

# E&P DAILY NEWS

## 2014 EAGE Conference & Exhibition

OFFICIAL SHOW DAILY PUBLISHER OF THE 76TH EAGE CONFERENCE AND EXHIBITION

## Experience the Energy at EAGE

Key issues in the spotlight include soaring energy demand, workforce needs and where to explore next.

BY MARK THOMAS, EDITOR-IN-CHIEF

Welcome to the thousands of geoscience and engineering professionals who are gathering at the 76th EAGE Conference & Exhibition in the beautiful city of Amsterdam. An expected 7,000-plus industry experts alongside 350 exhibiting companies will be participating in the world's largest and most comprehensive multidisciplinary geoscience event. This year's EAGE conference program will tackle many of the biggest issues facing them all.

This will not be the first visit to Amsterdam for plenty of attendees. EAGE was last held here in 2009, but since then (and reflecting its international status) this annual conference and exhibition has visited the world-famous cities of Barcelona, Vienna, Copenhagen and London.

The main theme of last year's event in London was "Changing Frontiers," and this year the organizers have once again moved the debate forward to focus on crucial issues that affect all segments of this global industry. Under the general theme of "Experience the Energy," much of the conference program will concentrate not only on technical topics and challenges but also on wider issues.

According to 2013-2014 EAGE President Gladys Gonzalez, the opening session and a number of executive forums "will again allow us to address some of the wider issues that the oil and gas industry in particular has to confront. In this context, I am pleased to welcome the second

'Women in Geoscience and Engineering' session, which offers an open discussion on how our business can be made more accessible at every level to professional women who continue to be very much in the minority."

### Meeting the challenge of future energy demand

Gonzalez described the main theme as being "very current, as the main business of the meeting is how the multidisciplinary approach to oil and gas exploration and production fostered by EAGE can contribute to meeting the energy demands of the future. The role of fossil fuels and increasingly low emission and low carbon fuels are set to continue for decades in the global energy system simply by virtue of the investment needed for any alternatives to scale up to meet the demand."

The forecast investment needed to meet that demand is astonishing. According to the latest figures from the International Energy Agency, the world needs to spend more than US \$40 trillion between now and 2035 to supply enough energy to meet demand, with \$23 trillion of that to be spent specifically on fossil fuel extraction, transport and refining.

Experience will play an essential role in providing sustainable solutions, Gonzalez said. "A major priority is to build on the experience of our current workforce and sharing this experience with new generations of professionals who need to be brought up to speed as rapidly as

possible. It is already very clear that manpower shortage could be a major issue in the years to come, which is why we put such an emphasis on the student program and associated activities to encourage new recruits into the geosciences and related engineering," she said.

Gonzalez highlighted EAGE's constantly expanding student program, now a substantial event in its own right. "This is how it should be. One of our biggest priorities as an association must be to recruit and nurture young talent, and the industry sponsors who encourage these initiatives have to be thanked," she said.

Students are able to attend a myriad of short courses, workshops, trial interviews, debates, a geoquiz and more at this year's event.

See **WELCOME** continued on page 16



EAGE President Gladys Gonzalez  
(Source: EAGE)

## Knowledge Sweet Spots in Technical Program

EAGE's technical program is a virtual 'A to Z' of accumulated geoscience knowledge, reflecting decades of broad experience and know-how, combined with examples of the latest technologies and techniques.

BY MARK THOMAS, EDITOR-IN-CHIEF

With the exploration industry's need to pass on its experience and knowledge to its next generation of professionals and young leaders, this year's EAGE conference program has sessions on a wide range of key subjects.

The role of geoscience and engineering is central to the upstream sector's continued success in its multidisciplinary approach toward meeting future energy demand, and this is reflected in a technical lineup assembled by the Local Advisory Committee (LAC) that features 1,040 papers and poster presentations from more than 1,400 abstracts submitted—each a record number.

Subjects range from seismic acquisition, broadband acquisition and processing, reservoir characterization and seismic imaging to tight formations, unconventional reservoirs, CO<sub>2</sub> rock physics and chemistry, deepwater sedimentary systems, tomography and subsalt exploration. There are many more.

But it is that word "experience" that appears to be at the core of this year's event. "Experience will play an essential role in providing the solutions," according to Bruce Levell, chairman of the LAC. "A major priority is to build on the experience of our current workforce and sharing this experience with new generations of professionals who need to be brought up to speed as rapidly as possible. It is already very clear that manpower shortage could be a major issue in the years to come, which is why we put such an emphasis on the student program and associated activities to encourage new recruits into the industry."

### Accumulated experience

Levell added that events such as EAGE's annual meeting, with its comprehensive technical program, exhibition, workshops, courses and field trips, are also about understanding the accumulated experience of the past as a guide to the future.

The challenges ahead include increasing safety and en-

vironmental performance and reducing subsurface risk, he said. "To meet them, we need to know how we arrived at our current perspectives on the earth's subsurface, the equipment we employ, the workflows involved and the direction of research and development."

Three dedicated sessions complement this year's technical program and are open to all delegates. Tuesday's session is titled "Low Enthalpy Geothermal Energy in Northwest Europe" and will focus on studying the exploration for and use of low-enthalpy geothermal in a number of European countries. This has resulted in many feasibility studies and research projects as well as the drilling of dozens of new geothermal wells.

Typically, the targets are sandstone aquifers or carbonates. Since these same targets often are potential reservoirs for oil or gas, there are both the risks for potential interference and the opportunities for synergy with hydrocarbon E&P activities.

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## The Official Show Daily of EAGE 2014

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or at [epmag.com](http://epmag.com)

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NEW

# QuietSea™

## MARINE MAMMAL MONITORING SYSTEM

Sercel announces QuietSea, its new passive acoustic monitoring system designed to monitor the presence of marine mammals during seismic surveys. For environmentally responsible operations, QuietSea complies with the increasingly widespread marine mammals monitoring regulations worldwide.

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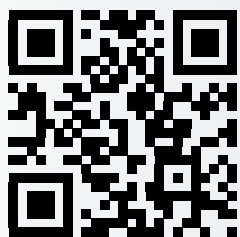
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# SCHEDULE OF EVENTS

## Tuesday, June 17

08:00 to 17:00	Registration
08:30 to 17:10	Technical program (oral and poster presentations, including student poster and ePoster presentations). <i>Conference area</i>
08:30 to 12:10	Dedicated session: Low Enthalpy Geothermal Energy in North West Europe (part I). <i>Room G106</i>
09:00 to 11:00	EAGE Forum: Experience the Energy—Doing More With Less. <i>Elicium 2</i>
09:00 to 15:30	Family members' tour. <i>Meeting point: K Entrance RAI (Main Entrance)</i>
09:00 to 17:00	Student registration. <i>Student court, booth 3100</i>
09:00 to 17:30	Student program. <i>Student court, booth 3100</i>
09:00 to 17:30	Exhibition.
09:00 to 17:30	Coffee Plazas opening hours. <i>Exhibition floor</i>
09:00 onward	Breakfast. <i>Exhibition floor</i>
10:00 to 16:00	Presentations at the International Prospect Centre Theatre. <i>Exhibition floor</i>
12:10 to 13:30	Senior Executive Managers Lunch (by invitation only). <i>Onyx Lounge</i>
13:30 to 14:30	Motivational Speaker: Roel Snieder—Leading the added-value life. <i>Student court, booth 3100</i>
13:30 to 15:10	Dedicated session: Low Enthalpy Geothermal Energy in North West Europe (part II). <i>Room G106</i>
16:00 onward	Afternoon drinks. <i>Exhibition floor</i>
17:30 to 19:00	Session for Professional Women in Geoscience and Engineering. <i>Room E103</i>
19:00 to 21:00	Technical Excursion: A Stone Walk in Amsterdam. <i>Meeting point: Dam Square, The Royal Palace</i>
19:30 to 00:00	Student evening. <i>Hotel Krasnapolsky</i>

For a detailed description of the program you can use the Amsterdam '14 app, or please refer to pages 12-14 of the EAGE catalogue for full descriptions of the EAGE highlights.

## Conference Highlights – Tuesday, June 17

### EAGE Forum: Experience the Energy—"Doing More with Less"

This year's EAGE Forum was scheduled for 09:00 on Tuesday. After introducing the panel members, the debate will be led by Mike Daly. The audience will be asked to participate by voting online to questions from the moderator as well as posting questions for the panel.

Moderator: Mike Daly (Oxford University)  
Panel members: Ceri Powell (Shell)  
Marc Blaizot (Total)  
Wouter van Dieren (Instituut voor Milieuen Systeemanalyse)  
Andrew Latham (Wood Mackenzie)  
Jose Luis Alcover Santos (Repsol)  
Mario Ruscev (Baker Hughes)

In all areas and on many levels the industry faces the challenge of doing more with less, including: more production with less cost; more work with fewer engineers; more complex operations in less time; more fractures with less water; more resource plays with less space; more production with less tolerance from stakeholders, etc.

The EAGE app will be used for online voting and posting questions. Free Wi-Fi will be available during the forum, which is open to all conference delegates.

### Session for Professional Women in Geoscience and Engineering

Following last year's success, EAGE will again offer a special session for women in geoscience and engineering. The session was scheduled to take place from 17:30 to 19:00 on Tuesday in room E103. The introduction will feature Gladys Gonzalez, the EAGE president from 2013 to 2014, and Mariella Amza-Prein, Paradigm Geophysical senior account manager and committee member for the Women in Geoscience and Engineering Special Interest Community (WGE SIC).

These sessions were scheduled:  
*Being a Woman in the Oil Industry: my Personal Experience*  
Speaker: Roberta Camuffo (Director Exploration North America & Brazil, Repsol)

*The Future Role of Women in Energy Business*  
Speaker: Intisaar Al-Kindy (Exploration Director, Petroleum Development Oman)

After the speeches, there will be time for discussion and networking.

This session is open to all conference delegates but in particular to female delegates.



# The Art of Broadband Seismic

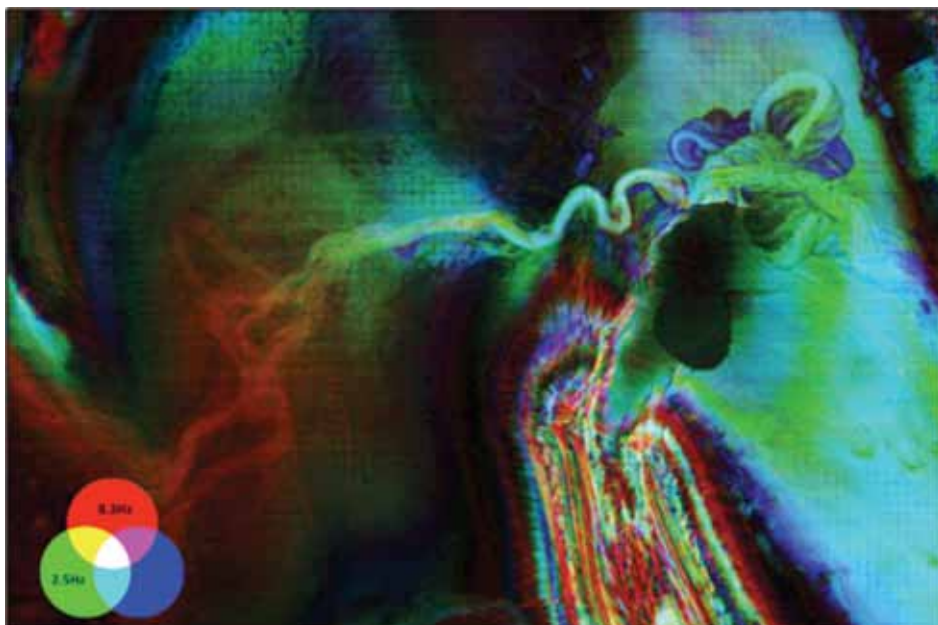
The full bandwidth and ultralow frequencies delivered by one broadband solution not only provide seismic artwork but also raise the bar in terms of subsurface information to improve interpretation and reservoir models and reduce risk.

CONTRIBUTED BY CGG

In recent years, the importance of low frequencies has been increasingly recognized at all stages of the E&P cycle. Low frequencies provide penetration beneath complex geology for better subsurface imaging, wavelets with minimal sidelobes for simpler and clearer interpretation, more detailed facies identification, better volumetric analysis and more accurate, quantitative inversion results.

At this year's EAGE, evidence of this can be found across a wide range of technical sessions and also at the workshop titled, "Broadband Seismic—What Can It Do For Me?" The workshop was scheduled for June 15 with time allotted for both interpretation and reservoir characterization benefits.

So if ultralow frequencies below 5 Hz are a vital component of broadband marine seismic, how do we make sure we record real data in this range? The proprietary curved profiles employed by BroadSeis allow an exceptionally deep tow, which combined with the superior signal-to-noise properties of Sercel Sentinel streamers at low frequencies, enables good quality signal to be routinely recorded down to 2.5 Hz. When this is combined with optimal deghosting by Ghost Wavefield Elimination to exploit the receiver-



Color-blend 3-D visualization of 2.5 Hz, 8 Hz and 15 Hz dominant frequencies at 2.65 seconds, highlighting Upper Miocene channel systems and surrounding salt bodies in the Kwanza Basin. (Source: CGG Data Library)

ghost notch-diversity and the use of BroadSource, a multilevel, synchronized broadband source, to eliminate the source ghost, we can record data up to the recording sample-interval Nyquist frequency. This delivers in excess of six octaves (2.5 Hz to 200 Hz) of signal for the only full-bandwidth marine towed-streamer data commercially available today.

