HARTENERGY MADRID WEDNESDAY

EAGE DAILYNEWS
2015 EAGE Conference & Exhibition

OFFICIAL SHOW DAILY OF THE 77TH EAGE CONFERENCE AND EXHIBITION

E&P Industry Facing Expanded Horizon of Risks

The upstream industry is already inherently risky, but its continued expansion into new areas is exposing it to a wider array of nontechnical issues and threats.

BY MARK THOMAS, EDITOR-IN-CHIEF

This year's opening EAGE forum "Nontechnical Risk in the Upstream Business" featured a panel of speakers all giving their varied opinions on what those nontechnical risks are.

Moderator Mike Daly, formerly of BP and now of Macro Energy Partners, pointed out that the oil and gas sector today is working "in an increasingly fragmented world" in which western technology is now increasingly being used by its enemies to fight the West, whether through cyberattacks or online social media campaigns.

Spanish operator CEPSA's Jagoba Cubes San Salvador, however, talked about viewing risk also as an opportunity. "E&P is a risky business," he said, "but as an industry we can manage it." He highlighted that the industry is currently adjusting today to a new era of lower oil prices, and warned that "our industry cannot stand still. We need to adapt."

Better integration

This can be done through better E&P integration within companies, more diversity and more flexibility to adapt to change, along with continued use of new technologies and know-how. "It is only the most efficient operators that will be successful," he told the packed audience.

Catherine MacGregor of Schlumberger discussed nontechnical risk issues related to local content. These included noncompliance risk, risk to market access, risk to revenues and profits, and risk to ethical standards and reputation. She went on to highlight that companies such as Schlumberger "can add real value to a national workforce" as part of local content programs.

She also pointed out the company's ongoing work to address the problem of recruiting new petrochemical professionals, a resource which she said the industry was currently in short supply of.

Albert Paardekam of Shell highlighted work he had done for the company on deepwater projects offshore Brazil, such as the BC-10 development with Petrobras. "Apart from the technical risks, there are all the nontechnical risks that must be managed as well. Deepwater projects span offshore, onshore and further field, and risks can be triggered by many different events," he said. Early targeting of negative issues related to a project is a key aspect, Paardekam added. "The technical and nontechnical risks are fully integrated and linked. We need to relish the nontechnical challenges just like we would a technical challenge and accept there is no 'one-size-fits-all' solution."

Oil price evolution

According to Repsol's chief economist Pedro Antonio Merino, risk starts with the oil price itself. He discussed the "evolution" of the oil price over many decades and how it tracks very differently (and much less stably) than the food or metal commodities markets. "The only really big difference between them is that we have Mother Nature and OPEC!" he said. Merino highlighted the changing face of the oil market from one dominated by OPEC to one influenced by unconventional oil price dynamics.

He went on to highlight that non-OPEC conventional oil production has been "pretty stable" since the 1980s but that today there is still "a lot of risk." This is largely due to living in a world where there are many different financial policies existing simultaneously.

When it comes to the upstream industry's performance on delivering oil projects, Dr. Marcos Gallego of ERM flagged nontechnical risks as the chief culprit for the often-documented schedule delays and cost overruns on major developments. "When nontechnical risks are introduced to oil and gas project developments, such as health, safety, environment and community-related issues, this normally leads to project delays, cost overruns and lost deals," he said. "Nontechnical risk is the main source—70% to 75%—of the delays and overruns."

The biggest cause of delay was often related to environmental issues, he added. ■

Collaboration Is King

The industry faces serious challenges. But together, we can work it out.

BY RHONDA DUEY, EXECUTIVE EDITOR

Collaboration is a word that seems to be on many people's lips these days. A challenging price environment coupled with increasingly complex targets means that cutthroat competition might not be the best strategy.

This type of collaboration was on display at the opening session Monday afternoon as Philip Ringrose, outgoing EAGE president, and Helge Hove Haldorsen, president of the Society of Petroleum Engineers (SPE), each spoke about the importance of the two societies working together. Ringrose said that the focus of his presidency had been on making EAGE more focused on sustainability. This will be expressed this week through the 633 presentations, 372 posters and 12 pre- and post-session workshops scheduled for the conference, he added.

The sustainability theme also is being expressed through the 40 meetings EAGE has held and will hold throughout the year, including near-surface geophysics. The association also has established the Green Fund, a charitable arm that currently is working on preserving the rain forest in Costa Rica and obtaining drinking water from humid air in Madagascar. (Members are encouraged to submit further initiatives.)

EAGE also is testing the use of e-lectures around the world, and again there is a growing core of activities centered on environmental themes, he said.

In addition to SPE, the association continues its collaboration with sister societies such as the American Association of Petroleum Geologists and the Society of Exploration Geophysicists. This year it signed three memoranda of understanding with local societies in other countries.

Haldorsen took the stage next, outlining the "great challenges" awaiting the industry, like where to drill to find plays like the large Lower Tertiary fields in the Gulf of Mexico or the sweet spots in the Bakken and Eagle Ford. But it also has internal challenges such as cost overruns, over-optimistic production forecasts and siloed operations.

He likened the industry's challenge to Charles Darwin's basic message: Adapt or else. However, he said, Darwin had a blind spot by overlooking collaboration. "The fittest will be the best collaborators," he said.

He outlined the success of the industry as "4-E": enough energy, economics of supply, environmental and social performance, and education of both STEM students and the general public. And the capability of humans to learn shouldn't be underestimated. "Fifteen thousand years ago, flint arrowheads were the highest technology we had," he said. "And then we put a man on the moon in '69. Today we're drilling in 10,000 ft [3,048 m] of water. It's like going to the moon every day."

Philip Ringrose, EAGE president. (Image courtesy of EAGE)

Today the industry produces 93 MMbbl/d of oil and 10 Bcm/d (350 Bcf/d) of natural gas. This energy is fueling human progress and raising living standards, he said. "Changing the world for the better should be in your job description," he said.

See **COLLABORATION** continued on page 13

INSIDE THIS ISSUE

Are you ready for a greener world?

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Sustainable seismic?

Come and listen to Drew St. Peter, our Arctic and Sustainability Manager talk, about the environmental challenges within our industry and learn about what Polarcus is doing to explore tomorrow's energy sustainably.

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MADRID 2015

1-4 June 2015 I IFEMA Madrid

SCHEDULE OF EVENTS

Wednesday, June 3

8:30 – 18:00	Registration. *Registration area*
9:30 – 12:40	Executive session on "Boldness vs. Risk in Exploration." *Room N102*
9:30 – 18:10	Technical program (oral and poster presentations). *Conference area*
10:00 onward	Breakfast at the exhibition. *Exhibition floor*
10:00 – 18:00	Student registration. *Student court, booth 1120*
10:00 – 18:30	Student program. *Student court, booth 1120*
10:00 – 18:30	Exhibition.
10:00 – 18:30	Coffee plazas. *Exhibition floor*
11:00 – 16:30	Presentations at the International Prospect Center Theater. *Exhibition floor*
14:30 – 16:30	Session for young professionals. *Retiro room*
14:30 – 18:10	Dedicated session: Geological Processes in Modern Continental Margins and Basins. *Room N110*
17:00 onward	Afternoon drinks at the exhibition. *Exhibition floor*
19:30 – 23:30	Conference evening. *Palacio del Negralejo*

For a detailed description of the program, use the EAGE 2015 app, or please refer to the relevant pages of the EAGE catalogue for full descriptions of the EAGE highlights.

Conference Highlights–Wednesday, June 3

Executive Session: Boldness vs. Risk in Exploration

9:30 to 12:40, Room N102

Well-known senior explorationists will share their experience and views, illustrated with famous case studies about high-risk, high-reward exploration strategies. They also will discuss how risk perception and mindset evolve in their companies and impact the decision-making process as well as how to live with multiscenario evaluations.

- Chairmen: J.J. Biteau (Total) and L. Bertelli (Eni)
- Technical assistant: P. Esquier (Total)
- Speakers: J.J. Biteau (Total); L. Bertelli (Eni); N. Maden (Statoil); A. McCoss (Tullow); M. Daly (Oxford University); and P. Carragher (Rose & Associates LLP)

Session for Young Professionals

14:30 to 16:30, Retiro room

The session will feature three inspirational speakers covering perspectives on working both in the industry and academia. Young professionals are invited to actively participate, share their experiences and network with other participants. Although tailored for young professionals, EAGE invites all delegates to join. Topics include:

- Introduction by F. Broggini (ETH Zürich)
- "Some Perspectives on Working in Research in Industry and Academia" by J. Robertsson (ETH Zürich)
- "From a Ph.D. Program to the Industry: Back to School Again" by F. Perrone (CGG)
- "A Career in a Midsize Operating Company" by K. Mogensen (Eni)

Conference Evening

19:30 to 23:30, Palacio del Negralejo

The conference evening has become a traditional feature of the annual EAGE Conference and Exhibition, allowing attendees from all disciplines to relax, meet with colleagues, and enjoy food and drinks in an informal environment. The evening includes a full program with different styles of music and food. The event is sponsored by PTT E&P.

