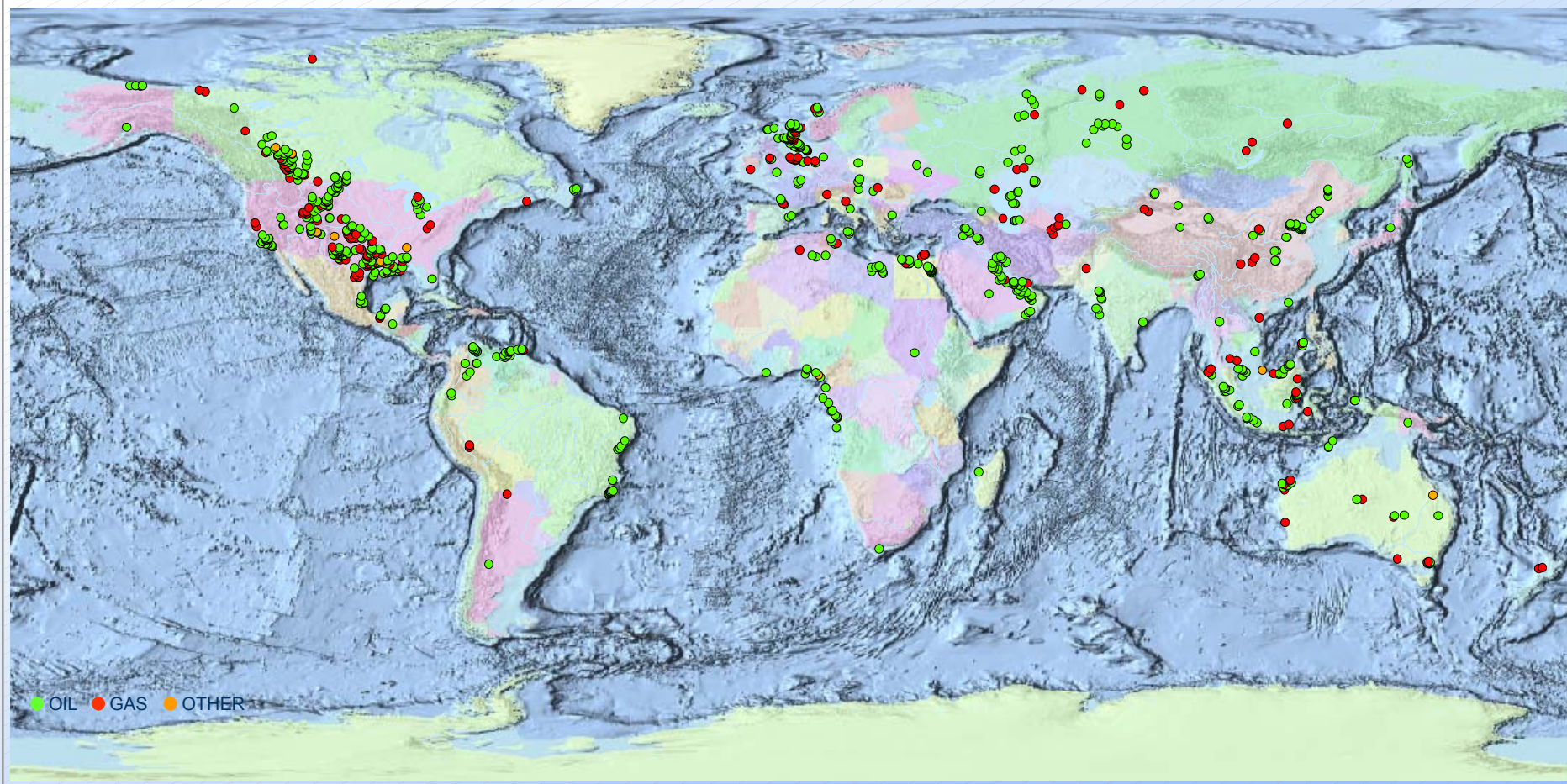


DIGITAL ANALOGS™ Knowledge System

The Premier Source of Global Field/Reservoir Analogs For Upstream E&P Industry



Greater Knowledge. Better Decisions.

