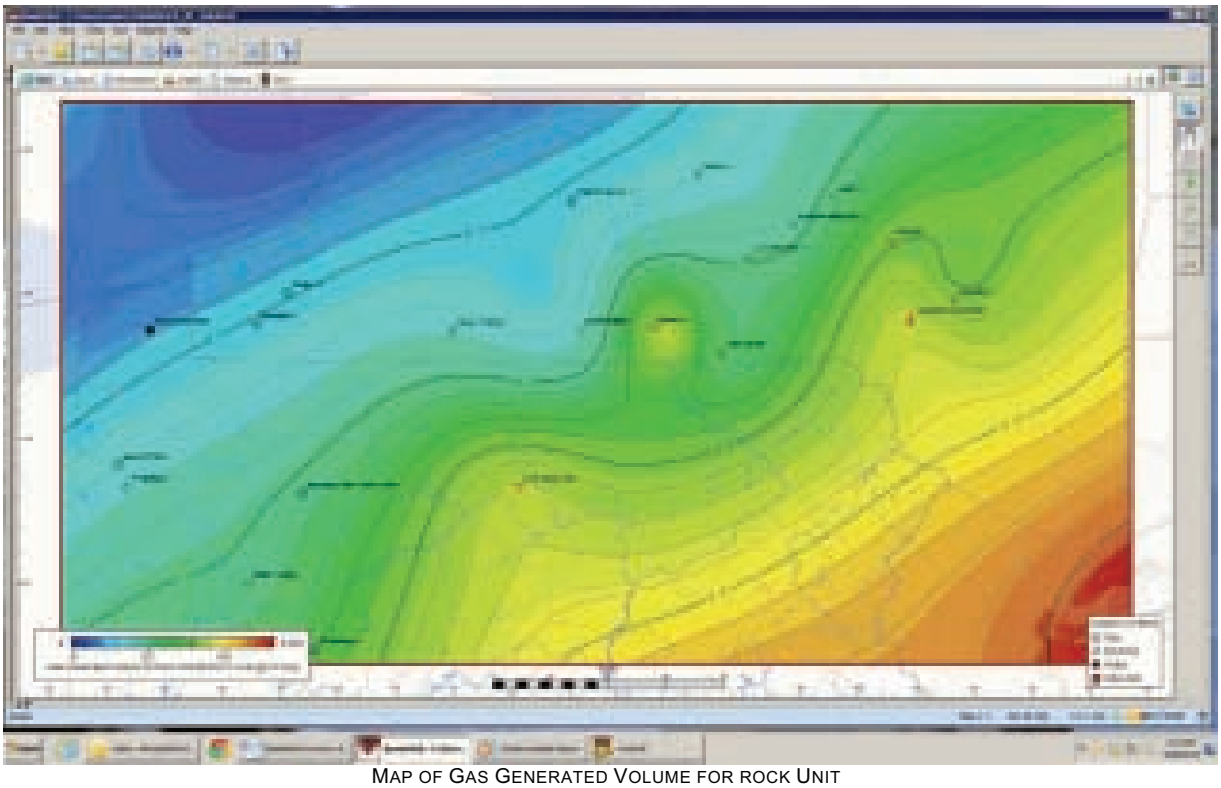
Model the volume of hydrocarbon generation and expulsion through time for multiple wells. Both conventional and unconventional resource plays can be modelled. A wide range of other values are modeled including maturity, porosity, permeability, pressure and temperature, all of which can be used to further analyze the petroleum system.

Burial History:

- Model complex stratigraphy, including unconformities
- Select from several calculation methods for compaction, porosity, and permeability
- Model porosity by mechanical, fluid flow, or chemical compaction
- Mix lithology or mineral components to create an unlimited number of custom lithologies
- Model changes in formation thickness due to salt or shale movement (diapirs).

Diagenesis and Pressure:

- Calculate pore fluid pressure to predict the timing and/or depth of abnormal pressure regions as well as subsequent fracturing
- Enhance porosity reduction by means of quartz cementation in sand and smectite-illite conversion in shales.



MAP OF GAS GENERATED VOLUME FOR ROCK UNIT

Thermal History:

- Model thermal maturation and predict timing of hydrocarbon generation/expulsion
- Model basement heat flow, radiogenic heat flow, and rifting heat flow
- Vary surface temperature and heat flow through time.

Logs:

- Drag and drop logs in LAS format
- Display logs adjacent to stratigraphy column for formation top editing
- Pick porosity points from a porosity log for use in calibration.

BasinMod® 2012

Source Rock Organic Richness:

- Determine Total Organic Carbon (TOC) from logs of resistivity and porosity
- Calculate Initial TOC

Maturity:

- Use several maturity indicators for calibration, such as %Ro, TMAX, TAI, and CAI.

