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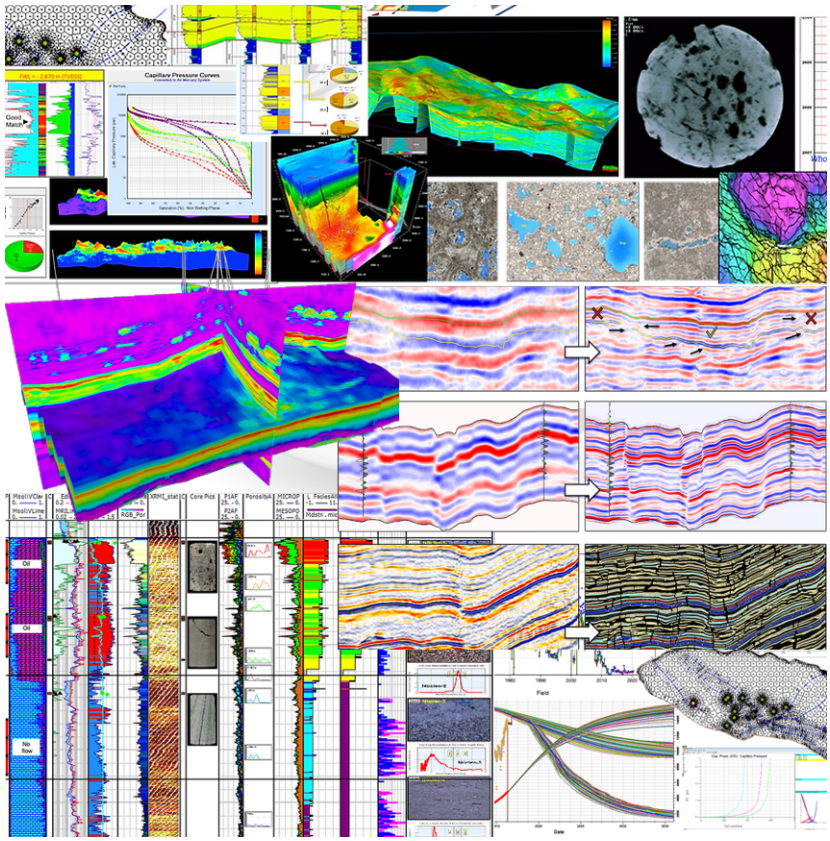
CAYROS

ADVANCED PETROPHYSICAL SERVICES

2022



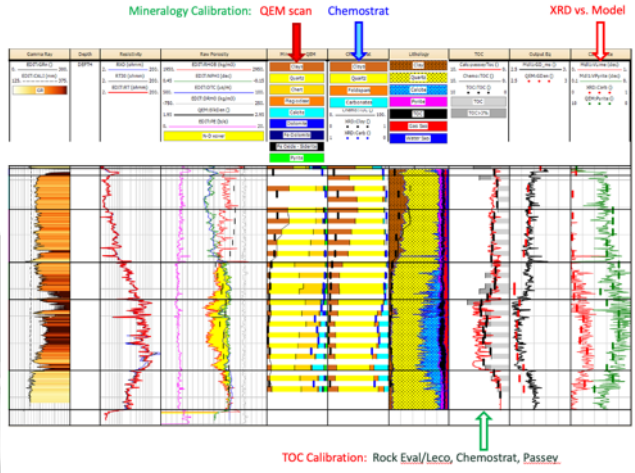
ADVANCED PETROPHYSICAL SERVICES

CAYROS group has developed the expertise to help E&P companies better understand their reservoirs, make better decisions faster, and implement customized, innovative workflows combined with an extraordinary set of sophisticated tools and technologies for cost-effective formation evaluation and advanced petrophysical services.

Depending on the complexity of the reservoirs and final goals of our clients, we customize our workflow to your needs. Whether it's applying deterministic and probabilistic techniques in complex mineralogy shaly sands, carbonates, tight reservoirs, shale gas, shale oil, CBM, fractured reservoirs, oil sands or something else, we have the experience you need to succeed.