Attendees can collect their conference evening ribbon and program (including transfer details and important information) at the EAGE Pavilion before 13:00 on Wednesday, June 3. Only the EAGE conference evening ribbon in combination with a valid badge will allow admission to the conference evening. Attendees are asked to wear their valid badge in combination with their ribbon during the conference evening. If the conference evening is not included in your registration fee, please ask at registration if tickets are still available for sale.

Redefining Broadband

Marine isometric seismic technology provides new interpretational insights from effective spatial sampling.

CONTRIBUTED BY WESTERNGECO

The seismic industry has tended to use the term "broadband" to refer to temporal bandwidth and vertical resolution. A narrower wavelet gives sharper resolution, while a reduction in side-lobe energy leads to a more direct view of the geology. This improves interpreters' ability to see complex detail in the subsurface and assess risk; however, interpreters also must take care that the frequency content observed in the data is real.

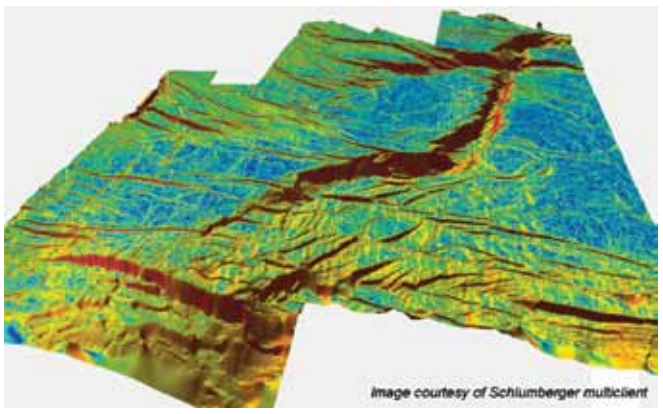
Frequency spectra contain both signal and noise, and it is often difficult for geophysicists to measure a reliable signal-to-noise ratio on the final migrated section. Methods used to measure noise can become the basis of methods to suppress the noise, and, as a result, the residual noise becomes closer to resembling signal. Interpreters also are learning that much of the noise comes from issues related to the spatial sampling limitations of acquisition geometries. For example, shallow overburden noise may alias to appear at different spatial frequencies. Adequate spatial sampling is required to avoid such aliasing, so survey design is influenced as much by noise characterization as by signal requirements.

The Earth presents complex 3-D geology, so interpreters must consider what happens to the signal in such environments. Complexity in the seismic wavefield results from large-scale macrostructures as well as distortions caused by smaller geologic features located closer to the sources and receivers. Assumptions based on simplistic 1-D geologic models predicting emergent waves propagating vertically no longer apply.

Interpreters must, therefore, expand the definition of broadband to encompass resolution in all directions, including spatial as well as temporal. This places new demands on the methods required to sample and reconstruct the seismic wavefield and a greater emphasis on controlling both amplitude and phase across the full bandwidth.

The term broadband should include spatial bandwidth, increasing the range of wave numbers in all directions—X, Y and Z—over which useful information content contributes to the image volume. Achieving adequate sampling to avoid spatial aliasing of the recorded seismic wavefield means that the data can provide high-resolution images of geological features irrespective of their orientation in the earth.

The IsoMetrix marine isometric seismic technology not only broadens the temporal bandwidth of towed-streamer seismic data though 3-D deghosting but also allows generation of datasets on a fine, evenly sampled grid. This provides a spatially de-alised broadband product in all three dimensions: in-line, cross-line and depth. This fine-scale resolution of the wavefield in all directions can translate directly to fine-scale resolution of the geology in all directions, enabling a more accurate representation of the subsurface.



Broadband data provided by IsoMetrix marine isometric seismic technology have revealed new insights into fine-scale faulting and channel systems in the East Loppa area of the Barents Sea. (Image courtesy of WesternGeco)

The 4,780-sq-km East Loppa survey, part of a major Barents Sea Schlumberger multiclient program, provides many examples of the benefits of acquiring a high-quality broadband IsoMetrix dataset. The Western Barents Sea is well known as a structurally complex region where several tectonic events have resulted in the development of a number of fault complexes. This new dataset is providing fresh insights into the geology of the area and its associated hydrocarbon prospectivity.

The survey area contains two main fault systems associated with the Asterias fault complex and a remote part of the Hoop fault complex, a strike-slip fault system angled at about 45 degrees to each other. The high spatial resolution of the seismic image has made it possible to auto-track the entire fault system independent of fault orientation. Some of the faults seem to control shallow hydrocarbon reservoirs in the Upper Triassic stratigraphic interval, and their mapping is crucial for shallow target exploration.

A complex Upper Triassic channel system is another important geological feature of the Loppa High area. High-quality seismic data demonstrate the Snadd Formation channel system associated with floodplain development in the Upper Triassic. Seismic attributes such as variance can highlight the fluvial depositional system. The data reveal a variety of small-scale fluvial geomorphological features, including point-bar systems, clustered channel fill complexes and ribbon channel sandstone bodies. For more information about 3-D broadband data acquisition and multiclient data from the Barents Sea, visit Schlumberger at booth 940. ■

Students, 'Fuel Your Future'

EAGE offers an extensive student program, "Fuel Your Future," which offers students many educational and entertaining activities for gaining up-to-date knowledge and skills about pursuing careers in the geoscience and engineering industries. Highlights include activities in the student court as well as short courses, student poster presentations, trial interviews and exhibition tours. The student program is sponsored by Exxon Mobil, Repsol, Statoil, Total and the EAGE Student Fund, including Shell.

Recruitment Café

12:30 to 13:30, June 3, student court

Students interested in hearing the latest on recruitment opportunities should not miss out on the Recruitment Café. The café is ideal for networking and supports job search efforts by providing the opportunity to meet up with potential employers in an informal and friendly atmosphere.

Trial interviews

June 3 to 4

Practice, practice, practice! Trial interviews offer a great opportunity for students to sign up for a 40-minute interview, including a 10-minute feedback session that will help you to prepare for the real deal. The trial interviews are fully booked, and it is not possible for student delegates to register onsite anymore.

Exhibition tour

12:30 to 13:30, June 3

The exhibition introduces a selection of companies every year, and students have the opportunity to become familiar with them by participating in guided exhibition tours.

Student challenge

Students are invited to become involved in EAGE's new student challenge. In addition to visiting selected company booths of sponsoring companies, the event also will include some new elements to make the student challenge even more exciting!

Student chapter wall

Student court

Do not forget to pass by the student chapter wall, located in the student court (booth 1120), where EAGE's student chapters have the opportunity to showcase past and upcoming activities to the public during all days of the conference.

