A Transition is Afoot
Conference in Copenhagen to be ‘innovative, memorable.’

BY RHONDA DUEY, SENIOR EDITOR, EXPLORATION

When EAGE was last in Copenhagen, the oil and gas industry was in a happy place. Not so much now. Interestingly enough, even in good times the geoscience segment feels a need to reinvent itself. Perhaps it is because the oil and gas industry as a whole finds ways to try to make this segment redundant. But given recent technological breakthroughs, it is also possible that the segment might continue to remain significant for years to come.

EAGE’s local advisory committee (LAC) has continued its efforts to make this year’s conference a major event. According to LAC Chairman Pierre Lanfranchi, this year’s show promises a “Scandinavian flavor” for the 80th annual convention.

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“Denmark has set ambitious goals in this regard,” he noted. “I look forward to what is sure to be a stimulating debate.”

EAGE President Jean-Jacques Biteau added that the energy industry is encountering a transition to less of a hydrocarbon-based industrial society.

“We know that oil companies and the service sector will need to continue to find and produce oil and [will] probably have to do this in a low-price environment,” he said. “In this context, we are seeing greater attention being paid to Big Data as an avenue to maximizing the value of current and legacy data.”

He added that this topic will be evidenced at the meeting by expanded exhibit space related to high-performance computing.

Another attraction, he said, is space related to startup companies, an initiative launched at the Paris show in 2017. This allows new companies the opportunity to introduce their ideas to the geoscience community at a discounted cost.

Show to Offer ‘Comprehensive Range of Activities’

‘Something for everyone’ might be the best way to sum up this year’s EAGE conference.

BY RHONDA DUEY, SENIOR EDITOR, EXPLORATION

The E&P industry is in a period of transition, and that will be the focus of this year’s EAGE. From renewables to digitalization to the great crew change, the conference will address the issues facing the industry.

The conference kicks off with a career-building session June 11, intended to help young professionals in the industry and academia develop and improve their leadership, communication, teamwork and networking skills. It will be followed by the opening ceremony and debate focusing on “The Role of Oil and Gas in the Energy Transition Era.”

The debate, in turn, will be followed by the annual awards ceremony and then the icebreaker.

Tuesday’s EAGE Forum will examine the digitalization of the E&P industry, including the current status and a roadmap to the future. Later that day is a general meeting for members wishing to learn more about the association. This will include a report from the board of directors and a discussion of topics that are important to the membership.

Wednesday’s executive session will discuss integration of disciplines for a more efficient E&P industry, and Thursday’s executive session will focus on Europe’s exploration plays, opportunities and challenges.

The technical program runs Tuesday through Thursday and will consist of oral and e-poster presentations as well as numerous workshops, field trips and short courses. Workshops will cover topics such as remote sensing for exploration, fiber-optic sensors in surface and borehole geophysics, the effect of seismic surveys on the marine environment and practical applications of full-waveform inversion. Short courses include understanding ocean-bottom seismic, integrated methods for deepwater reservoir characterization, and velocity imaging and inversion. Field trips include a visit to an outcrop in central Jutland, a study of chalk and bryozoan mounds, and a discussion of gas shales in southwestern Sweden.

Additionally, dedicated sessions on such topics as deep thermal mechanical modeling, fracture characterization in chalk formations and petroleum systems in the Middle East will accompany the technical program.

There are several student activities planned as well. The theme of this year’s program is “Turn Challenges into Opportunities.” EAGE’s student program is separate from the main program, although they can participate in the e-poster sessions, and includes workshops, short courses, the EAGE Geo-Quiz, Laurie Duke Challenge, trial interviews and a tour of the exhibition. A student evening is planned for Tuesday, providing an opportunity to mingle with other students as well as industry professionals. The EAGE student chapter will meet Thursday morning.

About 350 companies are expected to participate in the exhibition. Special interest areas include the Career Advice Center, a consultancy area for visitors to meet with experienced industry consultants, the EAGE Community Hub (formerly the EAGE Pavilion), a high-performance computing area, an area for startup companies, an international prospect center, a learning geoscience area and a university area.