Kinetic modelling of hydrocarbon generation:

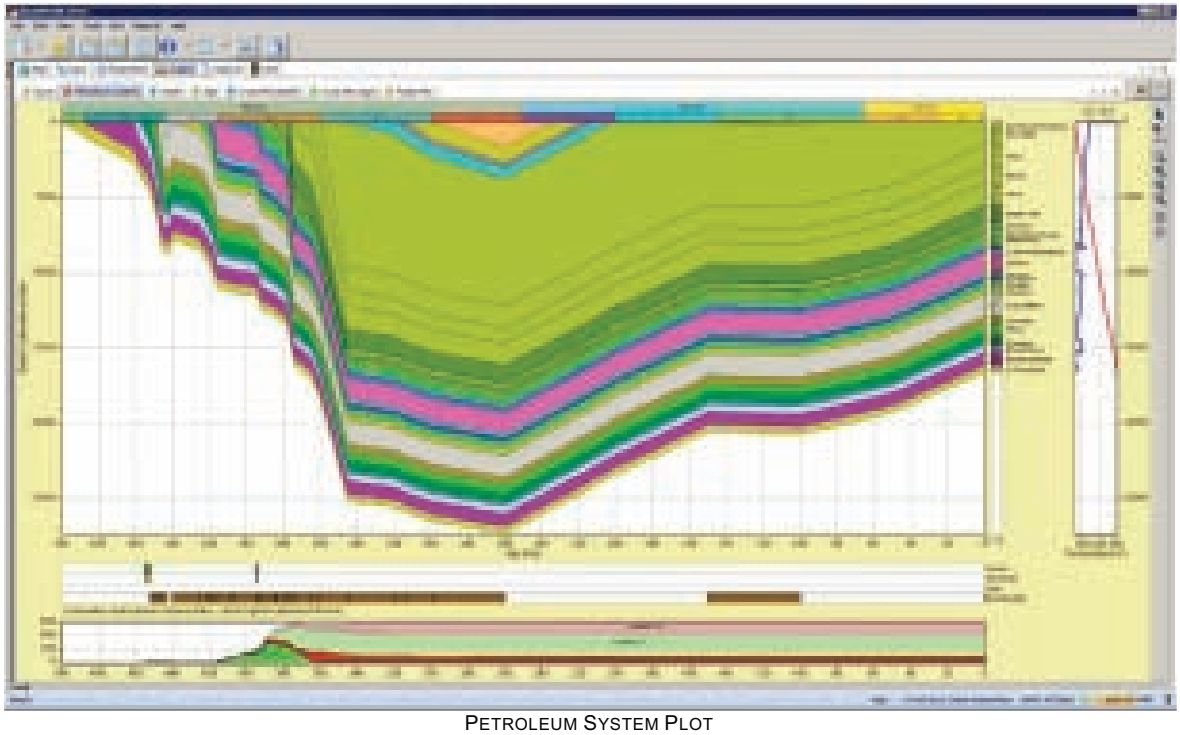
- Model one component of oil and gas using simple LLNL kinetics or organofacies kinetics (Pepper and Corvi, 1995).
- Model multiple components of oil, gas, and residue using compositional kerogens
- Access a library of kerogens compiled from literature including multiple variants of Types I, II, and III.

Erosion:

- Estimate the amount of surface erosion using a sonic travel time log.

Output:

- Spatially display any calculated or measured value using a variety of color and contour options
- Display shapefiles of cultural or hydrographic data
- Display radar plots which compare several calculated values against an ideal case
- Generate standard and continuous color burial history plots
- Plot any calculated value versus time or depth
- Plot any calculated value or measured data against any value or data
- Generate log-log cross-plots
- Display geochemical logs of pyrolysis data.



PETROLEUM SYSTEM PLOT

BasinMod 2-D

BasinMod 2-D Overview

BasinMod 2-D models dynamic geologic conditions within a petroleum system, by examining hydrocarbon generation from source rocks through secondary migration and accumulation in traps.

Model building:

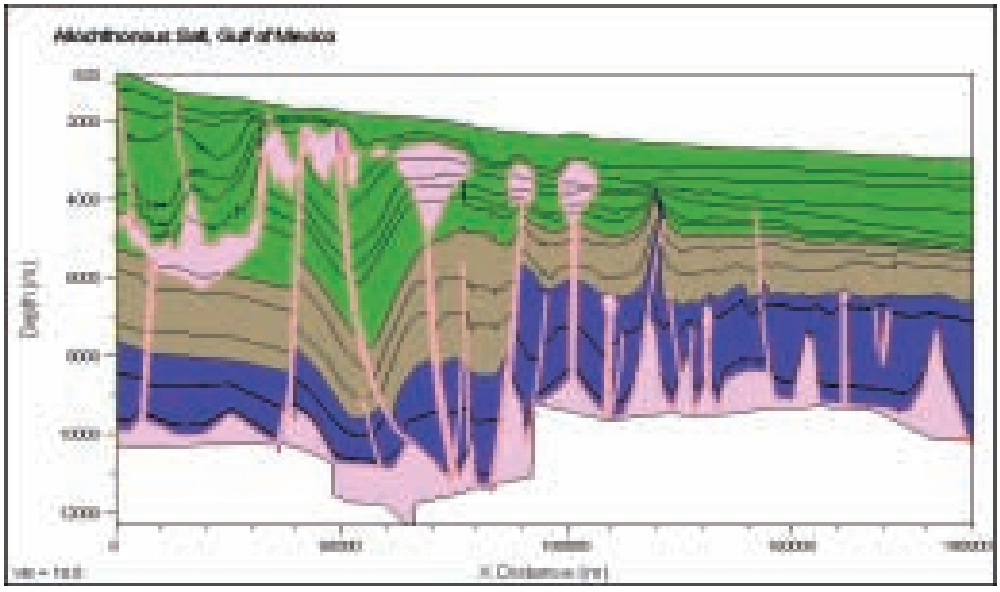
- Import data including BasinMod model files, digitized or scanned cross sections, interpreted horizons or interpret directly from seismic lines.
- Easily handle complex stratigraphy, including complicated unconformities.
- Vary surface temperature and heat flow through time.
- Model lateral and vertical facies successions.
- Graphically display and edit chronostratigraphic section.

