

# E&P Daily News

Hart Energy Publishing, LP

## Inspiration for innovation

Welcome to Barcelona in this football World Cup year; and what better place to enjoy this international spectacle than in a city with such a long-established sporting tradition, including the famous Futbol Club (FC) Barcelona, which has the motto "més que un club" (more than a club).

This is the first time the conference and exhibition has been held in Barcelona, an important cultural centre and a major tourist destination with a rich heritage. Particularly renowned are the architectural works of Antoni Gaudí and Lluís Domènech i Montaner, which have been designated UNESCO World Heritage Sites.

Gaudí was famous for his unique and highly innovative designs. He studied nature's angles and curves and incorporated their hyperbolic, parabolic, and other shapes into his designs and mosaics. The Museu Picasso in Barcelona has one of the most extensive collections of artworks by this 20th century Spanish artist. Pablo Picasso spent much of his early life here, and doubtless drew inspiration from the city. The 1992 Olympics are widely recognized as a turning point in the history of Barcelona. Hosting the games sparked a radical program of restoration of the old town and some imaginative redevelopment of several run-down neighbourhoods. Today, Barcelona is a confident, progressive city, one that is tirelessly self-renewing while preserving all that is best about its past. Gaudí, Picasso, and many other great innovators found inspiration in Barcelona, a city that has recreated itself with spectacular success. Let's hope that being here will inspire current and future generations of geophysicists to fulfill the theme for this year's conference: A New Spring for Geoscience.

For EAGE president Mahmoud Abdulbaqi (formerly of Saudi Aramco), this conference marks the culmination of his year in office. He supports the organisation's belief that students in geosciences and engineering are the future of the Association and also of the industries that it is serving. The EAGE Student Fund, which started a couple of years ago, has doubled the number of grants being given to students to come to this event. The special programme they will experience is stronger and more versatile than ever. The local love of football and the timing of the conference have inspired the theme of this year's Student Programme: "Go for the Goal". The programme includes four parallel sessions taking place in the student sports café, the student short course lecture hall, the poster pavilion, and trial interview meeting rooms. In addition to showing a selection of matches on a big screen, the sports café will feature several activities to engage students and test their skills, including the now famous, and ever evolving, Geo-Quiz hosted by Dr. Patrick Corbett and Mahmoud Abdulbaqi.

This 72nd EAGE Conference & Exhibition, incorporating SPE EUROPEC, offers plenty to stimulate all attendees, whatever their age and experience. Since the incorporation of the Society of Petroleum Engineers (SPE) EUROPEC meeting, this annual conference has become the world's largest multi-disciplinary geoscience event, offering an amazingly diverse range of contributions. The technical programme includes 888 presentations. The 8,000 m<sup>2</sup> exhibition area features 300 companies and organizations presenting the latest developments in geophysics, geology, and reservoir engineering. There are also 11 workshops, 3 field trips, and several short courses.

Mahmoud Abdulbaqi reports that, at the end of his term as president, membership of the Association (15,740 at the start of June) is continuing to grow in spite of uncertainties in the global economy. He interprets this to mean that its services and programmes are helping members during these uncertain times and that more and more professionals and students are appreciating this and coming on board. The

Association continues to reach out to members all over the world, trying to better serve them close to where they are. The Moscow and Dubai offices expanded significantly this year and started customized services that fit the particular needs of members and the businesses that they belong to in Eastern Europe, CSA, and the Middle East. An office in Kuala Lumpur is due to open its doors during the next few weeks.

At the end of the conference, Abdulbaqi will turn over the office of president to Davide Calcagni (ENI Exploration and

Production Division). Abdulbaqi says that he has had an exciting year and has met and worked with some of the best professional volunteers and students around the world. His main parting message is to ask students and members to start, and continue, to be involved in the Association's activities and have fun doing that. In addition to the satisfaction of volunteering, this will help personal and professional development and, among other things, build networks—one of the most valuable assets in any business. ■

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# Schlumberger

180 km (112 mi)



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## ► CONFERENCE PROGRAMME - TUESDAY 15TH JUNE

### ROOM 114 - SEISMIC DATA PROCESSING 1 (EAGE)

9:30 Simultaneous Sources - Processing and Applications. I. Moore\* (WesternGeco)  
9:55 Iterative Method for the Separation of Blended Encoded Shot Records. A. Mahdad\* (Delft University of Technology) & G. Blacquiere (Delft University of Technology)  
10:20 High Quality Separation of Simultaneous Sources by Sparse Inversion. R.L. Abma\* (BP America), T. Manning (BP), M. Tanis (BP America), J. Yu (BP America) & M. Foster (BP)  
10:45 Separation of Blended Impulsive Sources using an Iterative Approach. P. Doulgeris\* (Delft University of Technology), A. Mahdad & G. Blacquiere (Delft University of Technology)  
11:30 Signal-to-noise Estimates of Time-reverse Images. B. Witten\* & B. Artman (Spectraseis)  
11:55 Multichannel Matching Pursuit for Seismic Trace Decomposition. Y.H. Wang\* (Imperial College)  
12:20 Fast Sparse Time-frequency Decomposition. A. Gholami\* (University of Tehran), N. Amini (University of Tehran), H.R. Siahkoochi (University of Tehran) & A. Edalat (Pars Oil & Gas Co.)  
12:45 Can Thin Beds Be Identified Through Statistical Phase Estimation? J.A. Edgar\* (BG Group) & J.I. Selvaige (BG Group)

### ROOM 114 - LAND ACQUISITION (EAGE)

14:30 High Productivity without Compromise - The Relationship between Productivity Quality and Vibroseis Group Size. T. Dean\* (WesternGeco), P. Kristiansen & P.L. Vermeer (WesternGeco)  
14:55 On the Accuracy of Harmonic Estimation from Weighted-sum Ground Force. V. C. Do\* (WesternGeco) & C. Bagaini (Schlumberger Cambridge Research)  
15:20 Deharmonics, a Method for Harmonic Noise Removal on Vibroseis Data. F.D. Martin\* (Repsol) & P.A. Munoz (Repsol)  
15:45 Keeping the Data Quality of High Productivity Vibroseis Acquisitions Under Control. C. Bagaini\* (Schlumberger Cambridge Research)  
16:30 Harmonic Distortion Reduction of Seismic Vibrator Using Vibrator Control Electronics. T.F. Phillips\* (ION Geophysical)  
16:55 What if L.? - The Use of Vibroseis 'Energy Tests' as an Aid in Parameter Choice. P. Kristiansen\* (WesternGeco), J. Quigley (WesternGeco), D. Holmes & T. Dean (WesternGeco)  
17:20 Low-frequency Generation Using Seismic Vibrators. G.J.M. Baeten\* (Shell International E&P BV), A. Egretau, J. Gibson, F. Lin & P. Maxwell (CGGVeritas) & J.J. Sallas (GeoMagic)  
17:45 Directive Geophone. M.A. Al-Jadani\* (Saudi Aramco)

### ROOM 115 - EM 1 (EAGE)

9:30 Controlled-source Electromagnetic Modelling Studies - Utility of Auxiliary Potentials for Low-frequency Stabilization. R. Streich\* (GFZ German Research Centre for Geosciences), C. Schwarzbach

(University of British Columbia), M. Becken (GFZ German Research Centre for Geosciences) & K. Spitzer (Freiburg University of Mining and Technology)  
9:55 Exploiting the Airwave for Land CSEM Reservoir Monitoring. M. Wirianto\* (Delft University of Technology), W.A. Mulder (Shell International E&P BV) & E.C. Slob (Delft University of Technology)  
10:20 Using CSEM to Monitor the Production of a Complex 3D Gas Reservoir - A Synthetic Case Study. D.L. Andreis\* (OHMRSI) & L.M. MacGregor (OHMRSI)  
10:45 Fast-track Marine CSEM Processing and 3D Inversion. J.P. Morten\* & A.K. Bjorke (EMGS)  
11:30 Comparison of Marine TEM and FEM Techniques - Offshore West Africa. M. Watts\* (WesternGeco) & G. Cairns (WesternGeco)  
11:55 The Value of CSEM Data in Exploration. A. Buland\*, L.O. Løseth & T. Røsten (Statoil)  
12:20 Scalable Solutions for Nonlinear Inverse Uncertainty Using Model Reduction, Constraint Mapping, and Sparse Sampling. M.J. Tompkins\* (Schlumberger) & J. Fernandez Martinez (University of California, Berkeley)  
12:45 Sensitivity Study of Multi-sources Receivers CSEM Data for TI-anisotropy Medium using 2.5D Forward and Inversion Algorithm. A. Abubakar\* (Schlumberger-Doll Research), J. Liu (Schlumberger-Doll Research), M. Li, T.M. Habashy & K. MacLennan (Schlumberger-Doll Research)

### ROOM 115 - MIGRATION THEORY (EAGE)

14:30 Seismic Imaging with Multiple Scattering. A.J. Berkhout\* (Delft University of Technology) & D.J. Verschuur (Delft University of Technology)  
14:55 Angle-dependent Least-squares Imaging of Incoherent Wavefields. D.J. Verschuur\* (Delft University of Technology) & A.J. Berkhout (Delft University of Technology)  
15:20 Prestack Data Enhancement Using Local Traveltime Approximation. V. Buzlukov\* (Opera), R. Baina (Opera) & E. Landa (Opera)  
15:45 3D Prestack Beam Migration with Compensation for Frequency Dependent Absorption and Dispersion. Y. Xie\* (CGGVeritas), C. Notfors (CGGVeritas), J. Sun (CGGVeritas), K. Xin (CGGVeritas), A. Biswal (Reliance Industries Ltd) & M. Balasubramaniam (Reliance Industries Ltd)  
16:30 Pure P-wave Propagators Versus Pseudo-acoustic Propagators for RTM in VTI Media. X. Du\* (WesternGeco), R.P. Fletcher (WesternGeco) & P.J. Fowler (WesternGeco)  
16:55 Angle Gathers by Reverse-time Migration. M. Vyas\* (WesternGeco), E. Mobley (WesternGeco), D. Nichols (WesternGeco) & J. Perdomo (WesternGeco)  
17:20 Kirchhoff Beam Q Migration. J. Liu\* & G. Palacharla (ExxonMobil Exploration Co.)  
17:45 Impact of TTI Anisotropy on Elastic and Acoustic Reverse Time Migration. R. Lu\* (ExxonMobil Upstream Research Co.), P. Traynin, J.E. Anderson & T. Dickens (ExxonMobil Upstream Research Co.)

## Real World Collaboration



## Real World Results

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# ION and BGP launch INOVA

On March 25th, ION and BGP joined forces to establish a new land seismic technology company: INOVA Geophysical.

IONOVA was chartered to serve the energy industry with reliable and innovative land seismic acquisition equipment and support. BGP has a 51% stake and ION has 49%. The new company has headquarters in Houston and Beijing, with manufacturing capabilities and service centers in different locations around the world.

IONOVA's portfolio includes energy source and source control systems, land seismic recording systems, and digital full-wave seismic sensors, all of which are available to seismic contractors worldwide. The INOVA product line includes Aries®, FireFly®, and Scorpion® acquisition systems, AHV-IV® Vibroseis vehicles, ShotPro® and VibPro® source control systems, and VectorSeis® sensors.

BGP and ION are no strangers to working together. Throughout the years, the two companies have carried out

seismic projects around the world. Recently the companies collaborated on a survey in the Qaidam Basin in China, where a BGP crew took FireFly, then ION's land cableless recording system, into a remote desert area to acquire seismic data using VectorSeis digital multi-component sensors.

ION and BGP say that, through projects such as these, they recognized the value of cooperation between the world's largest seismic acquisition provider and a company focused on building innovative and reliable seismic equipment.

BGP is a subsidiary of CNPC, China's largest energy company. CNPC conceived the Bureau of Geophysical Prospecting (BGP) to fulfill its internal needs for seismic data and other services. As CNPC has grown as an international company, with output comparable to those of the largest multinational producers, BGP has grown as well, now boasting over 110 crews worldwide.

Mr. Wang Tiejun, President of BGP, commented: "We have always been impressed with ION's vision for land seismic technology and the products they have developed, such as VectorSeis, FireFly, and Aries. These instruments have proven capable of improving the operational efficiency and HSE

effectiveness of land seismic acquisition."

Houston-based ION Geophysical is a leading provider of seismic equipment and services. Originally founded as Input/Output in 1968, ION was built around seismic source synchronization equipment and has grown and expanded its portfolio through strategic acquisitions, including data processing subsidiary GX Technology in 2004 and ARAM in 2008. ION's CEO and INOVA Board Member Bob Peebler commented: "By teaming up with the world's largest land seismic contractor and combining our land seismic technology assets, we believe that INOVA will be the clear leader in land seismic equipment."

The INOVA Board of Directors appointed Steve Bate to head the new company. He formerly served as Senior Vice President of ION's Land Imaging Systems Division. Expressing his enthusiasm about the new company, Bate commented: "We are bringing together a truly global team of experienced innovators. Our comprehensive portfolio of seismic technologies will be put to the test every day, in every conceivable acquisition environment, which we believe will allow INOVA to offer the most effective and durable geophysical instrumentation available in the marketplace."