See More

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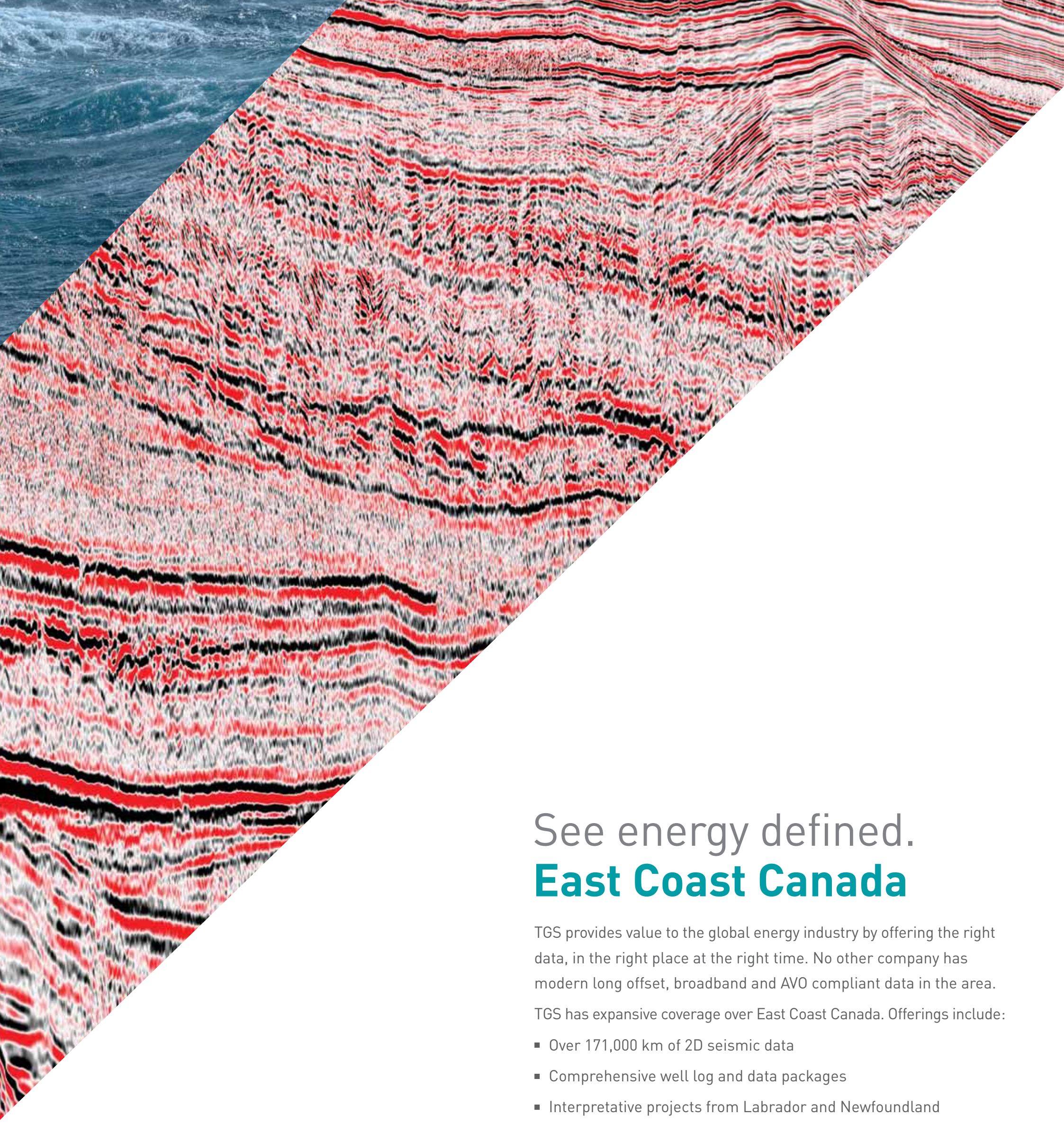

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Unconventional Techniques in Conventional, Low-productivity Oil Plays

More than 170 plays identified and three examples from France, Tunisia and China illustrate techniques operators are using to revive old plays.

BY MELISSA A. MANNING, IHS

As much as 141 Bbbl of potential incremental hydrocarbon resources could be unlocked if drilling and completion techniques refined in U.S. shale plays are applied to conventional, low-productivity oil plays outside of North America, according to a new analysis from IHS.

Curious as to what the potential might be if newer techniques were applied to old plays, IHS researchers conducted a high-level assessment that identified more than 170 mature oil plays worldwide with untapped oil potential that might benefit from horizontal drilling and hydraulic fracturing.

"While our analysis was an initial, high-level assessment of low-productivity plays outside the U.S., we were quite surprised at the impressive potential for increased recovery using these unconventional techniques," said Susan Farrell, vice president of upstream energy research at IHS, and one of the authors of the IHS analysis. "As many of the world's oil and gas producers struggle to lower costs and optimize existing assets, we wondered what kind of impact the application of newer technological innovations could deliver to the industry in terms of expanding conventional resource potential outside North America."

The rock properties in these mature plays are less than desirable for production using conventional techniques, and as a result, many of them have produced only a small portion of the total oil in place. Of the estimated 141 Bbbl of potentially recoverable oil using unconventional techniques, the IHS assessment determined that 135 billion of those barrels exist in plays that would likely require hydraulic fracture stimulation to produce, while about 6 Bbbl sit in plays that might not require hydraulic fracturing.

"Drilling horizontal wells allows access to thinner zones, where vertical wells are not commercially productive," said Leta K. Smith, Ph.D., director of upstream energy research at IHS Energy, and the principal analyst behind the IHS analysis. "Also, horizontal wells allow engineers to connect compartmentalized portions of the reservoir with one well instead of many vertical wells, which addresses cost and footprint considerations as well as increasing the well-to-reservoir contact ratio."

In addition, the study said modern seismic and MWD technologies would allow operators to achieve better placement of fractures to take advantage of natural fracturing and other geologic features for maximizing production and avoiding water zones. "Combined with other technologies developed for shale development, such as pad drilling, these improvements could breathe new life into some of these older, conventional fields," Smith said.

Three recent examples were cited in the IHS analysis that showed operators already leveraging some of these newer techniques to address different geologic and production challenges. They included the Saint Martin de Bossenay Field in the Paris Basin, the Tahe Complex in China's Tarim Basin and the Bir Ben Tartar Field in Tunisia.

The Saint Martin de Bossenay Field was first discovered in 1959. By 1996, the field's wells produced mostly water and it was abandoned. Recently, the field was redeveloped using modern technology, including seismic specifically targeting nonproduced portions of the field. Hydraulic fracturing was not used, since it is not permitted in France. Following redevelopment, the field's recovery factor improved from 40% to 44%–adding 1 MMbbl to the 2P (proven plus probable reserves).

According to the IHS analysis, the numbers of low-productivity conventional fields that could benefit from new technologies are relatively evenly distributed across the various regions of the world, but two-thirds of the estimated potential incremental oil volumes are in the Middle East and Latin American countries. The top four countries outside of North America for potential incremental oil recovery in low-productivity conventional plays include Iran, Russia, Mexico and China.

While many of the top 15 countries identified as potential for increased production are access-limited for international oil companies, Mexico, in third place, holds substantial incremental oil. With the upcoming opening of the country's upstream sector, Mexico might see new investment in these types of resources, Smith said. "For operators with experience in these drilling and completion techniques, Mexico may be an attractive option for future investment, along with some of the 14 countries identified outside the Middle East, including Brazil, the U.K., Norway, Congo and Indonesia," she said.

For more information, visit IHS Energy at EAGE at booth 331. ■

Polarcus Welcomes IMO Adoption of Polar Code

The Marine Environment Protection Committee met from May 11 to 15 at the International Maritime Organization (IMO) headquarters in London. At the meeting, the environmental (MARPOL) provisions of the Polar Code were adopted. With the earlier adoption of the safety provisions in November 2014 and now the MARPOL provisions, the path is clear for the International Code for Ships Operating in Polar Waters (the Polar Code) to come into force on Jan. 1, 2017.

The mandatory Polar Code now covers the full range of shipping-related matters such as design, construction, equipment, operation, training, search and rescue, and protection of the unique environment and ecosystems of the polar regions.

"We are very pleased with the IMO decision to adopt the Polar Code, making it mandatory for vessels operating in polar regions," said Peter Zickerman, executive vice president of Polarcus. "The fact that our modern 3-D seismic fleet already complies with the new Polar Code, coupled with our accredited arctic operational procedures and our hands-on experience of operating in ice-prone conditions, means we can truly say that Polarcus is arctic ready."

The Polar Code will apply to new ships constructed on or after Jan. 1, 2017. Ships constructed before that date will be required to meet the relevant requirements of the Polar Code by the first intermediate or renewal survey, whichever occurs first, after Jan. 1, 2018.

For more information on Polarcus' arctic capabilities, visit *polarcus.com/geophysical-services/marine-acquisition/true-arctic/*. ■

Taking Reservoir Modeling a Step Further

Imaging technology is a focal point for decision making and a crucial phase in helping operators deliver improved returns on their assets.

CONTRIBUTED BY EMERSON PROCESS MANAGEMENT

Despite several decades of innovation in reservoir modeling, limitations still remain, particularly in regard to fragmented structural modeling technologies. Such limitations can lead to poor drilling strategies and a compromising of the geological complexity of the reservoir, with modelers having to "make do" with a trade-off between complexity and quality rather than a complete decision-making tool.

Uncertainties in reservoir modeling are also so large, erratic and disseminated that only a thorough assessment of all the most possible scenarios can lead to accurate reservoir volumes and optimal production strategies.