Calculations:

- Calculation engine combines backstripping and forward modeling.
- Calculate values for all cells in a calculation grid. The variation of pressure and fluids in adjacent cells drives migration.
- Uses finite difference method for thermal and fluid flow calculations.
- Fluid flow along faults may be or automated or manually controlled.
- Calculate effects of mobile substrates (e.g., salt, shale) through time.

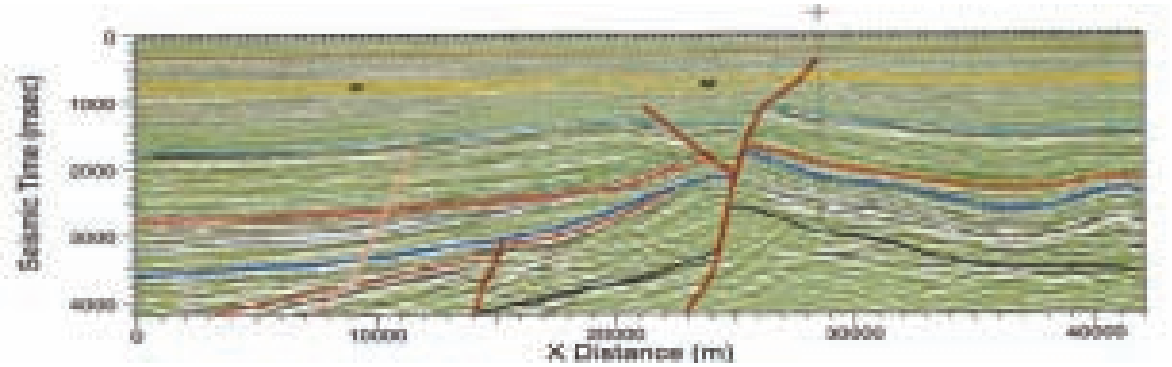
Output:

- Display model values, such as temperature, pressure, maturity, generation, and saturation in cross section either as continuous color or value windows at any point in time.
- Measured maturity, porosity, temperature and pressure may be displayed on the cross section for calibration.
- Draw a burial history or plot any model value versus time or depth.
- Display flow arrows for oil, gas and water.