Other highlights of the show include the EAGE/EFG photo contest, and several social activities also are planned, including the Conference Evening on Wednesday. Family members registered for the conference also can participate in the Family Members’ Tour on Tuesday.

EAGE President Jean-Jacques Biteau said, “I am confident that those . . . who come to Copenhagen will be more than satisfied with the comprehensive range of activities.”

Jean-Jacques Biteau
EAGE President

Lanfranchi noted that some of this year’s sessions will focus on tight rock formations that characterize many of Denmark’s reservoirs. And the student program will require participants to take a multidisciplinary approach to come up with the winning bid.

“These are just some of the ways in which EAGE is pushing boundaries to foster new thinking to meet the increasingly daunting business challenges facing many of our members and organizations,” Biteau said. “It will be my pleasure to meet fellow geoscientists and engineers, many for the first time, all anxious to advance our professional disciplines in this period of transition.”

Show to Offer ‘Comprehensive Range of Activities’

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07:30 – 18:00  Registration
  Registration area

08:30 – 11:00  EAGE Forum: “Digitalization of E&P Industry: Status and Roadmap to the Future”  Auditorium 15

08:30 – 17:10  Technical program (oral presentations)
  Conference area

08:30 – 17:10  e-Foster presentations
  e-Foster area

09:00 onward  Breakfast at the exhibition
  Exhibition floor

09:00 – 17:30  International Prospect Center Program
  Exhibit floor, booth 1860

09:00 – 17:30  Student program
  EAGE Community Hub, booth 410

09:00 – 17:30  Exhibition

09:30 – 13:00  Digital Transformation Area
  Exhibition theatre

14:30 – 15:30  Annual general meeting for members (EAGE)
  Treehouse

16:00 – 18:00  Special Session for Women in Geoscience and Engineering
  Treehouse

16:00 onward  Afternoon drinks at the exhibition
  Exhibition floor

16:30 – 17:30  Start-Up Area
  Exhibition Theatre

19:00 – 23:30  Student evening
  Tivoli Gardens – Aquarium

16:00 onward  Afternoon drinks at the exhibition
  Exhibition floor

For a detailed description of the program use the EAGE 2018 app or refer to the relevant pages of the EAGE program and catalogue for full descriptions of the EAGE highlights.

Conference Highlights—Tuesday, June 12

Annual General Meeting for Members
14:30 – 15:30, Treehouse
This year representatives of the Oil & Gas division (OGGD) and the Near Surface divisions (NSGD), as well as of the Research Committee (RC) and the Technical Programme Committee (TPC), are eager to meet members and chat about their mission, work, and possibilities for engagement.

Meet the Committees
15:00 – 15:30, Treehouse
This year the meeting will include new interactive elements giving members the possibility to engage with the board and share ideas and thoughts on EAGE and its future.

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Special Session for Women in Geoscience and Engineering
16:00 – 18:00, Treehouse
Copenhagen 2018 will once again offer a special session organized by and for the Professional Women in the Geoscience and Engineering (WGE) community.

Keynote Speaker:
Marit Brommer (Director of IGA)

Panel speakers:
Monica Anne Calvert (Total)
Laura Bornatici ( Cairns Energy)
Celine Ravaut (Statoil)
Julie Brantston (Schlumberger)
Severine Panetier Lescoffit ( Statoil)
Kristin Gjertsen (Aker BP)

Although tailored for the female members of EAGE, we invite all full delegates and conference delegates to join.

Visit EPmag.com for additional EAGE-related articles.
Look for stories tagged “EAGE Extra”!
Geoscience Suite Accelerates New Ventures and Exploration Workflows

Access to an integrated family of tools and databases gives exploration teams a competitive edge.

CONTRIBUTED BY CGG

The Robertson name has been synonymous with exploration-focused geological studies and data for more than 50 years, providing worldwide insight into play- and basin-scale petroleum geology. As the benefits of digitalization become apparent across the E&P industry, CGG GeoConsulting has taken the opportunity to digitally transform its geological library. A result of this is the Robertson New Ventures Suite, an integrated family of geoscience tools and databases that offers clients a competitive edge in global new ventures screening and frontier exploration.