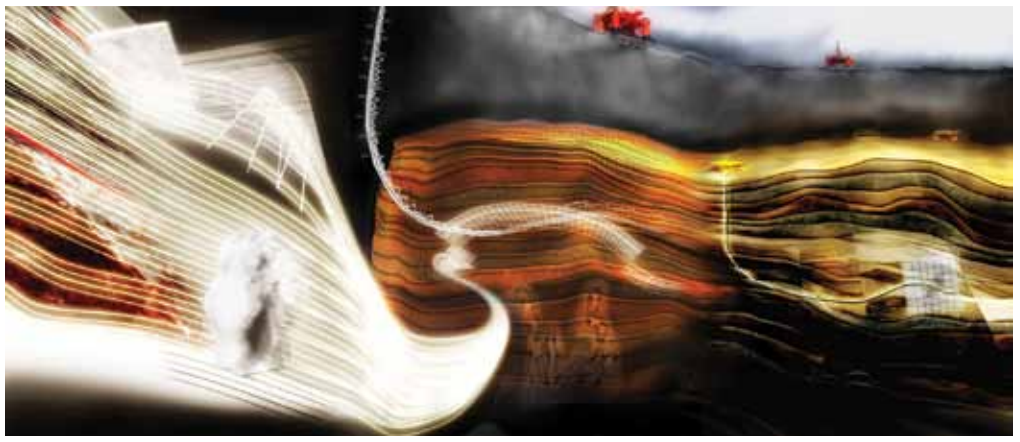
For more than 20 years, Emerson Process Management and its Roxar reservoir management software have bridged the gaps between multiple scientific domains and different knowledge sources, leading to a greater confidence in decision-making, better quality reservoir models and improved returns.

At EAGE this year, Emerson Process Management will illustrate how the toughest reservoir modeling challenges can be addressed through the latest version of its reservoir modeling software, Roxar RMS. The new software's tightly integrated structural modeling tools will enable users to quantify uncertainty more effectively and improve decision making.

The new software is designed to bring operators improved decision making via a better quality reservoir model, greater confidence in reservoir economics and increased productivity and efficiency throughout the modeling process.

Decision making is enhanced through a closer integration between structural modeling and 3-D gridding tools as well as horizon uncertainty modeling tools that allow users to incorporate realistic uncertainties into the horizon model.

This latest release also includes a new grid adjustment tool that supports the calculation of residuals between the grid and well picks. This enables the grid to be adjusted to exactly match the well picks and leads to greater flexibility in well data conditioning and improved well targeting and placement.



Roxar RMS brings operators improved decision making, greater confidence in reservoir economics and increased productivity and efficiency. (Image courtesy of Emerson Process Management)

To address the particularly difficult challenge of placing wells for optimal recovery in unconventional plays, the software includes a new predictive analytics tool that predicts sweet spot locations and enables the targeting of the most promising areas when planning new wells.

As a result of improvements in uncertainty management that generate realistic structural scenarios and enhanced volumetric sensitivities, the software also provides the operator with greater confidence in reservoir economics and improved predictions of oil and gas volumes.

This is achieved via an enhanced isochore modeling tool for more realistic models and improved usability as well as the ability to build fault uncertainty models in full and investigate a wide variety of scenarios.

Finally, the latest updates provide greater support for larger models, faster modeling and strengthened interoperability through higher responsiveness and a speeding up of the model-driven interpretation process.

The model can be built directly from the geophysical data through enhanced seismic import features and comes with an interface that allows users to quickly manage and manipulate large amounts of data. This represents a vital step in the move toward tighter integration and brings with it significant productivity and time gains without compromising the quality of the reservoir characterization.

Reservoir modeling is a focal point for decision making and a crucial phase in helping operators deliver improved returns on their assets. Emerson is taking this process a step further.

Emerson will be hosting a series of presentations on these and related topics throughout EAGE in IFEMA meeting room 9.1. Emerson also will be presenting the paper "How Reservoir Uncertainty and Sensitivity Studies Lead to Better Hardware Selection" in the History Matching and Uncertainty session on Wednesday, June 3. ■

Maximizing 3-D Seismic Data

Software solutions help operators and oil service companies use their 3-D seismic data in a cost-effective way.

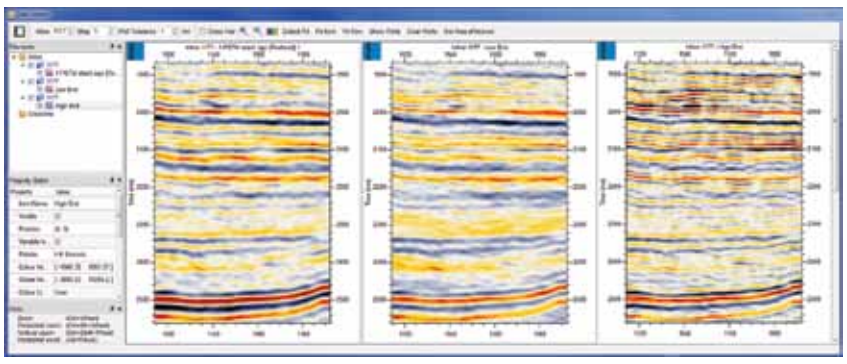
CONTRIBUTED BY ARK CLS

With the current low oil prices, getting more out of existing 3-D seismic data is more important than ever before.

Seismic techniques remain the best method the industry has to image the subsurface, short of drilling wells. While there has been much discussion in recent years about the benefits of broadband seismic in improving the imaging of subsurface geology, the main stumbling blocks have remained cost and extended lead times.

There is subsequently a need to be able to do more with smaller budgets and utilize the huge amount of conventional 3-D seismic data already available and which might already offer up the answers to an operator's next prospect evaluation.

It's against this backdrop that leading geoscience software company ARK CLS will be at EAGE 2015, highlighting how its software can be used to enhance 3-D seismic data and developing ever more innovative algorithms to derive seismic attributes.



ARK CLS Seismic Broadband showing (from left) input, low end and high end. The embedded visualization tool is used to help derive the optimum broadband seismic output. (Image courtesy of ARK CLS)

Following collaboration with two major oil companies, ARK CLS will be showcasing two new software tools at EAGE: Seismic Broadband and Spotlight. Both software solutions are targeted at helping operators and oil service companies use their 3-D seismic data in a cost-effective way.

ARK CLS Seismic Broadband is a new technique that integrates well data into broadband analysis and increases the value of the seismic data by extending its bandwidth.

By using reflectivity and acoustic impedance logs, two operators are simultaneously derived and, once applied to the seismic data, broaden the amplitude spectrum of the seismic data at both ends, low and high. The result is broadband operators consistent with seismic and well data and a highly cost-effective broadband analysis of 3-D seismic data.

ARK CLS Spotlight adds quantitative interpretation capabilities to a standard seismic interpretation workflow by rapidly combining up to four different colored seismic datasets into a single cube that resembles the behavior of a given elastic attribute.

This allows geoscientists to work with attributes that directly relate to rock properties with the relationship between the input data and the desired output established from prior well log analysis. The solution is fast, robust, easy to use and fits seamlessly within the ARK CLS Seismic Colored Inversion workflow.

Both technologies are being launched as plug-ins for Schlumberger's Petrel and dGB Earth Sciences' OpendTect platform and are provided on a subscription basis, through a variety of alternative licensing models or carried out directly by ARK CLS on behalf of the operator/oil service company.

"With budgets stretched, these advances couldn't have come at a better time for the industry," said Anthony Benn, director of geoscience at ARK CLS. "We are so confident that these advances will make a significant difference that we are offering a financial risk-free Geoscience service around these technologies where if you are not happy with the results, you have nothing to pay. This forms part of our new geoscience services that lead to more reliable studies, clearer interpretations and better decisions."

For more information or a demonstration, visit ARK CLS at booth 720. ■

Promoting Uptake of Advanced Quantitative Workflows

Plug-ins make it easier to add QI capabilities.

CONTRIBUTED BY IKON SCIENCE

Integrated geoscience platforms and application suites such as Schlumberger Information System's Petrel support extensive workflows from geological and seismic interpretation to reservoir modeling. Advanced technologies such as rock physics-based quantitative interpretation (QI) have, until recently, been executed using specialized software platforms such as Ikon Science's RokDoc.

While interconnector tools have made it easier to move data back and forth between Petrel and RokDoc, there remained a learning curve to become familiar with RokDoc. For generalist user communities, this could be seen as a barrier to a gradual adoption of QI. The launch over the past year of six RokDoc Plug-ins for Petrel aims at making it much easier and straightforward to add QI capabilities to familiar workflows.