The benefits of broadband seismic images for interpretation are well established in terms of resolution and lithology discrimination. Differences in frequency content also can be used to differentiate between sedimentary facies. Offshore Angola, an important target is turbidite channels that were deposited locally on the Kwanza Basin margin and are potentially trapped around or beneath salt-related structures. Ultralow frequencies from full-

bandwidth data enable greater detail of the turbidite facies distribution to be highlighted.


The image shows an example of frequency decomposition of the ultralow frequencies in full-bandwidth data in the Kwanza Basin in Angola. The data have been decomposed into dominant frequency bands from 2.5 Hz to 15 Hz and then merged using a color-blend technique. A turbidite channel complex with various phases of sediment fill, meander growth and incisions can be identified clearly. This representation indicates the variety of channel facies and allows their detailed mapping. Without the ultralow frequencies (2.5 Hz), the red component would be missing so the channel architecture could not be delineated properly. This kind of information creates new opportunities to interpret and delineate complex reservoirs in areas such as West Africa.

In addition to the benefits of full-bandwidth data to reduce exploration risk, the same data can offer further benefits for field development. BroadSeis ultralow frequencies are ideal for high-resolution velocity model building with full-waveform inversion (FWI), and papers in Wednesday's "Multiparameter FWI" and Thursday's "FWI—Case Studies" sessions will showcase this application. Reservoir characterization also benefits from ultralow frequencies, which enable more stable and accurate quantitative inversion results, and improved lithology prediction, even in areas with little or no well control. More quantitative inversion results deliver better reservoir models for improved field development decisions. For those who missed Sunday's broadband workshop, daily presentations at the CGG booth theater will demonstrate the added value of BroadSeis for reservoir characterization using case studies.

The benefits of full-bandwidth recording for 3-D acquisition are even more important for 4-D reservoir monitoring. Quantitative 3-D inversion provided by ultralow frequencies translates into improved 4-D global inversion for better dynamic reservoir models, which deliver accurate, detailed images of fluid evolution to maximize production. BroadSeis variable-depth streamer acquisition has been proven for 4-D and can be matched to any previous baseline survey using an efficient workflow of co-datuming and deghosting. This is scheduled to be presented in Thursday's "Time-lapse Seismic Processing" session. Both BroadSeis and BroadSource are compatible with streamer and source steering, and BroadSeis-on-conventional acquisition matching is simplified by advanced, real-time quality control of reflection-point repeatability. BroadSeis provides the optimal baseline for future full-bandwidth monitor surveys.

The future evolution of BroadSeis will benefit from a wide range of ongoing innovation and development across the fields of equipment, acquisition and subsurface imaging to enhance interpretation, reservoir characterization and monitoring with the ultralow frequencies and full bandwidth that BroadSeis brings.

Visit CGG at booth 1220 to get a full listing of BroadSeis in the 2014 technical sessions and see daily presentations on the applications of BroadSeis for enhanced interpretation of South Atlantic Conjugate Margin plays, enhanced seismic imaging and broadband inversion to quantify and qualify your reservoir. ■



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# Reservoir Modeling at the Center of Decision-making

A reservoir modeling software enables users to create the geological model while conducting seismic interpretation and capture uncertainty during the interpretation phase.

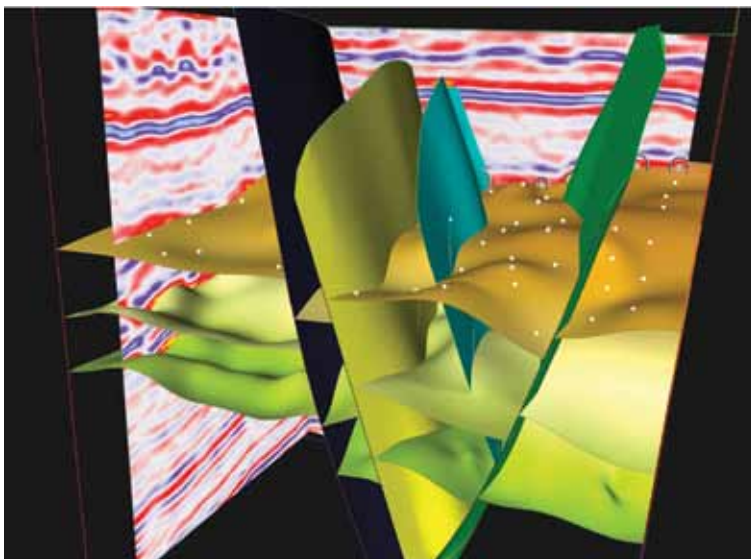
CONTRIBUTED BY EMERSON PROCESS MANAGEMENT

As the oil and gas industry moves into more complex tectonic settings, encounters more commercially complex prospects and looks to extend the life cycle of existing fields, the improved quantifying of geologic risk and uncertainty management remain among the biggest challenges facing reservoir modeling today.

Yet, to date, too many reservoir models have remained reliant on just a single model to risk predictions and are faced with inherent ambiguity in their data—data complicated by the bandwidth, resolution and migration issues affecting seismic. The result is configurations or scenarios that cannot be distinguished based on the data alone and a disparate seismic to simulation workflow.

It is the dangers of a disjointed and time-consuming workflow that can lead to a lack of collaboration between the geophysicists that interpret points at a seismic scale and the geo-modelers that try to fit the model to the interpretation and also can result in poor data quality control and the ignoring of crucial data and reservoir properties.

At EAGE this year, Emerson Process Management will be demonstrating how far reservoir modeling and characterization have come through a full seismic to simulation



Emerson's new model-driven interpretation capabilities are being seen within the latest version of its reservoir modeling software, Roxar RMS 2013. (Source: Emerson Process Management)

workflow where uncertainty is captured during interpretation and where the model is the interpretation.

This ability to quantify geologic risk early in the interpretation process and the integrated seismic to simulation workflow will have a strong future impact on the accuracy and effectiveness of bid valuations, new field development and operational plans, production estimates or divestments, and day-to-day reservoir management decision-making.

Emerson's new model-driven interpretation capabilities are being seen within the latest version of its reservoir modeling software, Roxar RMS 2013—launched late last year and already having an impact across the industry.

Roxar RMS 2013 enables users to not only create the geological model while conducting seismic interpretation but also capture uncertainty during the interpretation phase.

Rather than creating one model with thousands of individual measurements, RMS 2013 modelers create thousands of models by estimating uncertainty in their interpretations. The software then generates statistically significant ensembles of models based on these probability distributions, thereby providing immediate value to the geoscientist.

In this way, uncertainty maps can be used to investigate key risks in the prospect and other areas can be quickly identified for further study. Interpreters also can create models that more accurately represent the limitations of the data and the interpreter's vision for the geologic structure as well as having the flexibility to vary the uncertainty spatially depending on changing conditions in the data.

"Operators today have a number of key requirements when it comes to reservoir modeling," said Kjetil Fagervik, managing director of Emerson's Roxar Software Solutions. "They want seismic interpretation to be closely linked with geological model building; they want the best possible representation of all their data; and they want an integrated workflow from seismic acquisition right through to simulation that is defined by collaboration, knowledge-sharing and improved efficiencies."

The RMS 2013 software allows interpreters to guide and update their models directly from the data and this leads to improved quantifying of uncertainty and risk and better decision-making across the prospect life cycle, Fagervik said.

RMS 2013 represents just the starting point of a host of new developments during the next 18 months, designed around improving the software's interoperability, performance and usability.

The growth in cloud computing-based collaboration and information management also has significant potential applications for reservoir modeling, enabling users to collaborate in real time, access data at the same time and extend reservoir modeling further across organizations.

"Reservoir modeling sits as part of a much broader ecosystem that includes asset managers, auditors, advisers and senior managers—all of whom are responsible for making crucial decisions. Technology developments, such as cloud computing, will make reservoir modeling that much more accessible to these people," Fagervik said. "Cloud computing has the potential to usher in a revolution in how we handle, interpret and share reservoir models, and Emerson is determined to be leading the way in this area."

Reservoir modeling and characterization are undergoing changes like never before. For more information, visit Emerson at booth 1162. ■

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BGP is a leading geophysical contractor, providing geophysical services to its clients worldwide. BGP now has 51 branches and offices, 65 seismic crews, 6 vessels and 14 data processing and interpretation centers overseas. The key business activities of BGP include:

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- \*Reservoir geophysics;
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- \*Borehole seismic surveys and micro-seismic;
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## International Prospect Centre

For the first time, EAGE will organize an International Prospect Centre (IPC) and theatre at its annual exhibition. The IPC is a face-to-face networking opportunity and offers a program with presentations made by the participating licensing agencies or national oil companies (NOCs). Attendees can learn about forthcoming worldwide licensing rounds as licensing agencies and NOCs promote their exploration and investment opportunities, inform the industry on current and new exploration activities and announce licensing rounds. The IPC includes a theatre for live presentations and participants include: ANCAP, Croatia, Denmark, EAGE IPC, ETAP Tunisia, Greece, Lebanon, Malta, Norwegian Petroleum Directorate, ONHYM Morocco, Petroleum Agency South Africa, and Sonangol Angola. For timings please see the schedule on p3.





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# Arctic Exploration: Experience Drives Innovation

A company's experience has enabled it to develop technologies and processes that extend the operating season and allow efficient, predictable and safe acquisition of high-quality data near as well as under ice.

CONTRIBUTED BY ION

The Arctic Ocean contains an estimated 25% of the world's remaining hydrocarbon resources, and a growing number of major E&P operators are focusing on developing the area. Operating conditions can be hostile, and traditional seismic methods are only possible for a short season, typically one month to two months in some areas.

In the days of Scott and Amundsen, Arctic exploration required extraordinary bravery. Success was measured by how many lived to tell about it. Today, the key to success is well-informed circumspection, supported by meticulous planning and access to the right technology.

Planning a survey in the Arctic requires detailed knowledge and analysis of seasonal ice patterns over many years, enabling the selection of vessels that can maximize the probability of acquiring the required data within the season. ION's Narwhal for Ice Management system incorporates these and many other variables, providing unique tools to plan Arctic surveys and then guide full project execution. ION has more than 25 years of experience in delivering Arctic data acquisition systems and has been acquiring data in the Arctic for almost 10 years. The company's Arctic multiclient data library contains more than 70,000

km (43,496 miles) of high-quality basin scale 2-D seismic and more than 250,000 km (155,343 miles) of aeromagnetic and gravity data. This library covers the waters off the northeast coast of Greenland, the Chukchi Sea and both the U.S. and Canadian Beaufort seas. ION recently made available 17,000 km (10,563 miles) of data in the Russian sector of the Arctic. All that experience has enabled the company to develop technologies and processes that extend the operating season and allow efficient, predictable and safe acquisition of high-quality data near ice and even under ice.

The best way to work around ice is to avoid it, but when ice gets in the way, properly equipped vessels can still operate safely and productively. ION has developed specialized towing systems that allow equipment to be towed below the ice without causing damage to sources and streamers. Towing below the ice ensures cost-effective acquisition of high-quality, low-noise data. On a recent project, the company's crew acquired about 10 times the volume of data acquired by a competing crew working in similar conditions.

Although under-ice towing reduces streamer self-noise, noise created by the icebreaker as it fractures the ice, source-generated energy scattering off the ice can create significant challenges. ION's GX Technology data processing group



ION has Arctic seismic operations offshore Northeast Greenland. (Source: ION's GeoVentures division)

has developed specialized noise-removal techniques to ensure that high-fidelity deep seismic images are obtained.

In areas where access for seismic crews is challenging, potential fields data, such as gravity gradiometry, can be used to fill in the blank spaces between the lines of a 2-D seismic grid. This type of multimeasurement integrated interpretation proved very successful on a recent ION BasinSPAN project offshore Greenland. The company's SPAN programs can be used to build basin scale geologic frameworks and focus exploration budgets in the most prospective areas. ION is continuing to build its ArcticSPAN library of multiclient data and already is planning to move to the next phase of Arctic exploration by applying its skills and experience to 3-D surveying above the Arctic Circle.

To learn more, visit ION at booth 1445. ■

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## System Detects Marine Mammals During Seismic Operations

Sercel has released QuietSea, its new passive acoustic monitoring (PAM) system designed to detect the presence of marine mammals during seismic operations.

Unlike other separate antenna PAM systems, QuietSea is seamlessly integrated as an add-on within the Sercel Sentinel seismic streamer (Sentinel, Sentinel RD and Sentinel MS). This allows for greatly enhanced marine mammal detection capabilities in a wide frequency listening range that covers a large variety of vocalizing cetacean species. The system also benefits from synergies with the company's Seal 428 marine seismic recorder and the SeaPro Nav navigation system to accurately locate marine mammal positions.