The six core products of the Robertson New Ventures Suite are Basins & Plays, Geochemistry, Plate Kinematics, Predictions, Provenance and Analogues. Built on the brands of Tellus, Frego, Plate Wizard, Merlin+, ProvBase and ERGO, the digitally transformed products have been integrated and renamed as part of the GeoVerse program that is providing a common architecture and taxonomy across the New Ventures Suite.

Besides the quantity and quality of the data, what makes the Robertson New Ventures Suite particularly powerful is its interoperability and integration that supports a broad range of exploration workflows. This allows explorationists to easily interrogate one the industry’s richest sources of geoscience data to make quicker and better-informed decisions.

For example, in a frontier area of current interest in the offshore portion of the Doukkala Basin in northwest Morocco, the Robertson New Ventures Suite is helping de-risk exploration. The basin is underexplored with limited offshore well data, butshore wells have found oil and gas in Cretaceous reservoirs charged by a probable Lower Jurassic source rock.

How can we fill this data gap? By flooding the workflow with Robertson Plate Kinematics, which provides a deformable plate reconstruction model to correctly identify the paleo-location for the Doukkala Basin and place control data in their correct paleo-locations.

Robertson Predictions, a global paleogeographic/Earth systems modeling tool, is then used to evaluate whether the Lower Jurassic source rock is present offshore in the absence of well data and even assess its potential quality. Using this data-constrained modeling platform enables the prediction of the deposition and preservation of source rock. The model shows high organic content and a high potential for organic matter preservation due to predicted seafloor conditions.

Quickly linking to the Robertson Geochemistry database provides support for this prediction with data samples from a deepsea drilling program well sitting at the deep offshore margin of the basin recording a total organic carbon measurement of 2.8% for the Lower Jurassic. This provides a high degree of confidence in the presence of the potential source rock.

The workflow then moves into Robertson Basins & Plays, a play fairway and petroleum systems database, to look at the context for the maturity of the source rock. With consistent regional stratigraphic framework and depositional history, users are able to explore 1-D basin modeling and verify that the Lower Jurassic is mature in the offshore part of the basin. In fact, the source kitchen is likely to extend beyond the nominal basin boundary into the deeper offshore as well.

To characterize reservoir risk, a source-to-sink understanding of sediment supply can be developed using the dynamic paleo-Earth systems data in Predictions and exploring uncertainty in sediment routing using the Robertson Provenance tool. Understanding potential reservoir volumes and geometries in frontier areas often relies on analog data, and the comprehensive database in Robertson Analogues provides a basis for reservoir de-risking.

The Robertson New Ventures Suite complements CGG’s extensive multichannel offering that includes Seep Explorer, a comprehensive gravity and magnetics database, integrated JumpStart geoscience packages and an extensive high-end library of seismic data.

For more information, visit CGG at 16:00 Tuesday at booth 1640 for a happy hour to learn more about the Robertson New Ventures Suite and the company’s case study.
New Marks Set for OBN Deployment in the Deepwater Gulf of Mexico

Fit-for-purpose surveys require a system that is reliable and easily scalable.

CONTRIBUTED BY FAIRFIELDNODAL

Safety, flexibility, efficiency and the need for better seismic data quality continue to drive advancements in ocean-bottom node (OBN) technology. For a historically conservative industry, OBN acquisition has seen an unprecedented pace of adoption as operators realize the benefits of accessibility, repeatability and full-azimuth coverage among the crowded infrastructure of a working oil field.

However, new imaging technologies that require ultralong offsets, full azimuths and low frequencies also are creating demand for unique acquisition geometries that only can be accomplished with OBN technology. Large-scale sparse-node geometries suitable for exploration and velocity model building as well as small-scale dense geometries suitable for production seismic and 4-D analysis must be cost-effective to acquire. These fit-for-purpose OBN surveys require a system that is reliable and easily scalable.

FairfieldNodal’s ZXPLR is a new system that improves operational efficiency and flexibility while maintaining accessibility and repeatability in shallow or deep water.

