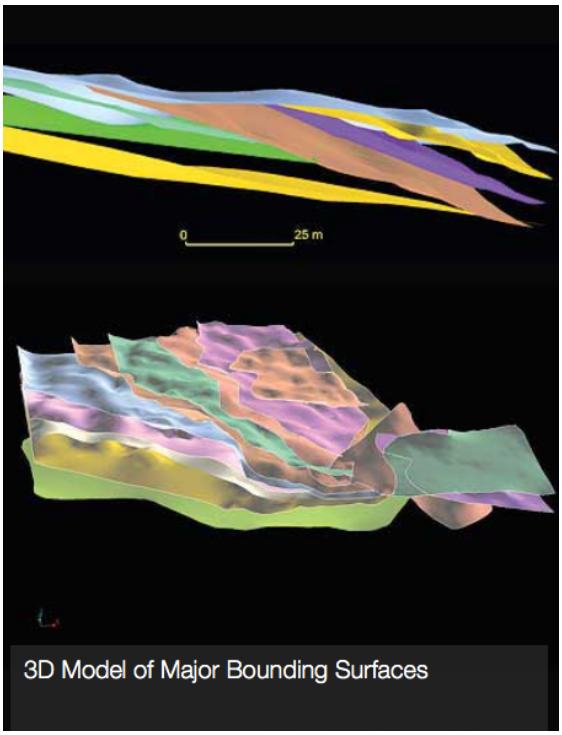
realearthmodels, LLC
precision 3D solutions

Meeting the Data Acquisition Challenges in Petroleum Exploration

New Digital, 3D Technology Improves Accuracy in Data Collection and Analysis for Increased Yield



Meeting the Data Acquisition Challenges in Petroleum Exploration

New Digital, 3D Technology Improves Accuracy in Data Collection and Analysis for Increased Yield

Overview

Energy companies seek accurate, detailed data to evaluate the potential for oil in promising locations. However, obtaining the high-quality data is a serious challenge. Traditional field methods for obtaining and interpreting data lack precision, leading to uncertainty, greater risk, and higher cost in drilling operations.

Improved data collection and analysis is vital because success in the petroleum industry depends on the discovery of new sources of petroleum ahead of the competition. Obtaining accurate hydrocarbon fluid flow calculations and projections requires a better understanding of data collected from outcrop analogs, studies, and surveys.

New 3D, digital technology now gives the petroleum industry the solutions to vastly improve exploration. A powerful new visualization tool combined with GIS/GPS, and Ground Penetrating Radar (GPR) maximizes hydrocarbon recovery efficiencies for increased yield.

The Problem with Finding Oil and Gas Reservoirs

Finding and harnessing subsurface resources is a difficult process if you don't have clear imaging data and a good understanding of the location and target.

Precise data is vital because nearly every decision made in petroleum exploration is based on spatial information and images of the earth's surface and subsurface.

The main problem energy companies face is how to obtain the highest quality images, quickly, safely, and cost-effectively.

Lack of clear, accurate data results in nearly two-thirds of exploration wells failing to meet their original objectives. Precise data guides planning and decisions that are critical to drilling operations. Without accurate data, the project may encounter unexpected geology or hazards. These unanticipated issues raise the cost of exploration, increase risk, and may prohibit project development.

Increasing the accuracy of hydrocarbon fluid flow calculations and projections depends on improved understanding of various types of data. Energy companies seek to enhance their data acquisition so they can better understand the distribution of key elements in a reservoir.

However, most conventional methodologies for acquiring data lack the ability to deliver accurate, clear reservoir pictures. Problems with current data acquisition methods involve:

- Insufficient imaging data for subsurface reservoirs, even when several types of data are combined, such as Ground Penetrating Radar (GPR) and seismic imaging
- Less precise quantitative geometric information, slow processing time, and perspective problems in 2D photomosaics of outcrops
- Skewed images, with form and crucial features indistinguishable, when viewing most "photorealistic" models from alternate angles
- Perspective problems that occur with overlapping stereo photography
- Establishing safe, efficient, and sustainable operations.

Exploration in the oil and gas industry is a complex process that requires analysis of many different types of data. Data comes from satellite imagery pertaining to topography, digital aerial photo mosaics of tectonic appearance, seismic surveys, and structural and sedimentary geology studies.

Additional data analysis may involve subsurface and cross-section interpretations and images, electromagnetic well logging, and existing infrastructure information. And these disparate data must be effectively tied together at the location in question to draw valid conclusions about subsurface structures.

