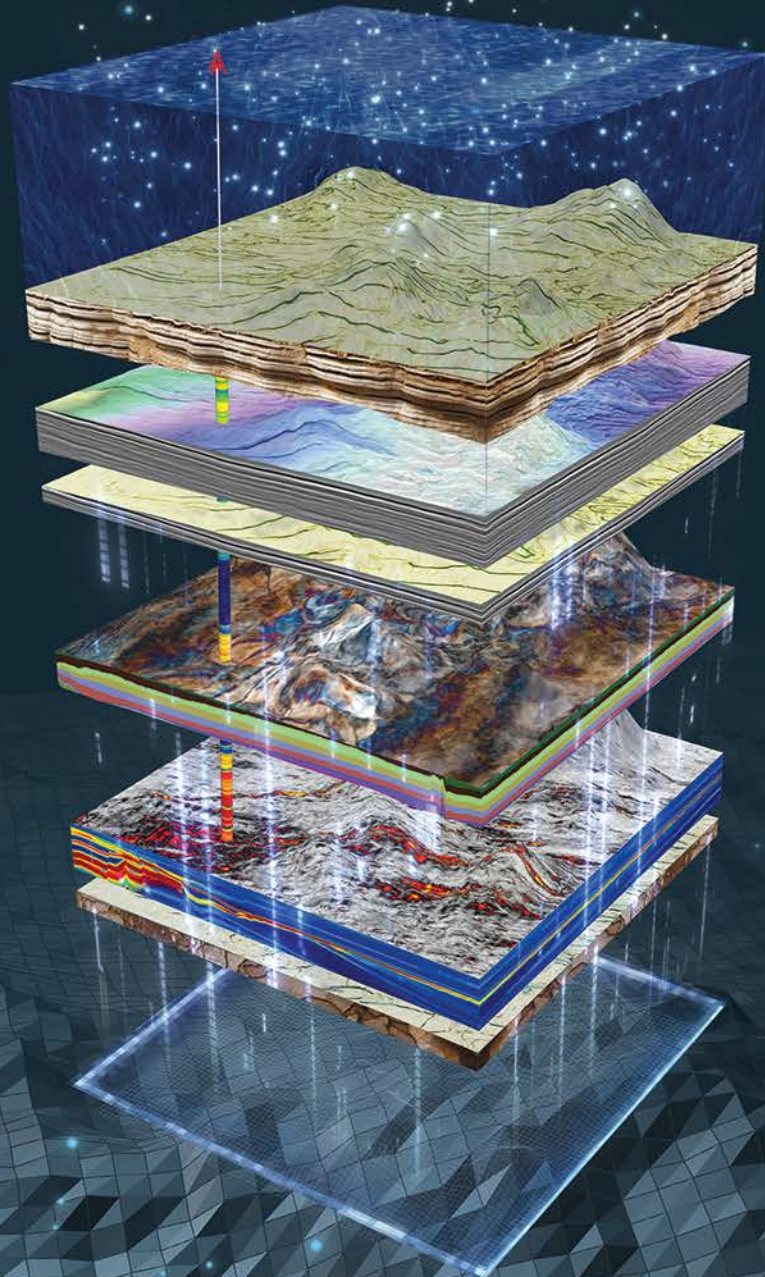


2023

PALEOSCAN™

Integrated Seismic Interpretation Software



HUMAN INTELLIGENCE FOR EARTH SOLUTIONS

Who We Are

Eliis designs and delivers seismic interpretation software solutions to the energy industry for a better understanding of the subsurface.

Our proactive, data-driven and innovative team of geologists, geophysicists, signal processing and software engineers has developed PaleoScan™, a next-generation software of seismic interpretation that pushes seismic analysis to an unprecedented level of geological expertise.

Our mission is to combine artificial and human intelligences, bringing together the automation provided by a modern software and the expertise of geoscientists. That synergy enables the creation of geological models of unmatched resolution directly from seismic data. Thanks to our technology and methodology, the interpretation cycles are drastically reduced and the capacity to detect and accurately characterize geological reservoirs is greatly augmented.

« When human creativity meets powerful technology: the key to unlock your seismic data »

Our Ambition

Over the years, Eliis has become an internationally recognized provider of subsurface geoscience solutions. Its technology, know-how and services are used around the world in many areas, from the exploration and production of fossil energy, and the strategic storage of gas. Eliis' disruptive technology, used for the detection and characterization of geological reservoirs, is a key asset for stakeholders in limiting environmental risks and offering sustainable energy solutions.

Today, Eliis has a global footprint with offices in the main regions of the world and is broadening its scope to new markets by adding value to the whole geoscience realm. Eliis is becoming an actor in the energy transition offering solutions to the challenges of a sustainable future.



What we offer



TRAINING



SUPPORT



CONSULTING



MENTORING

Eliis provides a wide range of services, on-site or in-house, from tailor-made training and support to full consulting services.

Our experienced consultants, with their in-depth technical and scientific knowledge, combined with our cutting-edge technology can help you succeed throughout the E&P lifecycle. Eliis' dedicated pool of experts can assist you to solve your interpretation challenges by leveraging our technology.

« For every project we accompany you to find the most fit-for-purpose solution »

Why Choose PaleoScan™?

At the confluence of powerful algorithms, computational power and data analysis, our revolutionary technology can deliver a substantial qualitative and quantitative change to E&P businesses by creating new opportunities for energy supply enhancement, reducing risk and making informed decisions.



Technology

- Seismic to model: Semi-automated global seismic interpretation workflow
- Cost minimization function
- Automated workflows
- Sub-seismic resolution
- Geological features identification enhancement



Integrated Platform

- Fully integrated 2D & 3D platform
- Unique global chronostratigraphic framework
- Well and Seismic data integration



Usability

- Client-driven development
- Intuitive, user-friendly interface
- Third party software connectors
- 24/7 dedicated support
- Online resources



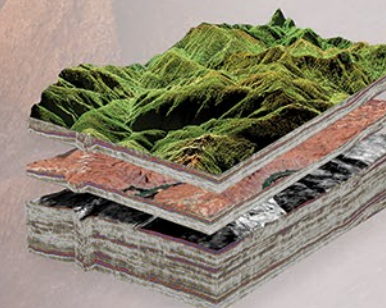
Results

- Machine-aided automation
- 80% time saving in your interpretation cycle
- Uncertainty mitigation
- Cost efficient solution

PaleoScan™ delivers throughout the value chain

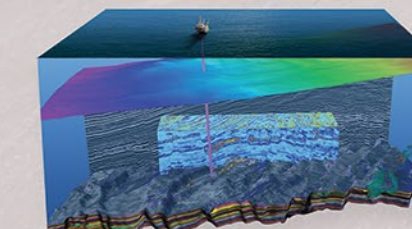
Data Reconnaissance

In frontier exploration, new ventures and large scale projects, PaleoScan™ allows the geoscientists to quickly assess the hydrocarbon prospectivity of seismic datasets. It has proven its value in a large variety of basin evaluations, data room situations, and became invaluable in peer review processes.



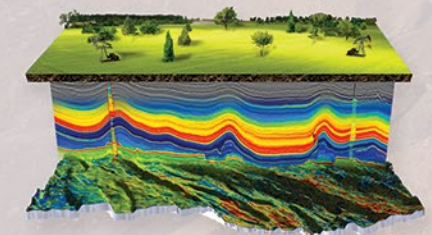
Exploration

Identify prospects and delineate reservoir geometries at an early stage of the exploration cycle. Innovative tools to map seismic attributes on a multitude of horizons and calculate volumes via geobody extraction are crucial for de-risking drilling decisions and defining next well location.