IONOVA's management team intends to build a highly innovative and efficient organization that combines the talents and cultures of the East and the West and the core competencies of BGP and ION. This blend of insights and capabilities is aimed at keeping INOVA's products on the cutting-edge of innovation, guided by the practical reality of what contractors require to execute complex seismic programs. ■

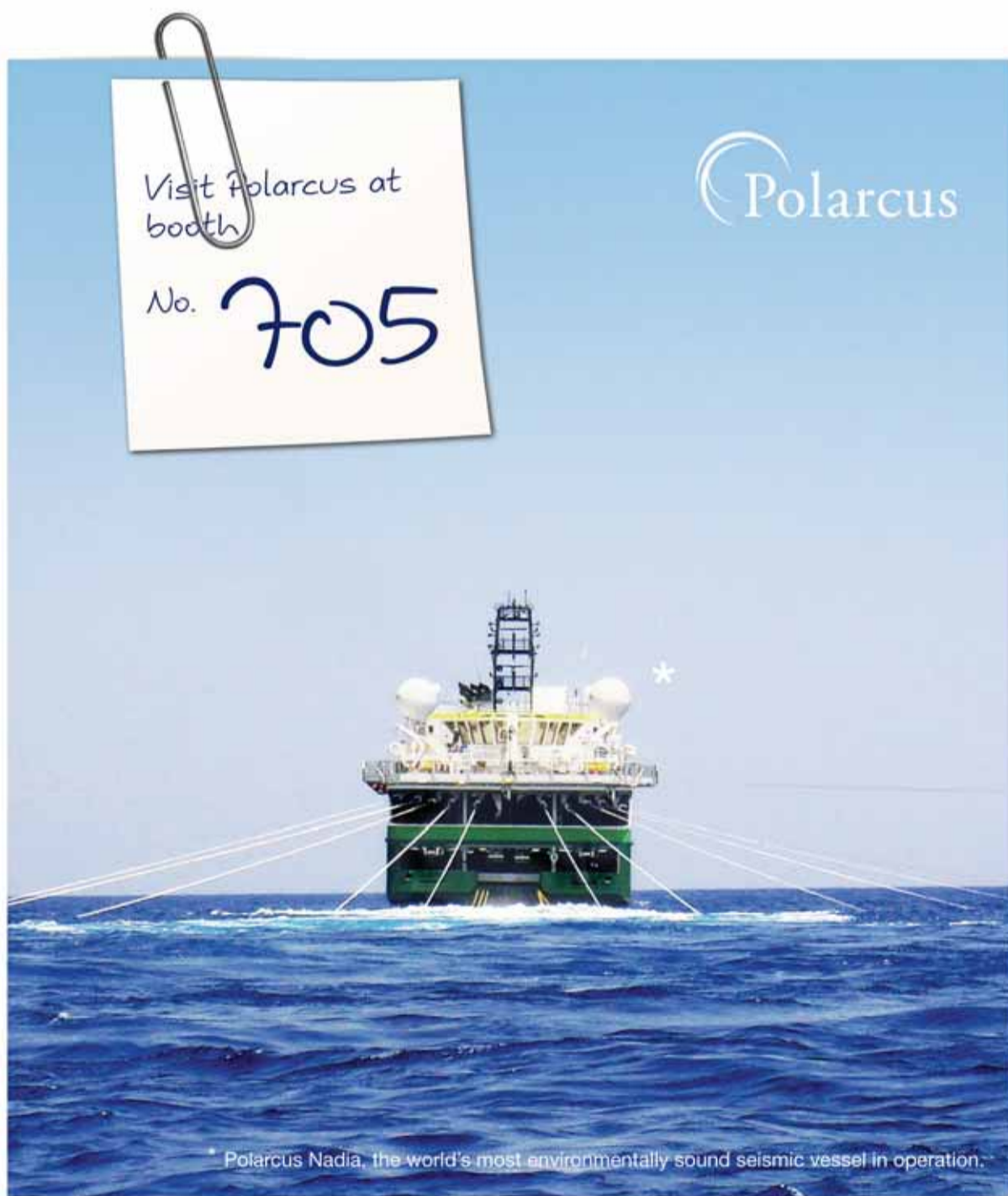
Meet the INOVA team at Booth 550.

## EM data for the 21st Norwegian licensing round

Electromagnetic Geoservices ASA (EMGS) has acquired multi-client 3D EM data in the Norwegian and Barent seas ahead of the 21st Norwegian licensing round. EMGS observes that oil companies are increasingly using EM data as a routine part of their exploration workflows, and expects there to be great interest in these new datasets.

The first survey was recorded in the Norwegian Sea between the Asterix and Luva discoveries. It acquired high-density full-azimuth 3D data over an area of about 325 km<sup>2</sup> that covers 4 open blocks: 6706-10/11, 6606-1 and 6605-3, all of which have been nominated for the upcoming licensing round. The survey was acquired primarily to test two prospect levels in the Vøring dome area of the Vøring Basin that had been identified on Fugro 2D long-offset seismic data. EMGS and Fugro are parties to a global cooperation agreement and will jointly process and invert the data. One of the key benefits of the agreement is the integration of EM with seismic data to improve the interpretation and understanding of the subsurface. Statoil has already demonstrated its confidence in the method by pre-funding an extensive multi-client 3D EM campaign that is being conducted in the Barents Sea. The program is a continuation of a successful 2008 Barents Sea project, which was the world's first large-scale multi-client 3D EM survey. The new survey will cover more than 4,000 km<sup>2</sup>, with full azimuth acquisition and 3 km receiver spacing. On completion, the EMGS multi-client data library in the Barents Sea will include more than 14,000 km<sup>2</sup> of 3D EM data and, subject to additional industry commitments, the company will consider further expanding the current acquisition program.

EMGS says that its surveys will provide its clients with a significant competitive advantage when it comes to evaluating the most prospective areas and effectively targeting their exploration resources. The final deliverable product is 3D full azimuth anisotropic inversion. This important tool allows geologists to position EM data at the proper depth for integration with their seismic-derived prospects. Data licensees receive workstation-ready 3D EM data that can be integrated into their Earth models for immediate high-value evaluation and analysis of potential prospect areas. A new method for processing and anisotropic 3D inversion offered by EMGS will help to ensure delivery of high-quality data in good time to be fully utilized during bid preparation for the Norwegian 21st licensing round. To discover more about EMGS multi-client data visit EMGS on booth 740.



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Find out more, visit [www.polarcus.com](http://www.polarcus.com)

# CONFERENCE PROGRAMME – Tuesday 15th June

## ROOM 116 – MULTI-COMPONENT (EAGE)

- 9:30 Up-down Deconvolution in the Presence of Subsurface Structure. Y. Wang\* (CGGVeritas), S. Grion (CGGVeritas) & R. Bale (CGGVeritas)  
9:55 Efficient Elastic Wave-mode Separation in TTI Media. J. Yan\* (Colorado School of Mines) & P. Sava (Colorado School of Mines)  
10:20 WAZ Mirror Imaging with Nodes for Reservoir Monitoring – Dalia Pilot Test. D. Lecerf\* (CGGVeritas), J.L. Boelle (Total), A. Lafram (CGGVeritas) & J. Cantillo (Total)  
10:45 High-precision Measurement of Split S-waves in OBS Data and its Application to Marine Slope Stability Assessment. R. Haacke\* (Royal Holloway University of London), R. Exley (Fugro Multi-Client Services) & G.K. Westbrook (University of Birmingham)  
11:30 PP/PS PSDM, AVO and Joint Inversion Applied to a Virgin Exploration Area in the North Sea. G. Ronholt\* (CGGVeritas), Ø. Korsmo (CGGVeritas), H. Hoerber (CGGVeritas), A. Smith (CGGVeritas), P. Hughes (Wintershall Norge) & M. Øygaren (Wintershall Norge)  
11:55 Extract Subsurface Density Information Using Converted Waves – Workflow and Case Study in the Gulf of Mexico. K. Zou\* & A. Koesoemadinata (WesternGeco/Schlumberger)  
12:20 PP-PS Joint Inversion Applied to 2D-3C High Resolution Seismic Data – A Case of Junggar Basin, Northwest China. Y.F. Dang (PetroChina Xinjiang), B. Lou (PetroChina Xinjiang), L. Shen\* (CGGVeritas), X.G. Miao (CGGVeritas), P. Wang (CGGVeritas) & S.H. Zhang (CGGVeritas)  
12:45 Simultaneous Inversion for Elastic Parameters Using PP- and PS-waves Jointly in the Ray Parameter Domain. F. Zhang\* (Imperial College London) & Y. Wang (Imperial College London)

## ROOM 116 – POTENTIAL FIELDS – THEORY (EAGE)

- 14:30 A Comparison of Three Automatic Interpretation Techniques for Magnetic and Gravity Data. D. Gerovska\* (University of Edinburgh), M.J. Arauzo-Bravo (Max Planck Institute for Molecular Biomedicine) & K. Whaler (University of Edinburgh)  
14:55 3D Gravity Inversion of a Faulted Basement Relief Using the Total Variation Regularization. C.M. Martins (Observatório Nacional), W.A. Lima (Universidade Federal do Pará), V.C.F. Barbosa\* (Observatório Nacional) & J.B.C. Silva (Universidade Federal do Pará)  
15:20 A Modified Tilt-depth Method for Kimberlite Exploration. G.R.J. Cooper\* (University of Witwatersrand)  
15:45 Interpretation of 2-D Gravity Data using 2-D Continuous Wavelet Transform. F. Salajegheh\* (Dana Geophysics/University of Tehran), A. Roshandel Kahoo & H.R. Siahkoobi (University of Tehran)  
16:30 Exact Finitely Expanded Gravity Anomaly of Uniform Thin Polygonal Sheets. H. Holstein\* (Aberystwyth University) & C. Anastasiades (Aberystwyth University)  
16:55 Analysing Full Tensor Gravity Data with Intuitive Imaging Techniques. J.L. Dickinson\* (Bell Geospace Ltd), C.A. Murphy (Bell Geospace Ltd) & J.W. Robinson (Bell Geospace Ltd)  
17:20 Potential Field Searchlights. M. Dransfield\* (Fugro Airborne Surveys)  
17:45 Gravi-magnetic Anomalies of Uniform Thin Polygonal Sheets. H. Holstein\* (Aberystwyth University), D. Fitzgerald (Intrepid Geophysics) & C. Anastasiades (Aberystwyth University)

## ROOM 118 ACID GAS SEQUESTRATION / SUSTAINABLE DEVELOPMENT (EUROPEC)

- 9:30 Evaluation of Petrophysical Properties of a Carbonate-rich Caprock for CO2 Geological Storage Purposes (SPE - 131525). D. Broseta\* (University of Pau), N. Tonnen (University of Pau), G. Mouroum (Total), P. Chiquet (Total) & J. Hy-Billot (Total)  
9:55 Capillary Trapping in Carbonate Rocks (SPE-130720). S. Iglaue\* (Caltech), C. Lamy (ESPCI), C. Pentland (Imperial College London), M. Blunt & G. Mailand (Imperial College London)  
10:20 Hydrate Formation – Considering the Effects of Pressure Temperature Composition and Water (SPE-131663). J. Rajnauth\*, M.A. Barrufet & G. Falcone (Texas A&M University)  
10:45 Development & Sustainability of a Small Gas Based Economy (SPE-131596). C. Boodoo\* (TSTT)  
11:30 Potential and Early Opportunity-analysis on CO2 Geo-sequestration in China (SPE-130358). Z. Xuan\* (CUPB) & C. Zhang (SLGC)  
11:55 Enhanced Gas Recovery – Challenges Shown at the Example of Three Gas Fields (SPE-130151). T. Clemens\* (OMV), S. Secklehner (OMV), K. Mantzatis (OMV) & B. Jacobs (OMV)  
12:20 Static and Dynamic Estimates of CO2 Storage Capacity in Saline Formations (SPE - 131609). M. Jin\* (Heriot-Watt University), E. Mackay (Heriot-Watt University), G. Pickup (Heriot-Watt University), A. Monaghan (BGS) & M. Naylor (University of Calgary)  
12:45 Water/CO2 system at High Pressure and Temperature Conditions – Measurement and Modeling of Density in Equilibrium Liquid and Vapor Phases (SPE-131636). F. Tabasinejad\* (University of Calgary), Y. Barzin (University of Calgary), R. Moore (University of Calgary), S. Mehta (University of Calgary), K. Van Fraassen (University of Calgary), J. Rushing (Anadarko) & K. Newsham (Apache)

## ROOM 118 – IOR STRATEGIES 1 (EUROPEC)

- 14:30 Improved Oil Recovery in Chalk – Wettability Alteration or Something Else? (SPE-131300). A. Zahid\* (Technical University of Denmark), E. Stenby & A. Shapiro (Technical University of Denmark)  
14:55 Effects of Oil Compressibility on Production Performance of Fractured Reservoirs Evaluated by Streamline Dual-porosity Simulation (SPE-130397). S. Tanaka\* (Waseda University), N. Arihara (Waseda University) & M. Al-Marhoun (KFUPM)  
15:20 A Review on Utilization of Crosslinked Polymer Gels for Improving Heavy Oil Recovery in Turkey (SPE - 131267). N. Topguder\* (TPAO)  
15:45 Effect of Gas Type on Foam Film Permeability and its Implications for Foam Flow in Porous Media (SPE-131297). R. Farajzadeh\* (Delft University of Technology), R.M. Muruganathan (Aragon Lab), R. Krastev (NMI) & W. Rossen (Delft University of Technology)  
16:30 Modelling Multiple-contact Condensation of Heat-transporting Fluids in Thermal Floods (SPE-130568). K. Lawal\* (Imperial College London) & V. Vesovic (Imperial College London)  
16:55 Wettability Alteration During Water Flooding and Carbon Dioxide Flooding of Reservoir Chalk Rocks (SPE-130992). I. Fjeldø\* (IRIS) & S.M. Asen (IRIS)  
17:20 Phase Behavior of Steam with Solvent Co-injection under Steam Assisted Gravity Drainage (SAGD) Process (SPE-130807). W. Li\* (Texas A&M University) & D. Mamora (Texas A&M University)  
17:45 Alkyl Polyglycoside/1-Naphthol Formulations with Ultra-low Interfacial Tensions against n-Octane for Enhanced Oil Recovery (SPE-130404). Y. Tang\* (Caltech), Y. Wu (MST), P. Shuler (ChemEOR) & W. Goddard (Caltech)

## ROOM 119 – SEISMIC RESERVOIR CHARACTERIZATION I (EAGE)

- 9:30 Quantitative Integration of Geology and Geophysics for Reservoir Modelling – A Case Study. M.S. Sams\* (Fugro-Jason), I. Millar (Premier Oil Vietnam Offshore), W. Satriawan (Premier Oil Vietnam Offshore), D. Saussus (Fugro-Jason) & S. Bhattacharya (Fugro-Jason)  
9:55 Characterization of Thin Turbiditic Sands in the Cantabrian Sea through Bandwidth Extension. J.G. de Castilho, A. Perez Garcia & V. Zucconi\* (Repsol), H. Poore, J. Pierce & J.H. Yu (Geotrace)  
10:20 Geomodel Update Using 4-D Petrophysical Seismic Inversion on the Troll West Field. K. Gjerding\*, N. Skjei, A. Norenes Haaland (Statoil), I. Machecher & T. Coleau (CGGVeritas Services)  
10:45 Integration of Seismic Data and Uncertainties in the Kims Model – Application to the Snorre Field. P. Nivlet\* (Statoil), S. Ng (Statoil), M.A. Hette (Statoil), K.M. Borsset (Statoil), A.B. Rustad (Statoil), P. Dahle (Norsk Regnesentral), R. Hauge & O. Kolbjørnsen (Norsk Regnesentral)  
11:30 Ocean Bottom Seismic in the Osberg South Area. J. Dangerfield (Dangerfield AS), J. Daniels\* (Statoil), P. Riste (Statoil), M. Skaug (Statoil) & V. Haugen (Statoil)  
11:55 Looking for Gas in All the Tight Places. T.L. Davis\* (Colorado School of Mines)  
12:20 Volcanic Rock Estimation and Uncertainty Evaluation from Surface and Crosswell Seismic Data. D. Grana\* (Eni E&P) & C. D'Agosto (Eni E&P)  
12:45 Surface-subsurface Integration Reveals Faults in Gulf of Suez Oilfields. A. Laake\* (WesternGeco), M. Sheneshen (WesternGeco), C. Strobbia, L. Velasco & A. Cutts (WesternGeco)

