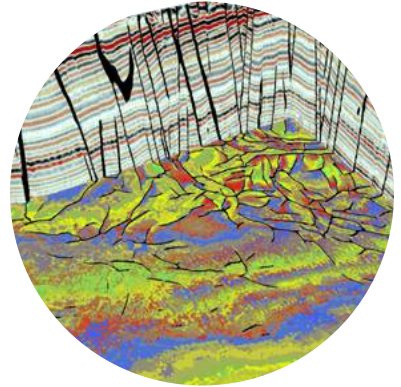




WELCOME TO
PARADISE®
The AI Workbench



BROAD AI FOOTPRINT

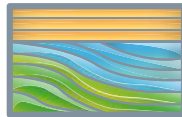
Paradise uses robust, unsupervised machine learning and supervised deep learning technologies to accelerate interpretation and generate greater insights from the data. Apply the guided ThoughtFlows™ in the Paradise AI workbench to...

- Distinguish thin beds below conventional seismic tuning
- Identify and calibrate detailed stratigraphy/facies tracts
- Interpret amplitude anomalies potentially related to Direct Hydrocarbon Indicators (DHIs)
- Analyze reservoir properties related to seismic facies contrasts
- Detect faults and fracture trends
- Estimate volume of reserves/resources



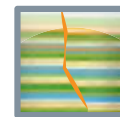
Multi-Attribute Classification

Classify multiple attribute volumes simultaneously utilizing Self-Organizing Maps (SOM), an unsupervised machine learning process



Deep Learning (DL) Seismic Facies Classification

Capture facies based on distinctive seismic patterns using Convolutional Neural Network (CNN) deep learning technology



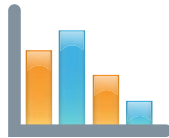
Deep Learning (DL) Fault Detection

Produce fault probability volumes based on existing fault engines (models) or from interpreter-guided, trained engines



Attribute Generation

Generate attributes to extract meaningful geological information and as input into machine learning analysis for advanced interpretation



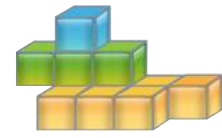
Attribute Selection

Identify attributes having the highest variance and contribution among a set of attributes in a geologic setting



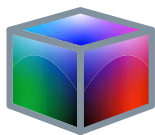
2D Colormap

Display the Neural Classes (topology) and their associated colors from Multi-Attribute Classification that indicate the distribution of related facies



Machine Learning Geobodies

Estimate volume of reserves/resources and geologic features



Color Blending

Highlight geologic features in 3D by blending up to three attribute volumes



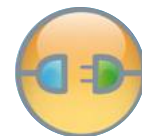
Paradise Scripting Language

Write and save scripts that can be run by the Paradise AI engine using over 600 geoscience, machine learning, and data analysis commands



High Performance Computing

Generate geometric and spectral decomposition attributes on a cluster of compute nodes in a fraction of the time required on a single workstation