ZXPLR extends FairfieldNodal’s ZNodal Technology portfolio with a node capable of dual-mode deployment with either a passive rope in shallow water or by ROV in deep water. From an operational standpoint, the system has been designed to simplify node management, maintenance and inventory control while decreasing overall operational costs by supporting multiple operational models with a single system. It features a compact design, high-efficiency battery charging, improved system performance monitoring, increased data collection rates, high-density storage and improved management of large unit counts. In either deployment configuration, overall survey and back deck management systems have been improved and made safer. Additionally, onboard data quality control has been largely automated, enabling onboard processors to quickly and consistently verify node data. The upgraded onboard processing simplifies downstream processing and node performance tracking.

OBN surveys of any scale are easily achieved using ZXPLR, but they must be efficient and cost-effective to acquire. Efficient OBN surveys are characterized by high-efficiency deployment and retrieval, source effort, and receiver effort in balance as well as a large receive area that minimizes repeated shots and efficiently utilizes simultaneous or blended sourcing.

In conventional marine acquisition, the time intervals between successive shots are large enough to avoid interference in time. With simultaneous source acquisition, multiple source vessels operate in a completely independent fashion. The multiple sources are shot in an overlapping fashion on a predetermined random spacing. Waiving the constraint of no interference leads to improved productivity since more sources can be used in a given time period. The procedure of recovering the data as if they were acquired in the conventional unblended way is called “deblending.”

In a well-designed survey, the node handling vessel and source vessel continuously operate after just enough nodes have been deployed to meet the offset requirements of the survey. The source effort and node deployment/retrieval cycle should remain in balance throughout the survey duration for efficient utilization of the vessels.

In deepwater OBN operations a high speed loader (HSL) conveys nodes to a ROV for deployment on the seafloor. ZXPLR significantly improves node deployment and recovery by increasing HSL payloads.

FIGURE 1. All subsea equipment is powered, enabling high-efficiency node deployment and retrieval. (Image courtesy of FairfieldNodal)

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OBN continued on page 7
Shaping the Velocity Field

New method updates deeper parts of the earth model through the inclusion of reflection data.

CONTRIBUTED BY WESTERNGECO

Full-waveform inversion (FWI) has emerged over the last decade as a high-resolution seismic imaging technique for accurately building and updating complex velocity models. The technique employs the full seismic waveform to derive models by using diving waves, precritical and post-critical reflections, and diffractions—all of which carry essential information about the subsurface.

The FWI technique has been successfully applied with various data acquisition methods in different geological environments. However, FWI works best with data acquisition techniques that deliver 3-D seismic data containing both long offsets and low frequencies, especially when attempting to construct the deep section and for mitigating the cycle-skip issue due to the nonlinear nature of FWI. In the past decade the reliance of viable FWI applications on long-offset, low-frequency data has meant that FWI provides poorer resolution for the deep section, where data sets are reflection-dominated and typically lacking diving waves and refractions.

The wavelengths recovered in FWI are heavily influenced by the subsurface, the local velocity and the illumination angular aperture. For wavefield transmissions and refractions, large illumination angle apertures facilitate reconstructing the long-wavelength portions of velocity models. For reflections, only the short-wavelength parts tend to be recovered by FWI due to the narrow range of reflection angle apertures.

This explains why FWI recovers long-wavelength components only in shallow areas and its resolving area improves when longer offset and lower frequency data are present. Unfortunately, the maximum offset of conventional streamer data is usually limited to 8 km (5 miles), in which case FWI updates are limited to the shallow section in deepwater environments.

Reflection data

To achieve meaningful deep updates, reflection data must be incorporated. How can geophysicists better use reflection to achieve more meaningful model updates deeper than those that conventional FWI currently provides? This becomes an even more significant concern when the data lack long offsets and are dominated by reflections.

To use reflection data with FWI to successfully update the low-wavenumber component of the velocity model, a new reflection-based method was developed to decompose the model representation into two models: a background model governing the kinematics and a reflectivity model governing the dynamics of the wavefield. During the reflection-based FWI iterations, both the background model and the reflectivity model are updated. These inversions start from very simple models without the standard tomographic model-building process.