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C&CReservoirs

DIGITAL ANALOGS™ Knowledge System

Version 5.0

Introduction

The **DIGITAL ANALOGS™** Knowledge System provides a platform for E&P geoscientists and engineers to easily, quickly and affordably access data, information and analysis on nearly a thousand of the world's most important fields and reservoirs. With the **DIGITAL ANALOGS** Knowledge System from C&C Reservoirs, geoscientists and reservoir engineers have a way to improve operational efficiency and reduce their E&P risks. DIGITAL ANALOGS gives them a worldwide set of objective information available at the click of a mouse for each decision-making process in the E&P workflow.

Most geoscientists and reservoir engineers have full and detailed knowledge of a relatively small number of oil and gas fields. When appraising prospects or new discoveries, devising development plans, assessing reservoir management strategies or undertaking economic evaluations, oil and gas professionals initially draw upon their own specific knowledge and experiences to help guide their decision-making.

The **DIGITAL ANALOGS** Knowledge System extends the experience of your geoscience professionals by providing detailed field/reservoir evaluation reports and geologic and reservoir engineering data on nearly a thousand of the world's key fields and reservoirs. It presents a re-interpretation, verification and synthesis of available data using modern concepts and techniques achieved through rigorous analysis and standardization processes. The system provides instant access to nearly every basin and play type around the world and can help you generate lower-risk prospects and quickly identify optimum field development strategies—all at the click of a mouse.

The **DIGITAL ANALOGS** Knowledge System is a powerful Web-based software application and database with four components:

Reservoir Evaluation Reports in Acrobat PDF Format

- ~820 important oil and gas fields
- >640 clastic and >340 carbonate reservoirs
- >20,000 graphics
- >15,000 literature references

Relational Database with Standardized Field and Reservoir Parameters

- >50 parameters for field information
- >170 parameters for reservoir information
- >200,000 data points