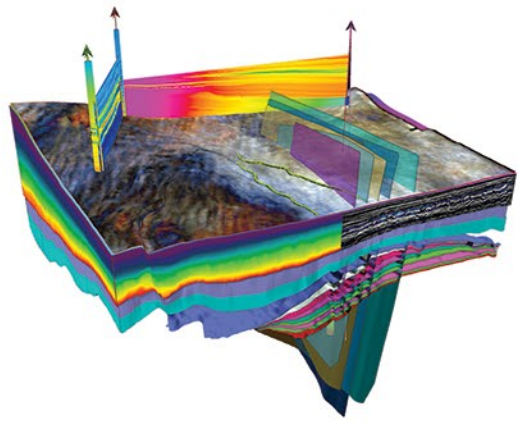


Development

Understanding reservoir properties and architecture with high resolution stratigraphic analysis and detailed fault imaging helps to better constrain your reservoir model and gridding process. PaleoScan™ includes intuitive QI tools including rock-property prediction and data classification through Cross-plotting.



Full Featured Seismic Interpretation Platform



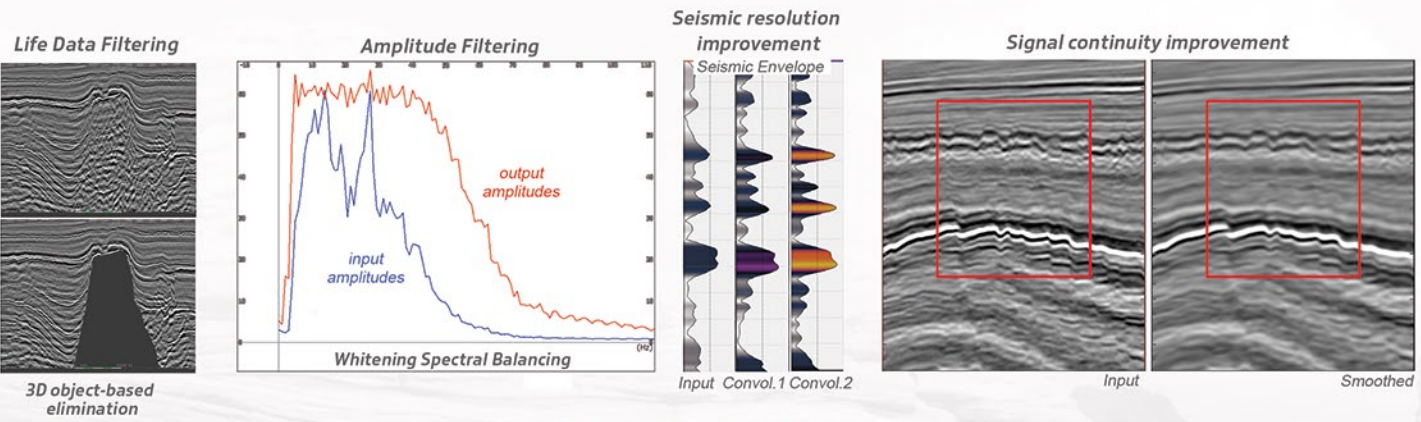
PaleoScan™ features a set of integrated tools and modules contained in a user-friendly environment and arranged in a comprehensive seismic interpretation workflow. Thanks to an iterative Relative Geological Time Model creation process, coupled with interactive cross-navigation and powerful editing tools, the seismic interpretation can be refined at its finest and provide top of the class geological models. PaleoScan™ signature workflows include semi-automatic generation of horizons, stratal slicing of the entire seismic volume, geobodies extraction and quantification, automated fault extraction, well and markers cross-correlation.

From early phase of data loading through rapid data screening to detailed reservoir characterization, PaleoScan™ cracks the deepest secrets of your seismic data.

PaleoScan™ runs on Windows® 64-bit and takes advantage of parallel computing with multi-core technologies.

Data conditioning tools

Seismic data conditioning is a key requirement for any quantitative seismic interpretation and reservoir characterization project. In this regard, PaleoScan™ offers specific processing routines to mitigate multiples and noise, enhance amplitudes and eventually correct frequency distortions and other undesirable effects.



Core Application

3D Relative Geological Time Model

Attributes

Spectral Decomposition

Well Correlation

2D Relative Geological Time Model

Automated Fault Extraction

AVO

Cross Plot & Classification

Horizons & Stratal Slicing

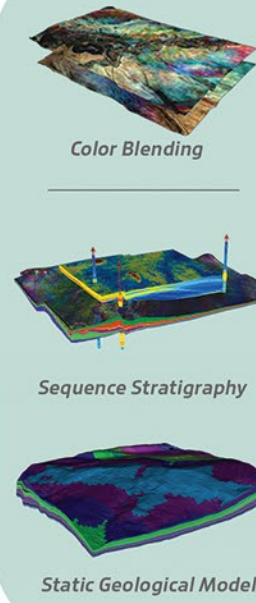
Geobody Modeling

EEI

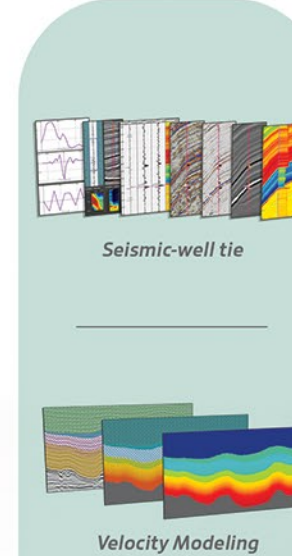
Inversion

Add-On Modules

Advanced Interpretation



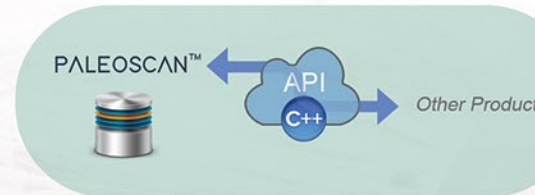
Time Depth



Property Modeling



Data I/O API



Connectors



Python API

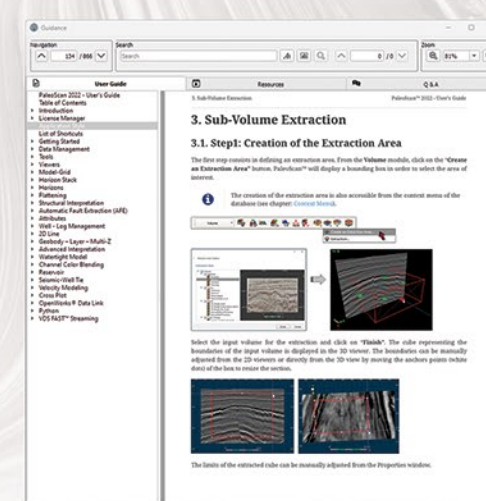


PaleoScan™ Data Loader



PaleoScan™ Data Loader is a dedicated solution for data management to prepare and assess project data quality before transferring them to the asset teams. It enables the users to easily import, preview and quality check input data as well as export all PaleoScan™'s objects and generated outcomes.