Case study: Gulf of Mexico

The example shown in Figure 1 is from the Gulf of Mexico and contains low frequencies of about 2.5 Hz to 3.5 Hz. The conventional FWI started with a frequency of 4 Hz, and after 10 iterations it increased to 6 Hz to achieve higher resolution to the velocity update with a further seven iterations. To extend the updates to the deep part of the basin and under the salt, reflection-based FWI was selected to run through 12 iterations at 4.5 Hz. The deep update shows subsalt improvements in imaging and velocity updates.

The initial velocity field (Figures 1a and 1b) was fine-tuned using reflection-based FWI to achieve the final updated velocity field and image (Figures 1c and 1d). The deep part of the model in the Cretaceous section shows improvements in reflector continuity and focusing after the deep-reflection FWI updates. Improvements in the Wilcox and the top Cretaceous sections are striking in these examples, proving the successful application of reflection-based FWI.

Conventional FWI has a major limitation: diving-wave penetration is usually up to only a few kilometers below the seafloor, which is too shallow for use in a deepwater environment. To extend this, reflections enable applying FWI to update the deep sections. By using reflection-based FWI, large improvements to the velocity model are obtained that benefit the quality of both shallow and deep imaging.

To learn more about the new method, visit Schlumberger at booth 610.

FIGURE 1. Figure 1e shows the input model and image inline. 1b represents the input model and image in the crossline direction. 1c shows the reflection-based FWI updated model and image overlay inline, and 1d shows the reflection-based FWI updated model and image overlay crossline. (Image courtesy of WesternGeco)
The oil and gas industry is on the cusp of a major shift, from standing on the sidelines of industrial automation to holistically embracing it. With more than 20 billion devices estimated to be connected, dependence on automation is expected to double by 2020. Initiatives to digitize oil fields also have accelerated as budgets consistently favor open over capex, and technological leaps in artificial intelligence (AI) are leading to a radically new operational landscape.

At the inflexion point of digital transformation, automation driven by reservoir data is creating new opportunities for revenue and growth. Within the megatrend of IT and operations technology convergence in automation platforms, this new digital operations model combines reservoir intelligence with operational efficiency to tackle inefficiencies and boost operational performance.

The new reality is that reservoir intelligence is at the fingertips of decision-makers, with a perpetual real-time update of all asset variables across the value chain. Genuine organizational renewal is critical in determining whether complex centralized organizations can adjust. The ability to combine a transformational mindset for the digital age with industrial platforms that are robust enough to leverage digital technologies becomes key.

This transformation path faces additional challenges. As several Industrial Internet of Things (IIoT) ecosystems shape up and compete to gain market share, two main trends have started to emerge: the first of which is the digital transformation rebrand. As strategists steer organizations to adopt digital transformation, some have tried to simply pin digital data breaches in digital platforms within industries that have already transformed long before oil and gas.

The second trend is the emergence of the Monopolist-in-Disguise, a so-called “open platform,” but where the data, cloud service, well equipment, and data processing and interpretation are controlled by the provider. In this scenario, where the network effect of the business is the only competitive differentiator, operators are forced to choose between their control of how, where, when and who accesses their data and the available emerging platforms. In those data exchange gray areas, risks for operator-vendor conflict of interest may arise. Lessons are being learned from recent data breaches in digital platforms within industries that have already transformed long before oil and gas.

Standing in contrast is Emerson’s sustained investment in creating an end-to-end software platform for interoperability and automation. At the core of this secure independent ecosystem is the adoption of an open cloud-based platform with decision-driven cloud applications, open data management, Big Loop orchestration, machine learning intelligence and high-performance computing. This comprehensive system is designed to translate huge volumes of data into meaningful intelligent information leveraged for decision-making in real time.

Open standards, in contrast to proprietary alternatives, encourage interoperability and flexibility and are ideal for guaranteeing the security of encryption solutions. They also ensure that companies are not locked into a single vendor’s products or subject to proprietary standards that might become obsolete in time.