The QuietSea's integrated architecture allows for easy and safe deployment, facilitating reliable operations. (Source: Sercel)

While enabling marine seismic contractors to fully comply with increasingly widespread marine mammal monitoring regulations worldwide, QuietSea also helps to optimize the productivity of marine seismic operations. Unlike other industry PAM systems, which carry the risk of their separate array becoming tangled at sea and causing downtime, QuietSea's integrated architecture allows for easy and safe deployment, guaranteeing reliable operations.

The system is a valuable tool for complementing the work of marine mammal observers during seismic operations. Its patented advanced and automated mammal detection and localization algorithms provide an additional, objective source of information for decision-making, particularly during nighttime operations.

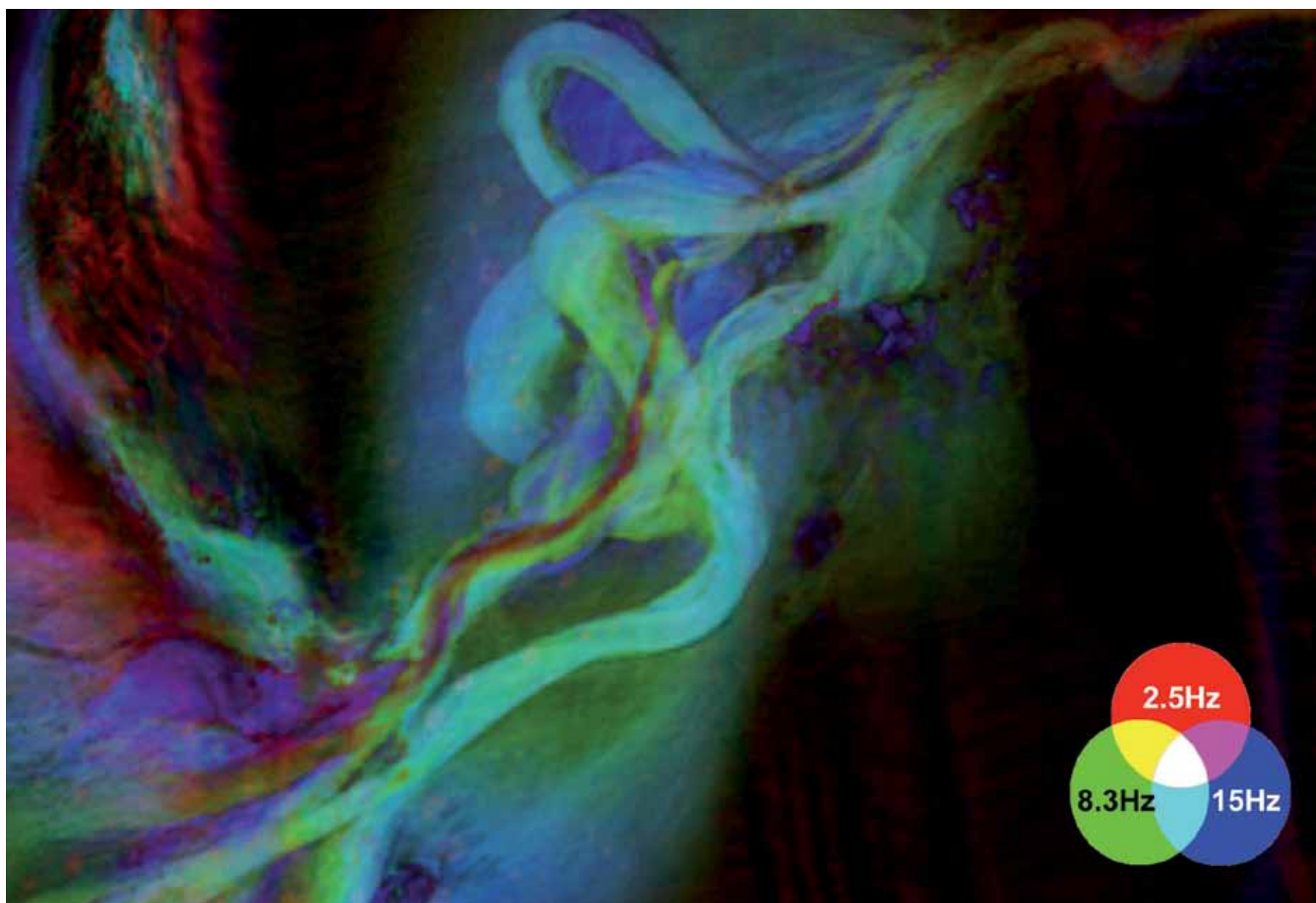
To learn more, visit Sercel at booth 1230. ■





# The Art of **BroadSeis**

Ultra-low frequencies complete the picture



In this fast-track data from our offshore Angola multi-client survey, frequency decomposition of the ultra-low frequencies enables the different channels to be disentangled to produce a more accurate reservoir model.

The ultra-low frequencies (2.5Hz) of **BroadSeis**<sup>™</sup> provide the stunning red channel in the image above. Without this broader bandwidth, it would not be possible to delineate the channel architecture properly.

Improve your ROI and create better development plans from more accurate reservoir models.

Contact us to see how ultra-low frequencies can define your reservoir.

Visit us at Booth #1220 at EAGE.

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# Extending Lower Frequencies in Onshore Surveys

Combined techniques to extend the lower frequency for onshore seismic surveys were applied in a subsalt area.

CONTRIBUTED BY BGP

It is crucial for broadband seismic surveys to get more low-frequency information. The low-frequency signals in seismic data can improve resolution, enhance deep reflection energy and provide better data for waveform and impedance inversion. How do we do it on land? After reviewing a conventional seismic survey, both seismic sourcing and seismic receiving might be improved to extend lower frequencies in the seismic survey. So an integrated solution for onshore low-frequency surveys is offered by BGP that includes both low-frequency sourcing and receiving.

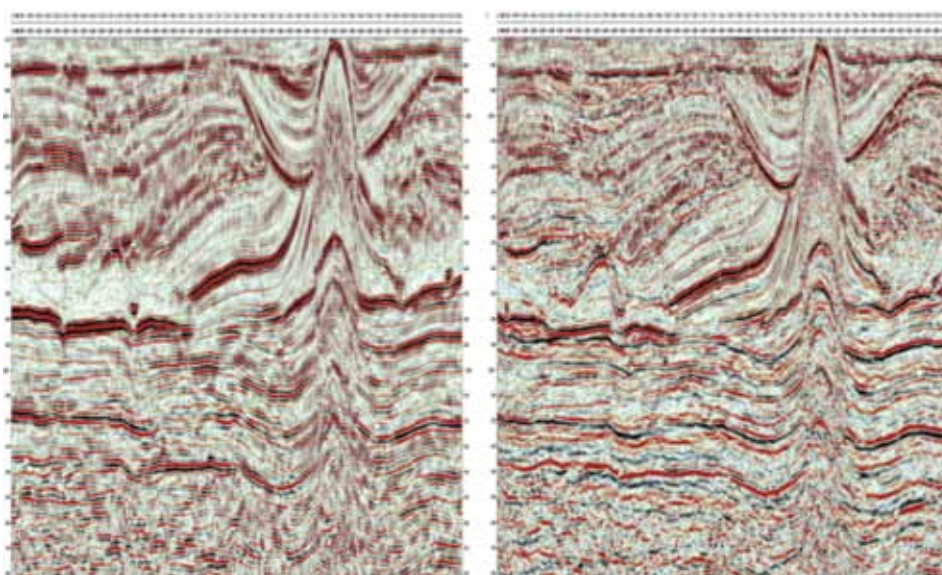
## Low-frequency sourcing technique

First, it is necessary to ensure that adequate lower frequency seismic energy is generated. Due to limitations of the mechanical system and hydraulic control system, the conventional vibrator is usually limited at 5 Hz or 6 Hz as the lowest sweep frequency. To extend the lower frequency, it must improve the performance of the vibrator to break the conventional limitation for a low-frequency survey.

A new-generation low-frequency vibrator, KZ-28LF-V3, was designed and developed by BGP and exclusively improves the lower frequency performance to 3 Hz with full force while also keeping other performances. The main improvements are:

- The maximum stroke is lengthened to 152 mm;
- Maximum displacement of the hydraulic system is expanded to 1,000 L/minute;
- The hydraulic system automatically converts the fluid flow as shaking requires; and
- The baseplate is renewed to improve the capability of coupling.

The solution is to design an exclusive nonlinear low-frequency sweep to further extend the lower frequency for the low-frequency vibrator. There is a low-frequency output characteristics curve for every type of vibrator due to the limitation of the mechanical and hydraulic system. The actual curve can be measured by a field test. This curve is provided as an input to KLSeisII-VibSig, a software prod-



Final prestack time migration sections are compared. The left window displays legacy 3-D data, while the right side illustrates the new 3-D data. (Source: CNODC)

uct developed by BGP to design an optimal low-frequency sweep. A nonlinear low-frequency sweep signal with 1.5 Hz of start frequency can be obtained for this type of vibrator. The final sweep signal will be further optimized and verified by a field test before applied in the production.

## Low-frequency recording technique

Usually, the resonance frequency of a geophone used in an onshore seismic survey is typically about 10 Hz. Due to the self-noise of a geophone, noisy artifacts at the low-frequency end will be produced simultaneously while the inverse filtering or deconvolution is used to compensate the low-frequency signals in geophone data. The method developed by BGP can estimate the lowest reliable frequency of signals in geophone data through analyzing the power spectral density ratio between data acquired by geophones and co-deployed broadband or low-frequen-

cy geophones. The exclusive software can design a suitable inverse filter to compensate for the low-frequency signals in geophone data according to the lowest reliable frequency value determined by estimating or scanning real data. This inverse filtering solution enhances the low-frequency energy of signal and avoids the noisy artifacts.

## Application in a subsalt survey in Central Asia

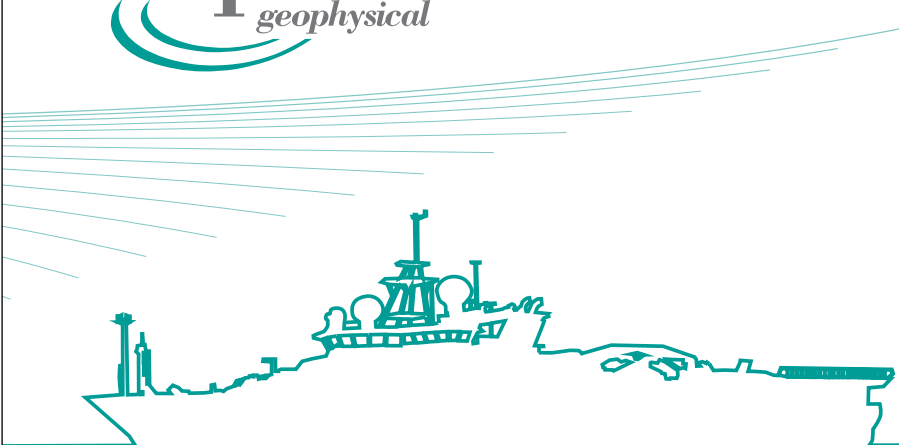

The integrated low-frequency solution, including the KZ-28LF-V3 low-frequency vibrator, low-frequency sweep design, low-frequency recording, and wide-azimuth and high-density geometry, was used to a secondary high-pre-

cision 3-D survey in a subsalt area in Central Asia, and it was the first industrial use of KZ-28LF-V3.

The 2-D comparison results between the conventional and low-frequency vibrator show that the low-frequency vibrator with lower frequency sweep acquires more abundant low-frequency data, and the boundary of the salt dome is clearer than the conventional survey. The stack sections by low-pass filtering show that the salt dome can be clearly identified below 2 Hz.


The comparison result of the final 3-D prestack time migration sections shows that new 3-D survey data provide better imaging for salt domes and better fidelity and signal-to-noise ratio for subsalt reflection events than the legacy 3-D.

The integrated low-frequency survey solution has been successfully applied and shows a satisfying result. For more information, visit BGP at EAGE booth 1450. ■




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## Students, 'Create Your Energy'

An extensive student program, this year under the theme "Create Your Energy," introduces once again many exciting educational and entertaining activities for gaining up-to-date knowledge and skills for students pursuing careers in geosciences and the engineering industry. The highlights include activities in the student court as well as student workshops, short course, student poster presentations, trial interviews, exhibition tours and much more. The student program is sponsored by Wintershall, ExxonMobil, Shell, Total, Statoil, BP, the City of Amsterdam and the EAGE Student Fund, including Shell and CGG.

### 'Create Your Energy' on bikes

This year's program theme "Create your Energy" is incorporated into the student court by the "Create Your Energy Challenge." Participants can compete in producing the most energy by biking under timing conditions. There are prizes to win for those who produce the highest amount of energy. Visit the student court for more information.

### Geo-Quiz

16:00 to 17:30, Student Court

Traditionally one of the most popular student activities to take place in the student court is the Geo-Quiz. It challenges university students to prove their geosciences knowledge and skills learned during the course of their studies. Up to 30 teams will be put to the test as they compete to outwit each other, striving to win prizes.