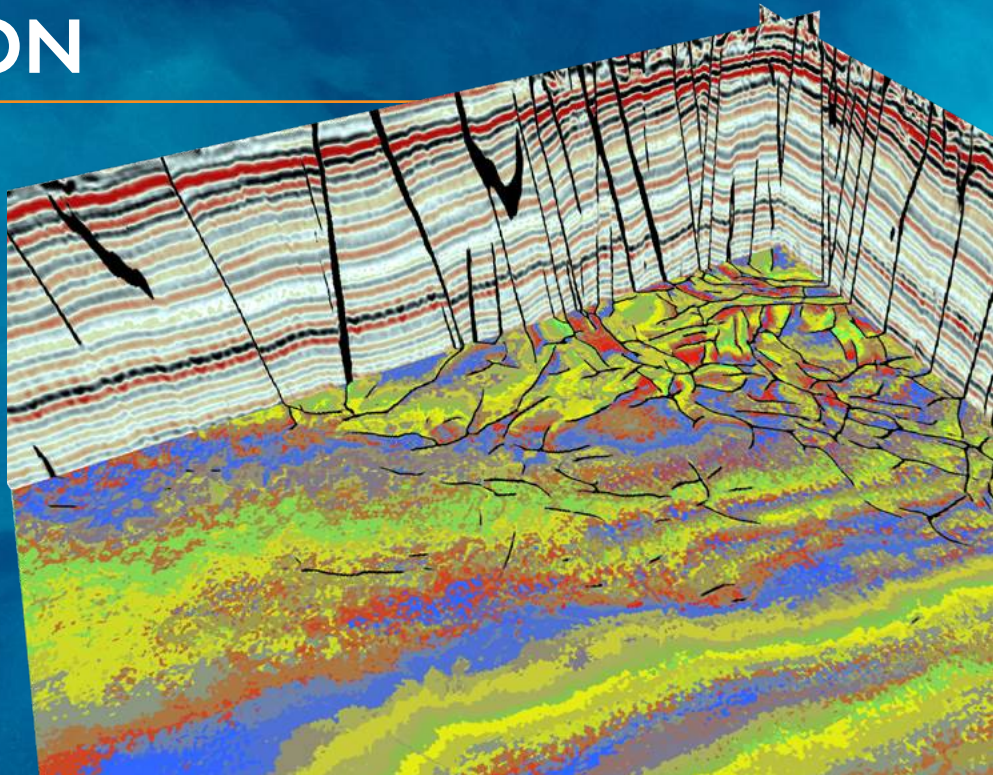


Petrel Connector

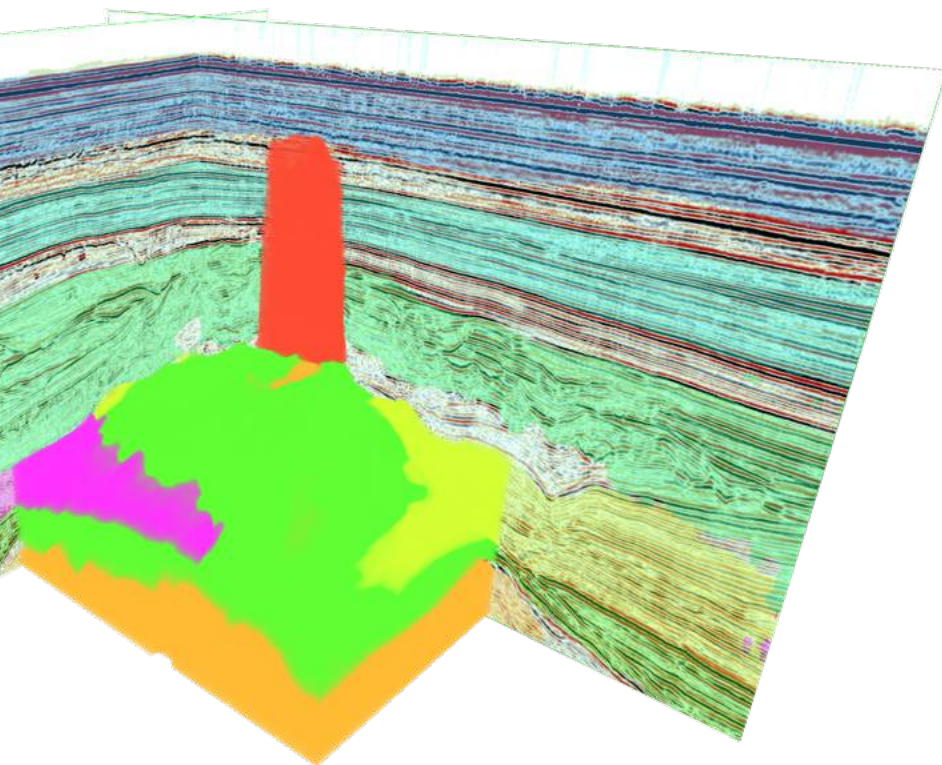
Move data between Paradise and Petrel easily and conveniently

DEEP LEARNING (DL) FAULT DETECTION

The DL Fault Detection application is equipped with general pre-trained deep learning engines (models), enabling their application to a wide range of seismic data without the need of user-provided fault examples for training. Using Graphic Processing Unit (GPU) technology, the tool dramatically reduces the time to identify faults in a volume.