Interactive User Guidance

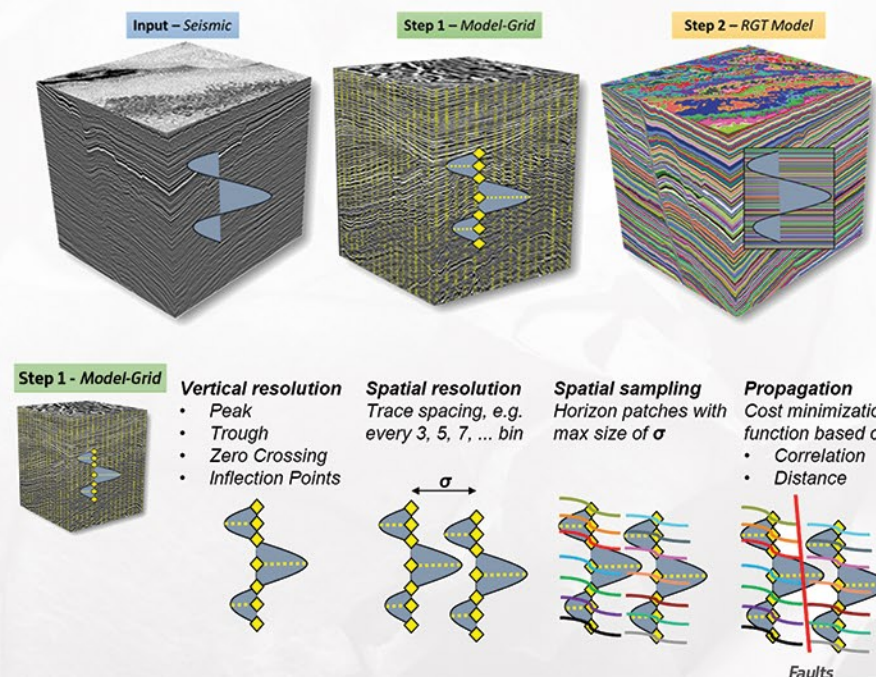


Get the most out of your PaleoScan™ experience by quickly, easily and seamlessly accessing our User Guide, Q&As and help Videos. Get acquainted with PaleoScan™, learn more about its use cases, become more proficient and autonomous in your PaleoScan™ usage and reduce searching time through our integrated resources.

NEW

RGT technology

Don't waste time on horizon picking, master our RGT technology and create value from your entire seismic cube in one click! Adopt our holistic and semi-automated seismic interpretation approach based on an iterative Model-Grid and Relative Geological Time (RGT) Model creation process.



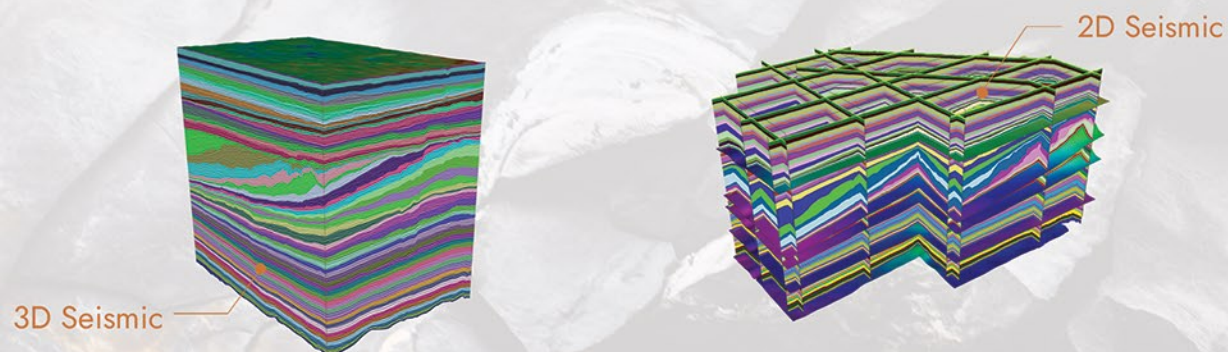
Highlights

- ▲ Grid made of a billion of horizon patches
- ▲ Manage peak, trough, zero crossing and inflection points
- ▲ Automated horizon tracking
- ▲ Automated fault detection
- ▲ Fast and interactive editing
- ▲ Geological model preview in real time
- ▲ 3D objects can be used as constraint
- ▲ External horizons can be used as constraint

NEW

This comprehensive method utilizes a three-step computer-aided workflow :

- **Autotracking:** our powerful algorithm converts all seismic reflections into horizons and stratigraphically organizes them.
- **QC and Iteration:** flexibility and ownership is given to the interpreter who can interactively edit auto-tracked horizons and update the Model-Grid in real-time to obtain a fit-for-purpose solution. Repeated cycles of adjustments enable to refine the product to the desired result.
- A **Relative Geological Time (RGT) Model** is consecutively computed from the seismic based on the aforementioned refined Model-Grid. The RGT model plays a central role in PaleoScan integrated workflows as many interpretative applications are directly derived from it.



2D Seismic Interpretation methods

2D seismic interpretation is a generally complex task, relying on 2D auto-tracking and manual picking of major stratigraphic events. Interpreters must extend this process to multiple lines, sometimes of various resolutions, amplitude ranges and mistie effects. Hence, it is often cumbersome to outline the main stratigraphic geometries from 2D interpretation. To ease this process, the Relative Geological Time Model method has been extended to 2D seismic data. Based on seismic polarities, a 2D horizon patch grid is computed and patch links are automatically derived via a minimization process. Relative Geological Time values are assigned to the marked horizons and intermediate values are calculated on the remaining patches using a thickness optimisation method. This approach produces a consistent 2D RGT Model honouring stratigraphic discontinuities and compensating misties at 2D seismic lines intersections.

Highlights

- ▲ Patch propagation improvement for 2D Model-Grid
- ▲ 2D RGT Model computation methods:
 - Between Marked Only Horizons
 - On all horizons as « Signal Based »

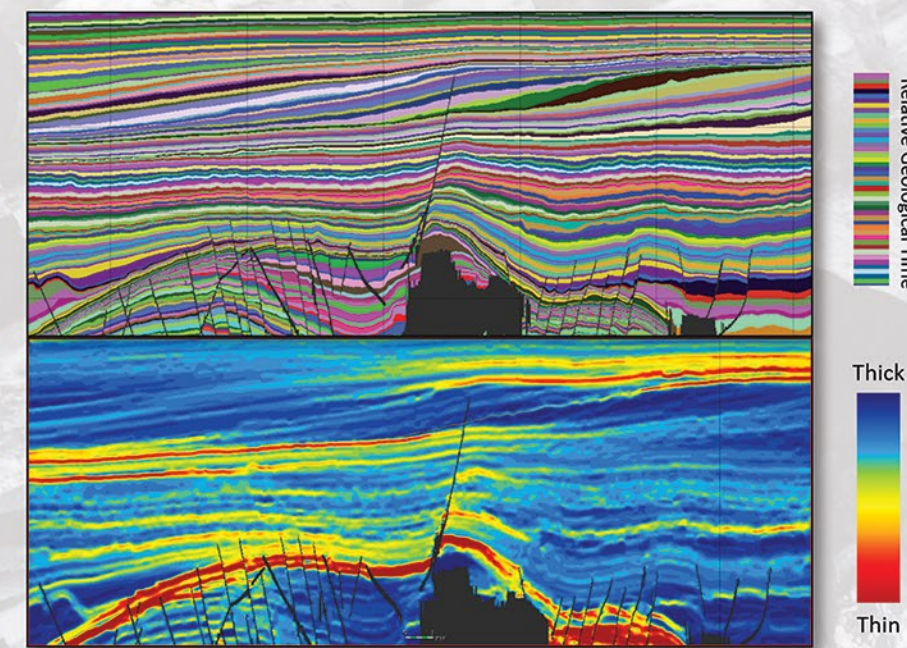
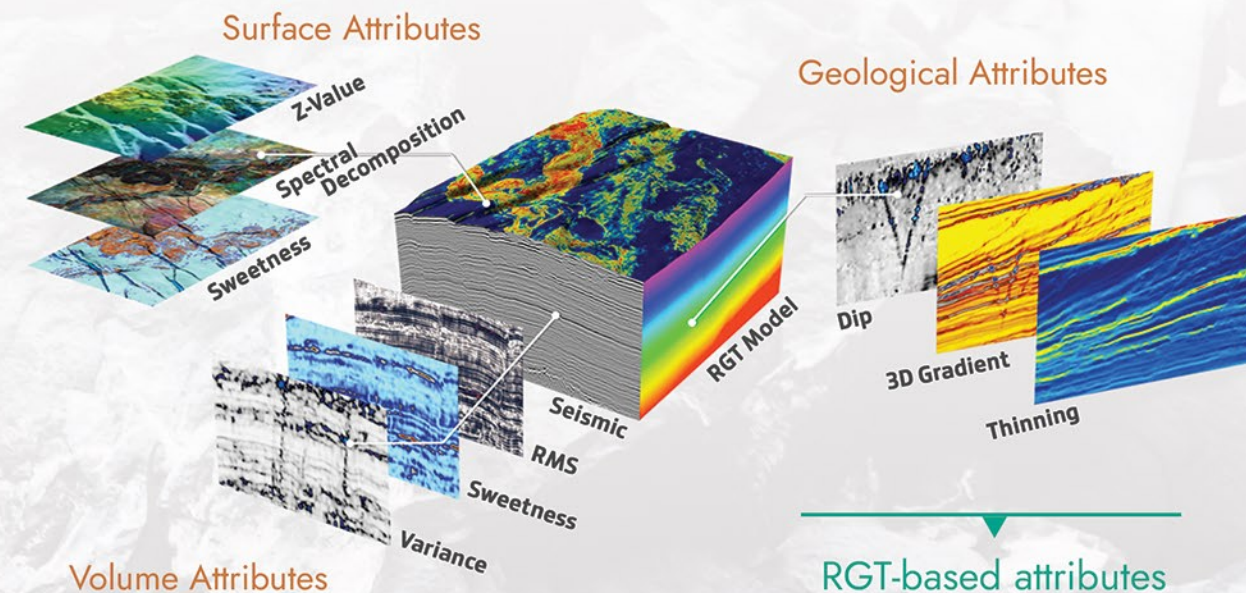
NEW