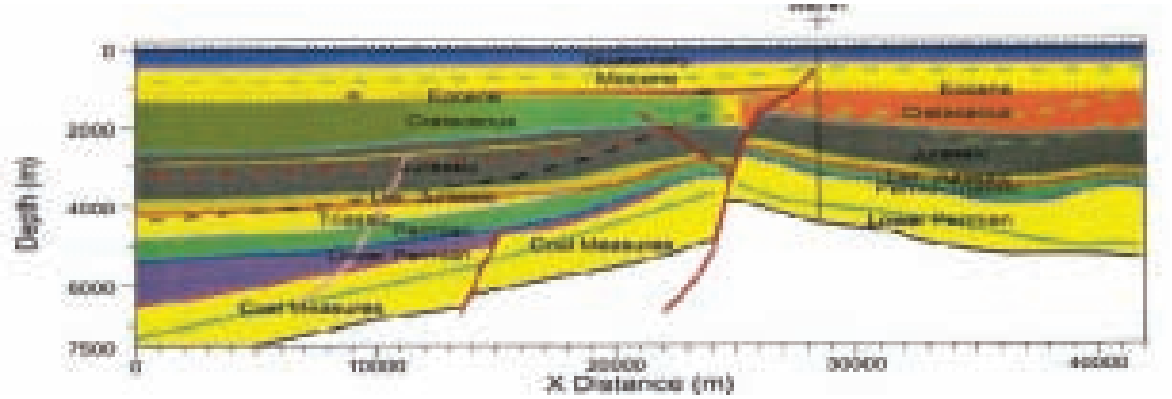


BasinMod 2-D

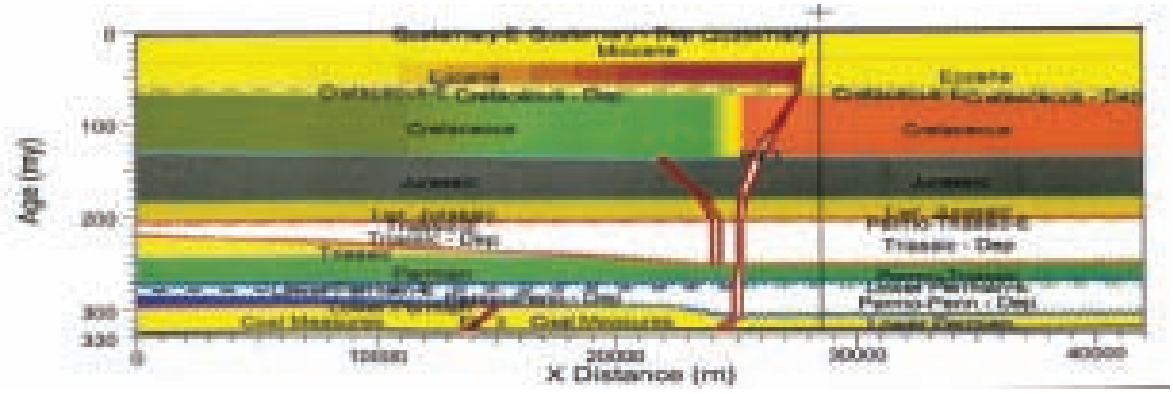
Model the entire Petroleum System from Source to Trap



Cross Section constructed from SEG-Y file



Cross section converted to depth section



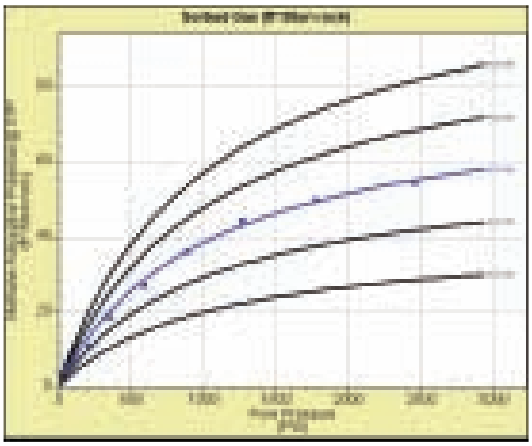
Cross section displayed in chronostratigraphy (Wheeler Diagram)

Unconventional Resource Module
for BasinMod® 2012

Unconventional resource plays differ from conventional plays with respect to the problems to be solved and the parameters to be considered. In these plays, organic shales must be assessed both as source rocks and reservoirs. Source rocks with great potential will not be economically viable if they aren't producible. The Unconventional Resource Module (URM) for BasinMod® 2012 provides specifically designed capabilities to evaluate these parameters.

Methane Adsorption

- Predict the quantity of gas which can be stored as a function of reservoir pressure by using gas storage capacity data from Langmuir isotherms.
- Extrapolate methane adsorption potential for different temperatures and for different amounts of organic carbon.



ISOTHERMS SHOWING VARIATION OF METHANE ADSORPTION POTENTIAL FOR A RANGE OF TOC VALUES

Nanoporosity

- Model porosity that forms as organic matter is transformed to hydrocarbon. Significant amounts of methane can be stored in nanoporosity.

Organic Matter Volume Percent

- Model the volume of generated hydrocarbon using organic matter volume percent rather than weight percent. The volume percent of organic matter is a factor in calculating nanoporosity and also determines whether a source rock is kerogen-supported or matrix-supported.

Oil Generation Pressure

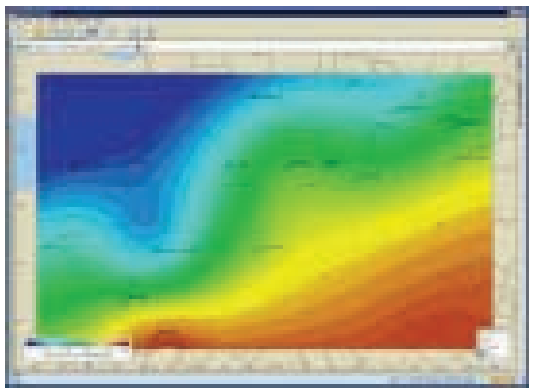
- Account for increase in pressure due to volume expansion as solid organic matter is transformed to liquid hydrocarbons, especially in source rocks that are very rich and when generation occurs rapidly.
- Augments pressure created by effective stress during burial.
- May contribute to overpressure and natural fracturing.

Gas Expansion Pressure ("Uplift Excess Pressure")

- Account for excess pressure that cannot be modelled solely by effective stress by using gas expansion pressure. This is a key factor in certain plays such as Appalachia and the Barents Sea.