Built using the Ocean infrastructure, these plug-ins are embedded in Petrel and do not require any data management or user interface training to be put to use. Companies already invested in the use of RokDoc by their advanced geophysical teams see the benefit of making it easier for a wider community of geoscientists to add QI capabilities to their toolkit. Each plug-in uses the same algorithms and parameter sets as the original features in the RokDoc application. Training courses focus much more on the underlying science and technology since the ease of use and familiarity of the interface considerably reduce the time normally spent acquainting trainees with a new software package. For more information, visit Ikon Science at booth 610. ■

Meeting Industry Requirements for High-end Seismic Projects

Superheavy vibrator offers improved performance, reliability and HSE features.

CONTRIBUTED BY SERCEL

High-density, wide-azimuth broadband seismic surveys are becoming the new paradigm for 3-D land acquisition. Multimillion traces per square kilometer can now be recorded on single-source, single-receiver 3-D projects using high-productivity techniques. The unequalled seismic data quality offered by such configurations optimizes interpretation of complex geologies and hydrocarbon detection and recovery. The use of single sources becomes mandatory on such projects to achieve the required levels of productivity to make these projects cost-effective.

However, deployment of vibrators as a single source implies reduced signal amplitude compared to conventional arrays, which means that more powerful sources are required to produce a satisfactory level of signal while maintaining an efficient sweep length. During previous decades, 60,000-pound-force (lbf) heavy vibrators became standard on the seismic market. The current industry focus is on 80,000-lbf superheavy vibrators that can meet the latest industry expectations.

To meet this need, Sercel has developed the Nomad 90 Neo, a new version of its superheavy vibrator. As an evolution of the Nomad 90, the Nomad 90 Neo vibrator capitalizes on the experience gained to offer improved performance, reliability and HSE features.

Broadband performance

Inherent from the larger scale of their design, superheavy vibrators are ideally suited to the generation of high-quality, low-frequency sweeps. A longer mass stroke, heavier mass and higher hydraulic pressures prove very beneficial for the generation of low frequencies. The low-frequency, high-amplitude mass oscillations required to generate the low-frequency seismic signal cause large pressure oscillation that can impact vibrator performance. To address this issue, the Nomad 90 Neo benefits from a mass design with integrated piston-type accumulators installed as close as possible to the servo valve to efficiently stabilize the hydraulic pressure.

For high frequencies, the Nomad 90 Neo performs well as a result of two key features:

- A 90,000-lbf hydraulic peak force (exceeding the 80,000-lbf hold-down weight) to address hydraulic pressure limitations, which can compromise ground force fidelity at the highest frequencies; and
- A baseplate design that is four times stiffer than that of the previous generation.

With these two features, the Nomad 90 Neo can ensure high-frequency signal fidelity and enable the bandwidth of the sweep to be extended.

The full-drive start frequency of conventional vibrators is between 6 Hz and 7 Hz. Below this frequency, custom sweeps with a reduced drive level ramp-up are used to remain within the physical constraints of the vibrator. However, this ramp-up requires time and affects productivity and cost. The Nomad 90 Neo actuator design makes it possible to reduce the full-drive start frequency down to 5 Hz. If used with a 62,000-lbf output, this frequency is further reduced down to 4.4 Hz. When compared to conventional vibrators, emitting a sweep starting from 1 Hz with a given level of energy can be achieved with a sweep length reduction of up to 76%, resulting in a significant productivity gain.

Reduced environmental footprint

The Nomad 90 Neo is fully compatible with Intelligent Power Management (IPM), a capability developed for the Nomad vibrator family. It measures the engine load and adapts the engine rpm accordingly. While vibrators usually operate at a constant rpm, this new feature significantly reduces fuel consumption as well as noise and exhaust emissions. Field tests carried out on different seismic surveys show fuel savings of up to 15% on the vibrators equipped with IPM.

Enhanced reliability

The Nomad 90 Neo benefits from experience gained with the Nomad 90 to offer the highest level of reliability and safety. The vibrator's center of gravity has been lowered to offer safe access even to the most rugged areas, without compromising on baseplate clearance. Its overall dimensions have been designed to be comparable to those of a 62,000-lbf vibrator and address maneuverability and accessibility constraints. Numerous components are standardized with those of the Nomad 65 Neo to offer flexible spare parts management. The large 1430L fuel tank and a rapid refilling system are standard, simplifying refueling logistics and the associated high HSE exposure.

A Nomad 90 Neo is operating in Oman. (Image courtesy of Sercel)

The Nomad 90 Neo has successfully been deployed on several recent projects in the Middle East where it has already demonstrated its improved features. Its 80,000-lbf output has achieved good signal levels for high-productivity, single-source projects. The ability to generate high-fidelity broadband (low- and high-frequency) sweeps with a reduction of the sweep length also has been demonstrated. For more information, visit Sercel at booth 430. ■

Blueback Changes Name to Cegal

Following the merger with Cegal, announced in August 2014, Blueback Reservoir will go forth under the Cegal name and logo. The companies are aiming to fill the gap between E&P and information technology (IT) by combining the expertise within geoscience and IT solutions.

Blueback Reservoir is a geoscience solutions partner, and Cegal is a provider of IT solutions to the oil and gas industry. Over the last nine months, the companies have established common offices in Stavanger and Oslo and have together opened an office in i2 Business Centre in Aberdeen, U.K. Going forward, the current and combined product portfolio will be brought to the market under the Cegal brand. With first roll out in Norway, Blueback Reservoir's subsidiaries in Houston, London, Calgary and Dubai are in the process of changing the company name. ■

Providing a Complete Subsurface Picture

3-D CSEM can improve exploration success by integrating data sources.

CONTRIBUTED BY EMGS

With a lack of well data, many operators today are dependent on structural images and acoustic properties derived from seismic data when evaluating prospective fields and making exploration decisions.

Current low oil prices, coupled with the desire for more certainty in risking fluid and hydrocarbon volumes, have led to an increased focus on integrating complementary data sources to improve exploration success. One such technology is 3-D controlled-source electromagnetic (CSEM) data.

3D CSEM surveys map resistivity in the subsurface, a rock property that correlates strongly with the fluid type and saturation of hydrocarbons.

At EAGE this year, EMGS will illustrate how 3-D CSEM surveys play a key role in regional prospectivity, portfolio polarization and the probability of economic success with new case histories from the last few months.

EMGS has developed workflows and tools to enable operators to quickly and accurately assess the sensitivity of their prospects to electromagnetic (EM) force as well as reliably embed CSEM information into their evaluation processes (see Figure 1).

The figure shows an example from a multiclient 3-D CSEM survey in the Sergipe Alagoas Basin of Brazil. Here, the average resistivity map with a depth window over the Barra analog play shows that the locations of the discovery wells are associated with elevated resistivity while lower resistivity values are at the locations of the dry or noncommercial wells. The results from this early processing stage can be used to determine the prospectivity of the region.

3-D CSEM also can accurately identify or disqualify prospects based on long-term commercial potential.

One key discovery in Barents Sea is the Wisting prospect in Lower Jurassic reservoir rocks. In September 2013, the Austrian oil company OMV announced an oil discovery in License PL537 on the Wisting prospect with an oil column between 50 m (164 ft) and 60 m (197 ft) and potentially recoverable reserves of 60 MMboe to 130 MMboe. The following year a new oil discovery, Hanssen, was announced in the same license area. In the neighboring license area there was a gas discovery, Mercury, during the same year.

All discoveries were found to be associated with a significant EM anomaly where a seismic line was overlaid with resistivity from 3-D CSEM data.

The CSEM results indicated the presence of hydrocarbons in several fault blocks. There also was a high correlation between the seismic and CSEM results, with the CSEM anomaly conforming to structure and matching the wells in depth and lateral extent with the seismic amplitude anomaly.

During the last few months, EMGS also has entered into a host of new agreements to provide 3-D CSEM data to clients worldwide. These include four new data licensing agreements in the Barents Sea, bringing the total number of companies holding licenses with EMGS Barents Sea multiclient data to 25; a contract with BG Group for CSEM acquisition in Uruguay; and CSEM surveys for PTTEP International in Thailand and Myanmar.