This next-generation platform will enable organizations to accomplish true digital transformation, providing cloud-based collaboration and open connectivity while keeping their data secure.

The combination of reservoir intelligence through AI-aided cognitive modeling and the power of IIoT makes it possible to proactively provide the right technology for every asset. However, technology alone will not provide the solution. While digital transformation is set to revolutionize the operational landscape, its ultimate success will require facilitators to converge processes, people and technology with a customer-centric mindset that prioritizes the security and autonomy of customers’ data above all.

For more information, visit Emerson at booth 720.

Stand Out from the Digital Crowd

Secure, independent automation ecosystems are key to growth.

BY HASSANE KASSOUF, EMERSON AUTOMATION SOLUTIONS

The oil and gas industry is on the cusp of a major shift, from standing on the sidelines of industrial automation to holistically embracing it. With more than 20 billion devices estimated to be connected, dependence on automation is expected to double by 2020. Initiatives to digitize oil fields also have accelerated as budgets consistently favor open over capex, and technological leaps in artificial intelligence (AI) are leading to a radically new operational landscape.

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ONB continued from page 5

employing mid-water docking and active heave controls on HSL and ROV systems. The increased deployment rates mean that two source vessels are required to keep the survey in balance. Simultaneous source acquisition is the enabling technology that allows efficient acquisition of OBN surveys using ZXPLR.

FairfieldNodal recently completed the first deepwater OBN survey using ZXPLR, and simultaneous source acquisition in the Gulf of Mexico. Compared to previous deployments, ZXPLR deployment rates were increased by 200%. The system’s compact design allows the HSL to carry up to 80 nodes, significantly reducing the number of HSL transits through the water column per day ROV payloads also have been increased from 8 to 10 nodes. The entire system has been made faster and more efficient by powered and piloted thrusters on the tether management system and HSL. (Figure 1). The net effect of all system improvements means that total survey duration can be reduced by nearly 50% while maintaining high safety and quality standards.

For more information, visit FairfieldNodal at booth 1420.

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For more information, visit FairfieldNodal at booth 1420.

A view of the drilling pipe on the Deepsea Stavanger drilling rig, from which the wells for the Maria field were spudded into the depths of the Norwegian Sea.

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Using CSEM in West Africa to De-risk Prospects

BY LOVDE BERRE, STEIN FANAVOLL AND PÅL GABRIELSEN, EMGS

E xploration in West Africa has a rather low commercial success rate when it comes to frontier deepwater wells, as evidenced by recent drilling campaigns. Of the nine West African frontier exploration wells drilled in 2017, only one was reported as a significant discovery. The key challenge is the nature of the stratigraphic trap being chased here, where in particular seal is notoriously difficult to assess and fluid type through quantitative interpretation using seismic data is ambiguous. This is well illustrated when viewing two of the wells drilled in 2017: the discovery Yakaar and the other neighboring dry well Requin Tigre-1. Both wells show large similarities in seismic definition as well as calibrated, positive amplitudes versus offset responses. Yet the outcome of the two wells is largely different.

A similar result can be seen across the Atlantic on the South American Margin in the Guyana Basin, where the two prospects Liza and Skipjack had almost identical seismic expressions and risking profiles. However, the outcome of the drilling was very different—Liza came in as a discovery, whereas Skipjack was dry. Operator Exxon Mobil has stated the drilling was very different—Liza came in as a discovery, while Skipjack was dry. Operator Exxon Mobil has stated that it was glad it decided to drill Liza first and alluded to the fact that it could have abandoned the entire area due to the dry Skipjack well if drilled first.

Controlled-source electromagnetics (CSEM) is a marine remote geophysical method imaging the Earth’s resistivity. The method is proven as a technology to identify oil and gas reservoirs and to separate low-saturation noncommercial reservoirs from commercial high-saturation reservoirs. The first full-scale field test of the CSEM technology was carried out in Angola over the Girassol Field in 2000. The results of this survey were encouraging, bringing a new remote geophysical method in the toolbox to detect hydrocarbons offshore. Since then, the technology development—with respect to equipment, acquisition, imaging and interpretation tools—has been enormous. EMGS has acquired a significant amount of CSEM datasets in Africa, covering, among others, such known discoveries as the Fortuna discovery in Equatorial Guinea and the Jubilee discovery in Ghana.