### Student evening

19:30 to 00:00. NH Grand Hotel Krasnapolsky, Dam Square, Amsterdam (entrance from Warmoesstraat)

EAGE invites all students to a spectacular night in one of the most iconic party venues in Amsterdam on Tuesday at the Krasnapolsky Hotel located on the Dam Square, directly opposite the Royal Palace of Amsterdam. The evening will provide an ideal opportunity to mingle with fellow students as well as with young and senior industry professionals. Enjoy great food and drinks, music and dancing.

The guest speaker of the evening, the Dutch astronaut André Kuipers, will give an inspirational talk about innovation and teamwork in the exploration of new frontiers. Kuipers will share some of the lessons learned around innovation and creativity from space exploration and will project those to the challenges and opportunities in oil and gas exploration. Kuipers is the first Dutchman with two space missions to his name. His second mission was the longest spaceflight in European history. In total, the ESA astronaut spent 204 days in space.

Please note that only the "student evening ribbon" in combination with your full delegate student badge will give you admission to the student evening. Students need to wear their valid badge in combination with their ribbon the entire evening.



# In an increasingly competitive business environment, explorationists are continuously looking for opportunities that others may have overlooked.

By Tom Ziegler, Vice President of Global MultiClient, Petroleum Geo-Services (PGS)

In a period of financial restraint and high levels of scrutiny over every project, exploration teams are finding it ever more important to be able to present their project recommendations with confidence. With so much competition in mature basins, there are many promising frontier areas which may seem attractive – but how do you build a strong case to pursue what could be seen as a more risky project? Conversely, in mature areas, how can you be confident that there aren't opportunities that others may have previously missed which might turn into significant discoveries if drilled?

Selecting the right seismic data is paramount and clearly not all data is equal. Obtaining data that is fit for purpose and which effectively images the target is critical. When you need high quality data at a high-risk phase of your exploration cycle, you'll also be looking for data that you know has been acquired and processed with the industry's most advanced technology.

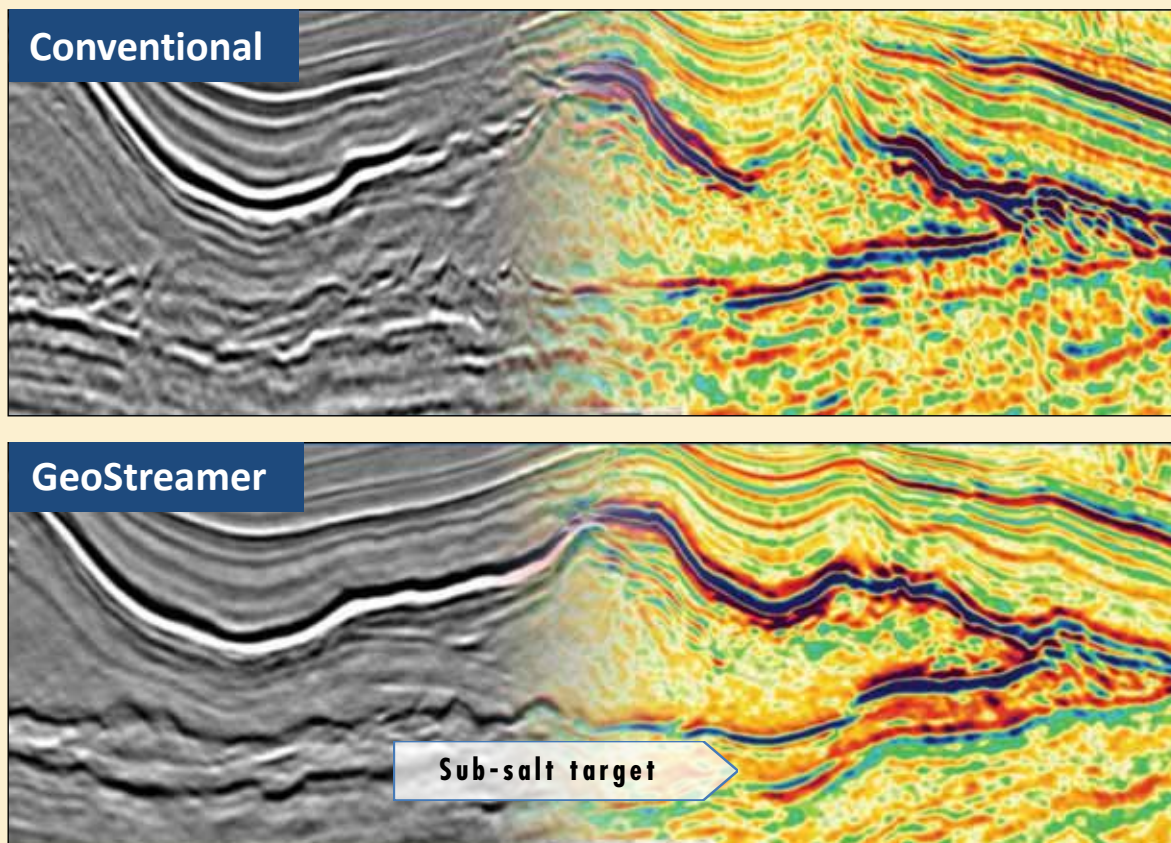
For PGS, it is core to our strategy to address risk, head on. We launched our unique dual-sensor towed streamer acquisition technology, GeoStreamer®, in 2007 to provide our E&P customers with more reliable data, enabling them to reduce the inherent risk of having to base decisions on poor and band-limited seismic. The response from the industry has been so positive that we have now deployed GeoStreamer across nearly our entire fleet of acquisition vessels, including the new Ramform Titan class. We use GeoStreamer extensively for both proprietary client surveys, as well as for building our MultiClient data library, resulting in recorded data that is richer in frequency content and ultimately enables better geological modelling and improved prospect definition and identification for our clients.

PGS are also exploration-focused in determining where to acquire new MultiClient surveys. We employ some of the world's leading G&G staff within our in-house Reservoir department who help us gain an understanding of subsurface prospectivity, guide our investment decisions, and help demonstrate the true exploration potential and value of our data library to our clients.

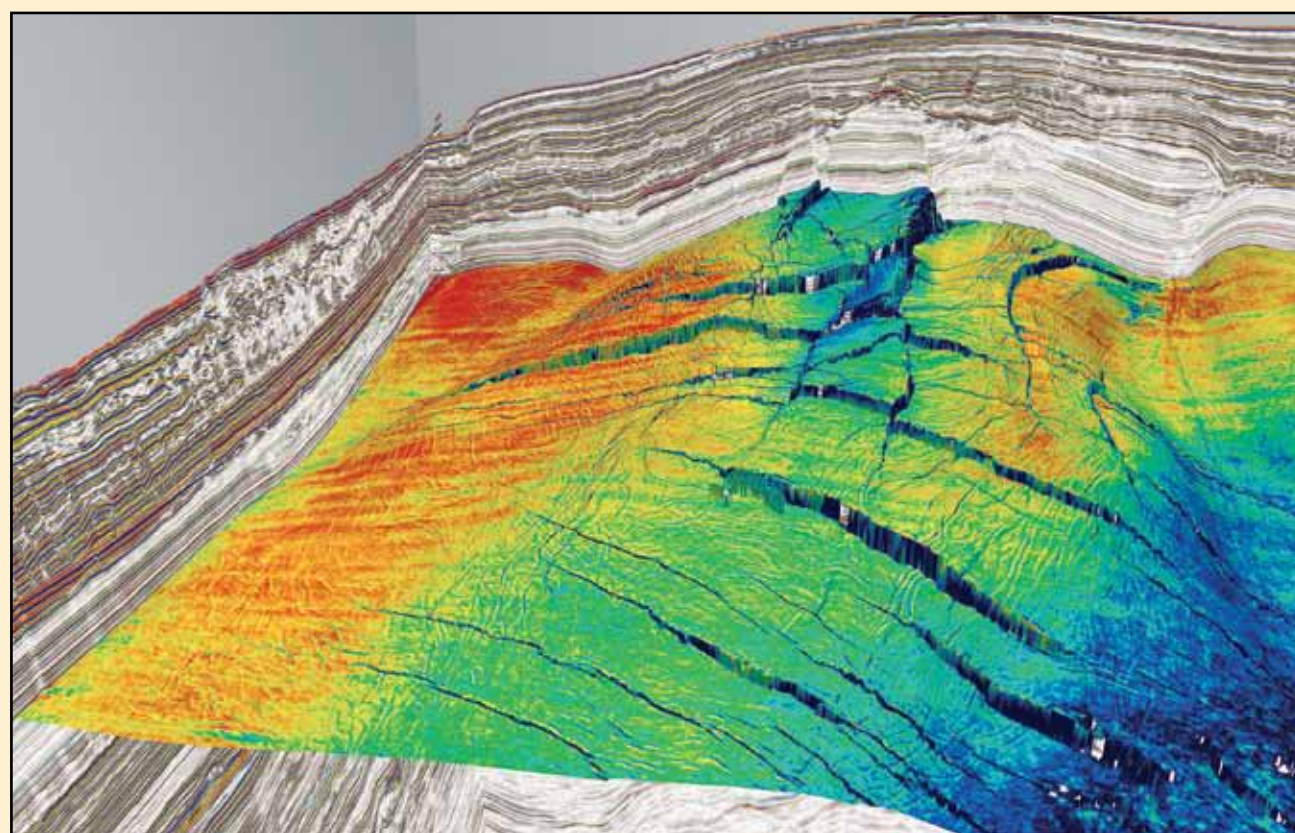
As a result, we are continuously building a diverse global data portfolio in many different exploration areas worldwide. Mature basins such as the North Sea, Norwegian Sea, Gulf of Mexico, and Australia are seeing new year-on-year acquisition of 3D GeoStreamer data by PGS, providing new insight and opportunities to the explorationist. GeoStreamer also provides a clearer image behind our 2D vessels in frontier basins such as Greece, East Canada, South Africa, and offshore Ireland.

With industry leading GeoStreamer data quality, the PGS MultiClient data library can help oil companies find new exploration opportunities and reduce their overall exploration risk – don't miss out – see us at the annual EAGE Conference & Exhibition in Amsterdam, 16-19 June, 2014. Amongst many PGS activities onsite, we'll be hosting data reviews for clients throughout the exhibition at set times or in private meetings at a time that suits your diary.

To learn more, please contact us at [globalmc@pgs.com](mailto:globalmc@pgs.com) or visit us at EAGE in Amsterdam on stand 1345. ■



The top image shows data acquired using a conventional streamer, the bottom image shows data acquired with the dual-sensor towed GeoStreamer – providing a clearer reservoir image. (Source: PGS MultiClient Data Library)



The PGS MultiClient data library offers global coverage and provides unparalleled access to exploration opportunity.

With nearly our entire fleet updated with GeoStreamer® acquisition technology, our surveys provide seismic data that have no comparison when it comes to imaging clarity.

To yield optimal returns on your exploration efforts, explore the world with us.

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# Dynamic Solutions for Unconventional Plays

Platform blends data management with applications in geophysics, geology, drilling, completion and production engineering to provide a unified analysis, interpretation and modeling system.

CONTRIBUTED BY LANDMARK

Profit margins in unconventional resource plays remain thin while the complexity and velocity of operations continue to rise. In some plays, a high percentage of perforations contribute little or no hydrocarbons to production. Since shale wells typically undergo rapid declines, the only way to sustain economic production is through increasingly aggressive drilling and completion activity.

As the intensity of operations escalate, however, shale operators might be reaching the limits of efficiency possible through innovations in horizontal drilling and hydraulic fracture engineering alone.

“To achieve the ROI [return on investment] that companies require today,” said Bill Ross, director of Geological and Geophysical Frameworks at Landmark Software and Services, “greater collaboration across disciplines is increasingly critical as well as more rigorous subsurface modeling and high-intensity well planning tools to target sweet spots efficiently and automatically.”

Landmark’s DecisionSpace platform provides a single-integration infrastructure to access the myriad of measurements—and databases—used in unconventional operations. It blends sophisticated data management with leading applications in geophysics, geology, drilling, completion and production engineering to provide a unified analysis, interpretation and modeling system.

“The DecisionSpace platform is the only multidomain workspace capable of handling the data growth swamping unconventional assets,” Ross said.

Once an effective means of integrating asset data are available, it is possible to create a high-definition digital subsurface model. However, this is not yet common in unconventional plays, Ross said. The engineering issues have received much more attention than the geology. “One of the biggest overlooked problems is how to keep the subsurface model fresh and relevant when so much new information keeps pouring in from the field, often in real time,” he said. Every additional wellbore provides not just a new data point, but a whole new dataset.