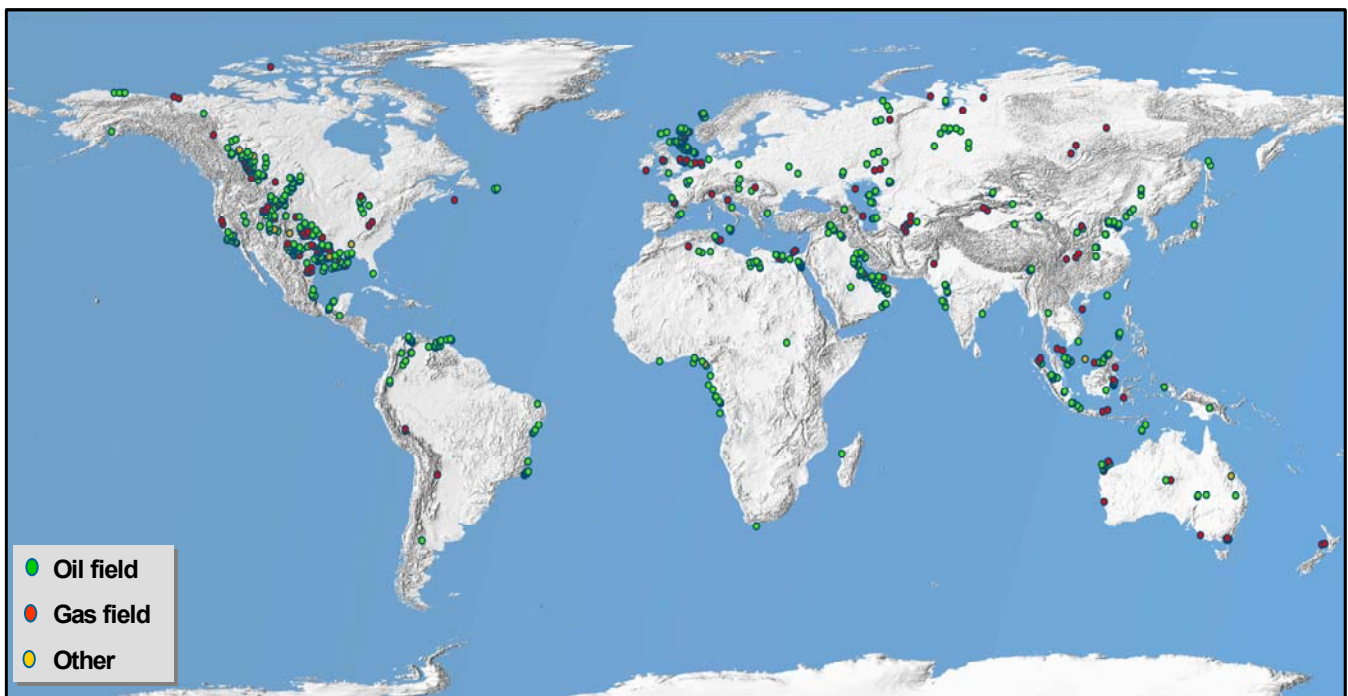
E&P Synthesis Reports

- Carbonate Reservoirs
- Clastic Reservoirs
- Fractured Reservoirs

Web-based Knowledge Platform with Powerful Searching and Analyzing Capabilities

- Menu-driven multi-criteria and graphic search engine
- World Map and GIS Map search features for quick field report access
- Keyword search through the database and field reports
- Map View function for selected fields with hotlinks to field reports
- Seamless export of reservoir parameters to Microsoft™ Excel
- Customizable histograms for 110 reservoir parameters
- Cross-plot of user-selected reservoir parameters
- Sub-search capability on all reservoir parameter histograms

The locations of nearly 820 fields and 1010 reservoirs worldwide in **DIGITAL ANALOGS** Knowledge System are shown in the following figure.



Reservoir Evaluation Report

C&C Reservoirs has invested more than 100 man-years in developing detailed reservoir evaluation reports with geologic and reservoir-engineering data on nearly a thousand of the world's most important fields and reservoirs. The reports capture E&P knowledge from a large number of giant fields to provide a predictive tool for exploration, asset acquisition and field development.

All reservoir evaluation reports are structured in a standardized format that covers exploration history, basin evolution and petroleum systems, structure, trap mechanism, stratigraphy, depositional facies, reservoir architecture, rock and fluid properties, development strategies, reserves and production, recovery mechanism, reservoir management and improved recovery techniques. Special emphasis is placed on identifying and understanding the key geologic and engineering factors that contribute to exploration success and control reservoir performance and recovery efficiency.

The following is a generalized format outline for individual reservoir evaluation reports:

| Summary Text | Illustrations | Table of Field Parameters |
|-----------------------------------|---------------------------|----------------------------------|
| Executive summary | Maps | General |
| Exploration history | Cross sections | Trap |
| Basin evolution/petroleum systems | Seismic profiles | Reservoir |
| Structural /trap definition | Stratigraphic columns | Source |
| Stratigraphy/depositional facies | Composite type logs | Seal |
| Reservoir architecture/properties | Crossplots | Reserves and production |
| Production engineering analysis | Photographs | Field characteristics |
| Key references | Production history curves | Completion practices |

The reservoir evaluation reports are currently available for the following reservoir types:

- Carbonate Reservoirs (>340 reservoirs)
- Clastic Reservoirs (>640 reservoirs)
- Fractured Reservoirs (>240 reservoirs)
- Deepwater Reservoirs (>160 reservoirs)

The reservoir evaluation reports cover the following regions worldwide:

- U.S./Canada (>280 fields)
- Latin America (>70 fields)
- Europe/Former Soviet Union (>180 fields)
- Africa/Middle East (>110 fields)
- Far East (>160 fields)

Relational Database

The geologic and reservoir engineering data in the original field-specific reservoir evaluation reports have been standardized, updated and incorporated into the **C&C Reservoirs DIGITAL ANALOGS** Relational Database Management System.