## ROOM 119 – PASSIVE & MICROSEISMIC METHODS (EAGE)

- 14:30 Joint Interpretation of Multiple Passive Seismic Data Volumes. B.W. Artman (Spectraseis AG), A. Goertz\* (Spectraseis AG), B. Schechinger (Spectraseis AG), P. Krajewski (GDF SUEZ E&P Deutschland GmbH) & M. Koeber (GDF SUEZ E&P Deutschland GmbH)  
14:55 A Low Frequency Passive Seismic Array Experiment Over an Oilfield in Abu Dhabi – Implications for Hydrocarbon Detection. M.Y. Ali (Petroleum Institute) & K.A. Bertussen\* (Petroleum Institute)  
15:20 Signal-to-noise Study on a Low-frequency Passive Seismic Survey. W. Yang\* (Spectraseis AG), N. Rihai (Spectraseis AG) & M. Kelly (Spectraseis AG)  
15:45 Automatic Survey Design for Passive Seismic Monitoring. B. Khadraoui\* (Schlumberger Cambridge Research) & D.G. Raymer (Schlumberger Cambridge Research)  
16:30 An Approach to Analyse Microseismic Event Similarity. M. Scholze\* (Free University of Berlin), K. Stürmer (Free University of Berlin), J. Kummerow & S.A. Shapiro (Free University of Berlin)  
16:55 Anisotropic Velocity Model Inversion for Imaging the Microseismic Cloud. T. Mizuno\* (Schlumberger), S. Leaney (Schlumberger) & G. Michaud (Schlumberger)  
17:20 Microseismic Sources in Anisotropic Media. W.S. Leaney\* (Schlumberger Oilfield Services) & C.H. Chapman (Schlumberger Cambridge Research)  
17:45 Modelling Frequency-dependent Anisotropy Observations Made on Microseismic Data. O. Al-Harrasi\* (University of Bristol) & M. Kendall (University of Bristol)

## ROOM 120 – FWI & MODELLING (EAGE)

- 9:30 Randomized Dimensionality Reduction for Full-waveform Inversion. F.J. Herrmann\* (University of British Columbia)

- 9:55 Acoustic Multi-source Waveform Inversion with Deblurring. G.T. Schuster\*, G. Zhan & W. Dai (University of Utah) & C. Boonyasirawat (King Abdullah University of Science and Technology)  
10:20 2D Elastic Frequency-domain Full-waveform Seismic Inversion Using the Varying PML Approach. A. Abubakar\*, T.M. Habashy, Y. Lin & J. Liu (Schlumberger-Doll Research)  
10:45 Robust Frequency-domain Multi-parameter Elastic Full Waveform Inversion. R. Brossier\* & J. Virieux (Joseph Fourier University), S. Operto (CNRS/University of Nice-Sophia-Antipolis/Geoazur)  
11:30 Extension of the Finite-difference Contrast-source Inversion Method to 3D Geometries. A. Abubakar\*, T.M. Habashy, M. Li & G. Pan (Schlumberger-Doll Research), P.M. van den Berg (Delft University of Technology) & L. Zhang (Schlumberger-Doll Research)  
11:55 A Helmholtz Iterative Solver without Finite-difference Approximations. D.A. Neklyudov\* & V.A. Tcheverda (Institute of Petroleum Geology & Geophysics SB RAS)  
12:20 Seismic Modelling with the Discontinuous Galerkin Finite-element Method – Application to Complex 3D Elastic Media. V. Etienne\* (Geoazur), J. Virieux (LGIT) & S. Operto (Geoazur)  
12:45 A Comparison of Finite-difference Grids for Anisotropic Elastic Modelling. H. Bernth\* (Schlumberger Cambridge Research) & C. Chapman (Schlumberger Cambridge Research)

## ROOM 120 – SEISMIC DATA PROCESSING 2 (EAGE)

- 14:30 Scale and Direction-guided Interpolation of Aligned Seismic Data in the Curvelet Domain. M. Naghizadeh\* (University of Alberta) & M. Sacchi (University of Alberta)  
14:55 Four-dimensional F-k Interpolation of Wide Azimuth Towed Streamer Data. M. Naghizadeh\* (University of Calgary), O.K. Leirfall (Statoil ASA) & M.D. Sacchi (University of Alberta)  
15:20 5D Interpolation of Seismic Data With a Least-squares Fourier Inversion. S. Jin\* (Shell Projects & Technology)  
15:45 Passive Interferometry of Deepwater Ocean Bottom Seismic Data. P.J. Hatchell\* (Shell) & K.J. Mehta (Shell)  
16:30 Event-driven Seismic Interferometry with Ambient Seismic Noise. D. Draganov\*, J. Thorbecke & K. Wapenaar (Delft University of Technology), X. Campman & A. Verdel (Shell International E&P BV)  
16:55 Kirchhoff-Helmholtz Representation for Interferometry and Virtual Reflectors in Acoustic Media. F. Poletto\* (OGS), K. Wapenaar (Delft University of Technology) & C. Bellezza (OGS)  
17:20 3D Seismic Imaging over Two Structurally Complex Surveys in TAL, Pakistan. V. Dolgov\*, R.W. Vestrum & J.M. Gittins (Thrust Belt Imaging), G. Wittmann (MOL Hungarian Oil and Gas)  
17:45 Improved Sub-basalt Structural Imaging in the Feroe-Shetland Basin Using Full Sequence Migration Multi-velocity Analysis. A.J. Hardwick\* (TGS), T.C. Travis, S.V. Stokes & B. Baumbach (TGS)

## ROOM 122 – ROCK PHYSICS 1 (EAGE)

- 9:30 Porous Medium Acoustics in the Presence of Viscous Boundary Layers. T.M. Mueller\* (CSIRO) & P.N. Sahay (CICESE)  
9:55 Weakly Anisotropic Elastic Compliance. L.A. Thomsen\* (University of Houston/Delta Geophysics/LBNL)  
10:20 The Role of Shale Anisotropy in Reservoir Characterisation of Heterogeneous Sands. P.A. Avseth\* (Odin Petroleum) & R. Bachrach (Tel Aviv University)  
10:45 Quartz Cementation During Mudstone Burial – Implications for Rock Property Development. B. Thyberg\* (University of Oslo) & J. Jahren (University of Oslo)  
11:30 Estimation of Carbonate Elastic Properties Using Nanoindentation and Digital Images. O. de Paula\* & M. Lebedev (Curtin University), B. Gurevich (Curtin University/CSIRO Petroleum), M. Martyniuk (University of Western Australia), M. Pervukhina & C. Delle Piane (CSIRO Petroleum)  
11:55 Bounds for Viscoelastic Properties of Heavy-oil Rocks. D. Makarynska (Curtin University of Technology) & B. Gurevich\* (Curtin University of Technology/CSIRO)  
12:20 Joint Velocity-resistivity Effective Medium Models. T. Han\* (National Oceanography Centre Southampton), A.I. Best (National Oceanography Centre Southampton), L. MacGregor (OHM), J. Sothcott & T.A. Minshull (National Oceanography Centre Southampton)  
12:45 Detection of Reservoir Sorting Characteristics from Seismic Data. M.E. Glinisky\* (CSIRO), J. Gunning (CSIRO), S.L. Bryant (University of Texas) & D.C. DeMartini (Lone Star Geophysical Consulting)

## ROOM 122 – ROCK PHYSICS 2 (EAGE)

- 14:30 3D Microanalysis of Geological Samples with High-resolution Computed Tomography. G. Zacher\*, J. Luebbehusen, O. Brunke & T. Mayer (GE Sensing & Inspection Technologies)  
14:55 The Importance of Clay Behaviour for Geomechanical Modelling of Gas Production in Unconsolidated Reservoir Sands. F.D.E. Cuisiat\*, L. Grande & H.P. Jostad (Norwegian Geotechnical Institute)  
15:20 The Effect of Intra-reservoir Shales on Effective Stress Sensitivity. Y. HajNasser\* (Heriot-Watt University) & C. MacBeth (Heriot-Watt University)  
15:45 Frequency and Fluid Effects in a Porous-cracked Rock – Experimental Investigations and Theoretical Predictions. M.A. Adelinet\* (Geology Laboratory of Ecole Normale Supérieure), J.F. Fortin, Y.G. Guéguen & A.S. Schubnel (Geology Laboratory of Ecole Normale Supérieure)  
16:30 Exploring Trends in Microcrack Properties of Shales Using Stress Dependencies of Ultrasonic Velocities. M. Pervukhina\* (CSIRO), B. Gurevich & P. Golodnicov (Curtin University of Technology/CSIRO)  
16:55 Microcracks Induced During Dilatancy and Compaction in a Porous Oolitic Carbonate Rock. J. Fortin\* (Geology Laboratory of Ecole Normale), S. Stanchits & G. Dresen (Geoforschungszentrum Potsdam) & Y. Gueguen (Geology Laboratory of Ecole Normale Supérieure)  
17:20 Frequency and Pressure Effects on Fluid Substitution in High Porosity Reservoir Sandstones. A.I. Best\* & J. Sothcott (National Oceanography Centre Southampton)  
17:45 Vp-Vs Relationship of Glauconitic Greensand. Z. Hossain\* (Technical University of Denmark), T. Mukerji (Stanford University) & I.L. Fabricius (Technical University of Denmark)

## ROOM 123 – OUTCROP ANALOGUE DESCRIPTION & MODELLING (EAGE)

- 9:30 3D Reservoir Model of the Maiella Anticline (Central Apennines, Italy) – Validation of Different Modeling Approaches. R. Di Ciaia\* & A. Riva (GEPlan Consulting) & C. Turrini (CT Geological Consulting)  
9:55 A Comparison of Facies Modelling Strategies in Fan-delta Reservoir Analogues. Sant Llorenç del Munt, Eocene, NE Spain. P. Cabello\* (University of Barcelona), O. Falivene (Shell International E&P), J.A. Howell (University of Bergen), M. Lopez-Blanco, P. Arbués & E. Ramos (University of Barcelona)  
10:20 3D Analysis of Fracture Patterns Affecting an Outcropping Anticline – Inferences for Similar Buried Reservoirs. G. Bertost\* (VU University Amsterdam), H. Boro (VU University Amsterdam), J. van der Vaart (VU University Amsterdam) & S.M. Luthi (Delft University of Technology)  
10:45 On- and Offshore Deep Weathered Basement Rocks, Norway. M. Broenner\* (Geological Survey of Norway), D. Bering (Norwegian Petroleum Directorate), E. Dalsegg (Geological Survey of Norway), K. Fabian, O. Fredin & B. Hendriks (Geological Survey of Norway), C. Magnus (Norwegian Petroleum Directorate), T. Møller, O. Olesen & J.S. Rønning (Geological Survey of Norway), T. Solbakk (Norwegian Petroleum Directorate) & J.A. Overland (Norwegian Petroleum Directorate)  
11:30 Mechanical Modelling of Fault Propagation Through Mechanically Layered Sequences – Implications for Fault Zone Complexity. M. J. Welch\* (Rock Deformation Research Ltd), R.K. Davies (RDR USA), R.J. Nriep, C. Tueckmantel, V. O'Connor & H. Lickorish (Rock Deformation Research Ltd)  
11:55 Digital Characterization of an Aptian Carbonate Platform Margin from the Western Maestrat Basin (E Iberia). T. Bover-Amal\* (University of Bayreuth), O. Gratacós (Institut de Recerca Geomodels), D. Garcia-Selles (University of Barcelona), O. Falivene (Shell Projects and Technology), R. Salas (University of Barcelona), J.A. Munoz & P. Cabello (University of Barcelona)  
12:20 Geological Mapping and Structural Interpretation Using a Virtual Outcrop Digitiser, Examples from the Zagros (Iran). E. Casciello\* (Institute of Earth Sciences Jaume Almera), J.B. Thurmond (Statoil/Research Center, Bergen), N. Fernandez, E. Saura, I. Romaire & J. Vergés (Institute of Earth Sciences Jaume Almera) & D.W. Hunt (Statoil/Research Center, Bergen)

## ROOM 123 – SEDIMENTOLOGY AND STRUCTURAL GEOLOGY (EAGE)

- 14:30 Structure and Kinematics of the Ramada High, West Berkin Basin, Algeria. G. Zamora\* (Repsol), M. González (Repsol) & A. Roviello (Repsol)  
14:55 Messinian Facies and Oligo-Miocene Slumping in Offshore Sirte Basin Libya and Sub-Messinian Seismic Imaging. T. Sabato Ceraldi\* (BP), H.M. Ali (BP), T. Green (BP), K. Benjamine (BP), M. Bourne (BP), M. Kamel (BP), J. Alexander (BP), K. Coterill (BP), A. Poole (BP) & A. Fraser (BP)  
15:20 Mesozoic to Cenozoic Sequence Stratigraphy of the Tarfaya Basin, Morocco. A. Wenke\* (GeoResources at University of Heidelberg), R. Zühlke (GeoResources at University of Heidelberg), L. Boutib (ONHYM), H. Jabour (ONHYM), O. Kluth (RWE Dea) & J. Schöber (RWE Dea)  
15:45 Integrating 3D Seismic Data and 2D Geomechanically Balanced Restoration, Teak Field, Trinidad and Tobago. X. Legend\* (Repsol)  
16:30 Structural Geometry of Late Jurassic Syn-rift Basins. R.Z. Saddique\* & R. Collier (Uni of Leeds)  
16:55 Outcrops with Seismic-scale Geometries – An Aptian Example from the Western Maestrat Basin, E Iberia. T. Bover-Amal\* (University of Bayreuth) & R. Salas (University of Barcelona)  
17:20 Late Cretaceous to Present Protracted Convergence between Arabia and Iran. J. Vergés\* (Institute of Earth Sciences Jaume Almera), E. Saura, E. Casciello, M. Fernández, I. Jiménez-Munt, D. Garcia-Castellanos (Institute of Earth Sciences Jaume Almera) & S. Homke, D. Hunt & I. Sharp (Statoil)

## ROOM 124 – CASE STUDIES / EXPLORATION & FIELD DEVELOPMENT (EAGE)

- 9:30 An Acquisition Model for an Interim Field of Field Seismic Project at the Azeri-Chirag-Gunashli Field in the Caspian Sea. R. Seabome\* (BP), D.J. Howe (BP), W. Slopey (BP) & A. Talibov (BP)  
9:55 Implementing the Long Term Seismic Strategy for the Azeri-Chirag-Gunashli Field, South Caspian Sea, Azerbaijan. N.D. Robinson\* (BP), M.C. Riviere (BP), K. Tough (BP) & P.A. Watson (BP)

- 10:20 Improvements in 3D Imaging over the Azeri-Chirag-Gunashli Field, South Caspian Sea, Azerbaijan. K. Tough\* (BP), M.C. Riviere (BP), N.D. Robinson (BP) & P.A. Watson (BP)  
10:45 4D Seismic Surveillance over the Azeri-Chirag-Gunashli Field, South Caspian Sea, Azerbaijan. M.C. Riviere\* (BP), N.D. Robinson (BP), K. Tough (BP) & P.A. Watson (BP)