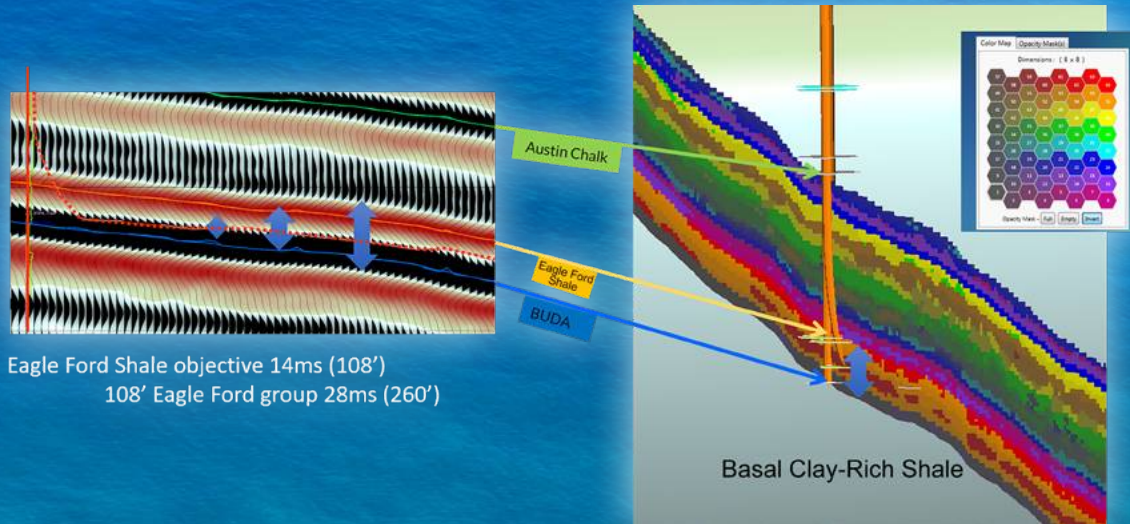


DEEP LEARNING (DL) SEISMIC FACIES CLASSIFICATION



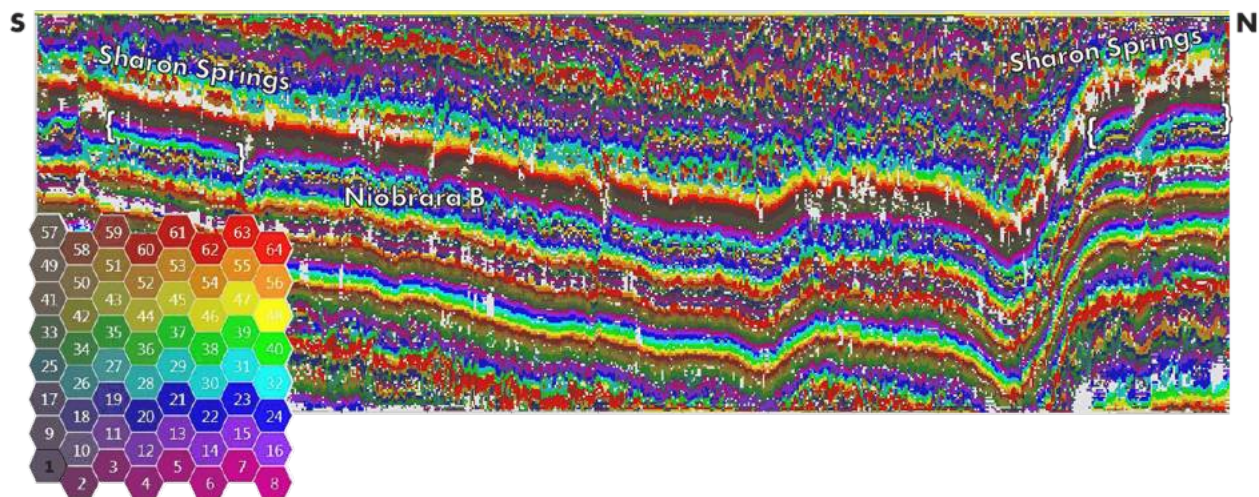
The new DL Seismic Facies classification tool enables the identification of structural and stratigraphic facies patterns based on deep learning technology. Seismic facies and any other patterns present on seismic data such as potential Direct Hydrocarbons Indicators, multiples, etc., can be identified in a seismic volume given the appropriate training. The 3D extent of these features can provide significant and valuable information to the interpretation process.