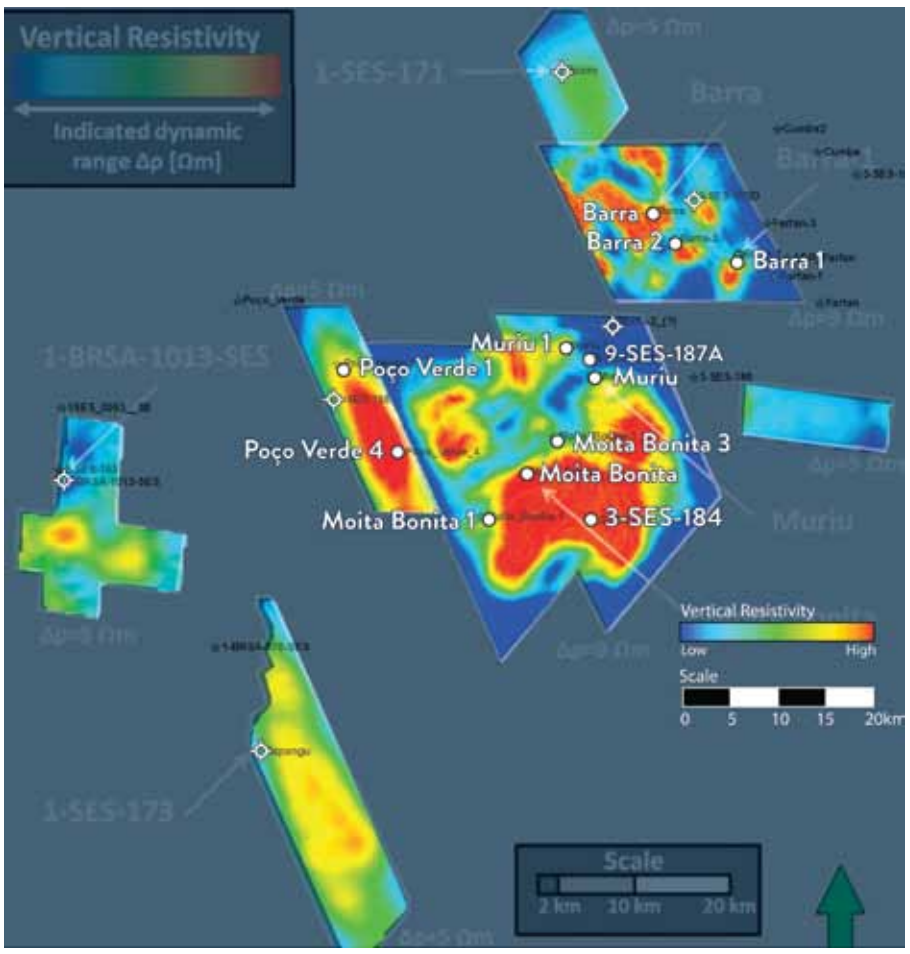


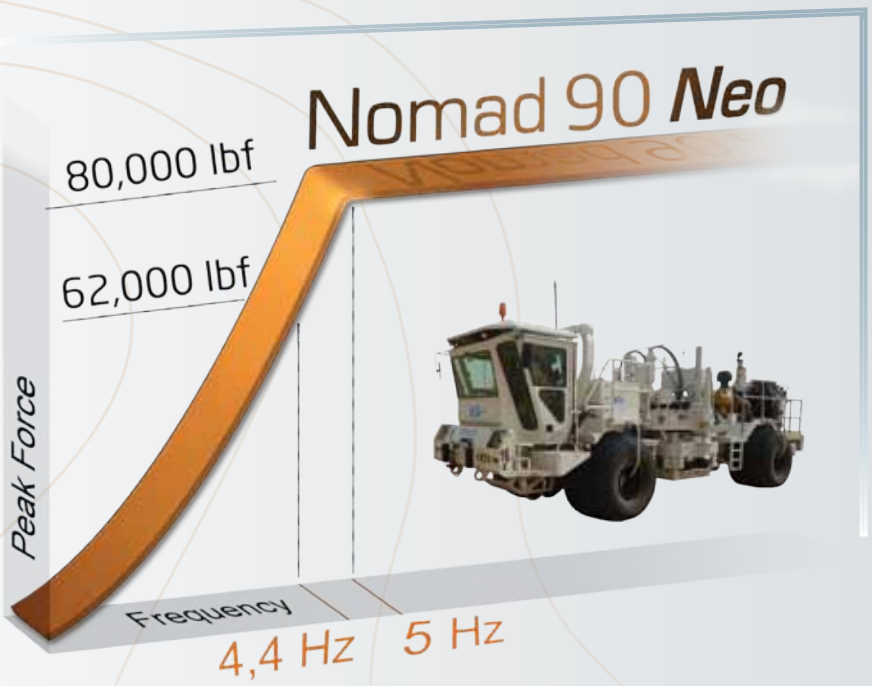
Figure 1. A resistivity map shows data from the Sergipe Alagoas Basin in Brazil. (Image courtesy of EMGS)

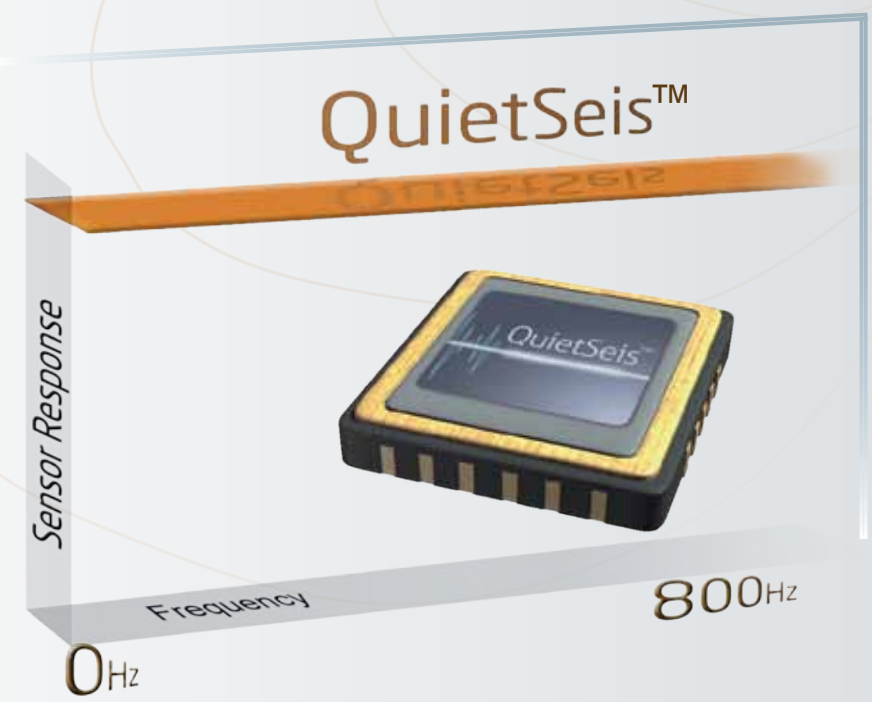
To find out why 3-D CSEM and resistivity are important complementary sources to seismic data, providing crucial information in areas of existing weakness (fluid identification and volumes), visit EMGS at EAGE at booth 310. ■

NEW

Nomad 90 *Neo* & QuietSeis™

BROADBAND WITHOUT COMPROMISE





By combining QuietSeis, featuring the lowest weight of all competitive systems, with the new Nomad 90 *Neo*, the most powerful vibrator in the industry, Sercel offers the most productive solution for broadband seismic data acquisition.

// Nomad 90 *Neo* : BROADBAND SOURCE

Highest peak force : 90,000 lbf
Stronger low frequency: 5Hz @ Full drive
High-frequency signal fidelity

// QuietSeis : BROADBAND SENSOR

Broadest bandwidth : 0 - 800 Hz
Lowest noise level : 15 ng/√Hz
Lowest distorsion : - 90 dB

// MOST PRODUCTIVE SOLUTION

Easiest deployment system
Lightest acquisition solution
Sweep length reduction

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Sercel
Ahead of the Curve℠

Decreasing Noise by Half from AGG Surveys

New technology provides improved exploration results, with better spatial resolution and greater accuracy.

CONTRIBUTED BY CGG

Airborne gravity gradiometer (AGG) surveys provide the ability to explore large areas for only a fraction of the cost of 2-D and 3-D seismic surveys. This allows a greater return on subsequent exploration investments by prioritizing the areas for further exploration. As explorers focus on increasingly deeper targets with subtle geophysical signatures, the noise level of the AGG instrument is of primary importance to increase accuracy.

CGG's FALCON technology is the only gravity gradiometer designed specifically for use in light aircraft and was engineered to isolate the instrument from aircraft-induced noise. Since 1999, more than 3 million line km (1.8 million miles) of FALCON data have been acquired. The FALCON system is acknowledged as having the lowest survey data noise of all available AGG systems—until now.

CGG recently released FALCON Plus, the latest version of the successful suite of FALCON systems. Multiple improvements in hardware, software and data acquisition technology enable FALCON Plus to halve the noise of the FALCON system. In addition, FALCON Plus provides 20 times better spatial resolution (150 m vs. 3,000 m, or 492 ft vs. 9,843 ft) and up to 10 times greater accuracy (0.1 milligal [mGal] vs. 1.0 mGal) than conventional airborne gravity.