- 11:30 Is Your Prospect Sealed – From a Geophysical and Pore Pressure Perspective. J.H. Yu\* (Geotrace) & M. Pottorf (Geotrace)  
11:55 Integrating Seismic & Potential Field Data in Hydrocarbon Prospectivity Assessment – Pantelleria Region Offshore Sicily. S.J. Coomber\* (ARKE Ltd), J. Field & D. Harrison (Northern Petroleum Plc)

- 12:20 Exploration Challenges in the Valencia Trough, Offshore Spain – The Lubina and Montanazo Discoveries. H.C. Matias\* (Repsol), J. Vila Pont (Repsol), J.J. Martin Banon (Repsol), L.R. Arnez Espinosa (Repsol), J. Loza Peirano (Repsol) & C. Bertoni (Repsol)  
12:45 Unlocking Resources in Mature Basins Using Seismic Technology. L. Ben-Brahim\* (Total E&P UK Ltd), F. Cailly, M.P. Duval-Valentin, J. Guerra, M. Rowlands & K. Patel (Total E&P UK Ltd)

## ROOM 124 – CO2 SEQUESTRATION (EAGE)

- 14:30 4D Joint Pre-stack Seismic Stratigraphic Inversion of the Sleipner-CO2 Case. N. Delepine\* (IFP), K. Labat (IFP), V. Clochard (IFP), P. Ricarte (IFP) & C. Le Bras (IFP)  
14:55 Data-driven Quantitative Analysis of the CO2 Plume Extension from 4D Seismic Monitoring in Sleipner. N. Dubos-Salée (IFP) & P.N.J. Rasolofoson\* (IFP)  
15:20 Passive Seismic Monitoring of CO2 Storage at Weyburn. J.P. Verdon\* (University of Bristol), D.J. White (Geological Survey of Canada), J.M. Kendall (University of Bristol), D.A. Angus (University of Leeds), Q.J. Fisher (University of Leeds) & T. Urbanic (Engineering Seismology Group Canada)  
15:45 Seismic Monitoring in the Framework of the Pilot Project CLEAN. L. Houpt\* (Free University of Berlin), S. Buske (Free University of Berlin), R. Giese & M. Bock (Helmholtz Centre Potsdam)  
16:30 Quantitative Seismic Monitoring of CO2 at Sleipner Using 2D Full-waveform Inversion in the Time-lapse Mode. M. Queisser & S.C. Singh\* (Institute of Geophysics of Paris)  
16:55 From Surface Deformation to Permeability – A Case Study. A. Rucci\* (Polytechnical University of Milan), A. Ferretti (Tele-Rilevamento Europa T.R.E. sr.l.), F. Novati (Tele-Rilevamento Europa T.R.E. sr.l.) & D.W. Vasco (Lawrence Berkeley National Lab)  
17:20 Mineral Sequestration of Naturally Occurring CO2 in Rankin Trend Gases, Carnarvon Basin, Australia. E. Tenthorey\* (CO2CRC/Geoscience Australia), C. Boreham (CO2CRC/Geoscience Australia), A. Horte (CO2CRC/CSIRO) & J. Underschultz (CO2CRC/CSIRO)  
17:45 Effect of Mixing on Acid Gas Sequestration Processes. A. Lukyanov\* (Schlumberger), A. Garipova (Schlumberger), A. Priestley (Schlumberger) & S. Hurter (Schlumberger)

## ROOM 125 – UPDATING RESERVOIR MODELS (EAGE/EUROPEC)

- 9:30 Probabilistic Seismic Inversion of a West of Shetlands Deepwater Turbidite Field. M. Florich (Shell UK Ltd), G. Jenkins\* (Shell UK Ltd), D. McCormick (Shell UK Ltd), J. Copp (Shell UK Ltd), K. Martin (BP Exploration Operating Co. Ltd), P. Allan, S. Day & J. Fletcher (BP Exploration Operating Co. Ltd), C. Macdonald (BP Exploration Operating Co. Ltd), A. Mannini (Hess Services (UK) Ltd), R. Gilham (Hess Services (UK) Ltd) & F. Boundy (Hess Services (UK) Ltd)  
9:55 Experience of West Siberia Oil Fields – Accurate Methods of Reserves Localization in Reservoir Modelling. A.B. Starostin\* (Roxar) & E.S. Makarova (Roxar)  
10:20 Using Time Domain Seismic Data for History Matching Processes. E. Tillier\* (IFP), M. Le Ravalec (IFP) & F. Roggero (IFP)  
10:45 Observation Sensitivity in Computer-assisted History Matching. M.V. Krymskaya\* & A.W. Heemink (Delft University of Technology), R.G. Hanea (TNO/Delft University of Technology), J.D. Jansen (Delft University of Technology/Shell International E&P BV)  
11:30 A New Method to Improve Convergence Rates with Seismic History Matching (SPE-131545). K. Stephen\* (Heriot-Watt University) & S. Aruvini (Heriot-Watt University)  
11:55 Simulation Workflow Development – Capturing Formation Damage Aspects during a Field's Production Lifetime (SPE-131195). H. Dahle Smith\* (Britannia Operator), F. Wahid (Schlumberger) & S. Ducroux (Schlumberger)

- 12:20 How to Propagate Petrophysical Properties in a Fracture Network for Naturally Fractured Carbonate Reservoirs – Case Study – Cretaceous Formation at Maracaibo Lake, Venezuela (SPE-130745). R. Soto Becerra\* (Digitoil), S. Perez (PDVSA), C. Martin Hidalgo & D. Arteaga (PDVSA)  
12:45 Iterative History Matching Technique for Estimating Reservoir Parameters from Seismic Data (SPE-131617). R. Souza\* (Unicamp), A. Machado (Unicamp) & D. Schiozer (Unicamp)

## ROOM 125 – RESERVOIR MONITORING AND MANAGEMENT (EAGE/EUROPEC)

- 14:30 Business Impact of Frequent Time-lapse Observations Around Valhall Water Injection Well. J. van Gestel\* (BP Norge), G. Tjeltland, M.J. Parikh, J.H. Kommedal & O.I. Barkved (BP Norge)  
14:55 Experiences on Seafloor Gravimetric and Subsidence Monitoring Above Producing Reservoirs. H. Alnes\* (Statoil), T. Stenvold (Statoil) & O. Eiken (Statoil)  
15:20 4D Seismic Benefits to Development Drilling at Enfield – North-West Shelf – Australia. G.P. Thomas\* (Woodside Energy Ltd) & M. Smith (Woodside Energy Ltd)  
15:45 Norne 4D and Reservoir Management – The Keys to Success. B. Osdal\* & T. Alsos (Statoil)  
16:30 Production-induced Stress Change in & above a Reservoir Pierced by 2 Salt Domes – Geomechanical Modeling & its Applications (SPE-131590). H. Mahani\*, J. Snippe & P. Schutjens (Shell)  
16:55 High-resolution Images and Formation Evaluation in Slim Holes from a New Logging-while-drilling Azimuthal Laterolog Device (SPE-131513). L. Ortenzi\* (Schlumberger), M. Allouche (Schlumberger), I. Dubourg (Schlumberger), S. Chow & R. Os (Schlumberger)  
17:20 Coupled Geomechanical and Micro-seismic Modelling of Secondary Faults (SPE-123383). A. Fouladvand\* (IFP), P. Bernard (University of Paris), A. Baroni, L. Cangemi & J.P. Deflandre (IFP)  
17:45 Integration of Static and Dynamic Data to Investigate Interwell Communication – The Case of Module II of Espadarte Field, Campos Basin, Brazil (SPE-131569). P.R. Pires\* (Petrobras), E. Lira (Petrobras), A. Costa (Petrobras), F. Souza (Schlumberger) & E. Benjamin Jr. (Schlumberger)

## ROOM 127/128 – TIME LAPSE CASE STUDIES (EAGE)

- 9:30 New Opportunities in 4D Seismic and Lithology Prediction at Ringhorne Field, Norwegian North Sea. D. H. Johnston\* (ExxonMobil Production Co.), U. Tiwari (ExxonMobil Exploration Co.) & B.P. Laugier (ExxonMobil E&P Norge)  
9:55 Ekofisk Time-lapse Seismic – A Story of Continuous Improvement. H. Haugvaldstad (ConocoPhillips), B. Lyngnes (ConocoPhillips), P.J. Smith\* & A.I. Thompson (WesternGeco)  
10:20 Seismic Monitoring of an Old Underground Blow-out – 20 Years Later. M. Landro\* (NTNU), M. Thompson (Statoil), A.S. Pedersen (Statoil) & L. Amundsen (Statoil)  
10:45 4D Case Study in the Deep Water Gulf of Mexico – Hoover, Madison and Marshall. M.B. Helgerud\* (ExxonMobil Exploration Co.), D.H. Johnston (ExxonMobil Exploration Co.), B.G. Jardine (ExxonMobil Production Co.), M. Udoh (ExxonMobil Production Co.), N. Aubuchon (ExxonMobil Production Co.) & C. Harris (ExxonMobil Production Co.)  
11:30 4D Fast Track Advanced Interpretation on Dalia Field, Block 17, Angola. E. Brechet\* (Total), H. Jorge (Total), P. Turpin (Total) & S. Maultzsch (Total)  
11:55 4D Seismic in Deep Water at the Dikanza Field, Offshore Angola, West Africa. P.C. Mitchell\* (ExxonMobil Exploration Co.), R.H. Paez (ExxonMobil Exploration Co.), D.H. Johnston (ExxonMobil Production Co.), G.D. Mohler (ExxonMobil Exploration Co.) & C.C. Neto (Sonangol)  
12:20 High Resolution Timelapse Imaging – Salt Creek Case Study. J. O'Brien\* (Anadarko Petroleum Corp.), J. Moran (Anadarko Petroleum Corp.), G. Willburn (Anadarko Petroleum Corp.), S. Morris & J. Andersen (Anadarko Petroleum Corp.) & O. Quezada (Spectraseis)  
12:45 Towards Quantitative Evaluation of Gas Injection using Time-lapse Seismic. R. Falahat\* (Heriot-Watt University), A. Shams (Heriot-Watt University) & C. MacBeth (Heriot-Watt University)

## ROOM 127/128 – RESERVOIR CHARACTERISATION (EAGE)

- 14:30 3D Geological and Seismic Modelling for Reservoir Characterization Workflow Optimization. S. Bardini\* (Eni E&P), D. Grana (Eni E&P), F. Maffioletti (Eni E&P), E. Paparozzi (Eni E&P), L. Ruvo (Eni E&P), C. Sala (Eni E&P) & C. Tarchiani (Eni E&P)  
14:55 Application of Distance Based Random Field Models to History Match a North Sea Field. D. Kachuma\* (Total E&P UK Ltd)  
15:20 Bilondo Oil Field – How To Deal with Sand Injections? Static and Dynamic Evidence, Modelling and Consequences. A. Mazerud\* (Total E&P Congo), B. Carbonnier (Total E&P Congo), Y. Painchaud (Total E&P Congo), J.F. Polpre (Total E&P Congo), P. Ferrand (Total E&P Congo) & M. Bourgeois (Total)  
15:45 High Permeability Zones and their Impact in Reservoir Model Simulation, Postle Field, Texas County, Oklahoma. C. Lopez\* (Colorado School of Mines) & T. Davis (Colorado School of Mines)  
16:30 Predicting Net Pay by Pushing the Boundaries of Seismic and Rock Properties in Complex Lithologies Offshore Angola. J.J. Doorenbos\* (BP)  
16:55 West Athabasca Grand Rapids Formation – A New SAGD Play. M. E. Connelly\* (Laricina Energy Ltd) & L.M. Weston Bellman (Oil Sands Imaging)  
17:20 3D Oil Sands Reservoir Characterization for Exploration, Development and Monitoring. L. M. Weston Bellman\* (Oil Sands Imaging)  
17:45 Reservoir Characterization Using a Streamline-assisted Ensemble Kalman Filter. S.P. Jung (Korea National Oil Corp.), M.J. Yeo (Seoul National University), H. Shin (Suncor Energy Inc.), W. Bae (Sejong University) & J. Choe\* (Seoul National University)

Timetable details correct at time of going to press \* denotes speaker

# Broadband marine solution

CGGVeritas is showcasing its new broadband marine solution.

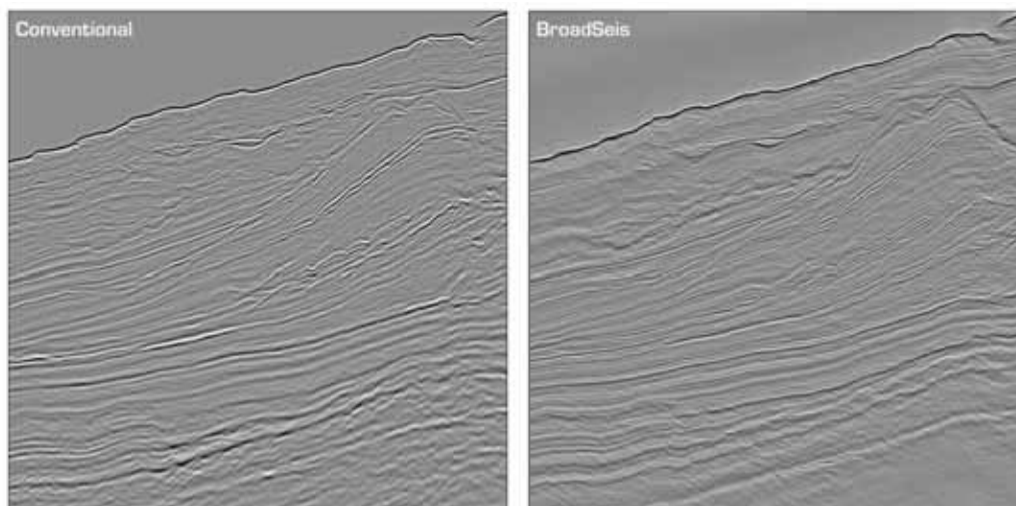
**B**roadSeis is a combination of leading equipment, unique acquisition techniques and patented de-ghosting and imaging technology that, the company says, provides a better subsurface image through a superior broadband marine acquisition solution.

The importance of recording a full range of frequencies—low as well as high—is widely accepted for high-resolution imaging. High-fidelity, low-frequency data provides deeper penetration for the clear imaging of deep targets, as well as providing greater stability in inversion. Broader bandwidths produce sharper wavelets, therefore both low and high frequencies are required for high-resolution imaging of important shallow features such as thin beds and small sedimentary traps.