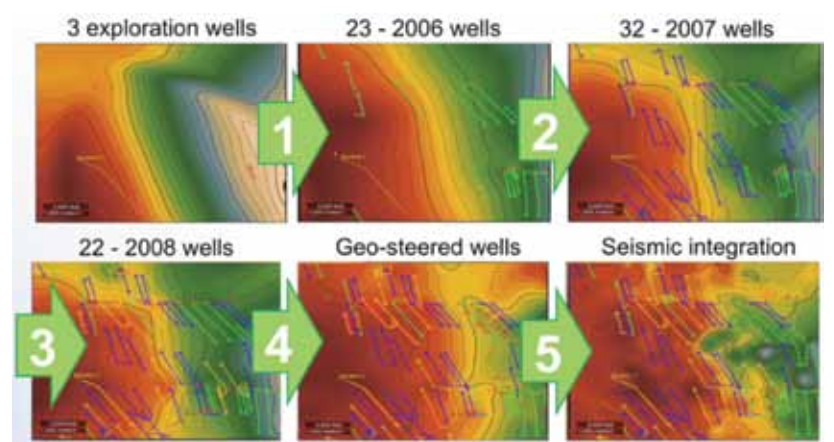
The DecisionSpace environment includes a unique modeling technology—Dynamic Frameworks to Fill workflow. It enables geoscientists and engineers to efficiently incorporate new information into a multisurface 3-D structural framework model that never gets out of date. “What differentiates the Dynamic Frameworks to Fill workflow is that we designed it from the ground up to update automatically,” Ross said. The system actively “listens” for new well data, geologic interpretations and newly interpreted seismic information. It has an intelligent topology engine that automatically calculates 3-D intersections among horizons, faults and unconformities, and then properly trims and seals them against one another.

Every surface in the sealed framework is dynamically linked to every other surface, and a single change triggers an instantaneous update to the entire model. “As a result, the model ‘learns’ and continuously improves with each well drilled,” he added, “which makes it ideal for fast-paced unconventional drilling campaigns.”

By integrating this evergreen 3-D framework with earth modeling technology, the DecisionSpace environment also allows geoscientists and reservoir engineers to populate or “fill” it with static or dynamic rock and fluid properties.

According to Ross, automated updating can accelerate mapping workflows by an order of magnitude—even in conventional plays. “One operator needed to map 10 unique reservoir properties over 14 distinct intervals, based on data from thousands of wells,” he said. “By replacing traditional gridding macros and property mapping techniques with Dynamic Frameworks to Fill workflows, geoscientists reduced the cycle time for each model update from two or three days to 15 minutes.”

In unconventional plays with hundreds of wells, thousands of data points and multiple-stacked reservoirs, this innovative technology can be even more valuable. Operators can



With Dynamic Frameworks to Fill workflow technology, new well and seismic data automatically refine the subsurface model, enabling operators to target sweet spots more precisely in subsequent wells. (Source: Landmark)

keep pace with aggressive drilling schedules, update the 3-D framework and maps with real-time LWD data and geosteering the drillbit to stay in the sweet spot.

To plan all those wells, operators also are turning to DecisionSpace Well Planning software, which seamlessly integrates geology and geographic information systems with directional drilling data. Automated multisurface field planning, visualization and optimization tools enable teams to rapidly design and refine pad locations, well spacing and complex trajectories. All workflows take place within the context of the dynamic 3-D framework, surface topography and user-designated “no-go” zones while adhering to rigorous drilling engineering constraints.

“By running multiple DecisionSpace Well Planning scenarios,” Ross said, “one large independent operator increased reservoir contact by more than 10,000 ft [3,048 m] in its shale asset, while simultaneously eliminating 16 wells and 22 pad locations from the original drilling plan. This saved millions of dollars in capital investment and dramatically reduced the operator’s environmental footprint.”

Learn more from Landmark at booth 1440. ■

## Ultrahigh Resolution Seismic Imaging Solves Industry Challenge

UHR3D provides resolution for imaging and analyzing shallow geohazards, 4-D imaging, shallow reservoir management and analyzing environmental safety concerns over a broad regional scale.

BY AL HISE AND DAN COOPER, NCS SUBSEA

High-resolution imaging of near surface seabed geology has long been an industrywide challenge, but today’s best available view of this geology is the product of P-Cable technology and the NavPoint Trawler integrated navigation and binning system. This combination produces an unprecedented ultrahigh resolution 3-D (UHR3D) image far exceeding conventional 2-D and 3-D high-resolution surveys methods.

Historically, the seismic imaging industry uses a single dataset or a combination of 2-D high-resolution seismic data, long-offset 3-D data reprocessed to high-resolution and sub-bottom profiler data. Unfortunately, none of these provide a sufficient high-resolution image of the shallow structure beneath the seafloor to meet today’s demands.

UHR3D provides the best available resolution for imaging and analyzing shallow geohazards, 4-D imaging, shallow reservoir management and analyzing environmental safety concerns over a broad regional scale.

Whether drilling, building out subsea developments or laying pipelines, mitigation of geohazard risks in the offshore production realm has long been a priority for operators. Knowing the extent of the geologic features just below the seabed is crucial to making informed decisions about where to conduct activities and perhaps more importantly, where not to. UHR3D provides a clearer, more detailed answer.

UHR3D seismic is not a new concept, but the progression of technology and the ability to process and interpret the data is now coming of age. Multistreamer ultrahigh resolution seismic acquisition has long been desired as it can provide true 3-D meter-scale resolution of the near seabed

geohazards, eliminating the unclear data and fuzzy decisions.

Only in the past several years has this technology come to fruition in the form of the P-Cable. The P-Cable technology offers a very efficient and robust UHR3D system that allows for cost-effective acquisition of data, with a larger footprint than standard 2-D site surveys and vastly improved resolution.

The key to achieving this vertical and spatial resolution comes from the design and configuration of the in-water spread. The chosen geometry includes 18 m by 100 m-long (59 ft by 328 ft-long) streamers with a group spacing of 6.25 m (20.5 ft) and a streamer separation of 12.5 m (41 ft). This array provides a natural bin size of 6.25 m by 3.125 m (20.5 ft by 10 ft), yielding fourfold data at 12.5-m shot spacing. The system can record at 0.25-ms intervals and process at a lower sampling rate to achieve the ultrahigh resolution image.

The P-Cable technology is only the first step in producing the best available image. NCS SubSea has developed NavPoint Trawler, a multipatented, precision, navigation and binning system for the P-cable technology. NavPoint Trawler provides a real-time GPS network adjustment of each element position in the array. The real-time binning allows on-the-fly steering and ensures complete coverage. The third step in the UHR3D process is the development of the data processing tools by Geotrace Technologies, to effectively process and render the data to its full level of resolution.

The culmination of all of this technology is SAFE-BAND, a regional geohazard imaging project for the multibillion market. Comprised of NCS SubSea (acquisition), Geotrace Technologies (processing) and Spec Partners (licensing), the program encompasses the central Gulf of Mexico, with acquisition beginning in June 2014. ■

## App Puts EAGE 2014 at Your Fingertips

During this year’s EAGE Conference & Exhibition, delegates will have the ideal navigation tool at their fingertips, because an improved version of the hugely successful mobile event app used at the 2013 EAGE in London is going to reappear at EAGE in Amsterdam.

The app will help conference delegates follow the interactive floor plan, network with fellow attendees, build their own schedule and find specific exhibitors. Information in the app will be updated regularly during the show.

The app also will contain a voting system that can be used at several sessions. This makes the sessions more interactive, and results will be shown immediately during the discussion. An overview of the session, which will include the votes, will follow.

The Amsterdam 2014 app will be available for all Apple/iOS iPhones and iPads, Android phones and Tablets, Blackberry phones and as a web app. Just download the app in the App Store or the Google Play Store under “EAGE Amsterdam 2014.” ■







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# Multiclient Program Benefits Stakeholders

Attribute analysis breathes new life into 2-D legacy data offshore East Africa.

CONTRIBUTED BY SCHLUMBERGER

The world's frontiers offer many challenges for both exploration companies and the nations who offer the operating licenses. Offshore East Africa is no exception. When little is known about a prospective basin, both parties risk overvaluing or undervaluing the offshore blocks from the standpoint of their potential and possible difficulties in the drilling environment.

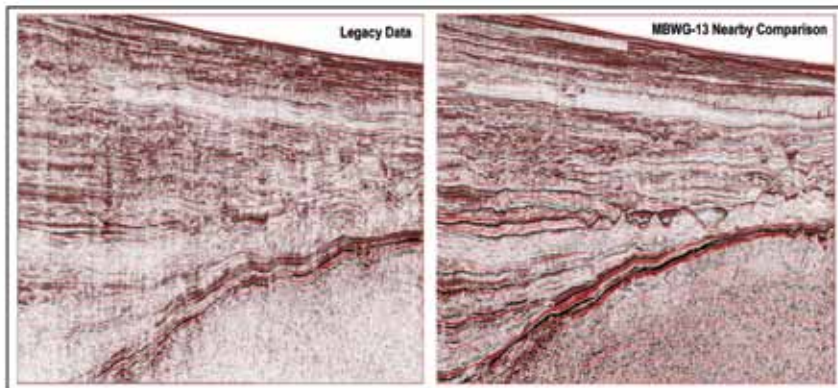
For centuries, the Zambezi River has carried rich organic material and sediment into the river's delta, which extends onshore and offshore to cover more than 100,000 sq km (38,610 sq miles). Experience proves that such a depositional environment can include rich reservoirs anywhere from near surface to deep basement rocks. Such is the situation in offshore Mozambique.

The Zambezi delta was explored in the past, with 2-D seismic acquired along with log data from legacy wells drilled onshore and a few wells offshore. In fact, in the last 30 years, 2-D seismic surveys have been acquired over certain portions of the area. However, the sparse legacy data and its relatively low resolution concerned the National Petroleum Institute of Mozambique (INP) and new ventures geoscientists looking to gather sufficient information to interest their companies in investing in the area. Neither side felt it had enough knowledge to adequately evaluate the potential of the basin, especially in deeper waters.

Schlumberger petrotechnical experts reinterpreted the legacy data using advanced attribute analysis. They concluded that the exploration potential of the basin was highly promising. Both the Zambezi River and Save River deltas possessed Precretaceous, Cretaceous and Lower Tertiary plays with both stratigraphic and structural traps. Three multilevel source beds were identified that correlated with onshore source rocks. Although the reinterpreted data were

enticing, more data of higher quality were essential before a proper licensing round could be planned.

To overcome the quality data challenge, the company in collaboration with INP, proposed to undertake a regional multiclient 2-D seismic program. The survey design was adjusted and expanded as clients had precommitted to the survey to meet their specific needs. Over a period of eight months during 2013, 30,000 km (18,641 miles) of seismic data were acquired, along with gravity and magnetic data. The survey spanned the entire Mozambique coastline and



The image computed from legacy data (left) is compared with the latest ObliQ marine broadband acquisition technique (right) from a nearby section. The latter demonstrates enhanced fault definition, higher frequency content and improved illumination of the base Tertiary channels. (Source: Schlumberger)

territorial waters and was subsequently expanded to 36,000 km (22,369 miles) to include acquisition in the deepwater Rovuma Basin.

Two vessels, the *Western Patriot* and *Pacific Falcon*, were used. Both of the vessels offered Schlumberger's Q-Marine point-receiver marine seismic system, augmented by the

latest ObliQ sliding-notch broadband acquisition and imaging technique. This technique acquires a wide band of frequencies from 3 Hz or 4 Hz to 190 Hz to provide high-quality data recorded to 12 sec in the survey.

The 10 km (6 mile) long single steerable streamers from each vessel could be positioned between 5 m to 50 m (16 ft to 164 ft) below the sea surface. The shallow end is closest to the vessel, whereas the deep end is closest to the tail buoy. In this case, the streamers were positioned between 8 m and 35 m (26 ft and 115 ft) below sea surface.

Quality assurance was made possible by onboard processing, and the 16,000 km (9,942 miles) of prestack time-migrated data were delivered to precommitted clients in a timely manner. Onboard processing also provided the opportunity to review the data and infill any prospective opportunities while the vessels were still on location.

The new high-quality seismic data assisted in reducing exploration risk for the upcoming licensing round. The clarity and scope of the new survey, complemented by the relationship with the legacy data, enabled exploration companies to understand and properly evaluate the potential of the basin. Structures were profiled and potential traps identified.

The Mozambique multiclient data are offered exclusively by the Schlumberger multiclient group to exploration companies interested in acquiring blocks in the forthcoming Mozambique licensing round.

For more information on the Mozambique multiclient survey, visit Schlumberger at booth 1405 or [multiclient.slb.com/mozambique](http://multiclient.slb.com/mozambique). ■

## Software Combines Static Models, Connectivity Information

Connections should be tested in the static model before undertaking dynamic simulation.

CONTRIBUTED BY GEOVARIANCES

Connectivity analysis improves static model quality control as it allows checking its consistency with dynamic data at a very early stage and identifying potential issues before starting time-consuming flow simulations. It facilitates communication between geomodelers and reservoir engineers by defining and quantifying the impact of geological parameters on wells connection. Connectivity analysis also provides some solutions to fix geological model inconsistencies and to ensure that the static model honors connectivity information.

From pressure and production history analysis, plus interference tests when available, it is possible to determine whether two wells are connected or not and if the production of one well has been and will be affected by the production of another well. Such information is required to anticipate and explain a well's behavior during the production history match phase.

Production history match optimization requires a good consistency between the geological static model and dynamic data. For this, it is at least required that the wells identified as connected from dynamic synthesis are really connected in the model.