Brittleness

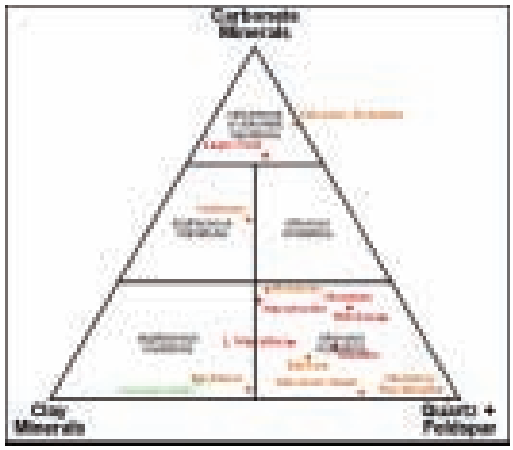
- Identify intervals with the best characteristics for stimulation and fracturing using analysis of brittle and ductile mineral compositions.
- Calculate and map a Brittleness Index using a proprietary calculation method that combines Young's Modulus and Poisson's Ratio derived from sonic and density logs.



BRITTLENESS INDEX MAP

Compositional Kerogens

- Model generation and expulsion of individual hydrocarbon components, including liquids. Liquids are especially important in resource plays such as the Eagle Ford, where trends of gas and associated liquids occur in relation to different levels of maturity.



TERNARY DIAGRAM SHOWING SHALE COMPOSITIONS OF MAJOR UNCONVENTIONAL RESOURCE PLAYS

Shale Library

- A shale lithology is typically thought of as clay-rich, but most shale resource plays are quartz-rich. BasinMod includes a library of shale lithologies which are commonly found in unconventional resource plays. These lithologies enable more realistic modelling of source and reservoir properties, especially those properties which contribute to brittleness and fracability.

Sequence Stratigraphy

- Determine the vertical distribution of organic-rich source rock intervals by correlation with Maximum Flooding Surfaces.
- Recognize intervals of enhanced producibility by identifying Maximum Flooding Surfaces and Condensed Sections, which commonly have appropriate petrophysical properties for brittleness, such as low clay content and abundant quartz.
- Spatially define the organic rich source rock interval by automatic correlation of surfaces across the project area.

SEQUENCE STRATIGRAPHY CROSS-SECTION IN NEW YORK SHOWING CORRELATION OF SEQUENCE BOUNDARIES (RED), THE MAXIMUM FLOODING SURFACE (CYAN), AND THE SYSTEM TRACT (SHADED BLUE)

BasinView®

BasinView® Overview

BasinView links the products in the Petroleum Systems Suite, including BasinMod®, BasinMod Risk, and BasinFlow. Multiple BasinMod well models as well as surface grids or isopachs can be imported and used to generate surfaces for a multitude of calculated values. Results can be displayed as maps, cross-sections, and in 3-D using the three-dimensional surface viewer. BasinMod Risk models can be generated from any well or pseudowell in the BasinView project.

BasinView:

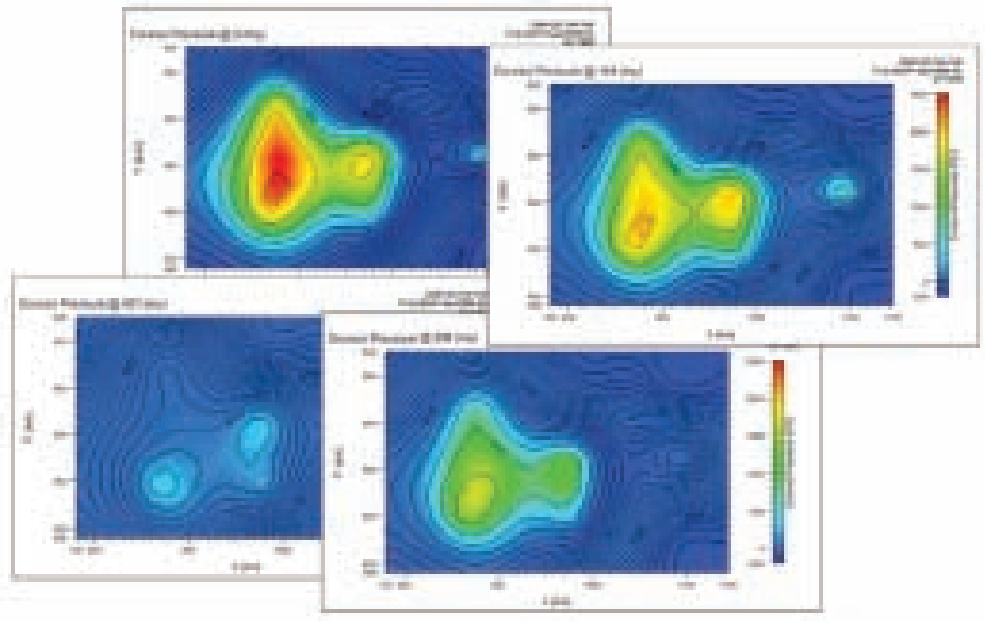
- Displays calculated results as surfaces for multiple, user-defined time steps.
- View maps of hydrocarbon generated, expelled, and retained, maturity, porosity, permeability.
- Modify gridding parameters to enhance local features or directional trends.
- Correct crossing horizons and insert new horizons.

Input:

- Gridded data from Z-Map, ARC/Info, Surfer, and others.
- Any data in ASCII xyz format.
- Models from BasinMod.
- Cultural data such as coastlines and lease boundaries in ESRI Shapefile format.
- User-created surfaces for thickness, missing thickness, porosity, Total Organic Carbon and other values.