MULTI-ATTRIBUTE CLASSIFICATION



Applied in Paradise, the Self-Organizing Maps (SOMs) improve the interpretation of stratigraphic facies and their distributions, and has demonstrated the ability to resolve thin beds that are below seismic tuning thickness. This methodology has proven to define potential fluid effects on seismic data given the appropriate seismic attributes. With the use of the interactive 2D Colormap, the distribution of one or more neural classes may be correlated and calibrated with geology. From the Multi-Attribute Classification results, volumetrics for selected geobodies can be calculated from specific classes using the Geobody detection application.

INTERACTIVE 2D COLORMAP



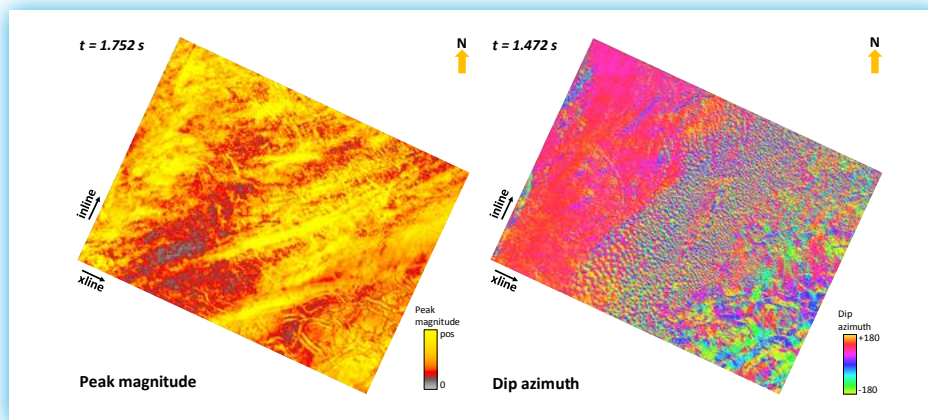
Paradise is the only software product in the industry with a 2D Colormap representing neuron classifications of attributes. The 2D Colormap is used interactively with the Paradise Universal Viewer to select and isolate specific neurons which have classified a set of seismic attributes from the SOM process. This enables the interpretation of neuron-identified, geologic features and their geometries.

ATTRIBUTE GENERATION

The Paradise Attribute Generator places best-in-class post-stack seismic attribute calculations in the hands of general interpreters and specialists alike using easy-to-follow ThoughtFlows and geoscience-focused visualization capabilities. The Paradise Attribute library includes a comprehensive list of Instantaneous attributes as well as commercial algorithms and workflows developed by the Attribute Assisted Seismic Processing and Interpretation (AASPI) group at the University of Oklahoma, led by Dr. Kurt Marfurt.

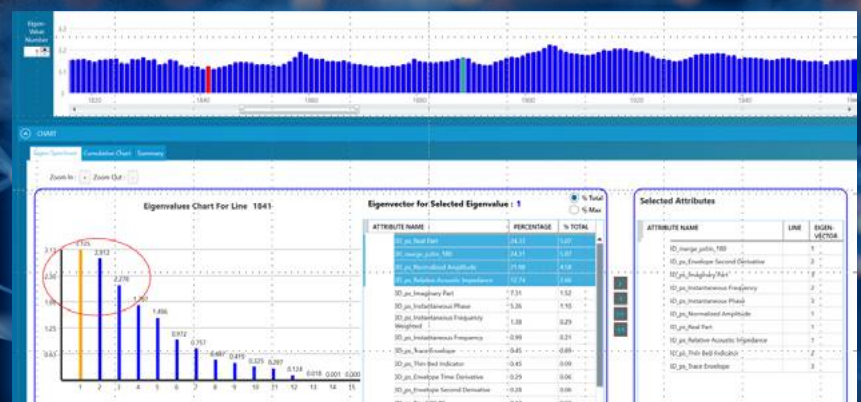
Families of Attributes

- Instantaneous
- Dip
- Structure
- Amplitude
- Similarity
- Curvature
- Spectral Decomposition
- Texture