Attributes

From the RGT workflow, you can instantly visualize more than 30 attributes and realize more than 40 attributes derived from seismic or RGT Model. Our 3-star workflow relies on 2 main stratigraphic attributes:

- **Spectral decomposition** is a technique relying on the transformation of each individual 1D seismic trace into a 2D time-frequency representation using either Short Time Fourier Transform (STFT), Continuous Wavelet Transform (CWT) or Matching Pursuit (MP). It aims at extracting discrete frequency magnitudes to tune beds according to their thicknesses and provides high precision imaging of source-to sink systems and reservoir complexity and heterogeneities.

Seismic-derived attributes



- **The thinning** attribute is the vertical derivative of the RGT Model. It shows for every seismic sample the instantaneous variation of the relative geological ages. It highlights zones of strata convergence and divergence leading to the interpretation of geometrical relationships within sedimentary units, relative accommodation space variations and seismic stacking patterns.

Sweetspotting at an early stage

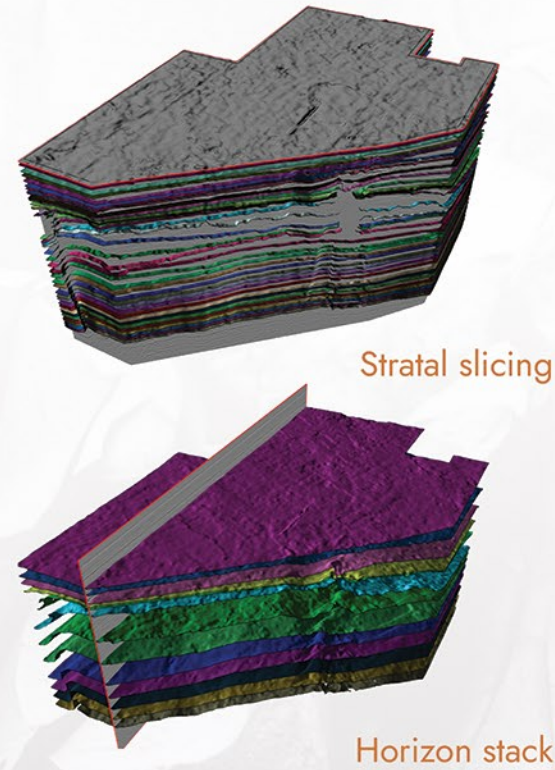
Explore your seismic volumes faster, further and beyond the seismic sampling!

To quickly assess your depositional environment and target sweetspot areas at an early stage, try our quick and pragmatic method.

One of the main applications derived from the RGT Model is the ability of extracting an infinite number of iso-age surfaces gathered within a so-called "Horizon stack" product. This high-density stratal slicing enables to interactively tie any key surface to major event and dynamically flatten or sculpt the data allowing you to accelerate data recognition, detection and characterization of fine-scale geological features.

Map your attributes on any horizon and start screening through your geomorphological data in no time!

The vast range of attributes, including Spectral and Frequency decomposition, and the excellent color blending functionality make high quality and fast attribute analysis to better visualize geological bodies from large scale source-to-sink systems to reservoir scale features. Save time and effort and focus more on integrating your knowledge and understanding your depositional history.



Stratal slicing

Horizon stack

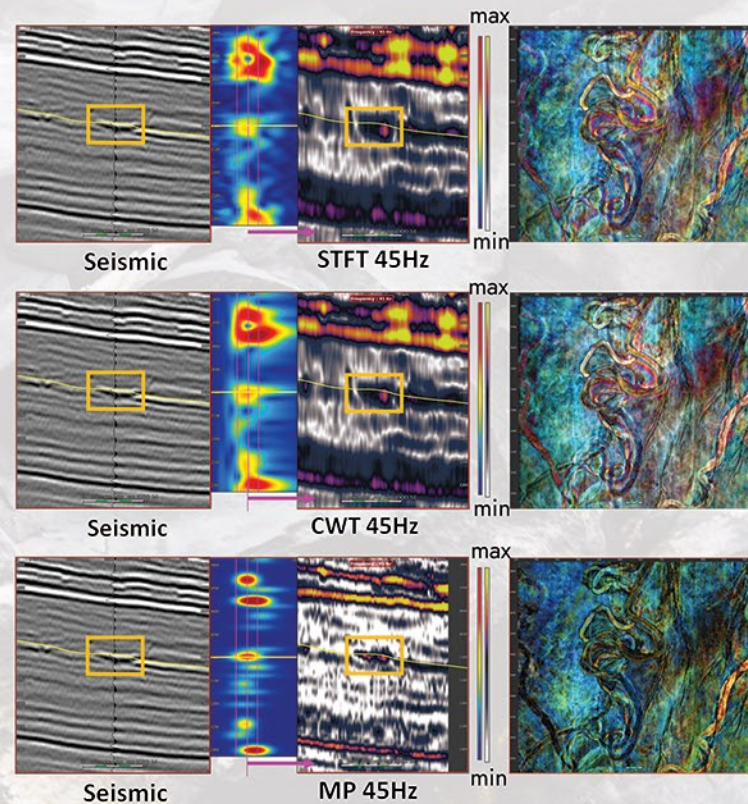
Various blending methods

- ▲ Alpha blending
- ▲ RGB (Red, Green, Blue),
- ▲ CMY (Cyan, Magenta, Yellow),
- ▲ HSV (Hue, Saturation, Value),
- ▲ HSL (Hue, Saturation, Lightness)

Spectral Decomposition methods

PaleoScan™ proposes different Spectral Decomposition methods

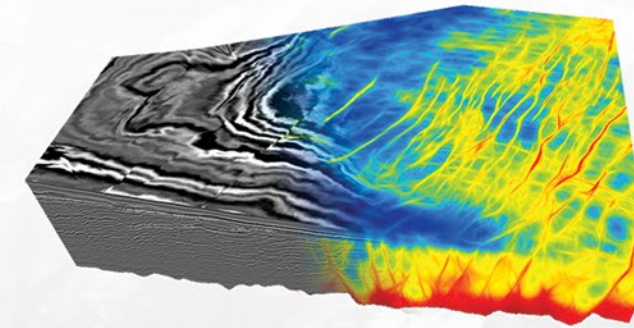
- ▲ The **Short Time Fourier Transform (STFT)** performs a Fourier transform inside a sliding window implying a time frequency resolution dependent to the window length.
- ▲ The **Continuous Wavelet Transform (CWT)** convolves the seismic signal with different compressed-dilated wavelets allowing a multi-resolution analysis of the signal: it gives high frequency resolution at low frequencies and high temporal resolution at high frequencies. These two methods are useful at regional scale for identifying main geological features.
- ▲ The **Matching Pursuit (MP)** independently decomposes each seismic trace in a linear combination of wavelets. The MP method has a superior temporal and frequency resolution compared to the STFT and CWT methods. Thus, this method offers a better vertical resolution in particular for reservoir analysis.