In an African CSEM campaign in 2004 several 2-D lines targeted mapped structural closures, but none of these structures could be correlated to any reservoirs. However, along one of the lines a strong resistive anomaly matched the extension of a channel/fan system identified on seismic offset structure. A well drilled some years later confirmed the presence of gas identified by the CSEM data. (Image courtesy of EMGS)

CSEM data are sensitive to the fluid content in a reservoir, separating seismic prospects with residual saturation from high hydrocarbon saturation. Therefore, CSEM data act as a complementary tool to seismic data in the prospect-risking process and should be considered to perform better decision-making on the next wells.

Microfluidics—Unrivaled Visualization of IOR/EOR Processes

Microfluidics allow the complex design of porous structures, matching real grain morphology, pore size distribution and porosity.

CONTRIBUTED BY HOT ENGINEERING

Oil production is taking petroleum E&P into challenging areas. In particular, mature fields and complex rock types pose challenges that require interdisciplinary approaches and thinking outside the box. To mobilize considerable fractions of the remaining oil in mature reservoirs requires a thorough understanding of reservoir rock and fluid properties. New and advanced technologies are required to be successful in this context and to bridge existing knowledge gaps.

HOT Microfluidics uses microfluidics technologies and a new rock-on-a-chip approach to tackle the above-mentioned challenges. In general, microfluidics is the science and technology of manipulating and controlling fluids—usually at the milliliter scale—in networks of channels with very small dimensions already established in various applications (including the chemical or biomedical industry), offering overall cost reduction as well as new and innovative insights. It also is a very attractive technology to investigate fluid flow through porous media as it requires only small fluid volumes (1 ml to 3 ml per experiment), and experiments can be conducted in a short period of time (hours instead of days or weeks).

A very precise, fast and cost-efficient solution for EOR process screening is offered by HOT Microfluidics. This new technology, which includes micromodel chips that resemble the reservoir rock, gives a better understanding of numerous EOR parameters such as recovery factor and in particular pore-scale oil mobilization and trapping mechanisms. Micromodel chips offer a variety of advantages:

They allow cost-efficient EOR process screening as they require only small fluid volumes and reduce the number of required core floods substantially;

An unlimited amount of chips with the same pore network can be produced;

Micromodels are generated based on rock images, and thus this technology can be applied even if physical core material is not available; and

They allow visual access to the displacement process, enabling a more detailed process description as well as control of wettability.

In microfluidic experiments image analysis substitutes for efficient material balance as performed during core floods. Flooding experiments are performed at reservoir temperature conditions, and several image analysis algorithms are available to evaluate experiment results, including phase saturation distributions, recovery factor versus time or PV-injected, ganglia statistics and dynamics, size and extension of mixing zones, and streamlines and particle tracing.

The transparent micromodels together with the experimental setup are used to generate high-resolution images of the flooding process. Results from displacement experiments obtained with the chips are analyzed through image analysis. Image analysis represents another major difference to conventional interpretation of rock laboratory experiments and offers interesting aspects to report on due to recovery factor, displacement efficiency, front stability, tortuosity, breakthrough performance, residual oil saturation and others. The improved visualization allows a deeper understanding of the processes and more informed planning, resulting in minimized risk and leveraged opportunities.

Microfluidics allow the complex design of porous structures, matching real grain morphology, pore size distribution and porosity at affordable pricing. Another important aspect in the design and construction of microfluidic chips for multiphase fluid flow experiments is the modification of surface properties such as wettability. For instance, surface coating using nanotechnology can be used to control the wettability of the micromodel. No matter if oil-wet, mixed-wet or water-wet, any wetting pattern and contact angle can be established. Thus, wetting conditions observed in reservoir rock samples can be established in the micromodel chips. The setup and handling of microfluidic equipment incurs low costs, experiments are repeatable due to the potentially large number of equivalent chips, they require only small fluid volumes, and comprehensive visual access is provided during the experiments, providing new and inspiring insights into IOR/EOR projects.
Time-to-depth Conversion Evolved

A new software application transforms the complexity of time-to-depth conversion into a modern, easy and intuitive experience founded on solid science.