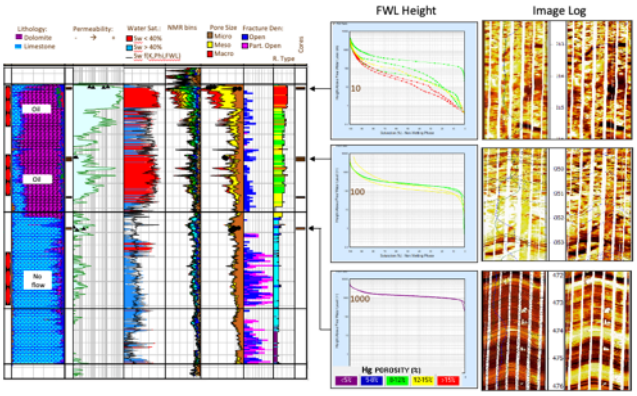
UNCONVENTIONAL AND ORGANIC RICH RESERVOIRS

Over the past decade, CAYROS has built a significant expertise in the characterization of unconventional resources.
Organic matter characterization, maturity, adsorption, intra-TOC porosity, porosity, HC saturation, mineralogy, chemostratigraphy, permeability, mechanical and seismic rock properties are evaluated using all the available data from core, cuttings, logs, drilling parameters, etc.



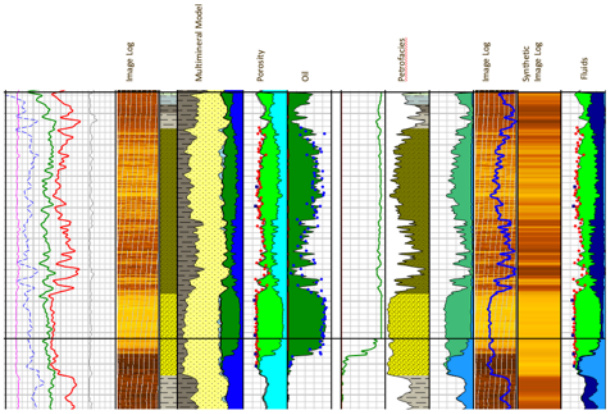
FRACTURED CARBONATES

Complex porosity architectures and mineralogy, combined with natural fractures make the characterization of these reservoirs a challenging task.
Our experienced petrophysicists have work in some of the largest fractured carbonates fields in the world.



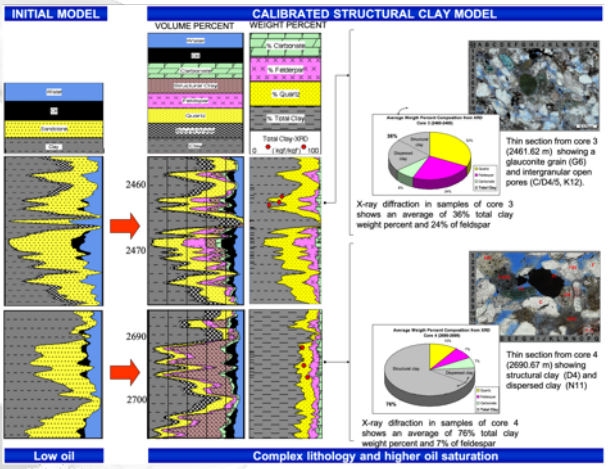
OIL SANDS

Bitumen / Oil Sands can be very complex with rapid lateral and vertical variations in both facies and fluids. Some of the challenges in their characterization include: Facies variation, formation water salinity variation, Top water, Gas, Lean zones, etc.
SAGD technology is used to produce these formations, and it relies on steam chamber growth within the reservoir, which is affected by the variability in the fluid and rock properties.