Output:

- Maps of calculated values at present day and at user-defined paleo ages.
- Cross-section for any user-created line on the map.
- Export results in a variety of formats to other mapping packages.
- Calculated output can be used by BasinFlow to determine migration pathways and accumulation in traps.



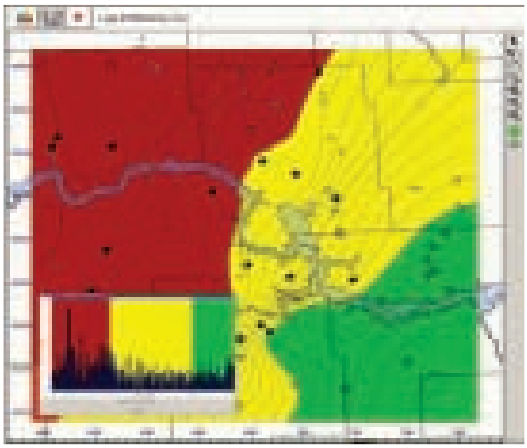
STRUCTURE OF ORDOVICIAN SOURCE SHOWING DEVELOPMENT OF EXCESS PRESSURE THROUGH TIME.

CRS+ Module
for BasinMod® 2012

The CRS+ Module for BasinMod® takes petroleum systems modelling one step further by creating maps of geologic chance as part of an integrated workflow in BasinMod 2012. The resultant spatial risk analysis is especially useful to high-grade areas of lowest risk, condemn areas of unfavorable geologic conditions for hydrocarbon potential and highlight areas of uncertain prospectivity which need further analysis or data.

A wide range of maps of calculated values can be generated from petroleum systems modelling. These can be used to create Common Risk Segment maps which are then combined via stacking stacked to create a Composite CRS or "Roll Up" Map.

Other applications commonly take into account play risk polygon maps, creating a stoplight map of risk. Platte River's approach is to use measured or calculated data (components) to represent the play elements. The user can then use the histogram analysis functionality to identify relative probability on a component level via setting thresholds.



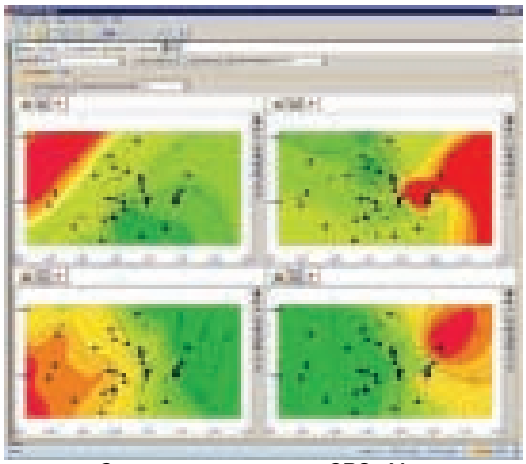
COMPONENT MAP WITH HISTOGRAM IN THE CRS+ MODULE

Maps made with CRS+ are not limited to three colors, but can take the relative probabilities of each component and place them in an ordinal framework. An example with nine levels of relative probability is presented.

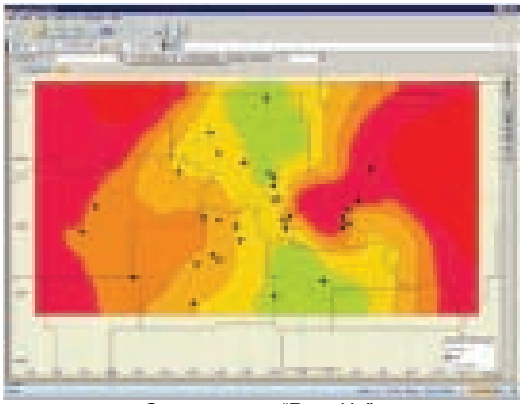
CRS+ can be used for conventional or unconventional resource plays since many alternate components can be rapidly evaluated to identify those that control the play elements.

Utilizing the Unconventional Resource Module, values such as Brittleness and Oil Generation Pressure, can be used to identify those areas in the play where favorable conditions for both hydraulic fracturing and oil generation can be delineated.

Multiple scenarios can be constructed to evaluate different components, or to consider different thresholds of the same components.



COMPONENT MAPS IN THE CRS+ MODULE



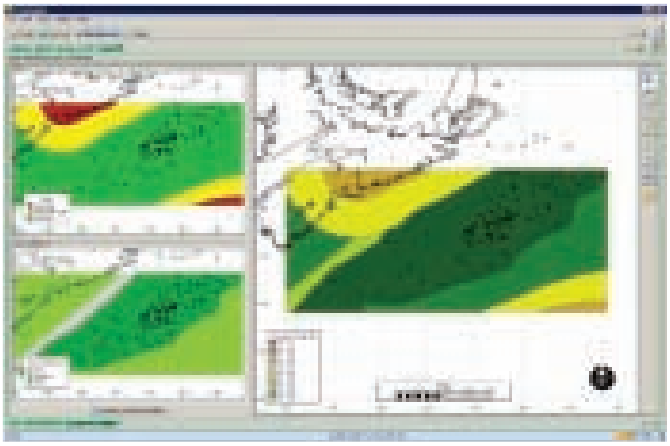
COMPOSITE OR "ROLL UP" MAP

PetroAnalyst®
Play Fairway Mapping and Analysis

PetroAnalyst provides a framework for the consistent, spatial evaluation of geologic risk in all types of plays from frontier areas, with sparse analog data, to mature areas with multiple grids, fields and wells.