This is why it is strongly recommended to test the connections between wells in the static model before dynamic simulation initialization. It means that dynamic synthesis (basic reservoir engineering) must be carried out at the same time as the geological study, before the geological modeling phase.

It must be kept in mind that there is no geostatistical algorithm currently available in commercial software, which is able to automatically honor connection data. This issue can be addressed with Isatis by mean of specific workflows mixing geostatistical techniques, mathematical morphology algorithms and grid management tools.

Such workflows have been implemented in Isatis, the Geovariances flagship software solution, and can be easily automated using batch procedures.

In Isatis, connections are tested by calculating connected bodies in the geological model. Such bodies are continuous geobodies made of grid cells of similar properties (i.e. with same facies or same permeability range) that are connected by one face. Isatis also allows taking faults into consideration.

A stochastic connectivity analysis, consisting of testing connections between wells in several equiprobable realizations of a geological model and in analyzing the sensitivity to model parameters, provides key information about the model consistency. When the model does not honor connectivity data, such an analysis is of primary importance to define the most relevant technique for solving the problem.

If adjusting the geological model parameters is not sufficient for fixing problems, then a method based on the probability of grid cells to belong to a connecting geobody can be used. It ensures that realizations will honor connectivity data and that the geological model's main characteristics will be preserved.

In the end, additional post-processing with mathematical morphology tools helps characterize the quality of the connection between wells.

To learn more, attend the Geovariances presentation titled "Conditioning Static Models with Connectivity Information," scheduled for 16:45 on Thursday, June 19 in room G104, or visit Geovariances at booth 1005. ■

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# Electromagnetic Data—A Perfect Partner to Seismic

Integrating EM data in the exploration workflow allows a better classification of the prospects in an area by downgrading or upgrading the probability of finding hydrocarbons in the reservoir.

CONTRIBUTED BY EMGS

For all the benefits seismic technologies have brought to oil and gas exploration and field appraisals, operators today need to access a variety of data sources and technologies to develop a complete picture of the subsurface and its economic potential. Chief among these additional technologies is 3-D controlled source electromagnetic (CSEM) data—acquired and interpreted by EMGS.

Using the most common exploration workflow that heavily relies on seismic data, significant uncertainties abound. There's no doubt that seismic is effective in providing structural and stratigraphic information as well as volume estimation parameters such as gross rock volumes. Seismic also has seen significant advances in areas such as amplitude vs. offset (AVO) and seismic inversion.

Yet, despite these advances, seismic data continue to have difficulties in telling interpreters about the fluid content and the potential hydrocarbon volumes within the reservoir. This brings with it the danger of operators identifying a prospect with what appears to be strong seismic, AVO and geological potential but failing to predict the fluids. Such uncertainties can have a significant impact on predictions of the economic viability of the reservoir.

It's in addressing these uncertainties that electromagnetic (EM) data is playing an increasingly influential role as a valuable addition to the existing exploration workflow.

Three-dimensional CSEM surveys map resistive bodies in the subsurface. The larger the resistive body, the greater the response. The CSEM signal is driven by the size (area and thickness) of the resistive body—two important parameters that tend to be associated with the highest uncertainties in reserves estimation.

Integrating EM data in the exploration workflow allows for a better classification of the prospects in an area by downgrading or upgrading the probability of finding hydrocarbons in the reservoir and improves the evaluation of the size of the accumulation.

Subsurface resistivity is being used today to improve play and prospect evaluation and well positioning, optimize portfolios, define appraisal programs, characterize gas hydrates (either as drilling hazards or for commercial exploitation) and for structural imaging in salt and basalt environments.

EMGS will demonstrate how EM surveys are significantly improving E&P workflow performance at this year's EAGE. To date, the company has delivered more than 700 surveys worldwide for many of the world's operators with four 3-D EM vessels.

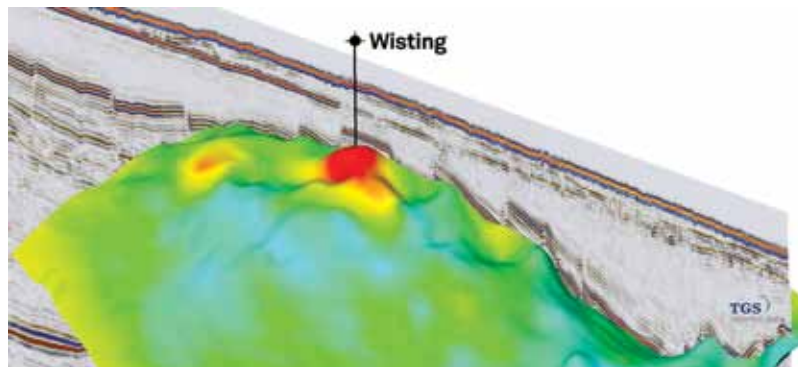
Prospective salt and basalt provinces also present a huge challenge to seismic's ability to image below or adjacent to such hard lithology. Seismic struggles to properly position the base of salt or basalt due to refraction and scatter makes it difficult to build an effective velocity model—so critical to imaging capability.

EM data measure a different rock property and are unperturbed by the scatter and refraction that confounds seismic.

The base of the salt/basalt is accurately picked out in depth by the change of resistance and applied to the velocity model to improve the quality of the migrated image. EM structural imaging capabilities have been applied to some of the world's most difficult-to-image salt and basalt areas such as the Gulf of Mexico (GoM), Brazil and the Red Sea.

In the harsh and sensitive environment of the Barents Sea, EMGS and the EM data generated have played a crucial role in influencing lease sale decisions and reducing the occurrence of expensive dry holes and noncommercial discoveries. In an area of complex geology and where seismic data alone can struggle, multiclient EM data has improved the success rate of subscribing operators and has led to a new play type in the Hoop area as evidenced by the Wisting discovery.

In the case of the Skrugard and Havis discoveries (now the Johan Castberg Field), two adjacent dry wells could have been avoided with results correctly predicted by the EM data. Several E&P companies also have used EM data in their strategies for recent Barents Sea licensing rounds, and the integration of EM and seismic data have led to the correct



Three-dimensional EM resistivity surface and 2-D seismic (courtesy of TGS) at the Wisting Central well location in the Barents Sea is shown. (Source: EMGS)

prediction of six recent exploration wells.

EMGS also has played an important role in the GoM where an extensive 3-D EM program has lowered exploration costs and increased discovery rates for PEMEX. The Barents Sea, GoM, structural imaging and other case studies will be presented by EMGS during EAGE.

To find out how EMGS can reduce uncertainty in exploration and development strategies, visit booth 1125. ■

## Polarcus Opens for Business in Stavanger

Polarcus has opened its first office in Norway to better service and support the company's rapidly expanding operations across Norway. The new office is situated in the center of Stavanger at Reidar Berges gate 9 and complements the global network of regional marketing offices in London, Houston, Singapore, Moscow and Rio de Janeiro.

The company has had very close ties with Norway since its inception in 2008, including successfully listing its shares through an IPO on the Oslo Bors in September 2009 before commencing its first 3-D seismic operations offshore Norway in June 2010. Appropriately for a company built around an ethos of environmental responsibility, this first project was acquired for Gassnova SF, the Norwegian state enterprise for carbon capture and storage. Polarcus also built its two latest vessels, *Polarcus Amani* and *Polarcus Adira*, at the Ulstein Yard in Norway.

The company has continued to expand its footprint in Norway ever since, successfully acquiring both proprietary and multiclient projects in the Norwegian Sea and Barents Sea. Bengt Magnussen, Polarcus' newly appointed business development manager for Norway, is based in the new office in Stavanger. ■

Visit Ikon at the EAGE, Booth #1380


## PREDICT THE UNCONVENTIONAL

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The Present And Future Of GeoPrediction



# HD Recording System Delivers Data Faster

The transcription efficiency of an HDR system makes it a competitive choice as the trend toward high-receiver density and increased channel counts continues.

CONTRIBUTED BY GLOBAL GEOPHYSICAL SERVICES

Throughout the first half of 2014, Global Geophysical Services has observed a significant increase in the total channels per crew on a worldwide basis. While the industry has seen gradual increases in channel counts since 3-D acquisition began, norms for station counts had, until recently, typically remained within the range of 6,000 units to 10,000 units. However, crews using 20,000 channels or more are becoming more commonplace. This development reflects two underlying trends. First, international oil and gas producing companies are becoming more comfortable with the use of nodal recording systems, and second, the inherent efficiencies of nodal systems in difficult terrain are being reflected in the market. As this progression continues, companies are challenged to quickly deliver greater amounts of data. Global has overcome this challenge with the streamlined transcription methodology of the AutoSeis high-definition recorder (HDR) HDR-1C.

Recently, the company completed a project using 27,000 HDR-1C stations in the Llanos Basin of Colombia. This was the third proprietary project in Colombia for the same client. The first project, recorded in 2012, had a channel count of 13,000. Laying out and picking up an average of

more than 2,500 channels per day, the crew's 2012 productivity assured the client that the company had the necessary efficiency to roll through the much larger recording spread in 2014.

Global operations in Kurdistan also have followed the movement to increasing channel counts. The company recorded its first nodal 3-D in the country in 2012 with 6,000 HDR-1C channels. During the 2013 dry season, they recorded three additional 3-D programs with a maximum channel count of 15,000. The progression has continued this year with a project requiring 36,000 channels per crew and a staggering 50-line recording patch.

Demand for higher channel counts is generally driven by the need for tighter spatial sampling and/or longer crossline offsets. In the case of an ongoing Global job in Kenya, a shallow primary target horizon led to the client's requirement for a very high nominal density of 400 receivers per square kilometer (1,024 RP/sq mile). This is as much as 10 times the typical receiver density of a project designed for a deeper target. While the offset requirements in Kenya were relatively short, the extreme receiver density alone led to the need for a 20,000 channel crew. Similarly, the company recently recorded a prospect on the North Slope of Alaska, a relatively shallow primary target and secondary zones of

interest at depth. In this case, the combination of imaging requirements led to the need for a 34-m (110-ft) receiver point interval and 18,000 channels.

A key factor in the deployment of large channel count crews is the ability to efficiently transcribe large amounts of data from recording nodes to the processing disk. One of the proven advantages of the AutoSeis recording system is the highly parallel nature of its downloading panel, which typically consists of 40 or more USB ports that provide parallel access to a high-speed network switch. This data pipeline funnels raw data into the server and RAID storage at a combined throughput on the order of 1 terabyte per hour. This is particularly important for high productivity jobs where 1,000 to 1,500 high-definition (HD) recorders might be downloaded per day with a total data volume of 5 terabytes or more.

Furthermore, AutoSeis data is initially processed in the receiver domain allowing it to be finalized immediately upon offload. Other nodal systems subscribe to a cable-like paradigm, in which deliverable data are ordered in the shot domain, requiring the entire active patch to be offloaded before field data can be delivered as final. The limitations of the shot domain transcription method are exacerbated in high-productivity jobs. In contrast, the deliverable receiver data of the AutoSeis nodal technology decreases the time it takes to provide final data to the client, delivering data much faster than most nodal systems.

The transcription efficiency of the company's HDR technology makes the system a competitive choice as the trend to high-receiver density and increased channel counts not only continues, but also becomes the new norm in both traditional survey areas and difficult terrains made accessible by nodal systems. ■

The poster features a blue background with a grid of white squares. On the left, a globe is partially visible. In the center, a stack of green books is shown, with a white folder or map in front of them. The text 'EAGE' is in a yellow box at the top left. 'EarthDoc' is written in large, stylized white letters. 'Amsterdam '14' is in a blue oval, followed by 'papers are now available online!'. At the bottom, the website 'www.earthdoc.org' is on the left, and 'Knowledge empowers you' is on the right.

**EAGE** EAGE's Online Geoscience Database

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WELCOME continued from page 1

## Doing more with less

On an executive level, special sessions at the conference will see professors and senior industry executives discuss and debate crucial challenges such as how to do more with less, where to explore next and whether resource plays can be "sweet spotted."

The high-profile EAGE Forum on Tuesday morning will feature a panel of experts, including: Ceri Powell, executive vice president upstream international exploration at Shell; Wouter van Dieren, director at Instituut voor Milieu- en Systeemanalyse; Marc Blaizot, senior vice president exploration at Total; Andrew Latham, vice president exploration service at Wood Mackenzie; Jose Luis Alcover Santos, executive director, business development at Repsol E&P; and Mario Ruscev, vice president and CTO at Baker Hughes.

They will focus on how the upstream industry constantly encounters the challenge of doing more with less, including more production with less cost; more work with fewer engineers; more complex operations in less time; more fractures with less water; and more resource plays with less space.

## Where next for exploration?

The executive session on Wednesday titled "Exploration Frontiers—Where Next for Exploration?" will provide the background on making choices as to where to explore, with geological insights into vertical movements in the earth's crust and their exploration significance, while remaining grounded in regional prospectivity.

The following day, the debate titled "Can Resource Plays be Sweet Spotted?" will feature panelists from oil companies, service companies, universities and institutes. They will debate the relative merits of a statistical "factory" approach to resource plays vs. a deterministic sweet spotting approach.