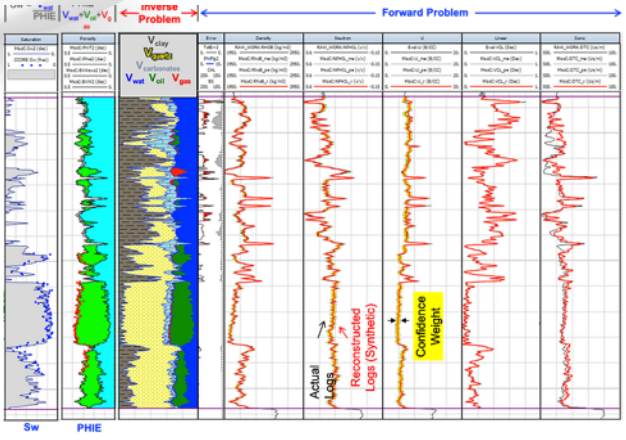
LOW RESISTIVITY / LOW CONTRAST RESERVOIRS

Reservoirs with very complex lithology, especially high content of structural clay, as well as high salinity of formation water affect the log readings, causing these formations to show high radioactivity and low resistivity, which in turn, makes their identification and evaluation difficult. In other cases, is the presence of metallic minerals that affect log readings.



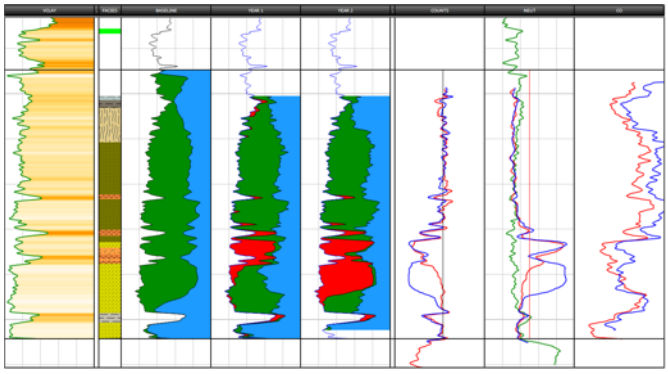
MULTIMINERAL PROBABILISTIC MODELS FOR COMPLEX LITHOLOGY

Deterministic petrophysical workflows have been applied successfully for decades in many reservoirs. Applying these workflows in formations with complex mineralogy has been challenging because traditional models / concepts are not always applicable.
Multimineral probabilistic models offer an alternative to overcome these problems in reservoirs with complex lithology.



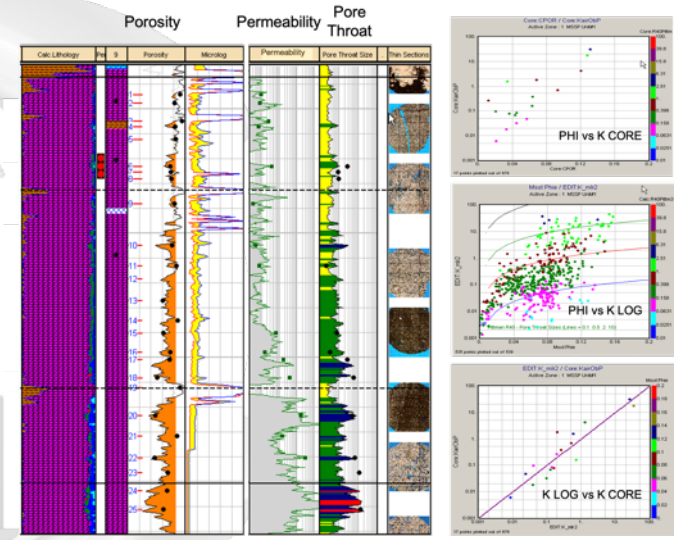
CASED-HOLE WELL LOG ANALYSIS

CAYROS has developed an in-house user program in two different platforms for the analysis and interpretation of pulsed neutron logging (PNL) tools to help our client monitoring steam chamber growth, sweep efficiencies, and residual oil saturations as part of their reservoir surveillance program for Oil Sands reservoirs. Our solution seamlessly integrates open-hole baseline interpretation.