Confidence estimates, derived from Data Density and Data Quality, can be integrated into the analysis to generate maps of Geologic Probability or Chance of Geologic Success (COS). This enables the geoscientist to avoid communicating unsupported estimates of high or low COS without sufficient data.

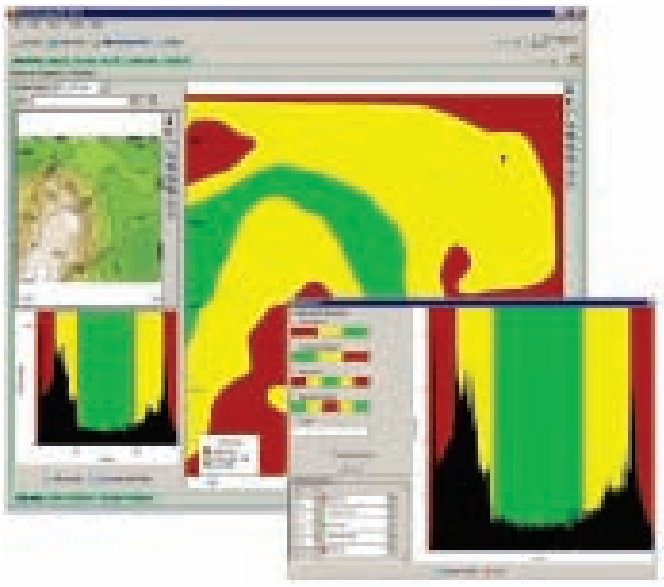
Composite Risk with Optional Data Reliability can be used instead of Geologic Probability for the final composite.



CRS MAP + DATA CONFIDENCE = COS

PetroAnalyst includes an interface with a guided workflow to set up the project, load/prepare all the data (polygons, grids, and/or point data), evaluate the play elements, integrate estimates of data confidence and produce a final COS map.

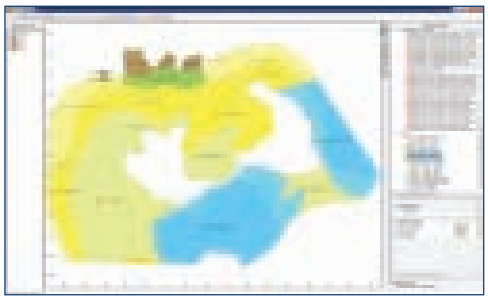
PetroAnalyst has been used for both unconventional and conventional play fairway analysis. With the former, the geoscientist can evaluate the many parameters that might control the producibility of an unconventional reservoir such as maturity, brittleness, pressure, thickness, etc. Sweet spots can be identified by evaluating each parameter individually then rolling them up into a final map.



MATURITY CRS MAP DERIVED USING HISTOGRAM ANALYSIS OF GRIDDED DATA

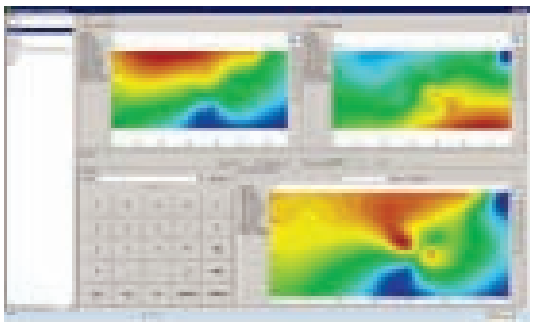
PetroAnalyst Key Advantages:

- A consistent methodology to communicate play risks across different business units for corporate decisions
- Repository for storing all corporate memory for a play yet can rapidly integrate new data or replace erroneous interpretations, well tests and alternate scenarios
- In areas of sparse data, a library of over 200 Gross Depositional Environments (GDEs) provides the facility to define polygons and assign relative probabilities to the play elements



GDE Assignment From Imported Shape File

- Supports the identification and evaluation of the critical play element or 'proxies' that control the presence and effectiveness for the play elements. Proxies can be used to support the evaluation of both conventional and unconventional plays
- Grid to Grid Manipulation Tool – Perform simple to complex mathematical functions on input grids with the ability to recall and use any previous equation