The relational database model consists of two subsystems: a Field Information Subsystem with more than 50 parameters, and a Reservoir Information Subsystem with more than 170 parameters. The parameters in both subsystems are defined using standard industry terminology, and the units of measurement are provided.

In addition, the **C&C Reservoirs** Relational Database incorporates a comprehensive classification scheme for depositional systems, environmental types, basin types, structural settings, trapping mechanisms and fractured reservoir types.

- Field Information Subsystem with >50 parameters in three categories:
 - Field general (location, operator, etc.)
 - Field reserves
 - Field production

- Reservoir Information Subsystem with >170 parameters in seven categories:
 - General
 - Trap
 - Reservoir
 - Source and seal
 - Reserves and production
 - Hydrocarbon composition
 - Engineering and recovery

E&P Synthesis

E&P Synthesis is a very powerful component of the **DIGITAL ANALOGS** Knowledge System. **C&C Reservoirs** has invested more than 20 man-years of development in synthesizing data and information into knowledge needed by exploration and production geologists and reservoir engineers. Each E&P Synthesis report categorizes and analyzes the world's giant fields according to play type, reservoir and fluid characteristics, recovery mechanisms and various engineering attributes.

These reports emphasize the distinctions among different play types and their exploration implications. Important exploration and production lessons learned are documented for individual play and reservoir types, and an understanding of the various controls on reservoir performance and recovery efficiency is presented.

Elements of the E&P Synthesis reports are listed below.

Exploration Considerations

- Exploration History/Play Concepts
- Tectonic Setting
- Reservoir Distribution and External Geometry
- Depositional Facies and Reservoir Architecture
- Diagenesis and Reservoir Quality
- Source Rock Characteristics
- Trapping Configuration
- Approaches and Strategies

Production Considerations

- Overview and Summary Statistics
- Reservoir Quality and Heterogeneity
- Reservoir Performance/EOR Techniques under Different Drive Conditions
- Controls on Recovery Efficiency
- Reservoir Management Strategies

Reservoir Categories

- Carbonate Reservoirs
- Clastic Reservoirs
- Fractured Reservoirs

Knowledge Platform

Knowledge Platform quickly and accurately finds the right analogs whenever and wherever users have access to the Internet/intranet. The robust search engine allows users to find the knowledge, information and data of analog reservoirs and fields by defining a wide range of criteria. The new and enhanced analytical tools enable users to carry out interactive sub-searches and perform various statistical analyses. The system is very easy to use, and the basic skills required to search and analyze results can be mastered in 10 minutes.

The software includes the following features:

- Web-based graphical user interface (GUI)
- A powerful menu-driven query builder that allows user-defined, multi-criteria searches with general-to-specific querying at both the field and reservoir levels
- Quick search with graphic parameter selection
- Intuitive WorldMap with hotlinks to the field evaluation reports
- Web-based GIS map display and search capability
- Keyword search function allowing the user to search through the entire system including each reservoir evaluation report
- Tabular display of search results where the reservoir evaluation reports, location map, production curve and statistical tools can be accessed.

- Map View of the search result with hotlinks to the reservoir evaluation reports
- Search result data export to Microsoft® Excel file format for selected reservoir parameters
- 110 Customized Histograms with clickable sub-search capability
- User definable Cross Plot for reservoir parameters with color coded data categories
- Query History “save / retrieve” and “import / export” functions
- Seamless access to E&P Synthesis
- Seamless access to E&P Treatise