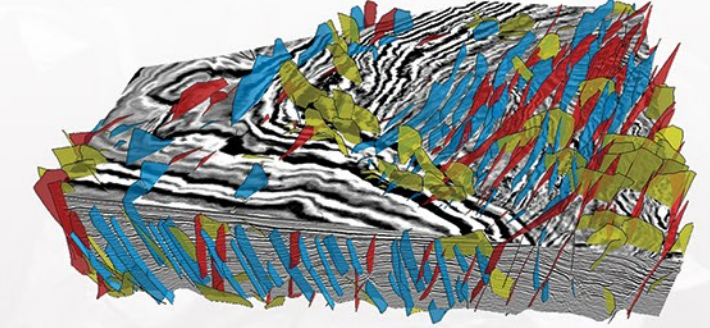
Automated Structural interpretation

Build your structural framework at the speed of a blink!

Handling dense and complex fault networks is at your fingertips with our fast and hands-on **Automated Fault Extraction (AFE)** workflow.



Fault detection through thinning attribute



Fault sets classification

Our innovative solution proposes an optimized computation of variance values at a given voxel location using different scanning orientations (dip/azimuth) to automatically extract set of faults from a seismic volume. PaleoScan™'s technology gives you the control to investigate and identify optimal parameter settings every step of the way!

Fault management tools such as **Fault Merge Assistant** and **dip/azimuth filtering stereonet** are tremendously useful to speed up the interpretation time and extraction of meaningful and valuable fault sets. The resulted extracted faults can then be used to optimally constrain the **RGT Model** and the **Geocellular grid**.

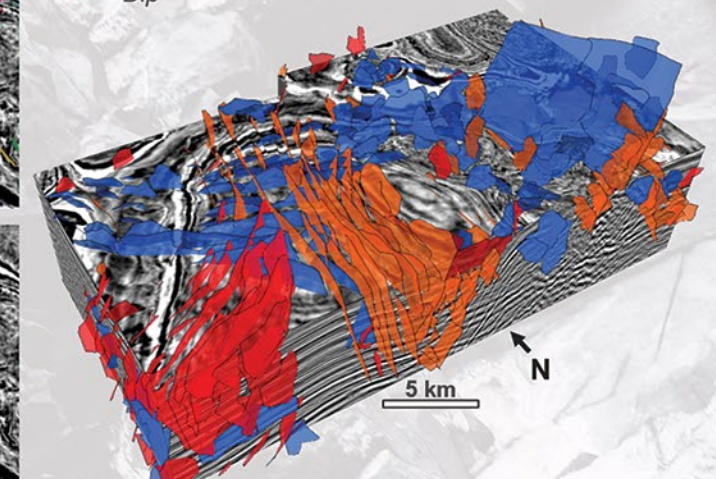
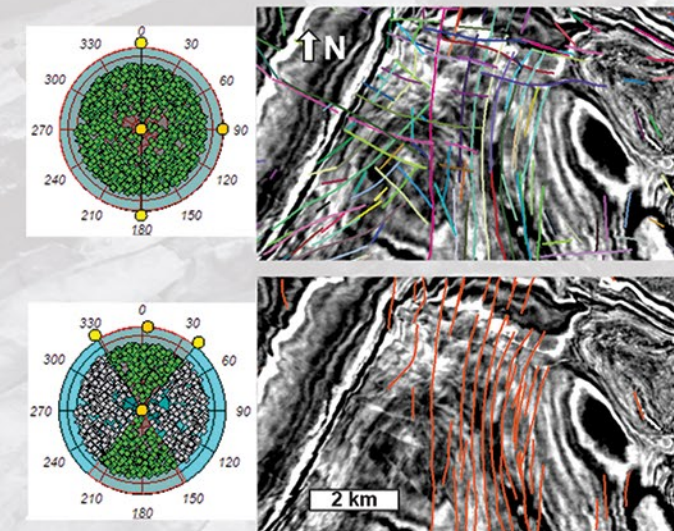
Sealing mechanisms and fault geomechanical properties are crucial information in prospect evaluation and productivity enhancement and can be preliminary assessed through our **Fault throw attribute** and **Allan diagram tool**.

Highlights

- ▲ Fault plane attribute
- ▲ Automated fault patch extraction
- ▲ Interactive editing
- ▲ Fault patch merge and split
- ▲ Fault merging assistant tool
- ▲ Stereonet filtering

Families of faults can be defined in real time according to:

- Size
- Azimuth
- Dip

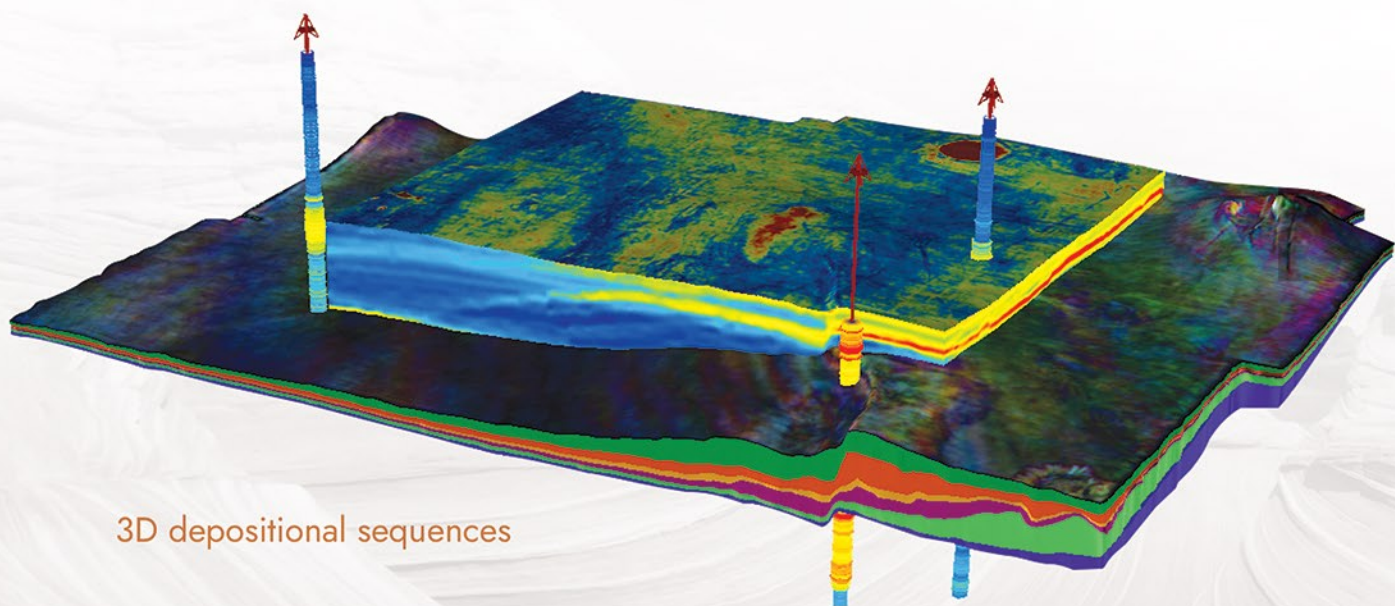


NEW

Wheeler domain interpretation

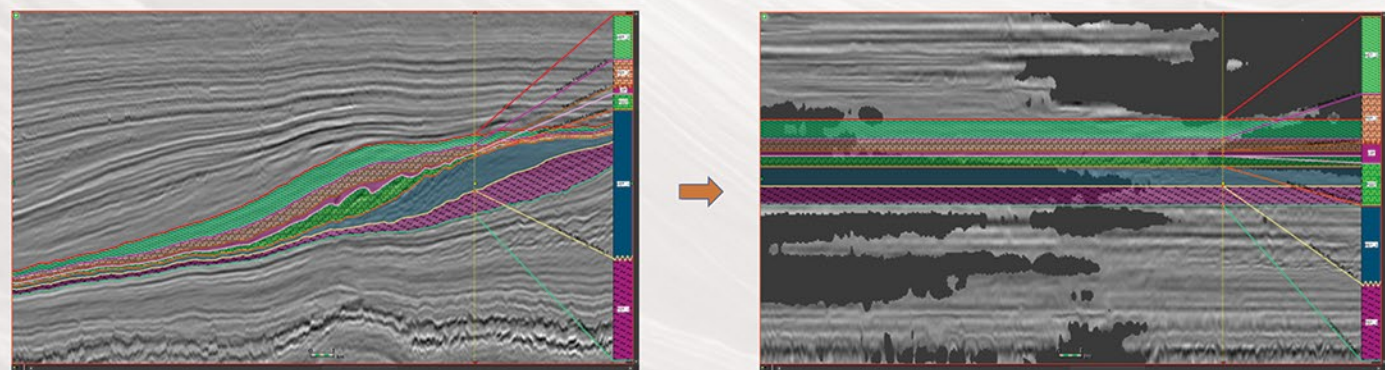
Strengthen your 3D chronostratigraphic framework, pinpoint your key stratigraphic surfaces, apprehend the spatial and lateral evolution of your megasequences and their intrinsic depositional environments through our **Seismic Stratigraphy module**.

Our **wheeler transform** optimized algorithm allows a direct translation of stacking patterns and systems tracts into relative geological times by flattening the seismic data along chronostratigraphic surfaces. In this way, the sedimentary layers can be considered in terms of base level changes and sedimentation interplay, unconformities and hiatuses, allowing you to be more predictive in locating reservoir, seal and source-rock facies.



Seismic Stratigraphy module, key elements:

- ▲ Generate an interactive Wheeler diagram
- ▲ Highlight depositional sequences
- ▲ Create geological cross-sections
- ▲ Identify unconformity-bounded seismic sequences in 3D
- ▲ Manage surface truncation
- ▲ Create horizon stacks by sequences



Seismic Domain

Wheeler Domain

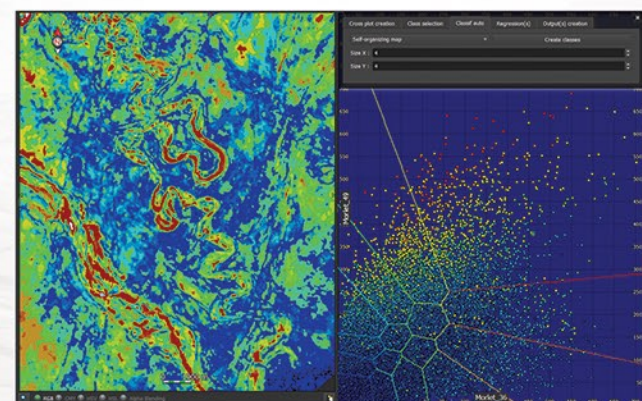
Prospectivity enhancement

Build a robust stratigraphic framework, control and predict your facies distribution and reservoir quality by integrating stratigraphic markers and well log data to your seismic data.

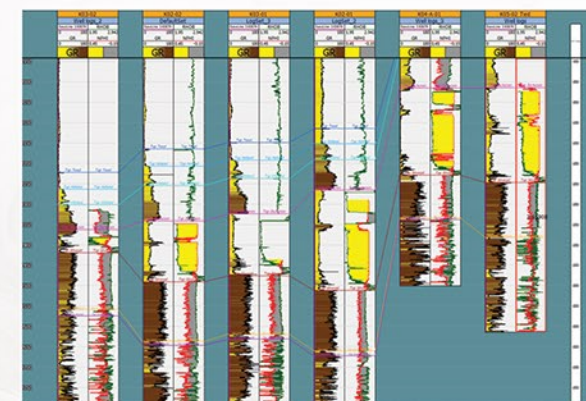
Scan, detect and extract 3D geobodies using our seismic facies-based cross-plot workflow.

PaleoScan™ provides a toolkit for **visualizing, editing and analyzing** well data. Create geological cross-sections, quality check your results and use markers and surfaces to **simultaneously flatten your well correlation panels, cubes and lines**.

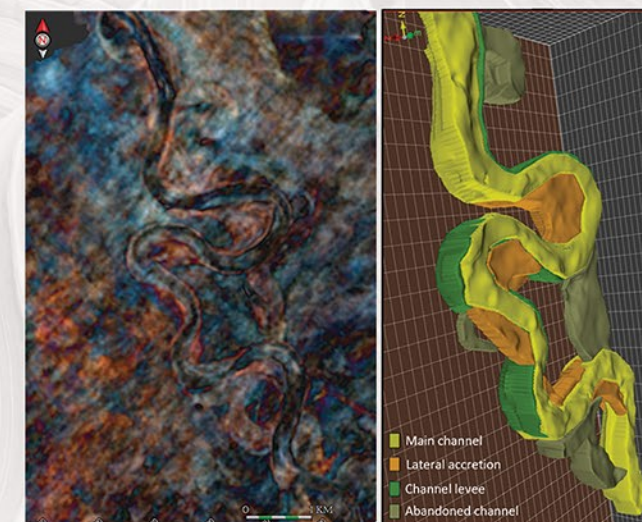
Interactive cross-plotting of attributes and well log data is a fundamental tool for lithofacies classification and fluid substitution effects understanding.



Cross-Plot Classification tool



Well Correlation Panel



Geobody Extraction

Both manual and automatic classification methods are available to create and organize your lithology or facies classes. By thoroughly and interactively analyzing seismic signatures, you can select a meaningful range of values within your cube and extricate the associated geobodies.

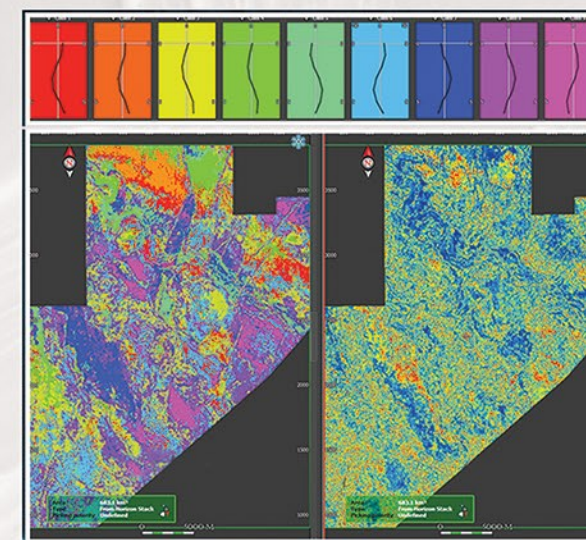
Lithofacies classification performed from well log data results in the creation of **discrete well logs** that can be further used in quantitative reservoir evaluation.