Towing the streamers deep reduces sea-state noise and improves low-frequency acquisition. However the streamer ghost—the reflection of data back down to the streamer from the sea surface—causes a notch in the amplitude spectrum that comes

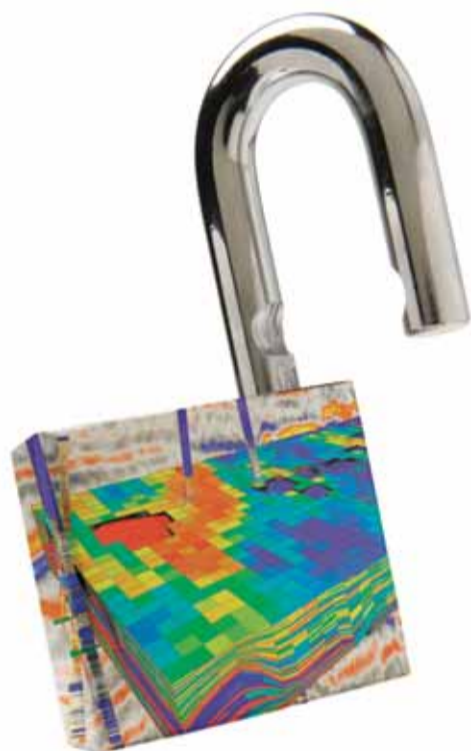
in at lower frequencies as the cable gets deeper; 100 Hz at 7.5 m streamer depth and 50 Hz at 15 m. In the past this has led to a choice between recording shallow for high frequencies or deep for noise-free low frequencies.

BroadSeis acquires both low and high frequencies using a single Sercel Sentinel cable with a variable depth configuration. The cable ghost notch varies along the cable, and this notch diversity is used by a patented new de-ghosting and imaging techniques. According to CGGVeritas, this produces an ideal wavelet with the best



**BroadSeis produces an ideal wavelet, with the best signal-to-noise ratio and best low-frequency content (data courtesy of CGGVeritas)**

Want to find all the potential in your reservoir quickly? **Unlock**



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signal-to-noise ratio and best low-frequency content. The unique combination provides the clearest images, especially at depth, around key target locations.

These new techniques build on the advantages of the Sentinel solid streamer with its extremely low-noise characteristics and precise low-frequency response. Solid streamers are quieter and can be towed deeper (more than 45 m) than other streamers. The new generation of Seal Sentinel streamers have lower instrument low-cut filters that allow recording down to 2 Hz, providing an entire extra octave of low frequencies compared to the old Syntrak system. It used to be widely believed that seismic sources did not produce sufficient low frequency to warrant recording below 5 Hz, but recent data from the TIDES Tsunami Research project, conducted by CGGVeritas in Indonesia, clearly demonstrate that frequencies below 5 Hz are being both emitted and recorded. As well as offering a quieter solution, with better signal-to-noise ratio and better low frequencies, BroadSeis uses fully-proven, readily-available equipment and is immediately operational. The combination of Sercel Sentinel streamers and Nautilus controllers is ideal for variable depth acquisition and allows for efficient operations. Control of solid streamers in variable depth mode is very robust and stable, especially using Nautilus, even at 45 m. The streamers retain their exceptional low-noise characteristics at all depths. As BroadSeis requires no new equipment where solid streamers are already deployed, it is immediately available on 75% of CGGVeritas vessels. There are fewer operational difficulties and there is no loss in productivity due to having to tow additional streamers.

BroadSeis includes a new, fully 3D de-ghosting algorithm that makes no 2D assumptions and has no complications for de-ghosting ray paths in the crossline direction. CGGVeritas says that this gives it unrivalled suitability for 3D and all wide-azimuth acquisition configurations, as well as being available for 2D data. Although the BroadSeis technique includes de-ghosting, the raw field data will be supplied to clients, allowing them to apply alternative processing techniques if so desired.

CGGVeritas says that the optimized and uniquely shaped variable-depth solid streamer configuration, combined with its patented new de-ghosting and imaging algorithms, delivers a broadband spectrum with increased low and high frequencies over conventional recording. This provides an exceptionally sharp and clean wavelet for interpretation. The notch diversity is designed and optimized for exploration and production targets, delivering the best possible resolution to interpreters. The variability of the cable depth can be tuned for different water depths, target depths and desired output spectra.

The company says that BroadSeis is ideal for all reservoirs, outperforming other industry solutions for high-definition broadband imaging of 3D data and delivering a signal spectrum of unprecedented bandwidth. As targets go deeper, BroadSeis can rely upon a larger useful bandwidth, particularly in the low-frequency range, benefitting challenges such as imaging beneath complex overburdens. Conversely, for shallow targets, BroadSeis benefits fully from the total bandwidth available and recordable. This delivers the sharpest wavelet and the best resolving power in the industry as well as the added penetration and imaging power of boosted low frequencies. The combination of Sentinel streamers, new variable-depth towing geometries, and breakthrough processing technology, creates stunning final images of the subsurface. BroadSeis provides a simple, available and robust solution for broadband marine acquisition in all dimensions. For more information, visit CGGVeritas at booth 540. ■

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REDUCING EXPLORATION RISK



# Superior signal to noise streamer performance

Sercel says that it has developed a unique technological solution, providing the best quality data resulting in the best seismic data image.

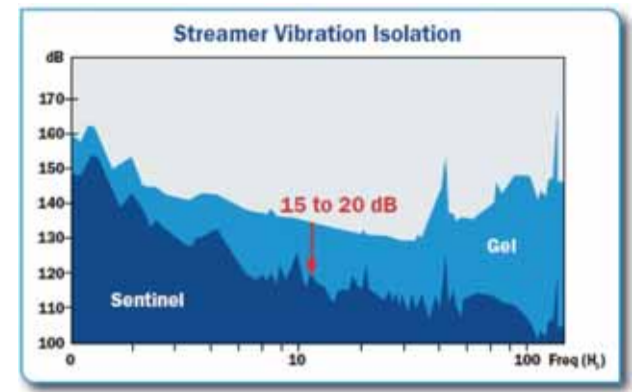
The company says that its Sentinel® streamer delivers superb signal to noise performance, primarily due its high immunity to vibration noise.

There are two primary sources of noise that affect conventional streamer performance; these are flow noise and vibration. Flow noise is caused by the turbulent boundary layer flow across the streamer. It is a very small contributor to the noise field and is only significant when the overall streamer noise is very low and occurs in very calm seas. Vibration noise is caused by vibrations that are transmitted into the streamer and converted to pressure waves. These vibrations can come from many sources including the ship, the towing arrangement, tail buoy, external devices, and the motion of the sea. Vibration noise increases very rapidly as sea conditions increase. Fluid or

gel filled streamers dissipate the vibration energy through bulge waves within the cable. These waves produce pressure fluctuations which are seen as signals by the hydrophones.

To avoid the coupling of vibrations in the cable into the hydrophones, the Sentinel streamer uses multiple techniques to isolate the hydrophone from the cable. The individual hydrophone elements are isolated from the hydrophone carrier and the carrier is also isolated from the cable. According to Sercel, these methods of decoupling the hydrophone from the cable are very effective at preventing the cable-borne vibrations from being transmitted into the hydrophone and corrupting the seismic signals.

The figure shows a comparison of vibration immunity between Sentinel and gel filled streamers. The acceleration input into the cable and the acoustic output due to the acceleration is computed in the transfer function. The Sentinel streamer has 20 dB better isolation from vibration noise in the seismic band, which provides improved signal to noise. Sercel says that the Sentinel streamer's superior vibration immunity is the principal reason it provides high signal to noise performance in all sea



A comparison of vibration immunity between Sentinel and gel filled streamers.

states. This performance allows improved imaging with enlarged bandwidth and more specifically low frequency signal to noise ratio allowing clearer imaging of deep reservoirs. For further information please visit Sercel on booth 530. ■



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## Tuesday Executive Sessions

### Morning Executive Session

09.50 - 13.10 hrs, Room 113

Latin American NOCs - Advances in the E&P Strategy

Chairmen: German Espinosa (Cepsa Colombia) and Carlos Macellari (Repsol).

Latin America has been characterized by the presence of long-lived and strong NOCs. However, each NOC is currently facing different challenges related to their internal circumstances and strategies. Facing the development of massive new resources, for example, or expanding for the first time outside their national boundaries. Other NOCs are redesigning their strategy to concentrate back in their country of origin, while some are newly created and developing a new business niche. This meeting will explore the different challenges facing Latin American NOCs in the light of their particular realities and needs, as viewed by their top executives. The following speakers are going to give a presentation during this executive morning session:

Bob Fryklund (Vice President Upstream Research, IHS-CERA), Santiago Ferro (Project Engineer, ANCAP), Diego Carvajal (VP Exploration, EcoPetrol), Erik Finnstrom (Vice President South Atlantic Exploration, Statoil), José Antonio Escalera (Vice President Exploration Technology, PEMEX), Rolanda Bolaños Zapana (Exploration Manager, Perupetro) and Mario Carminatti (General Manager, Exploration).

### Afternoon Executive Session

14.30-18.10 hrs, Room 113

Corporate Responsibility Planning "Managing the Expectations"

Chairmen: Eduardo Garcia Moreno (Repsol) and Carl Trowell (WesternGeco).

The panel session will be addressing corporate responsibility and holding a session on the environmental responsibility of the industry and managing expectations. During the afternoon executive session the following speakers will give a presentation following an introductions by Carl Trowell and Eduardo Garcia Moreno:

François Hermal (HSE & Performance EVP, CGGVeritas), Sarah Lindsay Tsofilias (Vice President - Marine Environment, IAGC), José Luis Blasco (Partner CSR Services Europe, KPMG), Désirée Abrahams (Programme Manager, International Business Leaders Forum) and Vicky Copeman (Partner, Environmental Resource Management)

**Note: the executive sessions are open to all full conference delegates!**



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# The rise and rise of gravity gradiometry

ARKeX is demonstrating the benefits of Gravity Gradiometry Imaging (GGI) at EAGE 2010, and how it the technique is justifying its line item in exploration budgets.

GGI, which maps small density variations in subsurface rocks by measuring the gradient of the Earth's gravity field, has seen sales jump in recent years. It can also lay claim to some well-known supporters; David Bamford, former exploration head at BP, describes GGI as a "potentially transformation technology".

GGI was first commercialised in the early 1990's and, according to ArkeX, has since demonstrated its ability to provide a complementary data source to seismic in some of the world's most complex geologies, allowing operators to hone-in on areas that require further seismic exploration. The increased resolution, bandwidth and 3D spatial awareness of GGI, compared to conventional gravity techniques, is helping support seismic imaging in correctly determining the velocity and density relationship and thereby reducing uncertainty and risk.

GGI's ability to incorporate offline components into its datasets-the ability to view geology sideways-also provides operators with increased spatial awareness and the ability to better understand influences on 2D seismic data outside the plane of acquisition. In this way, GGI can be integrated with 2D seismic to provide an improved 3D Earth model and 3D interpretations of the data.

Another key benefit of GGI is its light environmental footprint. Airborne and marine GGI surveys and the non-invasive passive technology allow the exploration of vast regions quickly, accurately and efficiently. Environmental control is vital in a wide range of environments, particularly as a growing number of reservoirs are in environmentally fragile areas.

At a time when many of the world's frontier regions are characterized by poor seismic responses, and with continuous pressure on effectively managing costs, operators will benefit from utilizing as many data sources as possible to economically image structures quickly and develop a more complete picture of the subsurface. ArkeX is convinced that GGI is one such data source. The company says that its recent partnership with Ikon Science demonstrates ARKeX's determination to extract the

maximum value from GGI alongside other technologies. The new service with IKON will see an integrated modelling workflow using Full Tensor Gravity Gradiometry data, well information and 2D/3D seismic data in conjunction with Ikon Science's rock physics technologies and reservoir characterization workflows.

In the marine environment, GGI is addressing a number of key offshore exploration issues, such as pre-salt imaging, which is an increasingly common challenge in many of the world's under-explored fields, such as offshore Brazil, Gabon and Angola. No matter how accurate the velocity model or how fast the 3D migration algorithm, seismic pre-salt imaging can only work effectively with successful illumination. The ability of GGI to accurately map the density contrast between salt and the surrounding rock, as well as add 3D velocity constraint to an otherwise interpolated field, can improve density and velocity models and generate a clearer picture of pre-salt basins. For example, GGI is being combined with seismic data from offshore Gabon where ARKeX recently completed a 9,250 square kilometre survey for CGG Veritas. Here, the combined data set of gravity gradiometry and seismic data is aimed at improving the overall understanding of the petroleum potential of the area, especially in the pre-salt section.

GGI has also been applied effectively to interpret the geologic fabric in a transition zone setting along the Louisiana coast in the Gulf of Mexico. Working with IONGEO, the GGI data generated by ARKeX provides an independent measurement of the spatial location and geometry of faults and salt features, resulting in increased confidence in velocity model building and subsequent depth imaging and regional interpretation.

ARKeX also has experience working in other environmentally fragile marine areas, one such example being a marine survey off the western coast of Greenland. Here, GGI is expected to be able to quickly assess the petroleum geology of the area and help de-risk any future exploration. From licensing to frontier exploration to prospect generation or evaluation, GGI is a powerful de-risking tool and a driving force in onshore and marine exploration today. To find out more, visit the ARKeX stand at booth #470. ■



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world. In addition, the combined company holds an even more extensive 2D and 3D multi-client data library covering North America.

Empowered by a broad range of technologies that include specialist Transition Zone equipment, four-component Ocean Bottom Cable crews and high-performance Land Vibroseis operations, we provide effective seismic project planning, proprietary and multi-client acquisition and complete processing and interpretation services.

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## Student programme

EAGE has brought the student programme to the next level this year with a football themed student sports café entitled 'Go for the goal'. The programme will not only include many exciting and entertaining football challenges but also knowledge and career developing activities for all student participants. The student programme is divided into 4 parallel sections:

- Student sports café activities
  - Workshops and student short courses in rooms 133/134
  - Trial interviews in room M218 and M221
  - Student poster presentations in the poster area of P2 floor
- The student sports café is located on the first floor in room 111/112. Please pick up your complete student programme schedule here!

### YOUNG PROFESSIONAL DEBATES

Come and experience our young professionals' perspective on important topics and issues affecting the industry. The young professionals will challenge each other on the best way to address these future issues. There will also be some surprise senior executive guests participating in the debates.

### EXHIBITION TOUR

Starting from the student sports cafe, the student exhibition tour from 10.30 - 12.00 today takes students around the exhibition floor in small groups to visit participating companies. Industry professionals are available to give specifics on their company and give out promotional materials and gifts to participating students.