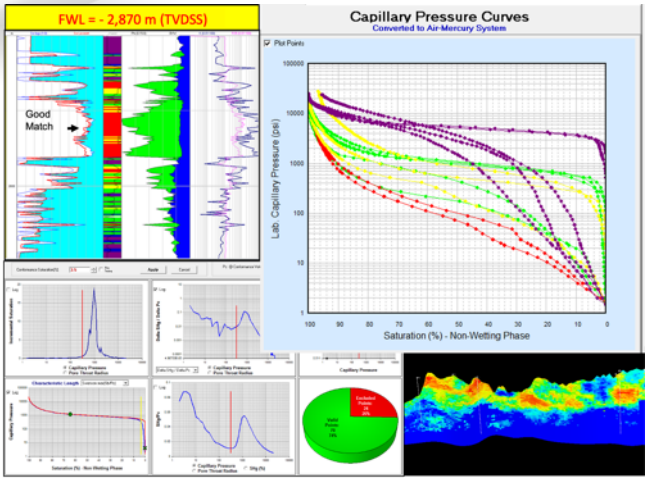
PERMEABILITY AND SECONDARY POROSITY MODELLING

We use several techniques to build working permeability-predicting models. When available we combine core / drilling cuttings measurements with log measurements to calibrate prediction.
We also characterize secondary porosity and permeability in naturally fractured reservoirs by integrating not only all the static available data, but also dynamic measurements.



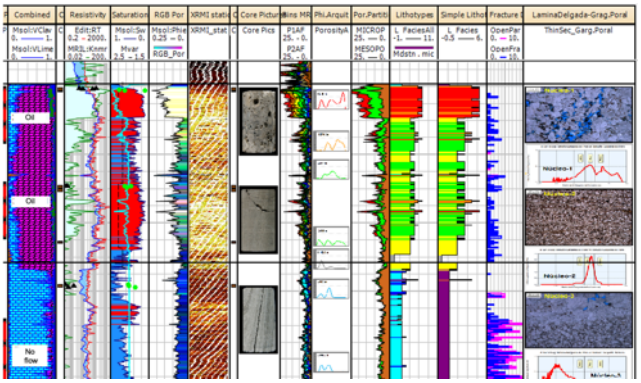
SATURATION HEIGHT MODELLING

In addition to commercial tools, we developed a proprietary software for capillary pressure data correction, validation, and analysis. It allows to perform conformance corrections, conversions, rock typing, saturation height modelling and permeability calculation from Pc.
Our saturation height modelling can be based on capillary pressure data (when available) or theoretical models using log interpretation.



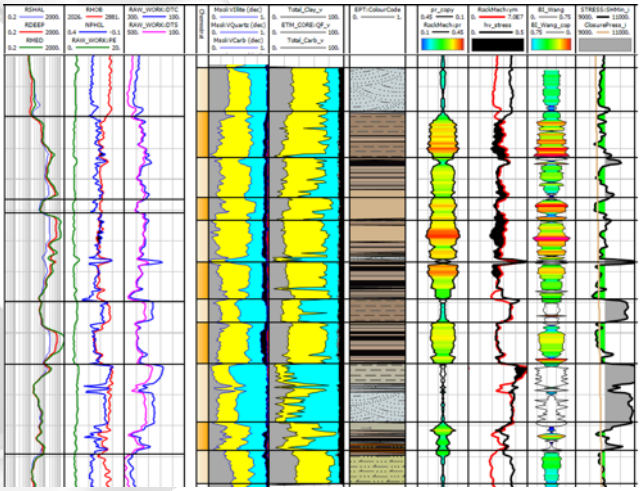
ROCK TYPING | PETROFACIES | LITHOTYPES | FLOW UNITS

By integrating geological data, core and drilling cutting measurements and descriptions with log data, we use different techniques to define rock types / petrofacies /flow units that allow us to better predict permeability and other properties. We correlate results to seismic facies to populate geocellular models.