Applications of **DIGITAL ANALOGS** Knowledge System

The **DIGITAL ANALOGS** Knowledge System allows users to acquire critical knowledge, information and data for their E&P decisions in exploration, development and production. Its interactive knowledge platform allows users to retrieve the field and reservoir analog reports that they need, through the powerful and easy-to-use menu-driven, multi-criteria search engine and graphic searching capability. Application of the **DIGITAL ANALOGS** Knowledge System means risk reduction in exploration and production. The following summarizes some of the key applications:

Generating New Exploration Ideas

“We usually find oil in new places with old ideas. Sometimes, also, we find oil in an old place with a new idea, but we seldom find much oil in an old place with an old idea” (Dickey, P.A., 1958, *Tulsa Geological Society Digest*, v. 26, p. 84).

Using subsurface geological analogs is a simple yet powerful and cost-effective technique for generating new exploration ideas in both frontier and mature basins. Even though no two traps are ever identical, their key elements are comparable within and between basins, and may be assessed from knowledge obtained in successful or failed exploration ventures worldwide. The **DIGITAL ANALOGS** Knowledge System provides the most efficient platform and diverse field and reservoir analogs for users to develop new ideas and apply established ideas in new places.

Reservoir and field analogs from the **DIGITAL ANALOGS** Knowledge System can be used to develop and calibrate ideas before acquiring expensive data in a new exploration area. By using the **DIGITAL ANALOGS** Knowledge System, a comprehensive understanding of the regional geology, petroleum system, trapping mechanisms, reservoir characteristics, and key production and engineering issues can be obtained instantly for the new area. Having rapidly attained an overall understanding of the new area’s petroleum system, a user can quickly cast a global net to find field/reservoir analogs that share a similar geologic context and represent exploration ideas/plays that have not yet been applied to the area of interest. By using the **DIGITAL ANALOGS** Knowledge System, a range of analogous play concepts, trap types, reservoir targets, key controlling parameters and potential risk factors become immediately available. Such information and knowledge can be applied to generate new exploration ideas.

In areas where ideas have been exhausted, the **DIGITAL ANALOGS** Knowledge System can be used to search for prospects and play ideas that have not been tested. The application of successful play analogs can guide explorationists in revitalizing old areas by applying new thinking.

Mature basins may contain horizons previously ignored because of high exploration risks or prohibitive costs. Through use of the **DIGITAL ANALOGS** Knowledge System, a quick comparison with analogs in similar geologic settings can help convert these bypassed zones into exploration opportunities.

Reserve Estimate for Exploration Prospects

Geoscientists need a confident basis for various parameters required for reserve estimate of exploration prospects. In areas where data are sparse, such reserve estimation becomes challenging. However, by interrogating the **DIGITAL ANALOGS** Knowledge System, a user can quickly acquire a range of parameters for specific types of prospects around the world. Through comparing and searching the wide range of reservoir parameters in the **DIGITAL ANALOGS** Knowledge System, a user can quickly obtain the distribution of those parameters that are commonly used for reserve estimate:

- Trap type, vertical closure, field area and associated hydrocarbon column height
- Reservoir depositional environment and associated lithology, reservoir thickness, net/gross ratio, porosity and permeability, and water saturation
- Fluid type, gas/oil ratio, formation volume factor and recovery factors
- Typical reserve size distribution

These parameters can help explorationists reduce risk in reserve estimation and calibrate their prospects against global reality. Any anomaly in reserve estimation can be easily identified and highlighted for further analysis and justification.

Exploration Risk Reduction

The **DIGITAL ANALOGS** Knowledge System provides a large number of examples with extensive coverage of geologic and engineering parameters that can be applied in the assessment of risks. These parameters can be compared and contrasted with respect to particular types of basins, source rocks, fluids, traps, seals and reservoirs. The distribution of those parameters gives users an insight into the implied risk of specific aspects of a prospect. Distribution of geologic and engineering parameters can be easily obtained using the interactive Histogram and Cross-plot tools of the **DIGITAL ANALOGS** Knowledge System.