Waveform Classification

NEW

Waveform Classification is an automatic pattern recognition technique applied on seismic traces along a selected horizon. By grouping portions of seismic traces with comparable amplitude, frequency, and phase, classification maps can reveal variations in lithology, stratigraphy, fluid contents, or bed thickness assuming waveform changes are not the result of source signature or processing.

Waveform Classification is efficient for swiftly analyzing **reservoir heterogeneities and stratigraphic characteristics**. It highlights the complexity of geological features and helps their extraction as geobodies.



Classification map

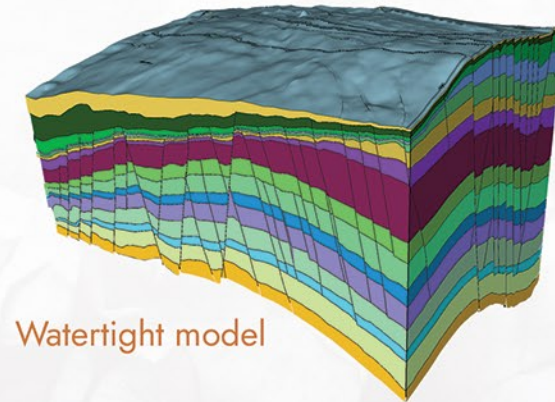
Probability map

Reservoir Characterization

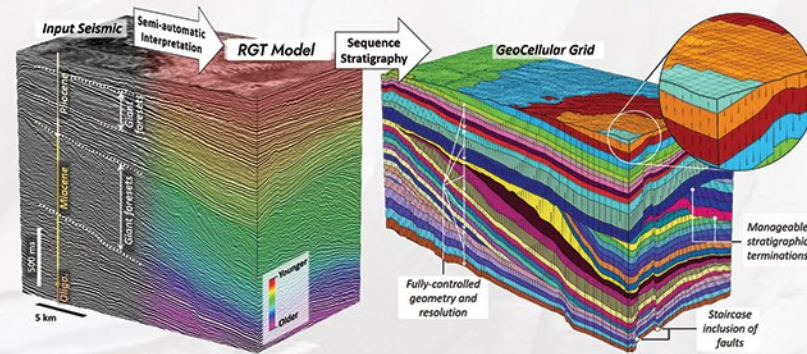
Bridge the gap from seismic interpretation to reservoir modeling by performing an initial assessment of reservoir heterogeneities and petrophysical properties three-dimensional distribution through the incorporation of all available information derived from well-log data.

To bring a step-forward structural interpretation, PaleoScan™ offers a unique method to directly generate vector space models from RGT-driven geological layers and fault networks. The newly computed **Watertight model** is then meshed in 3D to obtain sealed fault-surface contacts. These contacts form the basis for fault polygon extraction and layers juxtaposition display within an **Allan diagram**.

Using the same RGT-driven layers and fault networks input combined with **stratigraphic termination management** and **stacking pattern** assignment, a **Geocellular grid** can be computed and populated with seismic facies or rock properties. This regular stratigraphic grid of corner point type manages stair-stepped fault modeling.



Watertight model



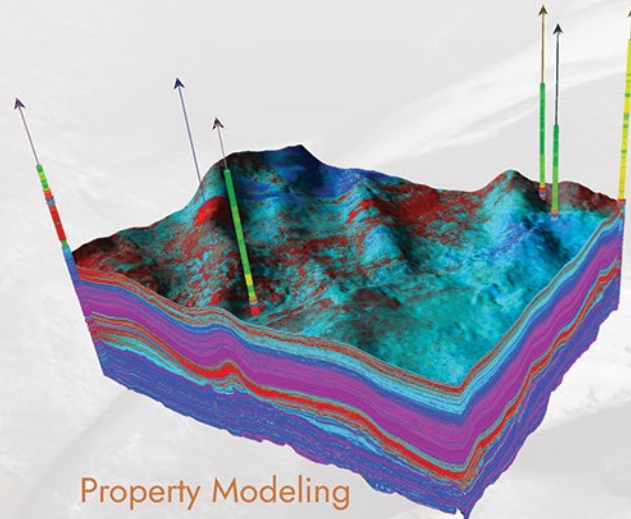
Reservoir Modeling

A thorough well analysis from all types of wireline logs achieved with PaleoScan™'s classification "Cross-plot" tool leads to static reservoir property extraction. Our **Property Modeling** module offers several propagation methods to interpolate between well logs such as inverse distance, kriging and co-kriging which can be visualized in real time on a surface or a cross-section through wells.

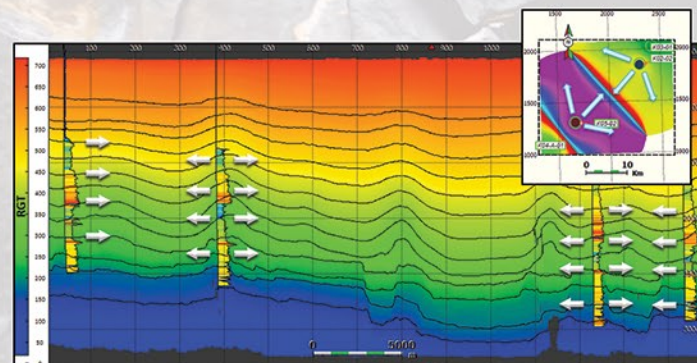
One of our signature workflows uses a priori Impedance Acoustic cubes from property modeling to constrain **Colored Inversion** and **Deterministic Inversion** processes. The subsequent results are finally used to populate the Geocellular grid with porosity and fluid content properties.

Highlights

- ▲ Propagate well log properties guided by RGT model
- ▲ Inverse distance, kriging and co-kriging methods
- ▲ Propagation parameters by stratigraphic sequences
- ▲ Rock physics distribution prediction
- ▲ Variograms and anisotropy according to reservoir architecture
- ▲ Real time preview on horizons and lines along wells



Property Modeling



Well log data propagation driven by RGT model

To go further in the Quantitative Interpretation:

- Forward modeling (synthetic seismic generation)
- Interval velocity model generation

PaleoScan™ conformance journey with OSDU™ Data Platform

Energy companies maintain numerous subsurface applications with local data stores. Consequently, they are burdened with petabytes of difficult to manage, duplicated subsurface data, siloed in proprietary formats that lack data interoperability, leading to additional storage, transfer and conversion costs as well as upstream workflow inefficiency.

In response, The Open Group OSDU™ Forum are developing a standard data platform to reduce silos and put data at the heart of the subsurface community to foster innovation. With the OSDU™ Data Platform, organizations can decouple data from apps and store trusted data unlocking end-to-end workflows.

Eliis is a member of The Open Group OSDU™ Forum since 2020 with the objective to frame PaleoScan™'s evolution to meet to new data standards. The first step of this journey is to guarantee that data can be accessed and delivered directly to PaleoScan™ from the OSDU™ Data Platform using Bluware FAST™ adaptive streaming technology.



bluware

Bluware VDS™ is a powerful and flexible storage format for signal data and it has been recognized as the standard of the OSDU™ Data Platform for **seismic storage and exchange**. This format can be stored in two forms including file based and cloud-based object store. It allows you to compress raw and interpreted volumes of seismic data sets. The user can make trade-offs between storage-space and performance based on different compression modes and qualities that can be applied to the signal data, providing a way to make **significant savings in storage space**.

Streaming, rather than copying data, removes local storage needs on traditional file systems and eliminates additional storage costs specific to the import-based workflow. It also centralizes data access and decreases seismic interpretation time cycle by reducing the effort required for data transfer and management. In addition, the object storage system is designed to compress and handle massive libraries of data in an affordable and highly scalable way.