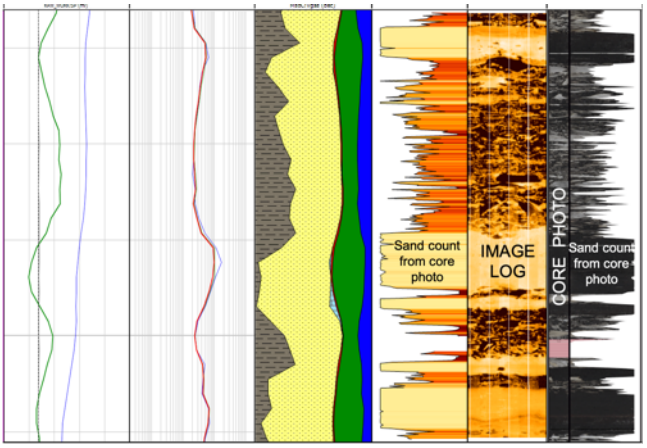
GEOMECHANICS & SEISMIC ROCK PROPERTIES

Compressional / shear sonic and density logs are used to calculate elastic properties: Poisson's ratio, Young's modulus, bulk modulus, shear modulus, vertical Biot's factor. (Core calibrated if available).
As part of our workflow we compute brittleness, rock strength (UCS), HV stress, SH min and seismic rock properties like Acoustic Impedance, VpVs, and LMR.



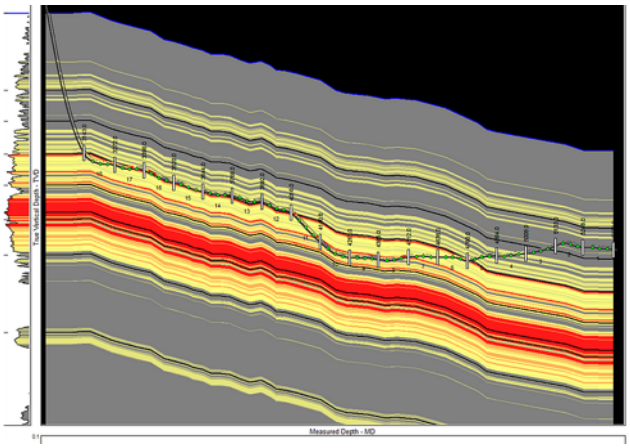
CORE PHOTO / IMAGE LOG SPECIAL PROCESSING

We have developed a tool for obtaining quantitative data from images. Our Computer Vision Technique (CVT) generates an image-based new set of logs (intensity and morphology) that can be used for quantifying Net to gross in heterolithic deposits, definition of fluid contacts, facies prediction, rock typing, and accurate core depth matching



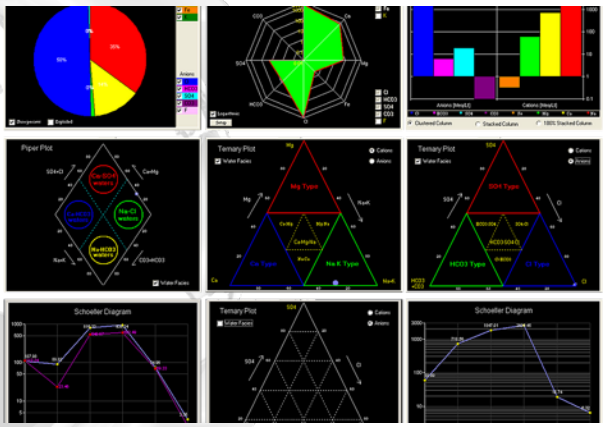
HORIZONTAL WELL RESTEERING INTERPRETATION

Re-steering interpretation to accurate position horizontal wells within a reservoir to better understand well productivity, assess the geology or drilling parameters, generate synthetic logs, properly include well in a 3D geological or simulation model.



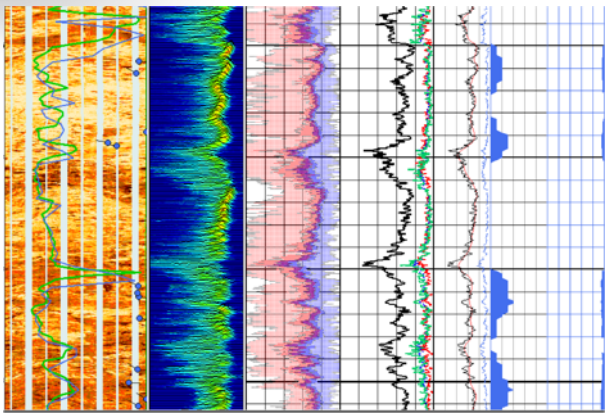
ADVANCED FORMATION WATER CHARACTERIZATION

Formation water is usually considered an undesirable by product of Hydrocarbon production. However, analysis of that same water can provide critical information for the reservoir characterization and field development plan. For example, connate water salinity and divalents are critical to chemical EOR processes for both surfactants and polymers.