### GEO-QUIZ

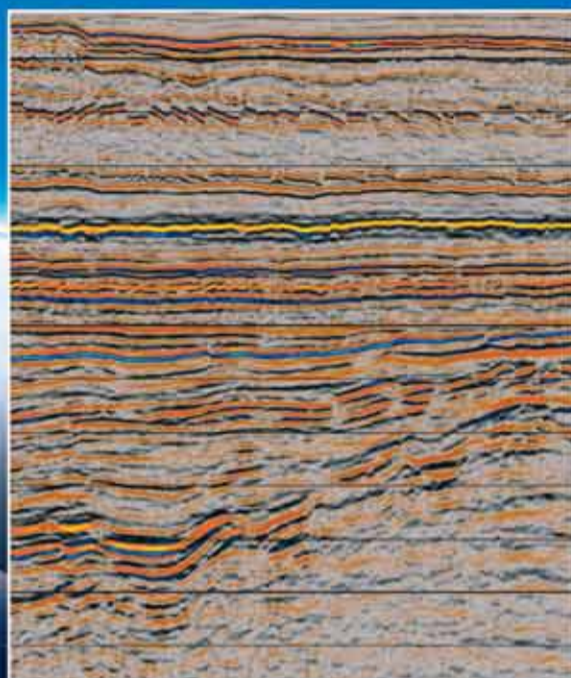
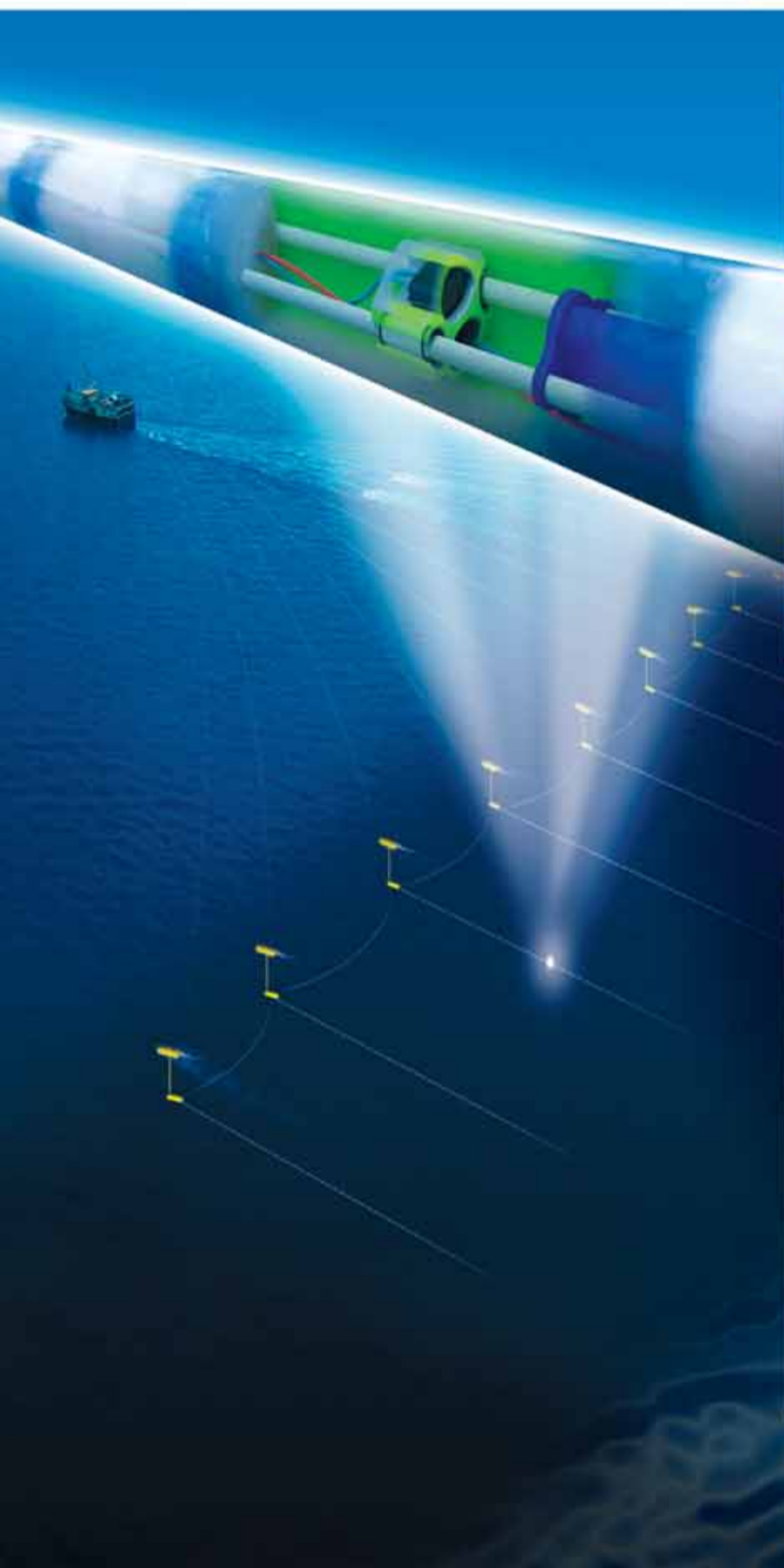
The Geo-quiz from 17.30 - 19.00 today challenges university students to prove their geoscience knowledge and skills learned during the course of their studies. Team up and put your knowledge to the test to win some fabulous prizes!

### EAGE STUDENT EVENING

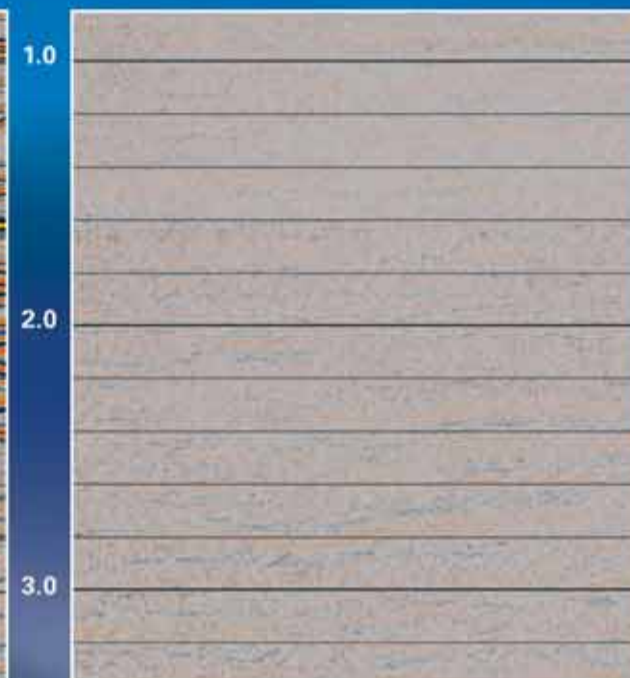
The EAGE student evening takes place at the Mellow Beach Club this year offering tapas style dinner, drinks, a DJ and dance floor, VIP industry professionals, EAGE board members, an international environment, beach front atmosphere, eventful and entertaining industry interactive activities and lots of fun. All participating students will also receive a special student gift during the celebration. The student evening starts tonight at 19.00 and finishes at 23.00.

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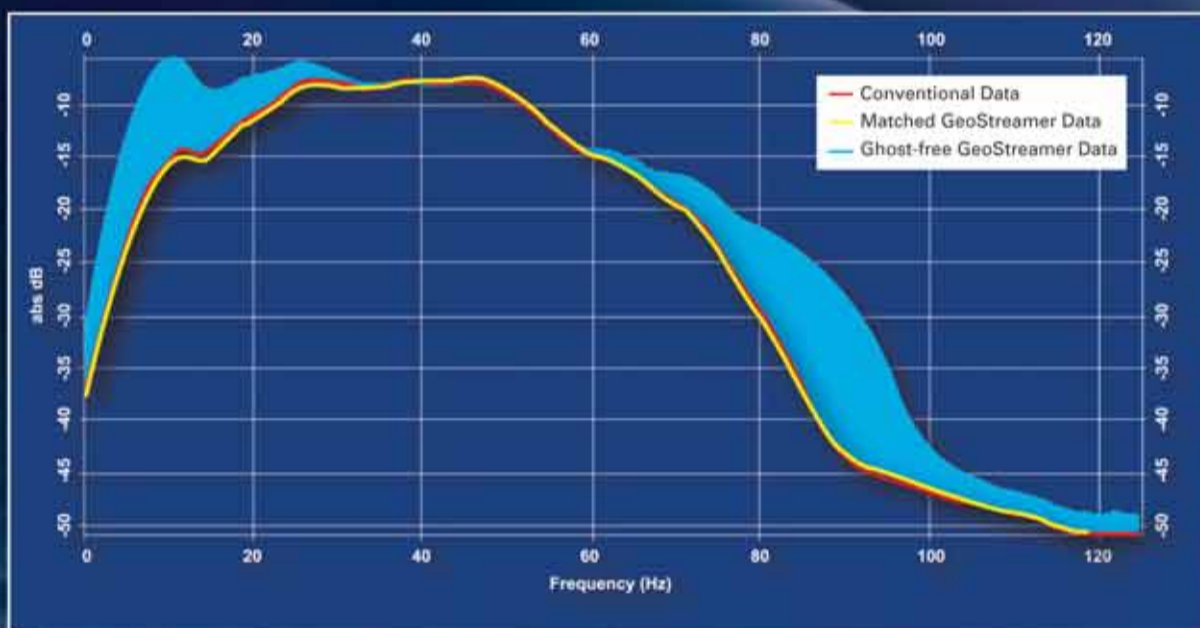


Conventional data acquired in non-producing area



Difference image – conventional vs. matched GeoStreamer.

GeoStreamer 4D processing allows reconstruction to match conventional baseline. The 4D repeatability is fully in line with conventional 4D studies.



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**Enhanced resolution**

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# GeoSolutions for an evolving market

Hart Energy Publishing spoke with Maurice Nessim, vice president WesternGeco GeoSolutions, about how the organization is focusing on meeting the changing needs of its E&P customers.

Nessim is a geophysicist by education and training. He began his career in 1981 with GSI, processing data in the field in Egypt. Since then he has gradually moved from technical towards managerial roles within Western Geophysical and subsequently WesternGeco. In 2008 he joined the Schlumberger reservoir management group, and moved to his current position in July 2009. He has since managed a restructuring process that has led to the formation of the WesternGeco GeoSolutions group. The group's responsibilities include survey design, modeling, data processing, imaging, inversion, multiclient projects, data processing research and development, 3D VSP, interpretation, and geological services.

"This restructuring reflects changes that are happening in our industry," says Nessim. "Multidisciplinary teams are better positioned to deliver tailored solutions that meet the needs of our clients. Our job is to first understand the geophysical and geological requirements of the customer and then develop

innovative workflows-integrating a range of services-to deliver better Earth models and solutions. This often involves feasibility studies, working together to evaluate potential solutions."

Seismic is a critical component in exploration and production (E&P). Operators are facing ever more complex geological challenges and many are exploring beyond their traditional geographical and geophysical comfort zones, so expert consulting, collaboration, and integrated solutions can make a real difference, Nessim said. "This calls for exceptionally high levels of innovation, imagination, and interpretation from our scientists."

Nessim suggests that the key factors that geoscientists should consider to achieve optimum results when addressing particular E&P challenges can be represented by "five I's": Illumination, Imaging, Integration, Inversion and Interpretation.

Illumination is critical to success. It requires designing suitable acquisition geometries that will enable the subsurface target to be seen. This includes consideration of offsets, azimuths, signal/noise and bandwidth, and requires close collaboration with the E&P asset team. Q-Technology\* point-receiver seismic hardware and software enables a broad range of flexibility and creativity for designing surveys to most effectively deliver the right answer. Offshore, WesternGeco has proven the value of the Coil Shooting\* single-vessel full-azimuth acquisition technique and is

now applying even more innovative acquisition geometries such as Dual Coil. On land, the UniQ\* integrated point-receiver land seismic system today provides over 150,000 channels and this capacity will rise in the future.

Imaging means ensuring the Earth model is as accurate as possible-reducing risk while drilling, maximizing reserves, and optimizing production. "The WesternGeco toolbox is broader and more advanced than most others; for example, our full waveform inversion (FWI) algorithm is now being applied to commercial projects, including the E-Wave\* advanced imaging project, which is focused on enhancing the quality of imaging complex geology in the Gulf of Mexico," said Nessim.

Integration means effectively and efficiently combining the right workflows and technologies to produce the best possible Earth model. This may include combining different measurements such as VSP and electromagnetic, gravity and magnetic data. As part of Schlumberger, the increasing diversity of software capabilities within Petrel\* seismic-to-simulation software provides WesternGeco with a significant advantage in integrating different types of data.

Inversion is required to get the best value from seismic data, providing rock and reservoir fluid properties in addition to a structural model. This process requires broad bandwidth data and robust amplitude control all the way from field acquisition and recording to the final product. Q-Technology provides the foundation to meet these requirements.

Interpretation, while ultimately the responsibility of an E&P company, is enhanced when the interpreter has all the information he or she needs to best understand the data. This is most effective when the people preparing and delivering the data also have a good understanding of the geology.

Nessim is changing the way that WesternGeco interacts with its customers, leveraging expertise in other Schlumberger segments to evolve from a diverse service organization into a focused geosciences company. This evolution is enabled by technology, teamwork and ever closer collaboration with clients. He suggests several differentiating factors that give WesternGeco a unique place in the geosciences market.

Firstly, that all the required geophysical technologies are available within one organization. Secondly, that the company has a world-leading software platform that can support and integrate many different technologies. Thirdly, that WesternGeco and the rest of Schlumberger deliver the best surface and downhole measurements in the industry, with unique levels of accuracy and reliability. Last but not least, WesternGeco is part of a global organization with an unmatched range of knowledge and expertise, including geophysicists, geologists, computer scientists, reservoir engineers, drillers and many others.

This range of expertise enables WesternGeco to listen, understand and collaborate with E&P companies in a more constructive way. "Having the best geoscientists put the best data through the best computer systems in a smart, structured, and integrated way is most likely to deliver the best results," Nessim says.