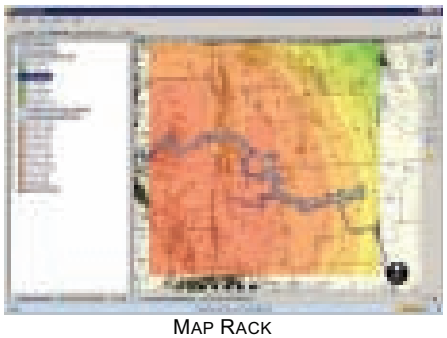


Grid to Grid Manipulation Tool

- Integrates with analog or third party databases to provide an initial framework for play analysis. This can be used in PetroAnalyst's GDE library to assign relative probabilities
- An extensive lithology library is also included where GDE's are unknown or lithology can be better used to represent the risk of presence or effectiveness of a play element

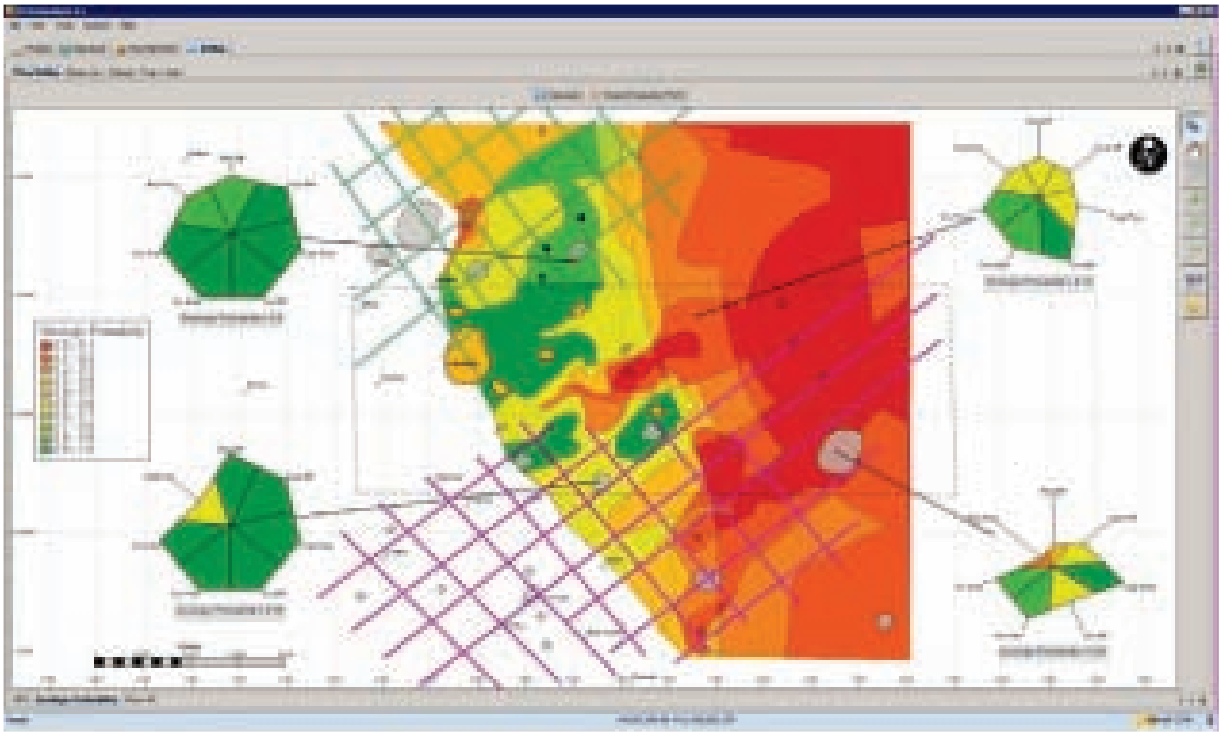
Key features:

- Audit Trail monitors changes to the project and the "undo" function permits roll back to any previous state
- Customize the interface, including the geologic probability matrix, map names, and assignment of map colors to maintain consistent corporate or group Play Fairway Analysis methods
- "Drag-and-Drop" import into the Map Rack of common data types including grids, shapefiles and spreadsheets
- Manipulate input grids to create missing play element maps (ex. porosity map from a depth grid using porosity vs. depth trend)
- Easily resolve projection discrepancies using the Projection Manager



Map Rack

- Internally construct grids from point data
- Make components (proxies for presence or effectiveness) independent or dependent
- Assign relative risk levels to areas from an included library of gross depositional environments (GDE) and lithologies
- Assign common areas of risk and data confidence with included digitizing tools or conversion of shapefile polygon attributes
- Roll up areas of common risk or chance of success into play element and play level summary maps
- Identify key risks for areas on rollup maps using evaluation points, radar plots, and color filled radar plots
- Generate slides automatically populated with screenshots produced by the maps and definitions in the project
- Automatically create individual images of all maps for use in other software packages
- View a summary of all maps contributing to the final rollup map, including CRS maps, data confidence maps, geologic probability maps, or data reliability input and data reliability result maps
- Export map inputs and results as shapefiles or grids for use by other groups or disciplines



COMPOSITE ROLLUP MAP WITH COLOR FILLED RADAR PLOTS SHOWING PROSPECT COS AND INDIVIDUAL PLAY ELEMENT RISK

For more information about PetroAnalyst or to schedule a demonstration, please contact sales@platte.com