BOREHOLE GEOLOGY

- Image processing (supporting all wireline imaging tools in vertical and horizontal wells) including EMI, FMI, OBMI, FMS, Earth Imager, XRMI, UBI, CBIL, STAR, RAB, ARI, OBMI and Quanta Geo
- Interpretation services focused on bedding, sedimentary dips, faults, natural fractures and stress



- Sedimentological analysis (determination of paleocurrent direction)

- Support on field studies using core and image integration for reservoir characterization
- Facies and fracture characterization in horizontal wells for improved completions design
- Porotex analysis (especially useful in carbonates to generate secondary porosity calculation)
- Lamination analysis to extract different scales of layering in to conventional and unconventional reservoirs

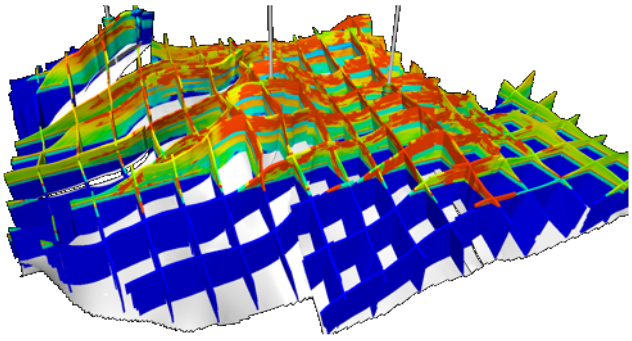
Depending on the project objectives, available data, type of reservoirs and other criteria, we offer customized workflows in conventional and unconventional reservoirs to meet and exceed our clients' expectations.

We help our clients design the correct project and workflow for their assets, and we firmly understand that integrating and honouring all the available data and disciplines is critical.

We are experts in validating, correcting, and integrating core analysis data. This is critical, because in many reservoirs (especially unconventional ones) complex mineralogy and organic content results in variable matrix density, which can compromise log porosity estimates. In addition, matrix permeability calculations, log-based rock mechanical properties, and hydrocarbon saturation calculations can be highly inaccurate unless calibrated with core data.

3D PROPERTIES POPULATION & GEOLOGICAL MODELLING

In addition to the petrophysical consulting services, we provide a wide range of geological and geophysical services, including 3D modelling and population of the petrophysical properties.



RECENT EXPERIENCE

In the table below are listed some of our recent projects involving petrophysical characterizations:

Company	Type	Description
Cenovus Energy - Canada	Bitumen/Oil Sands	Probabilistic Multimineral characterization for several fields with hundreds or thousands of wells each.
Obsidian Energy - Canada	Light oil clastic reservoirs	Probabilistic Multimineral characterization for several fields with hundreds of wells each.
Tamarack Valley Energy-Canada	Clastics / Carbonates / unconventional reservoirs	Petrophysical characterization for several fields / formations.
Deloitte - USA	Clastic reservoirs	Petrophysical characterization and technical support in different locations around the world
Pemex E&P - Mexico	Light oil in different types of Carbonates / Heavy oil clastic reservoirs	Probabilistic Multimineral characterization for several offshore and onshore fields
Torc Oil & Gas - Canada	Clastics / Carbonates / unconventional reservoirs	Petrophysical characterization for several fields / formations.
CC Energy Development - Oman	Fractured Carbonates	Petrophysical characterization for several fields / formations.

SOME CLIENT STATEMENTS

John McKinley

Sr. Geologist Oil Sands Resource Development

CENOVUS ENERGY | CANADA

"During the past two years the support and technical expertise we have received from CAYROS has been outstanding. Our team had a unique problem and a vision of what we wanted, CAYROS was able to bring this to fruition. We appreciate the attention to detail, creative approach, and the level of collaboration provided to ensure the project was completed beyond our expectations."

Scott Reimond

V.P. Exploration

TAMARACK VALLEY ENERGY | CANADA

"CAYROS has consistently provided Tamarack Valley a high-quality product. They have utilized their experience and expertise to develop customized workflows to apply to both our conventional and unconventional reservoirs. The service they provide has exceeded all our expectations, starting with the initial consultation, collaboration with the team, project management, data analyses, and final reports."