Exploration Portfolio Calibration and Normalization

The extensive coverage of subsurface analogs in the **DIGITAL ANALOGS** Knowledge System allows users to compare successful cases against prospects in their exploration portfolio. This comparison enables users to recognize and reduce potential interpretation bias on a number of prospect parameters, such as play type in certain geological settings, hydrocarbon column for certain trap types, net/gross ratio for specific types of depositional environment, recoverable reserves and recovery factors for certain types of reservoir and fluid properties, and the risks associated with source rock, trap, sealing and reservoir. The **DIGITAL ANALOGS** Knowledge System provides an internally consistent classification system and real analog cases that users can access to standardize and optimize their prospect evaluation and exploration portfolio management.

Field Development Planning and Optimization

During the process of field development planning, there are many uncertainties regarding the potential performance of a field, particularly in the early stages where few wells have been drilled due to high drilling costs (in the deep-water environment, for example). Various scenarios produced by reservoir simulation provide concepts from which these uncertainties can be reduced. An alternative and supporting approach is to use the **DIGITAL ANALOGS** Knowledge System to compare analog fields having similar reservoir and fluid types, pressure, water depth, drive mechanism and other technological challenges. Critical field/reservoir analogs provide not only ideas but also quantitative analysis to help in development planning and production optimization. This can help E&P companies reduce the risks of over- or underestimating production rates and recoverable reserves. Many potential production problems can also be recognized early in the development phase through use of analogs, thus allowing appropriate data gathering and mitigation scenarios to be planned for and initiated.

Production Enhancement

Improving hydrocarbon recovery is a global challenge for today's E&P companies. A key element in this endeavor is the improvement of recovery factors through the correct choice of EOR techniques. The **DIGITAL ANALOGS** Knowledge System can help managers and engineers refine their choice of secondary or tertiary recovery methods by quickly finding the most appropriate reservoir management or production enhancement strategy for their field of interest. A typical application of the **DIGITAL ANALOGS** Knowledge System consists of finding all fields that share a similar set of geological and engineering parameters and that have gone through secondary and tertiary recovery production stages. The performance of production enhancement cases can be readily retrieved and reviewed. With lessons learned from these analog fields, engineers can quickly discover the most effective production enhancement methods and estimated performance for their candidate fields.

Field Redevelopment Screening

The **DIGITAL ANALOGS** Knowledge System can also be used for screening candidate investment opportunities in mature or even abandoned fields with a low recovery. Specific technologies, such as horizontal and multilateral drilling, under-balanced drilling or gravity-assisted thermal recovery, may be applied to reservoirs with matching geological and engineering parameters obtained from analog fields. Furthermore, the **DIGITAL ANALOGS** Knowledge System can help develop field rejuvenation ideas from lessons learned from field redevelopment worldwide.

Our Clients

More than 30 international oil and gas companies are using **C&C Reservoirs’ DIGITAL ANALOGS** Knowledge System in their E&P workflow. Every day, these companies count on this powerful tool in their decision-making.

C&C Reservoirs’ clients include majors, international independents and national oil companies:

At C&C RESERVOIRS we are grateful to the following customers for their support:

| | |
|----------------|-------------------|
| Agip | JNOC |
| Amerada Hess | Kerr-McGee |
| Anadarko | KOC |
| Apache | Maersk |
| BHP Billiton | Marathon |
| BP | Newfield |
| British Gas | Nexen |
| Chesapeake | Norsk Hydro |
| Chevron | OXY |
| CNODC | PetroChina |
| CNOOC | Petronas |
| CNR (UK) | Pioneer |
| ConocoPhillips | Royal Dutch Shell |
| CPC | Saudi Aramco |
| Devon Energy | Sinopec |
| EnCana | Statoil |
| ExxonMobil | Talisman |
| Hunt Oil | Winterhsall |
| Husky | |

User Assessment of Benefits

DIGITAL ANALOGS user assessment of the product's benefits includes:

- *"Risk reduction from greater certainty on decisions—gives confidence to the geologist and reservoir engineer that their ideas are grounded in reality—shows them what is known versus unknown."*
- *"Greatly enhances field development decision-making."*
- *"Gives insight to the explorationist on the critical elements of a specific play that may be prospective."*
- *"Uncovers subtle opportunities that may not be apparent from any other technique or technology."*
- *"Improves predictive capabilities on the upside development potential."*
- *"Convinces management, investors and partners of the commercial viability of a prospect or merits of a field development program."*

DIGITAL ANALOGS users described the economic importance of geological analogs to exploration and field development in the following ways:

- *"We found a 3-billion barrel field in Africa using analogs. The discovery would not have happened without them."*
- *"We used negative analogs from the Gulf of Mexico to show why we should not make a major investment in a deepwater play in an expensive block in another part of the world."*
- *"Using analogs, I found a large, untapped accumulation under a salt dome where the seismic was poor."*
- *"We made critical decisions in the North Sea by using analogs from the U.S., South Africa and the Pyrenees."*
- *"We tried to talk management out of drilling a deep well offshore Africa because analogs indicated it could not be commercial. We drilled it anyway and lost a lot of money."*
- *"I found a 200-million barrel field solely through the use of analogs. It was a battle to get them to drill it."*
- *"Today, seismic technology sometimes becomes a ruling technology, and that's too bad because sometimes analogs are put aside or not used the way they should be."*
- *"Many view seismic as ground truth, but it tends to smooth things out and analogs tend to add detail. I'd like to see someone research the accuracy of seismic versus analogs. I bet analogs would show more detail."*

- *Sometimes we rely too much on seismic. We may be very confident of something based on analogs, but if management does not see it on seismic they are reluctant to act. That just proves younger managers do not really understand the power of analogs."*
- *"Still today some geologists only look at 'close-in' data and completely miss the point of using analogs."*
- *"Geologists should do more than look at what is close by."*
- *"Managers and engineers are comfortable with analogs that are very close; geologists are willing to look further a field; I used a Prudhoe Bay analog to develop a good prospect in Syria."*

Testimonials

One of our most successful users always begins and ends his prospect evaluation by quickly querying the database of more than 200,000 data points. A global manager for basin studies, he's really a wildcatter at heart. By searching the **DIGITAL ANALOGS** system with three or four criteria, he immediately pulls up more than a dozen fields with relevant matches, and he seamlessly exports the data to Excel so he can see which data correlate with the critical elements of the play he's evaluating. When he finds excellent matches, he then clicks to one or more reports to get an in-depth look at the reservoirs. By reading the analysis and reinterpretation and viewing the extensive graphics, he gains tremendous confidence in the quality of the prospect. And he has more than enough data to perform risk analysis and begin working with the engineers to build a production forecast and economic model.

When asked by an independent researcher to describe how he feels about the system, he said, "**DIGITAL ANALOGS** is the most accurate and reliable system I've run into. We do not use any other system or buy any additional data."

This basin studies manager was part of a team who developed all the options for this independent's multibillion-dollar investments made over the past three years. The overall strategy for their exploration program was based on specialized reports compiled from **DIGITAL ANALOGS** data and E&P TREATISE.

On the field development side, one of our users at a super-major told us that analogs convinced them that a GOM field could be optimally developed with just two or three wells as opposed to the traditional nine to ten well work plan. "Bottom line" for this business unit? They saved about \$60 million by drilling only the wells needed to efficiently drain the reservoir and that money was reinvested to drill additional prospects elsewhere.

Another user at a large independent used the **DIGITAL ANALOGS** system quite frequently to obtain information on fields that are analogous to the ones that they are doing water floods and CO₂ flooding projects. He told us that the data, information and analysis contained within the **DIGITAL ANALOGS** system are very accurate, complete and informative.

Contact Information

C&C Reservoirs has three offices positioned to best support our clients around the world. We are happy to answer your questions about our products and services.

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