The PaleoScan™ conformance journey with OSDU™ Data Platform will follow these steps:

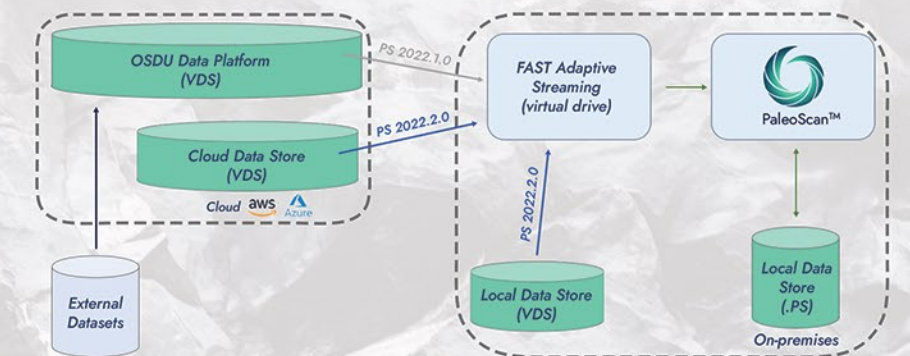
- Phase 1: Embedding Bluware FAST™ adaptive streaming technology into PaleoScan™ - available.

The integration of **Bluware FAST™** into PaleoScan™ enables the ability to store seismic data in VDS format and stream it from the cloud, leveraging cost-efficient, and highly scalable object storage (AWS S3 or Microsoft Azure BLOB store) to store raw seismic files. Bluware FAST™ acts as a translator between VDS and the read requests made by PaleoScan™. It transcodes from VDS to PaleoScan™ format on-the-fly and stores PaleoScan™ volumes into a virtual drive.

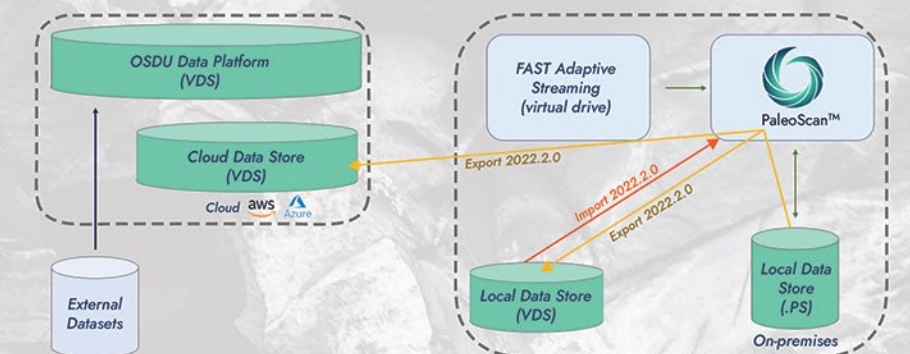
- Phase 2: Import/Export of VDS from PaleoScan™ projects - available.

- Phase 3: PaleoScan™ reads & writes VDS™ natively to boost overall performance to drastically reduce interpretation time cycle and fit to data standardization & centralization requirements of the energy industry.

PaleoScan™ 2022.2: VDS Streaming Workflow



PaleoScan™ 2022.2: VDS Import / Export



PALEOSCAN™ 2023

Core Application

Platform

Multi 2D and 3D SEG Y import
3D VDS Import/Export
3D VDS Streaming via FAST™
Faults, horizons, wells and culture data I/O
Data exchange between PaleoScan™ projects
Sessions management
2D & 3D viewer
Volumes blending viewer
Seismic 3D cube visualization
Volume sculpting
Volume stretch, squeeze and rotation
Shapefile management
Point location saving/editing
Geotiff management - Coordinate editor
Volumes orientation
Volumes extraction
Volumes merging
Coordinate reference system management
Unit conversion (feet, meter...)
License timeout
Interactive user guidance

3D Interpretation

3D Model-Grid creation
External Horizon constraint
Model-Grid between horizons and/or Z values
Semi-automatic horizon interpretation
Interactive Model-Grid refinement with attribute mapping
Interpretation along arbitrary lines
Smart auto-trackers for manual horizons picking
Horizons propagation and interpolation

2D Interpretation

2D Model-Grid auto-interpretation between lines
External Horizon constraint
2D Model-Grid creation
2D RGT Model computation
Multi 2D lines interpretation
2D environment
Misties correction with dynamic shift
Horizons creation from multi 2D lines
Pseudo-3D RGT Model computation

3D RGT Model

RGT Model from Model-Grid
RGT Model from marked horizons
RGT Model from horizon stack
RGT Model from external horizons
RGT Model 3D Multi-Z

Cross Plot & Classification

Cross plots from volumes, horizons
Cross plots from well logs
Manual and automatic classification (SOM, K-Means)
Regression curves
Retro-mapping and geobodies extraction
Facies volume creation

Geobodies

Geobody modeling
Geobody isochore
Geobody volumetrics
Geobody classification

Faults

Fault plane attribute
Automated fault extraction
Fault dip and azimuth filtering
Fault size filtering
Fault splitting and merging
Fault merging assistant
Fault plane extrapolation
Fault cutting
Seismic ghost

Horizons

Horizon stack creation
Horizon shifting
Horizon merging
Horizon picking along arbitrary lines
Horizon and horizon stack extraction
Horizon lightening
Isochore computation
GRV computation «using 2 threshold»
Horizon extraction using faults polygon
Horizon stack blending viewer
Horizon stack from horizons

Flattening

Horizon flattening
Dynamic flattening from horizon stack
Log viewer flattening
Interpretation flattening

Multi-Z

Multi-Z object picking for 2D and 3D
Multi-Z object editing
Multi-Z smoothing

Attributes

Seismic attributes
Spectral decomposition
Structure oriented smoothing
2D attributes
3D model attributes computation
Real time attributes
Deterministic inversion - New algorithm
Surface real time attributes
Spectral blueing
Colored inversion
Calculator (volumes, horizons, wells, 2D lines)
Volume despiking
AVO post-stack attributes
Extended elastic impedance workflow

Well correlation

Wellheads manager
Well set creation
Log viewer
Well markers picking
Well markers management and display
Flattening from well markers
Well markers QC table
Well trajectory picking
Arbitrary line picking
Arbitrary line creation along wells

Add-On Modules

Advanced Interpretation

Sequence Stratigraphy

Sequence creation
Real time wheeler diagram
Sequence along arbitrary lines
Sequence extraction:
- Layers
- Horizons
- Horizons stack
- Isochore
Isochore real time

Color Blending

Volume
Arbitrary line
Horizon stack
Horizon
Color blended volumes export

Automatic Geobody Extraction

Geobody extraction from attributes
Split / merge
Geobody volume computation
Geobody isochore computation

Unconformities Management

Horizons truncations
Terminations selection
Stratigraphic closures

Watertight Model

Horizons / faults
Fault polygons
Allan diagram

Static Geological Model

Corner point grid generation
Stair stepped faults
Seismic facies modeling
Export in Eclipse format
Export in RESQML format

Time-Depth

Seismic-Well Tie

Sonic calibration
Well tie processing
Log depth adjustment
Wavelet creation:
- Analytic
- Statistical
- Deterministic

Velocity Modeling

Layers definition from model
Interval, average, RMS and Dix velocities
Use interval velocities from wells

Domain Conversion

Real time conversion
Domain display
- Real time cross navigation

Object saving in depth domain :
- Volumes
- Horizons
- Faults

Property Modeling

Well rock property propagation:
- Inverse distance
- Kriging
- Co-kriging

Waveform Classification

Python API

Write and execute Python code in PaleoScan™ :
- Custom seismic attributes
- Custom user interfaces and tools
- Call external code and libraries
- Integration of existing Python libraries (SciPy, NumPy)
- Manipulate main PaleoScan™ objects

Data Connectors

Petrel®*

Faults
Horizons
Volumes
Wells
Culture Data
Geobodies - Layers - Multi-Z
2D Lines

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OpenWorks®**

3D Volumes
Faults
Horizons
Wells
Well markers
Well set

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