Achieving high-quality airborne gravity data is a daunting task. Obtaining airborne gravity data with an accuracy of 0.1 mGal is equivalent to successfully shooting an arrow 1,200 km (746 miles) from Madrid to London and hitting a 15-cm target from a low-flying aircraft flying at more than 200 km/hr (124 miles/hr). Despite such technical challenges, CGG has published favorable comparisons of FALCON Plus gravity data to ground gravity data at the R.J. Smith AGG Test Range in Western Australia.

FALCON Plus exhibits a minimum sensitivity to air turbulence and routinely covers in excess of 2,000 sq km (772 sq miles) per week in a fixed-wing aircraft. This translates into very rapid data acquisition, when compared to ground-based gravity acquisition.

Unique to FALCON technology, FALCON Plus incorporates two separate gravity gradiometer instruments onboard the aircraft. This allows for immediate assessment of the data accuracy and system noise, assuring consistently high data quality.

Because of its higher accuracy, FALCON Plus can be considered for detailed mapping of near-surface geology, particularly for velocity and thickness variations, which play a major role in the accuracy of seismic static corrections computation. Thus, ultimately, the system can contribute to an improved imaging of the deeper layers.

Significant deviations in near-surface layer velocity and thickness can be caused by meandering river channels or variations in thickness of glacial till. The subtle signatures of such deviations are more easily detectable with FALCON Plus and provide an independent set of near-surface geological information to be exploited by advanced seismic static-correction schemes.

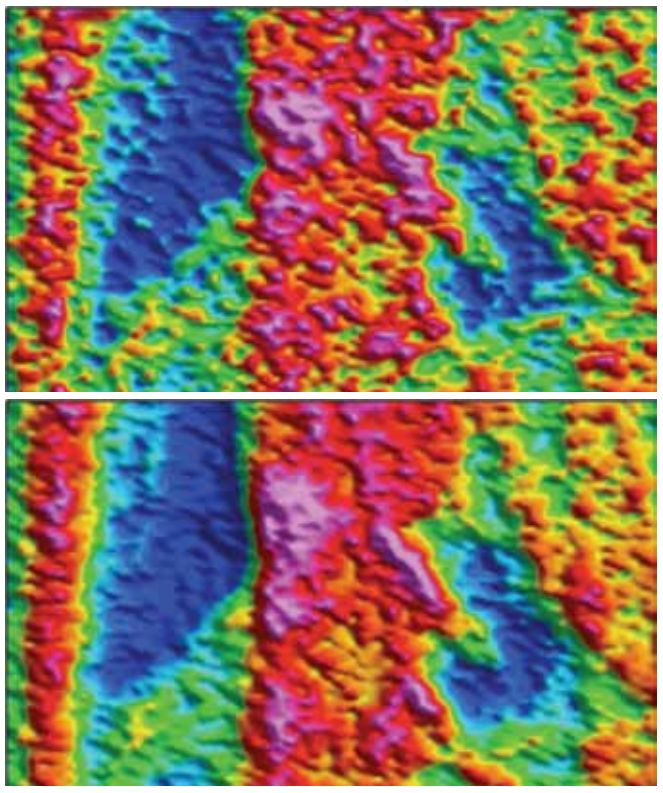


Figure: Simulated vertical gravity gradient response from near-surface geology and deeper basement sources degraded with the noise characteristics of (top) FALCON and (bottom) the recently released FALCON Plus system. Color code: blue represents low-value gravity gradient, red represents high-value gravity gradient. (Images courtesy of CGG)

FALCON Plus also allows for the detection of ever-smaller geological features, with the technology currently being trialed for detection and avoidance of near-surface cavities when drilling in karst terrains.

Additionally, the higher accuracy of FALCON Plus compared to conventional airborne gravity results in superior mapping of basement topography to depths exceeding 6,000 m (19,685 ft). This information can be used to de-risk further exploration efforts by optimizing the layout of any subsequent seismic data acquisition programs. This approach has been taken recently by Australian petroleum explorers who have used FALCON Plus to rapidly and cost-effectively map the basement structures over large areas of Western Australia. These exploration companies played a vital role in allowing CGG to refine the workflows associated with the low-noise characteristics of FALCON Plus.

Areas of remote and rugged topography, such as in Papua New Guinea or the South American Andes, can pose significant challenges for ground-based gravity acquisition, to the point where it becomes unfeasible, either due to financial costs or unacceptable occupational risks. CGG's FALCON technology can overcome these hurdles, and in areas of extreme topography HeliFALCON can provide near-perfect terrain-following capabilities. This enables collection of safer, faster and more accurate gravity data.

Visit CGG at booth 440 for its Happy Hour on Wednesday, June 3, and learn more about FALCON Plus during its 17:00 presentation. ■

AquaGeo and YMG Form Partnership

Aqua GeoProjects, based in Cornwall, U.K., has formed an exclusive business agreement with YMG (Yumzmoregeologiya), located in Gelendzhik near the Black Sea. YMG is active in the offshore geophysical industry, possessing four specialized marine vessels and an extensive suite of proven exploration equipment. The objective of the new agreement is to offer the global oil and gas sectors a turnkey and cost-efficient exploration service aimed at acquiring seismic data in marshland, transition zone (TZ) and shallow-water locations.

YMG has successfully completed a number of TZ and shallow-water exploration projects and hydrographic surveys in water depth of 0 m to 20 m (66 ft) with excellent data quality and coverage. Extensive operations have been mobilized in areas hard to reach by man, with a dedicated team, modern equipment and operating techniques. ■

Depth Domain Inversion

Amplitude inversion technique can improve the fidelity of rock property estimation.

CONTRIBUTED BY SCHLUMBERGER

Conventional methods of amplitude inversion assume that amplitudes in the seismic image are correctly located and can be inverted to elastic parameters from which a true representation of rock properties can be derived. However, complex geology, often combined with limitations imposed by surface seismic acquisition geometries, can lead to inadequate illumination of subsurface targets, which can have detrimental effects on the amplitudes and phase of the migrated image.

Conventional amplitude inversion techniques do not compensate for these amplitude and phase variations. Consequently, imprints of nongeological effects, including illumination, in the results of seismic inversion will lead to less reliable estimation of acoustic and elastic parameters, and attributes derived from these parameters will not accurately represent the properties of the corresponding lithology. An additional challenge to accurate amplitude inversion in complex geologic environments is that depth imaging is normally required to obtain a reliable image of the subsurface, while current amplitude inversion techniques are usually implemented in the time domain. This difference in approach between the imaging and inversion steps can compromise the fidelity of the attributes derived from seismic inversion.

To improve consistency between structural imaging and rock property estimation, Schlumberger has developed a technique to perform amplitude inversion directly in the depth domain. The new Schlumberger Depth Domain Inversion Services uses point-spread functions to capture and correct for space, depth and dip-dependent illumination effects resulting from the acquisition geometry and complex geology. The output from the Depth Domain Inversion is either a reflectivity image corrected for these illumination effects or, if appropriate well data are available for calibration, a reflectivity image and the associated absolute acoustic impedance (AI) volume. Additional constraints that can be included in the objective function relate to sparsity of the reflectivity model; lateral continuity of the output along the geological structure; and deviation from a prior low-frequency model. There also is the option to include more sophisticated physics to incorporate ghost effects or attenuation effects. Including such aspects within the inversion provides a mechanism to produce an even higher fidelity reflectivity image.