Warren Agena

Geophysicist & Advisory Team Lead

UKRAINE

"In working with our Ukrainian counterparts, our advisory team has relied heavily on the petrophysical interpretations from CAYROS, in our assessment of multiple gas field prospects. Their specialists, often working with challenging and problematic data, provided our team with detailed and timely interpretations of high quality which I sincerely feel helped us gain the respect of our counterparts. Moreover, the expertise and mentoring provided by CAYROS have helped us maintain a good working relationship with the organizations with whom we are collaborating."

Danya Tesarski

Manager, Development

OBSIDIAN ENERGY | CANADA

"CAYROS provides highly technical and professional resources that work with our development group to build practical geological models and reservoir simulations. The resulting models have met the goal of supplementing our ability to understand reservoir risk. The process of creating the models with the CAYROS team has led to enlightening discussions about fluid movement and reservoir characterization, and I am pleased with the value that CAYROS adds."

O. Travis Shackleton

Manager, Geological Optimization & Lloyd Thermal

CENOVUS ENERGY | CANADA

"The CAYROS Group is excellent; technical, openminded, timely, well-organized and most importantly extremely personable. Our company had a goal to unravel a complex reservoir properties issue we had been facing for several years. We reached-out to CAYROS who worked with us to understand our needs, objectives and to develop a solution that not only exceeded our expectations but has also built our own internal competency along the way."

Rafael Romero Peñaloza

Reservoir Characterization Superintendent

PEMEX E&P | MEXICO

"The gather conditioning, simultaneous seismic inversion, and generation of petrophysical properties pseudo-attributes carried out by CAYROS in the Wakax area of the Abkatun field, generated great value and increased the certainty in the original volume estimate."

RMNE Study Center, Cantarell Project and Extra Heavy Crudes

PEMEX E&P | MEXICO

"CAYROS provided great value in defining the pressure maintenance exploitation strategy in extra heavy oil fields with fast response times. CAYROS implemented the FEL methodology and a specialized technology that made it possible to generate and eco- nomically evaluate all feasible scenarios with risk assessments and a mitigation plan."

For more information please check www.cayrosgroup.com or contact us at:

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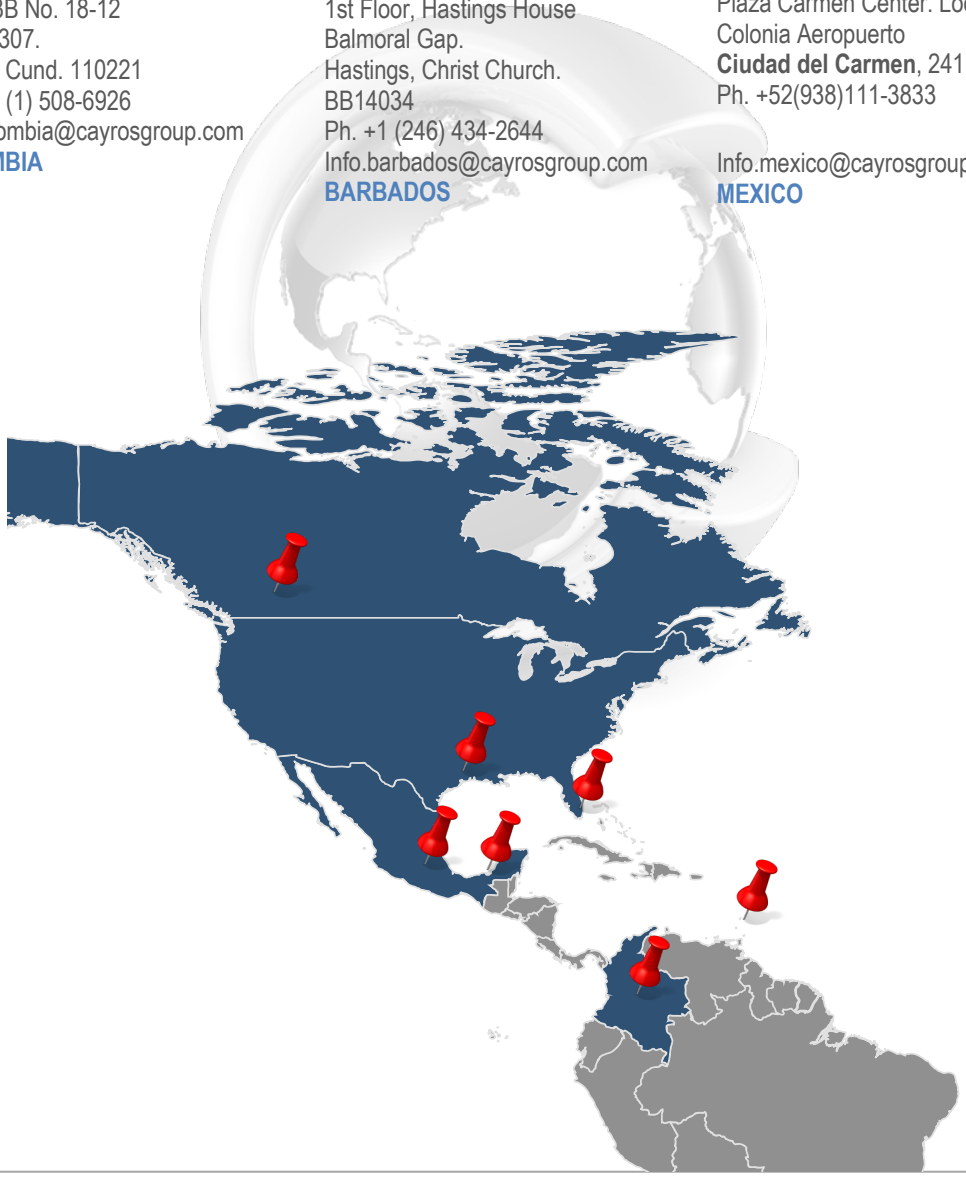