BY PEDRO CORREIA, GEOVARIANCES

Time-to-depth conversion is a mandatory operation in the oil and gas industry. It implies the conversion of horizons in seismic data from time to real depth. Direct depth sampling (i.e., wellbore) is usually scarce considering the full extent of the mapped subsurface and, consequently, this is a process often convoluted in uncertainty. Yet current software packages only provide a unique solution with little or no in-depth uncertainty analysis, and they’re seldom capable of accurately exploring the uncertainty space. The search for the solution to this problem led to the constitution of the international R&D consortium UncerTZ.

Started in 2016, the project was led by Geovariances and Mines ParisTech and sponsored by three oil and gas companies. The first version of the UncerTZ software was released in early 2018 for sponsors. It is a likely contender to the most modern and comprehensive depth conversion tool on the market. The efforts of the consortium led to the development of sophisticated new methodologies to deal with the propagation of uncertainty (typically when using a sequential methodology) and its quantification as well as a seamless user interface rich with spill point analysis, volumetrics, 3-D visualization and quality checking. The user can add a preprocessed time uncertainty map (reflecting picking uncertainty and seismic noise, among other sources) to each of the surfaces and compute different realizations within that uncertainty space.

The conversion can be made either using the classical depth modeling or velocity modeling. The base algorithm involves Kriging with external drift and factorial Kriging, and a new Bayesian mode allows the manipulation of the coefficients of the external drift to accurately represent whichever relation exists between depth and time or velocity and time. Surfaces can be converted individually or collectively using a new joint approach developed for this new piece of software. This avoids unnecessary propagation of uncertainty to the estimation of deeper surfaces. The user can make hybrid approaches, for example converting jointly the first two or three surfaces followed by a sequential approach for the remaining surfaces.

The geological aspects also were considered. Given the stochastic nature of the simulation algorithm, a post-processing phase will account for phenomena such as erosion or onlap, making sure the resulting conversions are not only within the mathematical uncertainty space but also realistic. Fault systems can be added and their uncertainty considered.

Each of the resulting scenarios can be computed for spill points and volumes (reservoir and gross rock volume), providing a far more complete picture of all the different aspects involved in this operation.

To know more about this new software solution and discover all its capabilities, ask for a demo at booth 1053.

A consortium has developed new methodologies to deal with the propagation and quantification of uncertainty as well as a seamless user interface rich with spill point analysis, volumetrics, 3-D visualization and quality checking. (Image courtesy of Geovariances)

Vibroseis Vehicles Deploy on a 3-D Seismic Survey in the Russian Arctic

Vibroseis trucks perform well in extreme conditions.

CONTRIBUTED BY INOVA GEOPHYSICAL

TNG Group, based in Tatarstan, Russia, has purchased INOVA’s Commander TRT vibroseis vehicles for deployment on a 3-D seismic survey in the Yamal Region of the Russian Arctic. The Commander TRT vibrator was selected for its ability to traverse arctic conditions and its ability to withstand the extreme cold temperatures of this environment.

Based on INOVA’s AHV-I 364 broadband vibrator technology, the Commander TRT is a 60,000-lb peak force class vehicle configurable for tires or tracks and includes an arctic housing package to protect the engine and shaker from extreme cold operations while allowing service access to key components. Other special features include an environmental protection package and supplemental in-cab heater and engine heater package.

The vibrators are being used in tandem with their predecessor arctic vibrator XVII. TNG has operated XVIs each year for more than 15 years, a testament to the durable design and fit-for-purpose features, many of which are carried over to the new vibrator design.

INOVA’s Commander TRT vibrator recently was deployed on a TNG Group seismic survey in Siberia. (Photo courtesy of INOVA Geophysical)

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