EAGE is not, of course, all about the conference. The event always has provided a prime opportunity for the geoscience, engineering and academic community to get together, both formally and socially, in a welcoming technical and commercial environment.

Gonzalez said, "When staging an event in a great cultural and historic capital such as Amsterdam, it is almost superfluous to mention our social program, including our customary very special conference evening, but we know how important these less formal occasions are for the overall success of the event. So let's just say we are all lucky to be able to 'Experience the Energy' in a great setting with conference excellence." ■



# Airgun Engineered for the Marine Environment

The bandwidth-controlled airgun addresses concerns that high frequencies might disturb marine wildlife and also offers optimal imaging results.

CONTRIBUTED BY BOLT TECHNOLOGY CORP.

**B**olt has engineered a new type of airgun designed to reduce the potential impact of seismic acquisition operations on marine life while also delivering optimal bandwidth for subsurface imaging. Based on principles established through modeling work performed by WesternGeco, eSource is designed to reduce the high-frequency components believed to have most potential for causing disturbance to marine life while retaining the low-frequency components critical to seismic exploration.

The world's first statutory marine mammal mitigation measures were established in 1998 and were included in licensing agreements for U.K. waters. Other areas that have regulations in place include Australia, California, Gulf of Mexico, Brazil, Canada, New Zealand and Sakhalin. Key elements of these guidelines include visual observations and passive acoustic detection of marine mammals in the survey area. Soft-start procedures are commonly used, gradually increasing sound pressure levels with the intent of warning animals of pending seismic operations and allowing sufficient time for them to leave the immediate vicinity. There is a general trend toward increasingly stringent additional regulatory requirements, which might include reduced nighttime usage and total exclusion zones. Such restrictions are likely to increase survey cost and in some cases might prohibit exploration activities.

The release last year of the "Draft Guidance for Assessing the Effects of Anthropogenic Sound" by the National Oceanic and Atmospheric Administration has focused industry attention on the issue of high-frequency sound and its effects on marine wildlife. The estimated auditory band-

width varies for different marine mammal species. For example, toothed whales and dolphins fall under the mid-range while porpoises are in the high-frequency range. Research shows that the high-frequency mammals are potentially more sensitive to seismic disturbance.

Historically, the design goal for airguns was for ever-higher peak pressures, leading to pulses with unnecessarily steep rise times and increasing emission of high-range frequencies that are of no benefit to seismic imaging. The eSource airgun is designed to counter this trend and address concerns that high frequencies might disturb marine wildlife, while also offering optimal imaging results. The design allows a gradual release of air at a predetermined rate. Users can tune the spectral content of the pressure signal depending on the local mammal sensitivity and the geological requirements, with three different settings possible.

Extensive testing and signature analysis carried out over the last year indicates that the new airgun has the same proven reliability as existing models. The trials also identified where design efficiencies could be realized through the optimization of some components. As a result, an eSource unit is lighter than standard Bolt sources, which will ease handling. The airgun will use the same control interface as current Bolt systems and will be compatible with all existing airgun controllers. In addition, eSource will be compatible with existing arrays.



The new design of the eSource airgun means that marine wildlife will be subjected to less sound in the vicinity of seismic operations. (Source: Bolt Technology Corp.)

The output profile of the new airgun design means that marine wildlife will be subjected to less sound in the vicinity of seismic operations. High-frequency sensitive species will be particularly less affected because of this reduced exposure level as well as the reduction in peak pressure. The new airgun represents an example of the seismic industry's commitment to minimizing the potential impact of its operations. It could potentially unlock exploration activity in geographical zones previously restricted because of environmental constraints. Reliability tests are continuing; the airgun will be commercially available in 2015. To learn more, visit Bolt at booth 1180. ■

## New Features Make Exhibition Best Yet

The world of geoscience and all its cutting-edge technology will be displayed to delegates in one vast space at the 76th EAGE exhibition in Amsterdam, but look out for new features such as the International Prospect Centre, which will ensure that this exhibition is the best yet. Explore the exhibition to enhance product knowledge, see, touch, experience and understand new technologies, and meet the people behind the products. Share ideas with peers from around the world, and grow a network of invaluable contacts for benchmarking, partnering and building your company and career.



Scenes from the 75th Annual EAGE Conference and Exhibition 2013 in London. (Images courtesy of EAGE)

More than 350 companies will cover more than 11,000 sq m (118,403 sq ft) of exhibition space, including international oil companies, national oil companies, energy industry consultants, software vendors, service companies, equipment suppliers, research institutes, licensing agencies, governmental bodies and more. Plus, as usual, the EAGE exhibition will include areas of particular interest.

### Consultancy Area

Consultants have comprehensive knowledge of the upstream sector. They deal with field development planning, market research, risk management systems and also help their clients make critical decisions in organizing their business. Even a short stop at the Consultancy Area could be very beneficial.

### Job Centre

Looking for a new challenge in the geoscience industry? The demand for energy will increase and companies need talented people to help develop conventional and unconventional energy sources. Pass by the Job Centre and meet with recruitment agencies, oil companies and service companies.

### Learning Geoscience Area

Recent graduates must build on their academic education and become independent contributors in the workplace as quickly as possible, while experienced professionals must continue to learn and adapt to new technologies. Find out what the education and training specialists can offer at the Learning Geoscience Area.

### University Area

Stay up to date on new projects and latest R&D from universities. Institutes and universities are combined in one dedicated area at the exhibition, making it easier to make contacts with national and international universities.

### Additional Highlights

The exhibition will be a hub of networking and exciting product launches. Spend time on the exhibition floor to meet with exhibitors or stop by one of the coffee plazas to relax. In the morning, the coffee plazas will have a small breakfast, and during the day, professional baristas will make perfect espressos, cappuccinos and lattes. Recharge yourself and your electronic devices at the seating area where there is free Wi-Fi. Recap the highlights of the day at one of the coffee plazas during afternoon drinks. For more information on participants in any of these specialized areas, please refer to the EAGE app and program.



## Centralizing Global Rock Properties in One Open System

CONTRIBUTED BY IKON SCIENCE

Rock property data often are worked on and stored in discrete projects, usually developed by one individual covering his or her own specific play. But companies now have data for hundreds of different projects. The reality is that if the person or persons who actually worked on a rock project study were no longer active in the relevant business unit, there was little chance of reusing the knowledge. With the approaching "generation change" on everybody's mind, this is rapidly shaping up as a crisis.

Ikon Science has developed an open platform for all rock properties and associated data. The Ikon MetaStore enables users to search through their company's rock properties and knowledge base using an interactive map selector or by keywords of geography, rock age or facies, rather than by project. This allows geoscientists to both retrieve existing answers where relevant as well as find useful analogues.

The MetaStore also allows the combination of third-party data that have been acquired or purchased or that come from other software packages including Petrel (by Schlumberger), Paradigm or custom in-house software. Information from Ikon Science "Roknowledge" regional studies also can be added, comprising extensive regional rock physics and geopressure data and analysis. Taken together this content will significantly increase the potential to leverage knowledge and gain insights from all available data.

As well as making the platform commercially available, Ikon Science will be using the software internally to keep track of the thousands of studies that the company has completed for its global custom base. "We're going to be a super user of our own product" said the vice president of product strategy and marketing for Ikon Science.

The MetaStore search tool is Java based and works with most browsers on a computer or tablet device. It will have the option to be hosted via an internal or external cloud-based system. Companies with high security concerns often choose to operate such systems within their own corporate networks, while independent operators might use a secure cloud solution.

Visit Ikon Science at EAGE booth 1380. ■



# Designed for Seismic

New vessel suite aims to reduce slamming, help maintain streamer control, reduce noise in the seismic data and benefit crew safety.

CONTRIBUTED BY WESTERNGECO

This month saw the introduction of the world's first class of vessels specifically designed for 3-D seismic operations. *Amazon Warrior*, the first of this class, has completed sea trials and is now fully outfitted with seismic equipment and on its way to acquire its first survey in Equatorial New Guinea for Noble Energy. The naming ceremony and hull launch of the second *Amazon Class* vessel will take place this month and is scheduled to begin operations later this year.

Until now, seismic service providers have selected existing hull designs that they considered suitable for their operational needs and have then converted the decks to accommodate and deploy the large volumes of heavy equipment, typically including two or more arrays of airguns and at least eight streamers. A feature common to all of these hull designs is that they were originally optimized for purposes other than seismic operations—mostly for economic transit from one location to another at high-cruising speeds. By contrast, in addition to supplying the necessary pulling power, seismic vessels need to be efficient and cost-effective at their normal production speed of just 5 knots, which on average represents about 80% of their time at sea.

WesternGeco took a “bottom-up” approach to designing and building a new sustainable and efficient marine seismic platform capable of supporting all of its present and potential acquisition techniques for at least the next 10 years while also optimizing operational performance. This approach is consistent with the Schlumberger philosophy of maintaining competitive advantage through technological differentiation, HSE leadership and efficiency in different environments. While for most newbuilds the back deck and gun deck are designed to fit a hull, this project worked the other way around and with no such constraints. It started with defining the seismic elements and operational criteria for the working areas through extensive research and analysis, leveraging more than 80 years of worldwide operational experience. Next, starting with no preconceived

ideas, expert maritime engineers were tasked with designing a hull, propulsion system and the other vessel components required to optimally meet operational efficiency for the seismic requirements while also focusing on HSE performance.

The design process involved considerable input from experienced hands-on equipment users, and the WesternGeco HSE knowledge management database was used to evaluate and mitigate potential safety risks identified from a wide range of industry incidents and lessons learned over many years. Advanced 3-D visualization technology was used to create virtual versions of specialist working environments, where experienced maritime and seismic crews could provide realistic feedback on interim designs, considering practicalities such as the safe movement of people while handling equipment.

At 126 m (413 ft) long and 32 m (105 ft) wide, the *Amazon Class* vessels provide a large, powerful and stable platform for forward motion and manoeuvrability during operations in challenging environments. The entire hull was designed to reduce slamming, help maintain streamer control, reduce noise in the seismic data and benefit crew safety. There is capacity for more than 200 km (124 miles) of streamers and 18 streamer tow points. A “quad-deployment” design enables four streamers to be handled simultaneously. Ample working space enables safe and efficient at-sea reconfiguration of streamers suitable for a wide variety of acquisition geometries.

*Amazon Class* vessels are designed to be able to work worldwide in all operating arenas, including current and challenging frontier areas, and they incorporate many features that maximize environmental performance. They are designed to meet DNV CLEAN Class and CLEAN Design specifications and have ICE-1A class and Polar Class 7 for



The *Amazon Warrior* is the first of a new class of purpose-designed seismic vessels. (Source: WesternGeco)

safer Arctic operations. They will have a production endurance of 120 days, which is important in sensitive regions and remote exploration areas. Routine maintenance can be done during live operations and the docking interval is five years.

The propulsion system was designed to match the hull and includes independent, ergonomically designed port and starboard engine rooms. The system delivers optimum fuel performance for the towed footprint during seismic operations and also during the estimated project-to-project transit speed of about 17 knots. Full redundancy in the propulsion and steering systems means that normal production can be maintained in the event of a breakdown, which is important for production continuation and critical in mitigating safety risk within obstructed or environmentally sensitive areas.

WesternGeco is inviting conference delegates to its exhibition at 16:30 on Tuesday at booth 1405 to toast the launch of the world's first purpose-designed seismic vessels. ■



## EAGE Bookshop Set to be a Great Story

The EAGE Bookshop is getting bigger and better all the time, so attendees should take the opportunity to have a good look at the latest titles and bestsellers available at the 76th EAGE Conference & Exhibition in Amsterdam. The exhibition floor opens on Monday, June 16; from then on you will be able to view all the best-selling publications that EAGE has to offer at the EAGE Pavilion and Bookshop at booth 1590.

More than 500 top-quality scientific, academic and specialist geological publications are now available, including those published by EAGE under its own imprint. Also featured are works from publishing houses such as Cambridge University Press, Editions Technip, Elsevier, Springer and many more.

The amount of EAGE publications keeps growing. This year seven new books on a variety of subjects will be published, and six of them will be ready for perusal at the conference.

New publications to be found on the EAGE Bookshop shelves include:

- *Satellite InSAR Data: Reservoir Monitoring from Space*, a guided tour of InSAR and its applications, written by Alessandro Ferretti;
- *The Black Gold: Good for Another 200 years of Oil Extraction*, a critique of the oil and gas world, written by industry insider Herman van Kasteel;
- *Elements of Mathematical Sedimentary Geology: The GeoChron Model*, a book about “mathematical geology,” also known as “numerical geology” or “geomodeling,” written by the founder of the GeoChron model Jean-Laurent Mallet;
- *Integrated Geophysical Models: Combining Rock Physics with Seismic, Electromagnetic and Gravity Data*, an introduction to quantitative integration in geoscience with a particular focus on the integration of seismic, electromagnetic and gravity data, written by Paolo Dell’Aversana;
- *Full Waveform Inversion: Where are the Anisotropic Parameters Hiding?*, a gentle-yet-scientific introduction to full waveform inversion with a focus on its practical application to anisotropic media, written by Tariq Alkhalifah; and
- *Principals of Seismic Velocities and Time-to-Depth Conversion*, which comprehensively addresses the topic of time-to-depth conversion on the basis of true propagation velocities; it is by Mac Al-Chalabi.