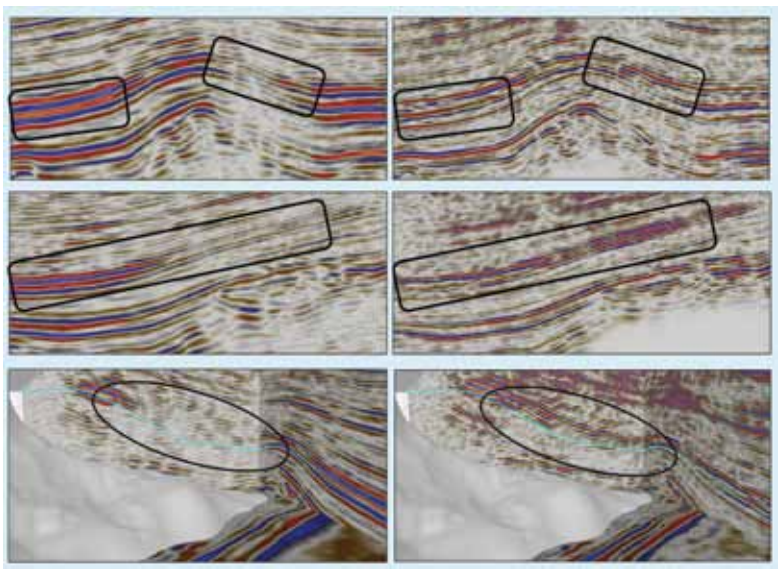
The new Depth Domain Inversion Services workflow has been applied to part of a dataset from the Green Canyon area of the Gulf of Mexico (GoM) that features thick salt sheets with complex morphology. Modeling studies have indicated that adequate subsalt imaging in such areas requires not only full-azimuth (FAZ) coverage but also long source-receiver offsets. Schlumberger has acquired and processed more than 30,000 sq km (11,583 sq miles) of long-offset (up to 14 km, or 8 miles) FAZ data—equivalent to almost 1,300 Outer Continental Shelf blocks—in its Revolution program of multiclient surveys in the deepwater GoM. The data have been acquired using the Dual Coil Shooting multivessel FAZ acquisition design, which involves two recording vessels with their own sources and two separate source vessels sailing in large interlinked circles. In addition to full 360-degree subsurface illumination, the configuration delivers a trace density about 2.5 times that of current wide-azimuth survey designs, which improves signal-to-noise ratio to further enhance the imaging of weak subsalt reflections.

Because of the high geological complexity of the salt overburden, the target in the study area had highly variable levels of illumination, leading to detrimental effects on the amplitudes and phase of the migrated image. Analysis of amplitudes extracted along key horizons showed a correlation with variations in illumination. Conventional amplitude inversion techniques do not compensate for these variations in amplitude or phase.

The new workflow was applied to produce a reflectivity image corrected for illumination effects that provided improvement in the continuity of major events. A significant increase in bandwidth delivered overall sharpening of the reverse time migration (RTM) image, revealing details of minor events previously unseen. The workflow also produced an AI volume corrected for the imprint of the acquisition geometry and complex overburden, enabling an improved structural and quantitative interpretation, compared to the time domain inversion.

Further details of the technique and data examples from the GoM case study are being presented in the paper "Depth Domain Inversion Case Study in Complex Subsalt Area," (which is being presented at 15:45 on Wednesday in Room N104) as part of a technical session on subsalt and sub-basalt exploration and development.

A special presentation on Schlumberger Depth Domain Inversion Services will take place followed by a cocktail reception at Schlumberger booth 940. ■



Example RTM images with source illumination compensation (left) compared to equivalent reflectivity images output from the Depth Domain Inversion (right) are shown. The black rectangles in the top and middle sections outline some high- and low-amplitude areas in the RTM image that have more balanced amplitudes in the reflectivity image. The area in the bottom panels outlined in a black oval is an example of where structural interpretation can be significantly improved after depth domain inversion. (Images courtesy of Schlumberger)

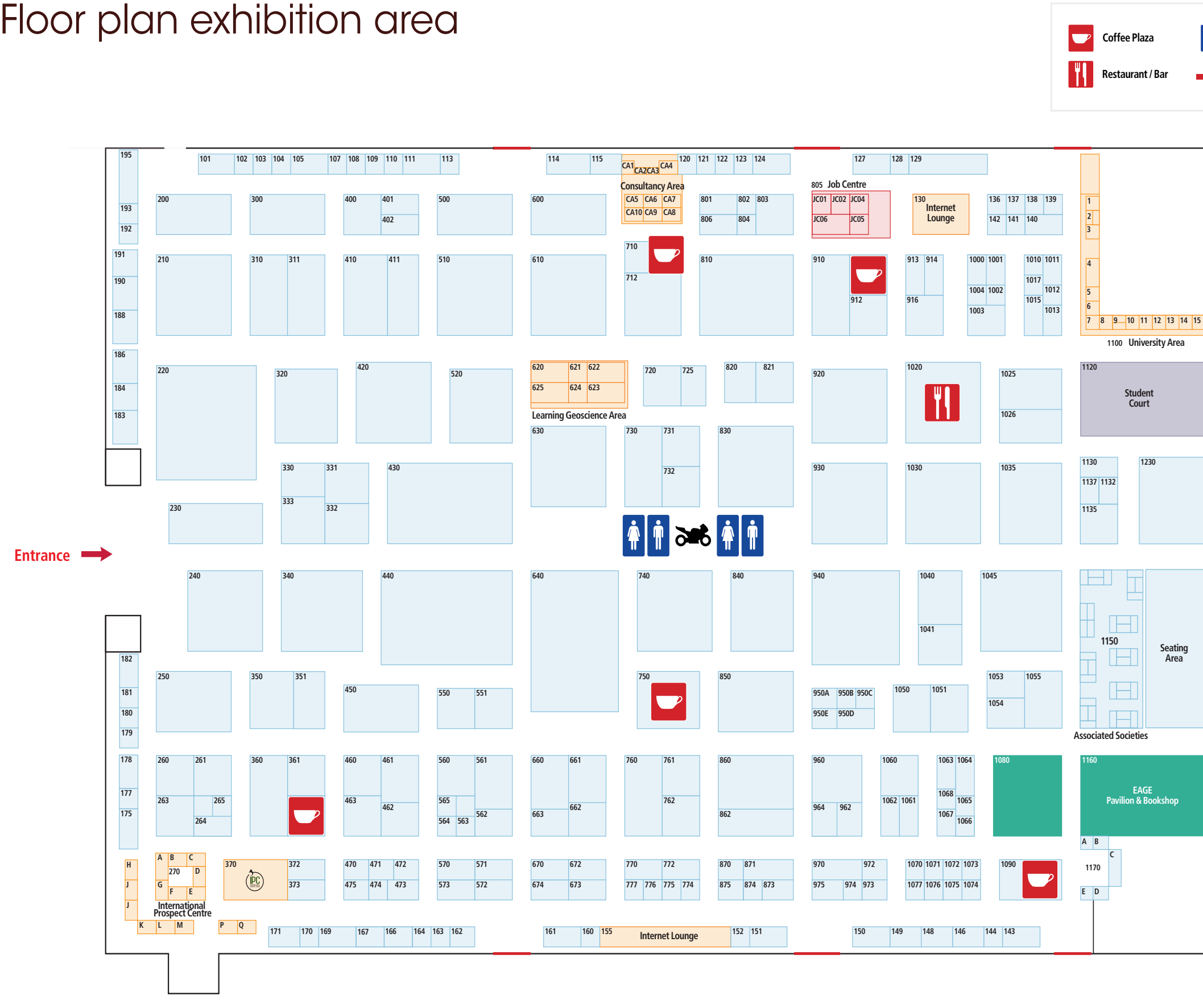
COLLABORATION continued from page 1

But while most forecasts indicate that oil and gas will still be major contributors to the energy mix as far out as 2040, there is sobering news as well. Haldorsen said that the price crash has so far resulted in 150,000 people losing their jobs. In response to this, SPE has added a link to its website listing 10,000 jobs globally. Combined with cost overruns and the complexity of the targets, the E&P sector needs an "extreme makeover," Haldorsen said. "We have to do something in every part of the business, whether it's geoscience, appraisal, field development, value creation, operations or production. We have to do it smarter, faster, cheaper and more sustainably."

This will require, he added, an "assembly line" of both incremental and disruptive technological improvements.

Finally, Haldorsen pointed again to the "systematic sugar-coating" of forecasts that are increasingly wrong and megaprojects that are consistently over budget. This would be a red card in European football, he said. Better collaboration would help companies come up with a more realistic base case. "We need to operate jointly on the patient," he said. ■

Floor plan exhibition area



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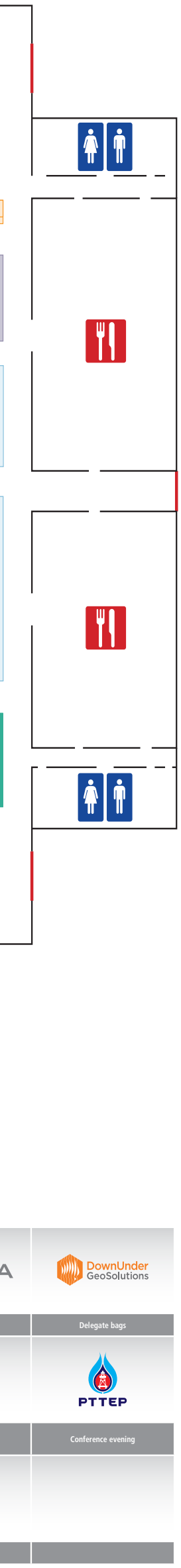

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