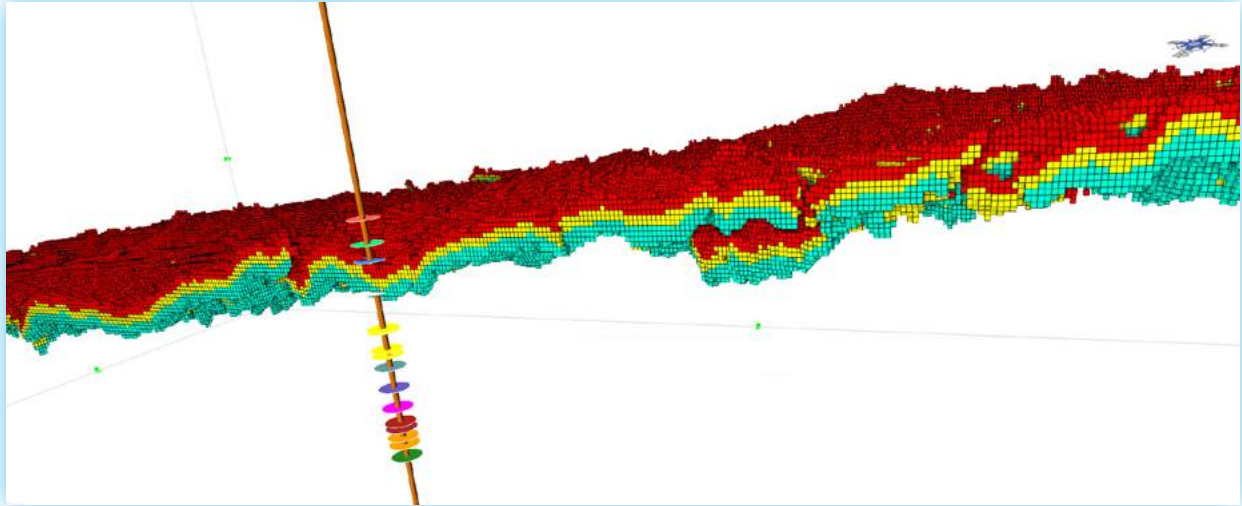


ATTRIBUTE SELECTION

Attributes differ in their relative contribution to information (energy) in a given volume. In Paradise, Principal Component Analysis (PCA) is employed to identify those attributes that are the most prominent and quantify their relative contribution to a volume. Using an Eigen spectrum chart, the relative contribution is easily seen both graphically and numerically, taking the guesswork out of selecting the right attributes for the region.



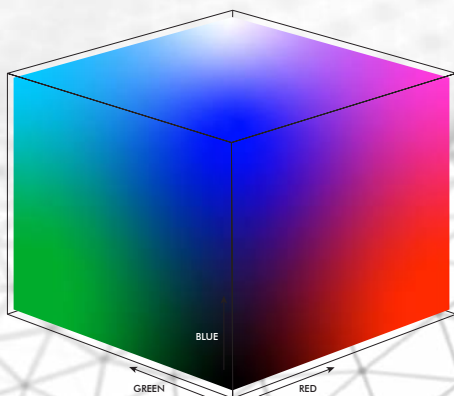
MACHINE LEARNING GEOBODIES



Geobody generation and editing are unique to the Paradise AI workbench. Geobodies are created from one or more neuron groups selected from a Self-Organizing Map (SOM), and are used to generate a three-dimensional visualization of geological features and interpreted or drilled reservoirs. Once generated, industry-standard volumetric calculations are available in the tool to estimate the amount of in-place and/or recoverable oil or gas where reservoir data is available. Using Paradise to identify geobodies empowers interpreters with the ability to:

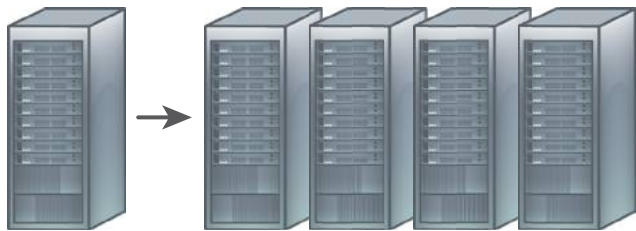
- Investigate geobodies at the sample level of each neuron
- Capture details on areas of interest, including volumetrics and statistics
- Edit/clean-up selected geobodies by filling in areas or pruning extraneous samples
- Export areas of interest to an interpretation system

COLOR BLENDING



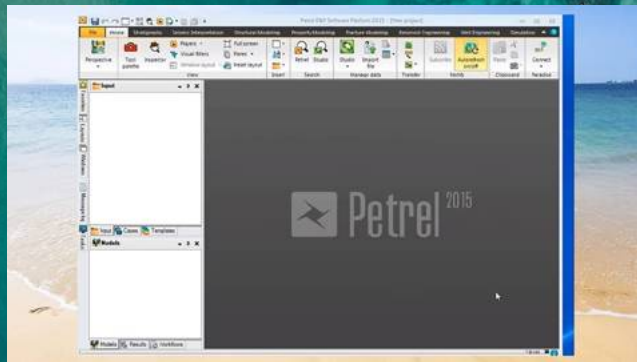
The blending of attributes in an RGB display can dramatically enhance the visibility of geologic features within the seismic data. The Color Blending application is a 3D visualization tool that co-renders three separate attribute volumes (e.g., three spectral decomposition volumes) into a single volume for interpretation. When applied to seismic data, Color Blending or co-rendering can highlight geologic and geophysical features thereby, improving interpretability.

HIGH PERFORMANCE COMPUTING



With the increase in the size of data volumes, traditional servers and workstations can limit the speed of interpretation. The new Paradise HPC capability enables the generation of geometric and spectral decomposition attributes on clusters of machines, dramatically reducing computation time.

PETREL CONNECTOR



The Petrel* connector allows Paradise users to import and export data from Paradise into and out of Petrel.

The Petrel Connector to Paradise is installed on the same machine with Petrel and appears as an icon on the Petrel ribbon. Simply open the Paradise Connector, select the data to be moved to Paradise, drag and drop the data items onto the Petrel Connector dialog,

and select Export. Import from Paradise to Petrel is equally straightforward. Multiple items can be exported at once by selecting the folder to export, such as all wells. The products of machine learning and deep learning in Paradise, such as Deep Learning Seismic Facies, Faults, and Multi-Attribute Classification volume, can be imported easily into Petrel for further analysis.

**Petrel is a Registered Trademark of Schlumberger Limited*

PARADISE SCRIPTING LANGUAGE

```
ImportSegy.kfi*
1 batch/
2 set survey name = 1/
3 set survey path = 2/
4 set segy path name = 3/
5
6 newlabel survey name/
7 Beg
8 newlabel survey_path/
```

The Paradise Scripting Language (PSL) is a powerful procedural language for geophysical signal and neural network analysis. The language includes over 600 geoscience-specific commands for analyzing geoscience data. PSL is designed for geoscientists and researchers to develop new geophysical data procedures. Unlike Python or other programming tools, many geoscience constructs are pre-built and readily available in PSL, saving time while providing a rich toolset for analysis and investigations.

The Paradise Script Processor (PSP) is a software application for optimized multi-thread vectorized performance. PSP modes include interactive operations, numerical batch processing, and multi-batch parallel processing. Included with PSL is the Paradise Script Editor (PSE) to write and run scripts interactively.



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