Another reason to stop by the EAGE Pavilion and Bookshop is to exchange your voucher instead of the public transportation card. If you have chosen the voucher (which is worth 25 euros) instead of the transportation ticket, you can exchange it for a gift, a book discount, or donate it to support a student with his/her EAGE membership fee. You can collect your ticket to the conference evening at the pavilion. EAGE staff also will be available to answer any questions.



# Delivering Advanced Science to Everyone

The latest version of an integrated solution suite enables effective seismic data processing and imaging, velocity modeling and seismic interpretation.

BY RICHARD EPERJESI, PARADIGM

One of the greatest challenges facing software development companies in the oil and gas upstream industry is making the advanced technologies needed to handle huge amounts of data coming from complex geological environments easy to use and install. Product integration, automation and shared datastores are all key to enhancing the user experience. Together, they enable software providers to deliver advanced science to all users, from the interpreter performing daily tasks to the geoscience specialist.

With that in mind, Paradigm has recently released Paradigm 14, the latest version of its integrated solution suite. The focus of this release is the science and technology that enable effective seismic data processing and imaging, velocity modeling and seismic interpretation. With more than 700 new features and enhancements, Paradigm 14 applications streamline the entire upstream workflow, from processing and imaging to interpretation and modeling, reservoir characterization, reservoir engineering and drilling, and data management.

The integrated solution suite highlights enhancements to the company's processing and imaging solutions: Echos, GeoDepth and EarthStudy 360. Used together in an integrated workflow, these solutions deliver high-definition images that enable users to see the smaller features that are important in modern reservoirs. The solutions reduce risk by ensuring a clearer understanding of the subsurface and increasing the value of the investment in both legacy and modern seismic surveys. They also allow users to verify results from their processing partners. Among the critical capabilities offered by these solutions are:

- Overcoming acquisition limitations in surveys by mathematically repositioning sources and sensors into a desirable geometry with 5-D regularization;
- Improving signals and reducing noise in both marine and land surveys; and
- Defining geological features more precisely through more accurate velocity determination.

Paradigm 14 also enables efficient quantitative seismic interpretation workflows that allow interpreters to qualify amplitude prospects for hydrocarbon detection and identify sweet spots. These capabilities benefit users by improving efficiency and speed when identifying zones of interest. Benefits also include delivering faster identification of reservoir characteristics in cases of limited well control and tying seismic to well logs to better understand the aerial extent of reservoirs. Critical capabilities include:

- Defining rock properties using seismic inversion, seismic facies classification and on-the-fly calculation of complex trace attributes;
- Identifying fluids within the reservoir with amplitude vs. angle inversion and quality control (QC) of prestack data; and
- Predicting flow for well planning using full-azimuth fracture orientation and intensity analysis.

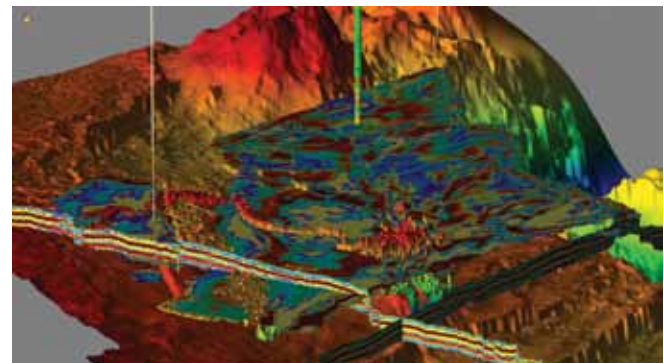
In this integrated solution suite, major upgrades have been made to GeoDepth grid-based and model-based tomography solutions. These include a new system for performing QC of residual moveouts generated from autopickers, with interactive exclusion of problematic residual moveouts based on quantitative criteria. In Echos, new job management features, a new 3-D radon transformation application, 5X performance improvements in 5-D data regularization and new correlation noise suppression options in Paradigm

Reverse Time Migration enhance the efficiency of processing geoscientists.

The GeoDepth Kirchhoff migration has a new graphical user interface and new aligned software components that improve memory management and integrated operations. Finally, the EarthStudy 360 full-azimuth angle domain imaging system includes improvements to imaging quality (acquisition footprint suppression), fracture and stress characterization fidelity and support for ocean-bottom cable acquisition data.

The company's SeisEarth interpretation and visualization solution suite improves efficiency when working with large data volumes, through roaming in rendering mode with volumes larger than the graphics processing unit's memory. The structural interpretation toolbox has been significantly expanded and includes both full support for multisurvey flattening and extension of the correlation polygon. New functionalities for picking prestack data support QC and seismic reservoir characterization projects.

Synthetic workflows for all interpretation and seismic characterization products have been greatly enhanced with improved layouts, new checkshot calibrations and new workflows when working with depth-migrated data. The release also provides support for full-seismic inversion



Seismic facies in SeisEarth 3-D Canvas. (Source: Paradigm)

workflows with Vanguard on the Windows platform.

As part of the ongoing Paradigm initiative to support production and engineering data, the Paradigm 14 release includes new displays for casing, perforations, core property data and gridding of time-based production data.

Finally, VoxelGeo users are now able to achieve more precise geobody detection results with extended support for more than 8-bit seismic volumes.

This release also eases product installation significantly, especially for single users, where installation is automatic with no configuration required. ■

## EAGE

EUROPEAN  
ASSOCIATION OF  
GEOSCIENTISTS &  
ENGINEERS

### About EAGE

- World's largest multi-disciplinary geoscience society
- Head office in the Netherlands with regional offices in Houten, Moscow, Dubai, Kuala Lumpur and Curaçao
- Two divisions: Oil & Gas and Near Surface
- Around 17,000 members worldwide (geologists, geophysicists and reservoir engineers)
- Conferences, exhibitions, workshops, publications, educational programmes, student activities, recruitment

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- Access to Members Only webpage (including member search)



The geoscience publication with around 17,000 issues each month



EAGE's Annual Conference & Exhibition 7,000 visitors



EAGE's Regional Conference & Exhibition



Annual Near Surface Meeting



EarthDoc, search scientific articles and event papers online

For a complete overview of all EAGE activities, please visit our website.

[www.eage.org](http://www.eage.org)

### TECHNICAL continued from page 1

The exchange of data, knowledge and experience in the performance of aquifers and reservoirs between both industries is resulting in new ideas and practices. This session is bringing together geoscientist and engineers from the industry, government and academia involved in this area.

Wednesday's session is concentrating on high-performance computing for geoscience applications. The aim is to review the current and future state of modeling and inversion implementations using hardware innovations.

Thursday's session, meanwhile, will focus on the use of production data in the geologic model. The integration of new data is not an easy task (e.g., due to scale issues), and this session will focus on practices used to integrate geological, geophysical and production data in a consistent manner to build or update a geological model. ■

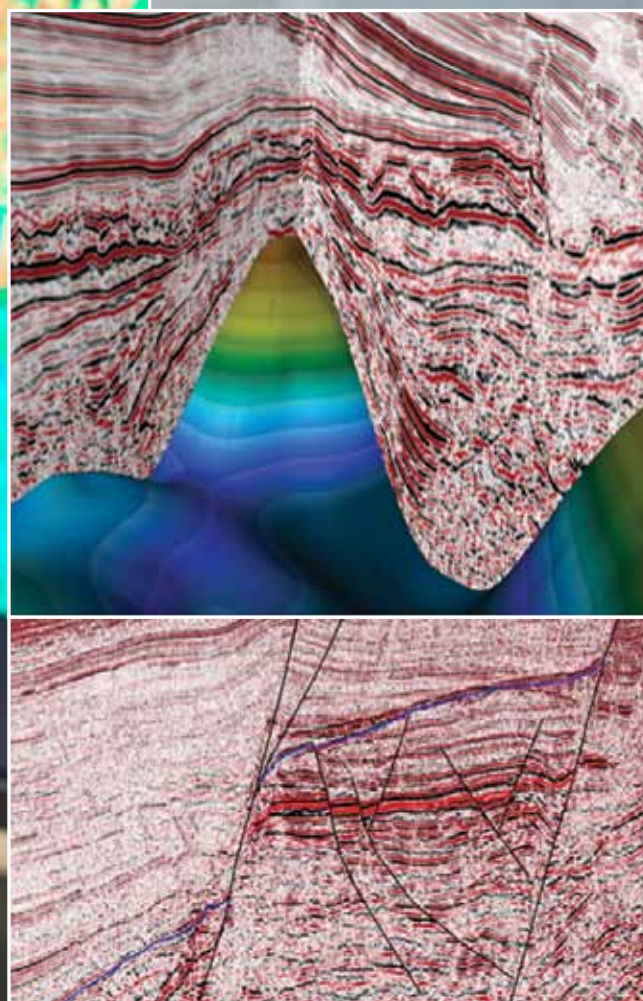
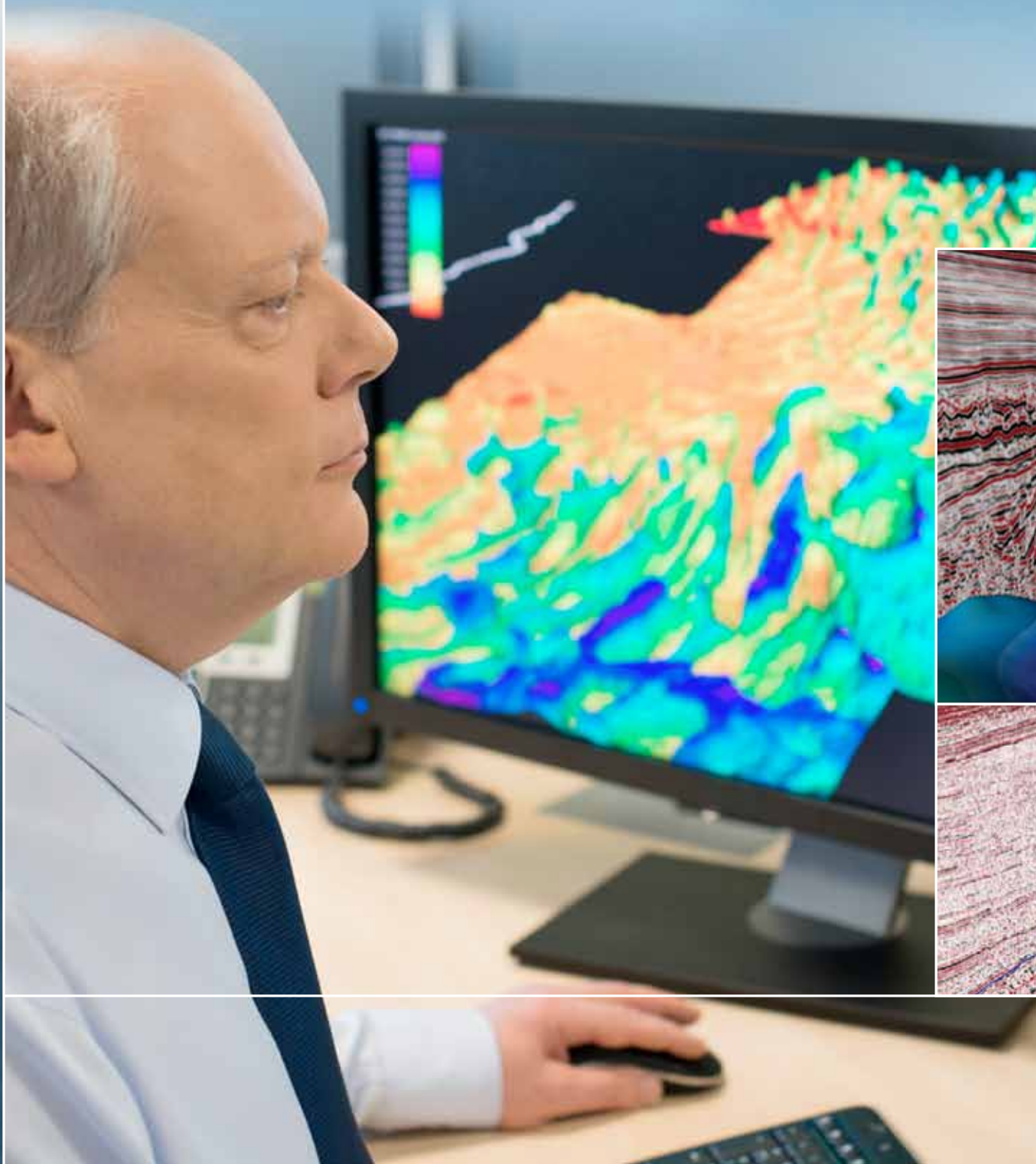


“MAJOR OIL DISCOVERY  
in the Barents Sea”

“SUCCESSFUL PRESALT WELL  
offshore Angola”

“SIGNIFICANT DISCOVERIES  
in Mozambique and Tanzania”

Multiclient



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Nobody knows where the next exploration success is going to be, but recent discoveries in the Barents Sea and the West Africa presalt Kwanza basin all have Schlumberger multiclient data at the heart of the story.

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