Nessim envisions a bright future and growing demand in the market for the services of his organization. "Results to date are very promising," he said. "Many of our clients have commented that this is exactly what they need. They recognize that it will decrease their exploration costs and speed-up their development cycles-sometimes in a game-changing way". For more information about WesternGeco GeoSolutions, please visit the Schlumberger and WesternGeco booth or go to [www.westerngeco.com](http://www.westerngeco.com) ■

\*Mark of Schlumberger



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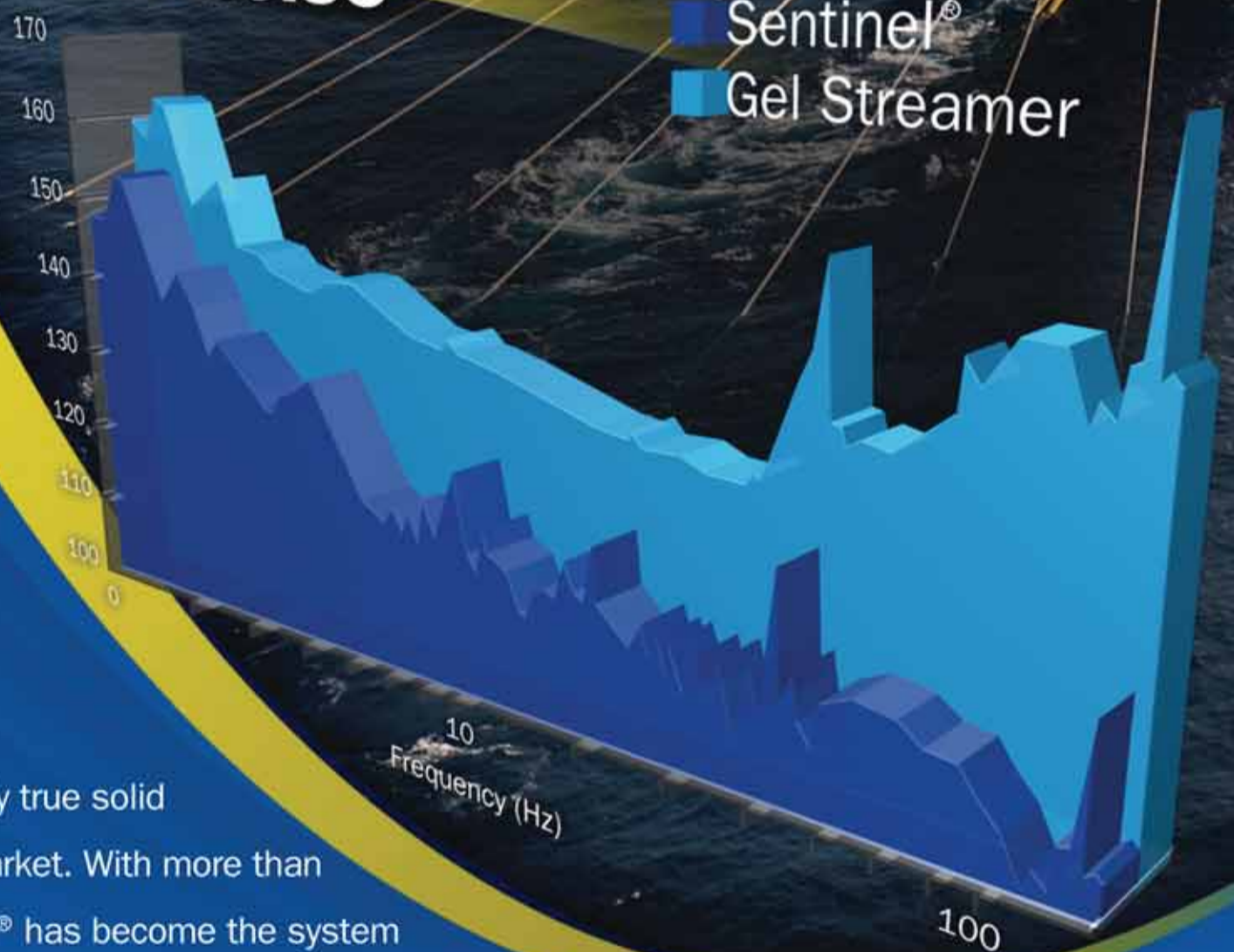
## Southern Permian Basin Atlas

A new Petroleum Geological Atlas of the Southern Permian Basin Area is now available from the EAGE bookshop. The Atlas presents a comprehensive and systematic overview of the results of over 150 years of petroleum exploration and research in the Southern Permian Basin area. It aims to stimulate the petroleum E&P industry to continue their activities in this mature basin. The subsurface characterisation provided in the Atlas will also be of great value to governments, researchers and other individuals interested in the deep subsurface. This publication, which provides an overview of the geological development from Precambrian to Holocene, and details of hydrocarbon exploration and exploitation, is the definitive reference for the petroleum geology of the area. The Atlas is available in print (A2 format) and in PDF format. The enclosed GIS Maps and the SPBA Project Database are also available as a separate digital product on DVD. For more information go to the EAGE bookshop or visit [www.eage.org/bookshop](http://www.eage.org/bookshop).

# Sentinel®

## The Best-in-Class Streamer Performance

### Low Noise



Sercel's Sentinel® is the only true solid streamer available in the market. With more than 2500km delivered, Sentinel® has become the system of choice in the industry in terms of high reliability and unsurpassed data quality.

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- Best signal/noise ratio

#### HIGHER PRODUCTIVITY

- Outstanding noise immunity in all sea states

#### DEEP RESERVOIR IMAGING

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# Unveiling the unexpected and unexplored

PGS says that 2010 is set to be an exciting year for GeoStreamer® enthusiasts.

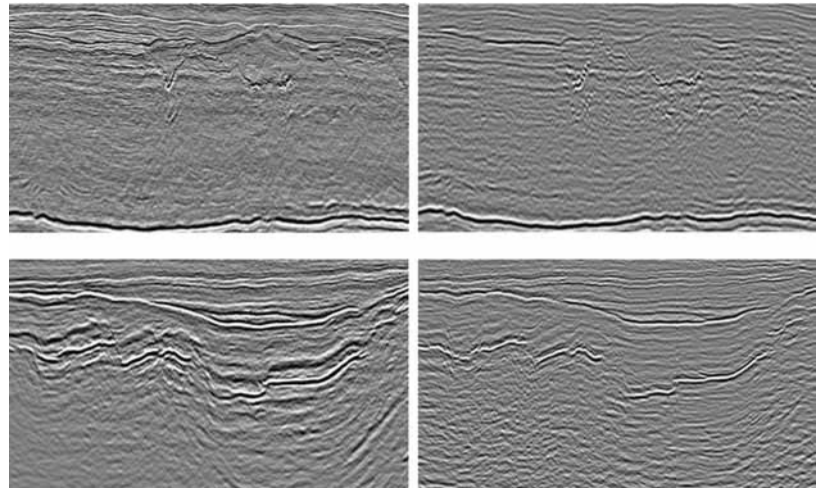
Two vessels will acquire MultiClient 3D dual sensor towed streamer data in mature parts of UK and Norwegian North Sea waters, looking for the unexpected and unexplored as well as better images of known reservoirs. Over 5,000 km<sup>2</sup> of GeoStreamer data will be acquired in the Viking and Central Graben this season. So why reshoot North Sea areas already covered by generations of 3D data? What more can possibly be added by dual-sensor towed streamer technology?

The story started back in 2007 with a 2D test program in the Norwegian Sea. The high capacity vessel Ramform Explorer towed two streamers at different depths - one conventional and one dual sensor - and hence created a dataset for direct comparison of data quality. According to PGS, the results raised eyebrows around the world. The GeoStreamer data showed a much higher signal-to-noise ratio and significantly improved penetration and imaging of deep basins due to the increased low frequency content. The high frequencies were also clearer and overall frequency bandwidth was broader. This was a proof of concept. Since then, PGS has acquired

more than 120,000 line km of 2D and 19,000 km<sup>2</sup> of 3D GeoStreamer data in all major hydrocarbon basins of the world.

2009 was the year that GeoStreamer 3D was introduced in the North Sea. Results from a proprietary group shoot conducted in Norwegian Quad 16 are being presented in the Marine Acquisition technical session on Wednesday afternoon. Two other surveys were acquired as MultiClient datasets over held and open acreage. Targets vary from very shallow Neogene channel systems to sub-salt Permian structures within one dataset through producing Paleocene sands to a Jurassic discovery at more than 4,500m depth in the other. Deep imaging is massively improved, as well as the shallow resolution. What appeared as random noise on previous datasets clearly stands out as small-scale faulting on the crisp GeoStreamer data. PGS poses the question: could this be the tool to simultaneously acquire site survey and deep structural data?

This summer, the Ramform Explorer is being fitted with a 3D GeoStreamer spread, utilizing its full towing



Shallow and deep portions of the same seismic line in the Peik area of the Viking Graben: GeoStreamer data (left) and MegaSurvey data (right). Note the combination of high resolution and superior deep imaging.

**WGP**

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capacity. Another Ramform sister is acquiring 3D GeoStreamer data in West Africa and soon a third Ramform will arrive in the North Sea to start acquisition of a high density 3D GeoStreamer MultiClient program. Although the North Sea region is a mature E&P basin, its exploration potential remains excellent. However, to release that potential, there is an urgent need to improve the quality of the seismic database to enable exploration of deeper, more complex and more subtle targets. Expanding the seismic frequency bandwidth is desirable, as it enables a better understanding of deep structure at the same time preserving the detail in the shallower section. Broader bandwidth also offers a superior input to all inversion techniques. PGS says that its GeoStreamer technology achieves this expanded bandwidth by combining data from collocated pressure and particle velocity sensors in towed streamers.

GeoStreamers are towed deep, which has a number of operational advantages over conventional acquisition. In particular, dual-sensor streamer operations are less susceptible to weather-related noise and seismic interference. This fact has been observed in all GeoStreamer surveys acquired to date, and was very clearly illustrated during the 2009 North Sea season. PGS was operating two of its 6-streamer 3D vessels on neighbouring areas for a continuous period of two months. One was a GeoStreamer spread, towed at 15m. The other had conventional streamers towed at 8m. Whereas the conventional operation was down for weather 24% of the total time, the GeoStreamer operation only had 4% weather standby, saving valuable time and money. In addition, the greater weather tolerance of GeoStreamers renders it possible to extend the acquisition season to complete key projects.

PGS believes that reshooting the North Sea makes sense on a number of levels. The dual sensor data offers significant improvements at both ends of the bandwidth and is likely to uncover new potential in the low risk, highly efficient production province that is the North Sea. Although the project is ambitious, the company expects that the operational advantages of GeoStreamer mean it is likely to be the most efficient acquisition the region has seen. For more information, and to view data examples in full resolution, visit PGS at booth 350. ■

## Feasibility study for Burundi survey

Surestream Petroleum, an independent E & P company with interests in sub-Saharan Africa, has contracted WGP to perform a feasibility study in preparation of undertaking a 2D seismic survey in Burundian waters of Lake Tanganyika. Surestream has been awarded licenses for Blocks B and D and has since opened an office in Bujumbura; the largest city and capital of Burundi, which is a landlocked country. Surestream is relying upon WGP's experience of providing safe, efficient and successful 2D surveys in challenging marine environments to provide an expert consultation service to address all elements of a potential 2D seismic survey. Key members of WGP's operations team recently returned from an investigatory visit to Lake Tanganyika to inspect potential vessels to be used, assess the conditions on the lake, as well as investigate local infrastructure and logistical capabilities.

WGP Operations Manager Marcus Smith commented: "Having completed a trouble free 2D survey off the coast of Somalia in 2008, we are familiar with the complexities of operating in demanding locations. Performing a safe and high-yield survey on Lake Tanganyika is certainly possible but will require detailed planning and flexible execution. This is exactly the kind of niche seismic exploration that WGP has led the market in for the last ten years." For more information, go to [www.wgpgroup.co.uk](http://www.wgpgroup.co.uk) or visit WGP at booth 190.

TOTAL met en place les standards d'échange de données (open data exchange) d'Energistics pour simplifier les architectures IT et contribuer de façon efficace à l'exploration et à la production de champs de plus en plus complexes.

TOTAL is implementing Energistics open data exchange standards to simplify IT architectures and contribute efficiently to the exploration and production of increasingly complex fields.

Philippe Malzac  
Chief Information Officer, E&P, Total

# Systematically assess exploration risks

Schlumberger says that, with Petrel 2010, users now have the ability to improve their exploration success rates through the use of new tools that systematically analyze trap and reservoir, as well as charge and fault seal, two of the greatest points of failure when dealing with exploration.

To better address the evaluation of complex structures, the modeling-while-interpreting\* function has been added in Petrel 2010, allowing geoscientists to automatically create a structural framework. Users can create faults on the fly as new interpretation is added, including the rules that define the relationship between faults.

"With previous versions of Petrel, focus has been predominantly on exploration workflows concerning the assessment of trap and reservoir," said Jaime Vargas, seismic-to-simulation specialist. "This latest release of Petrel will enable users to improve exploration success by providing tools to systematically analyze risk associated with trap and reservoir, as well as charge and seal." Additionally, geoscientists have the ability to add horizons that are correctly intersected with all of the faults, resulting in a structural framework that has the integrity to be passed directly into the modeling realm. Interpreter knowledge is preserved in modeling workflows, which allows modelers to avoid recreating framework. Both interpreters and modelers can test uncertainty in the structure and iteratively refine velocity and property models. The modeling-while-interpreting function provides more accurate volumetrics, volume-uncertainty quantification and multiple scenario analysis.

In the past, says Schlumberger, exploration has been

traditionally driven by hypothesis based on specific geological concepts supported by a combination of experience and the ability of geoscientists to visualize geological features. While exploration success has often been linked to past successes in similar geological structures, operators are looking to more complex reservoirs to replenish reserves.

With this latest release, the inherent visualization technology and probabilistic approach within Petrel allows for the augmentation of existing experience with a set of flexible, data-driven workflows. This concept extends from concept to basin-to-prospect analysis. Additionally, the seismic-to-simulation software can easily handle datasets that range in size from multibasin scale to prospect scale. This allows users to move from prospect to concept without having to switch applications.

Petrel 2010 also offers greater exploration scalability that is enabled by the compute power of a 64-bit system-coupled with a highly scalable seismic architecture. Spatial awareness enables users to group data from various coordinate reference systems, which is a necessity for handling regional exploration datasets.

Direct integration of petroleum systems modeling within exploration software is also added with this release. The

Petroleum Systems Quick Look plug-in allows geoscientists to analyze all known hydrocarbon accumulations and model charge in new structures to more accurately rank prospects. By combining with PetroMod\* 3D analyses, users can estimate the geochemistry of these possible accumulations, taking into account all of the complexities of historic reservoir processes.

Fault-seal analysis is a critical step in both prospect and field appraisal, as well as in the identification and mapping of critical high-flow zones or seal-continuity areas. Correctly modeling faults is critical in achieving a history match. The fault-seal tools developed by Rock Deformation Research have been incorporated into Petrel 2010, enabling fault-seal analysis to be achieved quickly, as well as with greater accuracy and repeatability. Additionally, the module delivers front-line juxtaposition and property-mapping tools in both exploration and production environments, providing users with the ability to integrate with core data to allow calibration and reduce uncertainty.

For more information, visit Schlumberger at booth 340 where various presentations regarding Petrel 2010 are scheduled. ■

\*Mark of Schlumberger

## Microseismic hydraulic fracture monitoring

Baker Hughes announced in May that VSFusion, a borehole seismic processing joint-venture between Baker Hughes and CGGVeritas, recently completed one of the largest microseismic hydraulic fracture monitoring surveys ever undertaken. The survey for Apache Canada Ltd. in the Horn River Basin of northwest Canada deployed Baker Hughes' geophone strings simultaneously in two observation wells for over 30 days. Microseismic events were recorded for hydraulic stimulations in 13 wellbores adjacent to the observation wells. In all, over 75 separate hydraulic stimulations were recorded.

The project used a variety of deployment geometries in both the horizontal and near-vertical sections of the observation wells to optimize hydraulic fracture imaging in the reservoir. Operations were conducted 24 hours a day and VSFusion provided realtime display of recorded microseismic events, both on the wellsite and in Apache's offices in Calgary and Houston. Monitoring and analysis of microseismic information during operations provides the ability to optimize the hydraulic stimulation process by modifying the fracture stage design while pumping into the formation. Apache used the real-time data to experiment with how different perforation patterns impacted fracture propagation and to then make real-time changes in the fracture program as a result. At one point, the data showed an absence of growing microseismic activity, alerting Apache to switch from pumping proppant to flushing the well with water to avoid a potentially costly sanding-off of the fractures.