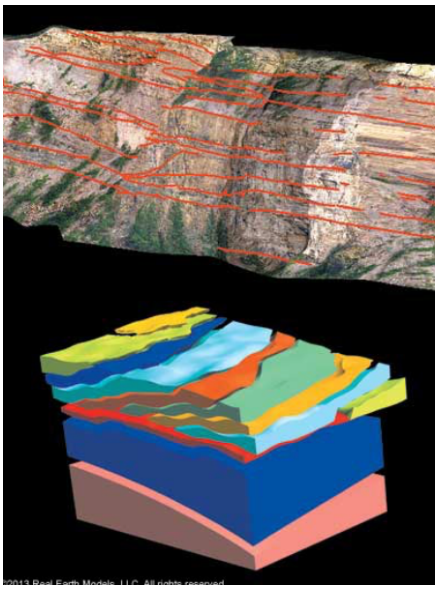
An Ideal Solution to Improve Data Accuracy and Analysis in Hydrocarbon Exploration

Finding and reaching areas suitable for oil and gas exploration is more challenging than ever. Today, exploration is increasingly carried on in deeper, more complex locations offshore. New solutions in data acquisition are needed to provide precise detail that can pinpoint oil and gas deposits. Enhanced visualization using new, sophisticated imaging technologies, increases the possibility for successful, safe, and efficient oil discovery and recovery.

Oil and gas exploration also continues onshore… again with greater complexity than in the past. Here, advanced subsurface imaging data can uncover under-explored resources. Faster, high-resolution, digital, 3D images supply precise data for more rapid, accurate decision-making.

Benefits of 3D Visualization Technology in Petroleum Exploration

- **Improved Analog Reservoir Characterization**
- **Maximized Resource Recovery Efficiencies**
- **Greater Precision, Globally Positioned**
- **Value Added to Existing 2D Studies**
- **Fast, Safe, Efficient, Replica Created for Detailed Analysis**



- **Improved Analog Reservoir Characterization:** The goal of the reservoir characterization process is to allow engineers to extract petroleum more efficiently. Advanced visualization technology creates a precise reservoir picture. This life-like picture, or digital model, enables a more thorough analysis of detailed data sets of surface exposures of rocks similar to those which form the buried reservoirs for petroleum. 3D digital visualization technology combined with Ground Penetrating Radar (GPR) enhances current reservoir characterization and fluid flow prediction models.

- **Maximized Resource Recovery Efficiencies**: Surveys demonstrate that conventional technology has extracted only a portion of oil thought to be available. In combination with conventional GIS/GPS services, GPR and seismic data, technicians can overlay, view, and manipulate the data in the form of new 3D digital models. This new visualization and interpretation tool gives analysts a more complete picture of the subsurface. Enhanced visualization enables scientific teams to thoroughly investigate the prospects for finding new resources or extending existing potentials. Discovering sources of petroleum ahead of the competition and maximizing productivity is key to success in the petroleum industry.

- **Greater Precision, Globally Positioned**: Advanced visualization models improve conventional, time-consuming qualitative and non-digital procedures. The new imaging technology provides quantitative digital information. On-screen digitizing of PhotoReal

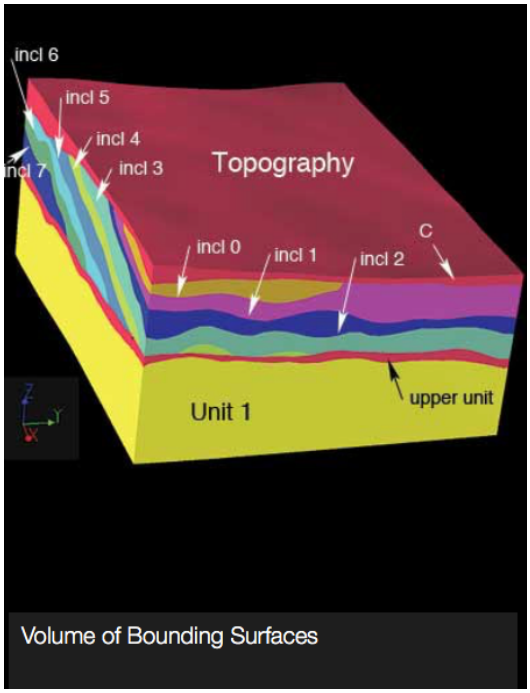
outcrop features provides a true-to-scale, geographically positioned, 3D model. The Model is a life-like replica of the actual terrain or structure that can be rotated, examined, and quantitatively analyzed from any perspective without compromising accuracy.

- **Value added to existing 2D studies**: Thousands of detailed, interpreted, existing photomosaics of outcrops can be economically and accurately converted to advanced digital visualization models. This data, combined in an exact replica, or digital, PhotoReal™ Model, enables extraction of more precise quantitative geometric information.

- **Fast, Safe, Efficient, Replica that Allows Detailed Analysis:** Advanced, 3D digital modeling technology accomplishes complex procedures rapidly while providing information with greater accuracy and detail than currently available through other scanning methods. Rather than taking days to analyze data, geoscientists have a precise, accessible model from which they can make accurate, quick decisions.

  This technology results in minimal disruption to the existing surroundings. Risk to personnel is also mitigated. Laser scanning and photographic data are gathered from vantage points that are safe for field crews. All laser-scanned data can be processed and the 3D digital model constructed from nearly any location, including at the site.

  The digital model allows for complete rotation of the viewing angle while all features maintain the original integrity with distortion virtually undetectable. In-depth analysis of geologic formations and structures from any location are now possible in the comfort of an office or boardroom. The viewer can zoom in for precise measurement of specific surface features and examine objects or formations by color and texture, just as if the viewer were actually “on location.”