Geology & Geophysics

- Sequence Stratigraphy Analysis & Seismic Stratigraphy
- Sedimentology and Depositional environment interpretation for clastics and carbonates reservoirs
- Detailed Core Analysis & Description
- Bioestratigraphic and Petrographic Analysis.
- Structural Evaluation & Modeling
- Facies modeling and stochastic rock properties distribution.
- 3D Geological Modeling
- Basin Modeling
- Seismic Geometric Decomposition
- Advanced Seismic Interpretation
- Seismic Attribute generation & Interpretation
- Velocity Modeling & Depth Conversion
- Multicomponent Seismic Inversion & AVO Modeling
- 3D/3C Seismic Inversion
- Seismic Attributes & Petrophysics Data Integration

Petrophysics

- Advanced petrophysical Characterization in conventional and unconventional reservoirs (complex mineralogy, fractured Carbonates, tight reservoirs, shale gas, shale oil, CBM, etc.)
- Resource and reserve estimation
- Rock typing, petrofacies and lithotypes classification. Flow units definition.
- Permeability and Porosity architecture characterization.
- Saturation Height Modeling
- Rock physics characterization
- Advanced core data analysis and integration.
- Formation water characterization
- Seismic rock properties

Field Development Planning, Economic & Risk Analysis

- Lifecycle financial assessments for multiple field development scenarios
- Project Risk Analysis
- Front-End-Loading (FEL) Projects
- Field Development Planning
- Concept Design and Project Feasibility

Facility and Process Engineering

- Process design, evaluation and optimization (Energy and Material balance)
- Process simulation and flow assurance
- Steady-state multiphase flow modeling in oil and gas networks and pipeline systems
- Pipe line network analysis
- Conceptual Facility Design
- Process Equipment analysis (separation, compression, etc.)
- Hydrocarbon mix characterization

Reservoir and Production Engineering

- Numerical Reservoir simulation
- Reservoir Surveillance (advanced PTA - RTA)
- Enhanced Productivity Projects
- Production Log analysis
- Advanced Reservoir Engineering
- Design & analysis of Hydraulic Fracturing results
- Production & Artificial Lift Optimization
- Material Balance Analysis
- Well test Analysis
- Enhanced Oil Recovery -EOR studies

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