Conclusion

New, 3-D digital modeling technology provides the enhanced visualization that overcomes many problems encountered with conventional data acquisition. Energy companies seeking higher resolution subsurface images of hydrocarbons can use this new visualization technology as a safe, fast, cost-efficient way to improve their understanding of reservoirs, and increase yield.

Case Study: Norsk Hydro

Advanced Data Acquisition Using 3D Digital Visualization Technology Increases Accuracy of Hydrocarbon Fluid Flow Calculations

Company:
Norsk Hydro ASA (Hydro) Formerly, having a large presence in the petroleum industry, Hydro merged with multinational oil & gas company, Statoil, based in Norway. Hydro is now an international manufacturer of aluminum headquartered in Norway.

Challenge:
Hydro wanted to better understand the distribution of key architectural elements and spatial variability of an outcrop in the Spanish Pyrenees. The traditional field methods for obtaining and interpreting data lacked precision, and Hydro faced uncertainty in planning critical drilling operations.

Solution:
REM created a 3D PhotoReal™ Model with which Hydro integrated Ground Penetrating Radar (GPR) and seismic imaging data. The PhotoReal™ Model provided enhanced visualization with precise data vital for accurate analysis of the region's geological complexity.

Results:
Information gained from REM's 3D PhotoReal™ modeling technology increased the accuracy of their hydrocarbon fluid flow calculations. Norsk Hydro geologist, K. Soagard, commented that he estimates up to 60% improvement in accuracy of fluid flow calculations. Improved visualization and interpretation achieved using the 3D PhotoReal™ model helped Hydro assess oil field accommodation for additional wells.

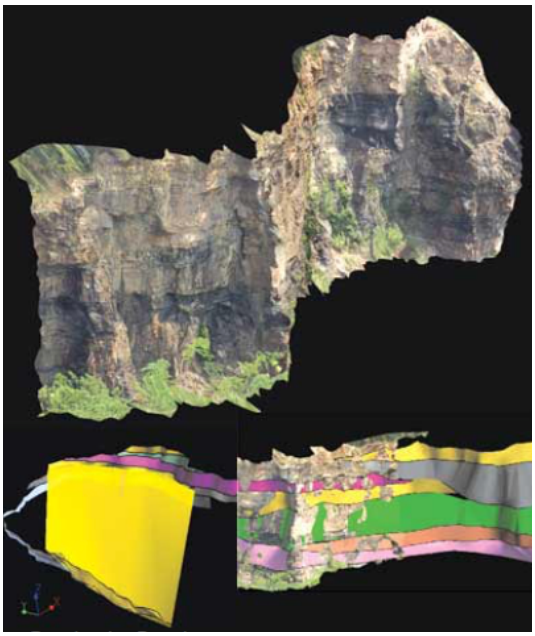
By superimposing the outcrop data captured in the PhotoReal™ Model over seismic data, and comparing a drilling report, accurate drilling pressure assessments were possible, thus helping ensure the integrity of the wellbore.

The PhotoReal™ Model also enabled integrated analysis with other surface and subsurface data to better understand and appraise deep-water reservoirs in the North Sea, the heart of much of Hydro's petroleum activities.

About Real Earth Models, LLC

Real Earth Models, LLC (REM) specializes in providing precision 3D visualization technology to businesses, industries, governmental and educational institutions, organizations, and individuals worldwide.

REM's PhotoReal™ modeling technology is based on the fusion of 3D laser and photographic data that enables the viewer to see what the eye cannot. The interactive PhotoReal™ model brings precise data to the viewer, regardless of location. Enhanced visualization and rapid access to accurate data generate remarkable solutions for even the most complex projects. REM developed its methodologies to deliver a higher standard of precision in 3D visualization.



REM's PhotoReal™ Models are distinguished by the significant detail and accuracy achieved. Our proprietary method for transforming point cloud data into our 3D PhotoReal™ Model transcends conventional scanning methods by enabling the viewer to see the scanned object, structure, or terrain accurately, *as it really is,* in full texture, volume, light, and color. Our refined methodology in processing displays information not only from each point in the laser scan but *between the points*. PhotoReal™ Models, unique in the industry, retain complete accuracy regardless of changes in either the viewing angle or the viewing distance. Accurate, in-depth, analysis of uncompromised image data is achieved with greater ease, precision, and cost-effectiveness.

The unification of point cloud data with digital photographs that yield the 3D PhotoReal™ Model is generated in a computerized visualization laboratory. Processing is intensive, requiring large multi-core processors, hundreds of gigabytes of storage, and gigabytes of RAM. Proprietary software, used in addition to various CAD and animation software programs, aid in completing our PhotoReal™ projects. Supplemental software includes Autocad, Revit, NavisWorks, Rhino, 3DS Max, and Zbrush.

REM is a privately held company headquartered in Dallas, Texas. REM's clients include Exxon/ Mobil Corporation, Norsk Hydro ASA, DFW International Airport, Massachusetts Bay Transit Authority (MBTA), Dallas Area Rapid Transit (DART), and Balfour Beatty Construction

How to Learn More

To find out more about REM's 3D PhotoReal™ Modeling technology for enhanced visualization that improves data acquisition, visit www.realearthmodels.com.