"The data collected from Baker Hughes' microseismic survey are important to Apache's success in the Horn River Basin," says Ron Larson, senior staff geophysicist with Apache Canada. "The ability to evaluate the effectiveness of our hydraulic fracture program, both real-time and post-project, affords us the opportunity to optimize the spacing of the horizontal wells on future drilling pads, with potential near-term cost savings that may exceed the cost of the microseismic data," he notes.

"We are pleased that this microseismic survey yielded excellent results for Apache," says Mike Davis, president of Baker Hughes in Canada. "We believe microseismic monitoring is a key technology in our growing production enhancement portfolio. The addition of pressure pumping to our wide range of drilling and completion services will further enhance our ability to partner with our customers to create wider solutions on these critical projects."

Recording microseismic events to monitor rock fracturing in 3-D space and time during the stimulation process allows confirmation of the rock volume and formation geometry being stimulated. From this information, future well placement and completion designs can be optimized for cost-effective drainage of unconventional reservoirs. For more information about VSFusion, visit them on the CGGVeritas booth (540) or go to [www.vsfusion.com](http://www.vsfusion.com).



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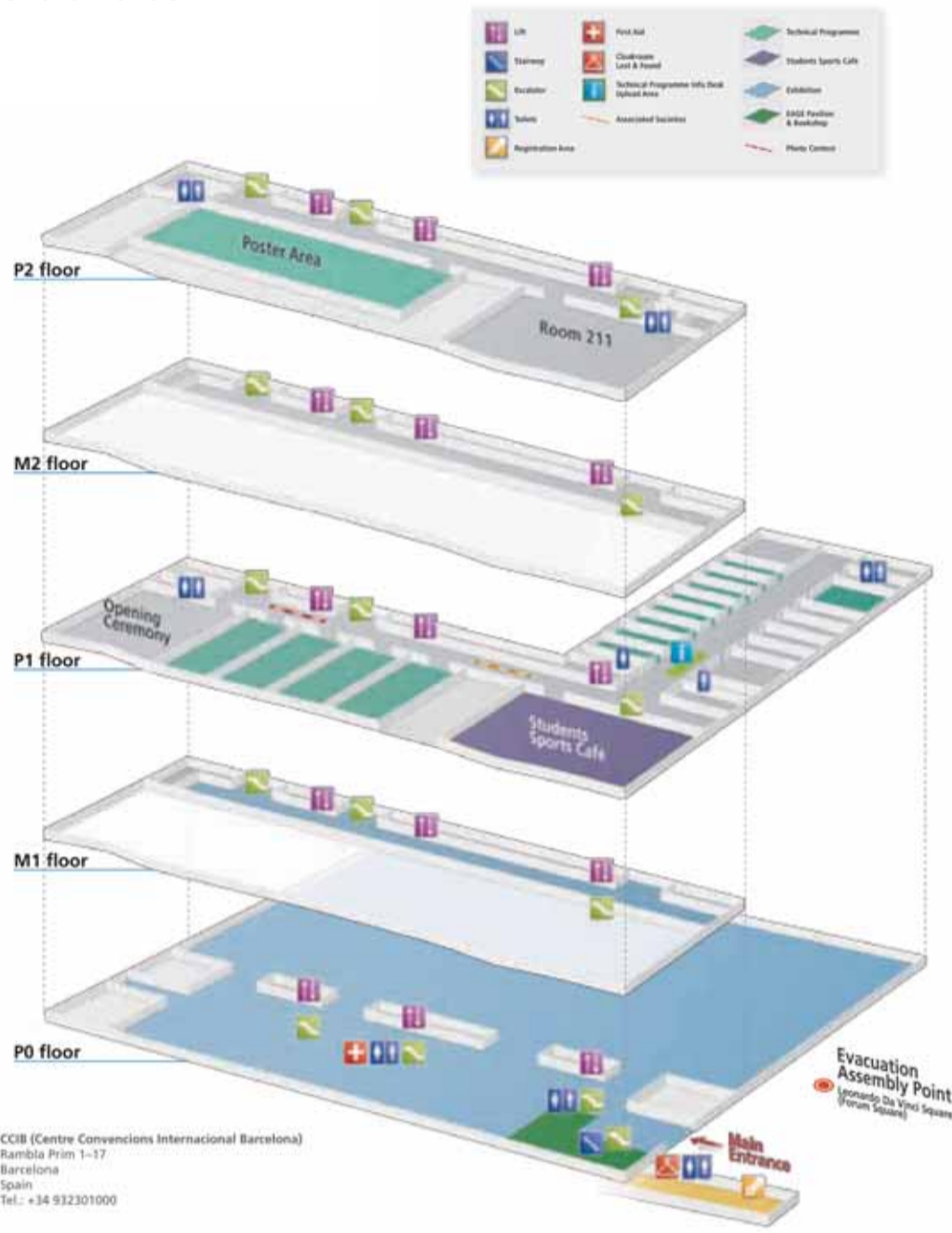
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# EXHIBITION FLOOR PLAN & LIST OF EXHIBITORS

## Plan of the Venue



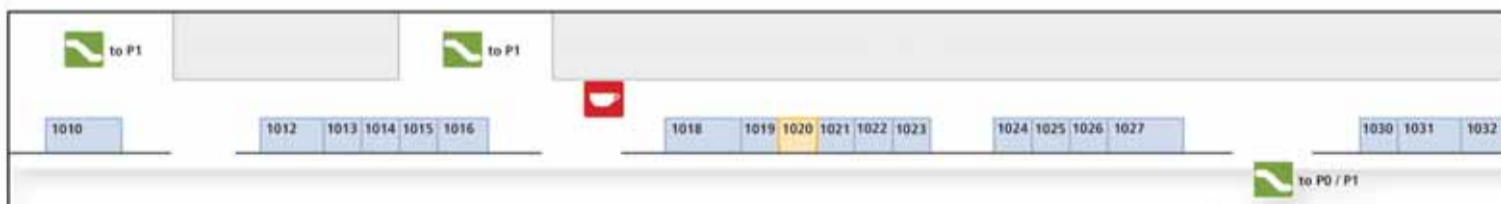
Company	Stand	Company	Stand	Company	Stand
AAPG	135	Dynamic Technologies	912	GeoScience Limited	172
ABEM Instrument AB	460	E & P Training Services	810	Geosoft Europe Ltd	470 - E
Acoustic Geophysical Services	152	EAGO (EurAsian Geophysical Society)	1200	Geospace Engineering Resources International	620
ADDAX PETROLEUM	8 - JC	Earthworks Environment & Resources Ltd	671	Geospace Technologies	620
Advanced Geosciences Europe S.L.	771	Eliis	692	GEOSVIP JSC	192
Aeroquest Ltd	583	EMC Corporation	160	Geotec spa	131
A-G Geophysical Products Inc.	465	EMGS ASA	740	Geotech Ltd	101
AGGEP (Spanish Association for Geologists & Geophysicists)	1200	Energistics	775	GeoTomo	220
Air Walsler Srl	900	Engenius Software	170	Geotomographie GmbH	144
All Ukrainian Association of Geoinformatics	1200	Enigma Data Solutions	145	Geotrace	710
ALT s.a. (Advanced Logic Technology)	460	Enres International	906	Geovariances	122
Altamira Information	1010	EnVision AS	173	GEOVERS Ltd	154
Amphenol Steward Enterprises	694	EOST - University of Strasbourg	5 - U	Global Geophysical Services Inc.	572
ANEGA Holding LLC	120	ESG	470 - H	GNS Science	147
ANH Colombia	127	ESRI	300	Guralp Systems Ltd	1016
Aptomar AS	1018	ETAP-Entreprise Tunisienne d'Activités Pétrolières	1022	Halliburton Energy Services	650
ARETECH Exploration Services S.L.	158	European Association of Geoscientists & Engineers (EAGE)	230	Hampson Russell	540
ARK CLS Ltd	210	European Geosciences Union (EGU)	1200	Hart Energy Publishing	99
ARKeX Ltd	470 - B	Eurotech Computer Services Ltd	210	Headwave Inc	782
Ascend Geo	302	Evomec AS	880	Hellenic Geophysical Union (HGU)	1200
ASPG (Azerbaijan Society of Petroleum Geologists)	1200	Exploration Electronics Ltd	880	Heriot-Watt University	2 - U
Association of Hungarian Geophysicists (MGE)	1200	Exploration Logistics Group	590	Hewlett Packard	180
Atlas Fluid Controls Corporation	197	Exxonmobil International Ltd	870	HUE AS	163
Atlas Seistech	162	FairfieldNodal	224	Hydroscience Technologies Inc.	760
Aurensis SLV	133	ffA	130	IBM Corporation	125
Australian Society of Exploration Geophysicists (ASEG)	1200	FGPS	167	IFP	700
Avalon Sciences Ltd	570	Flodim	130	IHRDC	209
Balkan Geophysical Society (BGS)	1200	Fluid Inclusion Technologies	161	IHS Global Ltd	175
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Bell Geospace Ltd.	1019	Fugro Data Solutions Ltd	682	Industrial Vehicles International Inc.	142
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Bergen Oilfield Services	673	Fugro Gravity & Magnetic Services	640	Ingrain	110
BGP Inc	310	Fugro Multi Client Services	640	Institut Polytechnique LaSalle Beauvais	3 - U
Blueback Reservoir AS	310	Fugro NPA	640	INT (Interactive Network Technologies)	182
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Boston Ltd	465	Fugro Seismic Imaging Ltd	640	Intrepid Geophysics	1 - CA
BP Exploration Operating Co.	168	Fugro-Geoteam AS	640	ION	550
British Geological Survey	5 - JC	Fugro-Jason	640	IRIS Instruments	514
Bull SAS	1 - U	Fusion Petroleum Technologies Inc.	1027	iSeis	684
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Central Geo Ltd	158	GAS S.r.l. Geological Assistance & Services	150	Isys - The Imaging Systems Group Inc.	764
Cepsa E.P., S.A.	198	GEDCO	141	Italian EAGE-SEG Section	1200
CGGVeritas	282	GEM Advanced Magnetometers	460	Jaguar Exploration Inc	910
Challenger Geoinstruments Ltd	540	Geo Publishing Ltd/GEO Expro	171	JDR Marine Cables	730
Colombian Association of Petroleum Geologists & Geophysicists (ACGGP)	212	Geocable Systems	3 - CA	JOA Oil & Gas B.V.	480
Croatian Academy of Sciences & Arts (ZVN HAZU)	1200	Geofizyka Kraków Sp. z o.o.	824	Kadme AS	1024
Curtin University	1200	Geofizyka Torun Sp. z o.o.	738	Kinematics Inc	514
Czech Association of Geophysicists (CAAG)	6 - U	GeoGlobAll Group	812	King Abdullah University of Science & Technology	1300
DataDirect Networks	1200	Geokinetics Inc.	720	Knowledge Reservoir (UK) Ltd	1015
DECO Geophysical Co. Ltd	774	GeoKnowledge AS	690	Kuwait Oil Company	320
Deutsche Geophysikalische Gesellschaft (DGG)	502	Geological Survey of Norway	211	LandOcean Energy Services Co., Ltd	800
dGB Earth Sciences	1200	Geomage	904	LARGEO LLC	225
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DMT GmbH & Co. KG	460	Geophysical Data Systems Ltd (GDS Ltd.)	115	Macha International Inc.	910
Dong Energy Exploration & Production	560	Geophysical Survey Systems Inc.	514	Mærsk Oilie og Gas A/S	508
DownUnder GeoSolutions	1 - JC	Geophysik GGD mbH	149	Marac Enterprises Inc.	470
DPTS Limited	490	GeoPro GmbH	146	Marine Arctic Geological Expedition (MAGE)	184
	156	Company	Stand	Maritim Service AS	590
				MicroSeismic Inc.	762
				Mitcham Industries Inc.	664
				Mørenot AS	590
				Mount Sopris Instrument Co.	460
				MSU Oil & Gas Research	1301
				National Oceanography Centre	7 - U
				Nautilus Ltd	209
				NCS Subsea Inc	166
				Network Appliance Inc.	222
				NEXT	209
				NORSAR Innovation AS	270
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				Oyo Corporation	514
				OYO Geospace Corporation	620
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				PBG Ltd	157
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				Petrosys Europe Ltd	308
				PGS Exploration (UK) Ltd	10 - JC
				PGS Exploration (UK) Ltd	350
				Phillystran Europe BV	844
				Phillystran Inc.	844
				Phoenix Geophysics Limited	470 - G
				Pico Envirotec	470 - A
				Plato Alliance	209
				Polarcus	705
				Poseidon Offshore Ltd	3 - CA
				Prospectuini S.A.	571
				R.T. Clark Companies Inc.	470 - C
				Real Time Systems	465
				Reality Mobile	1023
				Repsol Exploracion S.A.	280
				Reservoir Imaging Ltd	680
				Robertson Geologging Ltd	514
				Rock Deformation Research Ltd	773
				Roxar Software Solutions AS	505
				RPS Energy	100
				RXT - Reservoir Exploration Technology AS	605
				Sander Geophysics	153
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				SATPOS AS	902
				Saudi Aramco	630
				SBGf (Brazilian Geophysical Society)	1200
				Scandinavian Visualization Society (ScanViz)	1200
				Schlumberger Oilfield Services	340
				Scintrex	470 - I
				Scout GTS-Geotech Group	6 - JC
				SeaBird Exploration	600
				Seamap Pte Ltd	664
				Seamap UK Limited	664
				Seaterra GmbH Geophysics & EOD Services	203
				SEG (Society of Exploration Geophysicists)	140
				Seismic Equipment Solutions	694
				Seismic Image Processing Ltd	580
				Seismic Instruments Inc.	195
				Seismic Micro-Technology Europe Ltd	480
				Seismic Source Company	684
				Seismotekhnika	148
				Seisquare	715

# VENUE FLOOR PLAN & LIST OF EXHIBITORS

## P0 floor



## M1 floor



Plan of the Exhibition Area



Seistronix	770	System Development Inc. (SDI)	890	Vinci Technologies	199
Senergy	202	T&A Survey BV	183	VNIIOkeangeologia	908
Sercel	530	TechnoImaging LLC	905	VSFusion	540
Sevmorneftegeofizika (SMNG)	304	TEEC	560	VSG (Visualization Science Group)	718
Sharp Reflections	682	TEECware	560	W.L. Gore & Associates GmbH	786
Siberian Geophysical Research and Production	132	Teledyne Marine Geophysical Instruments	290	Wacom Europe GmbH	1012
Siberian Research Institute of Geology&Geophysics	1013	Tele-Rilevamento Europa - TRE S.r.l.	660	Weatherford International (Corporate)	750
SKB SP	192	TERRASYS Geophysics GmbH & Co. KG	560	WEIHAI SUNFULL GEOPHYSICAL EXPLORATION EQUIPMENT	102
SkyTEM ApS	903	TGS	510	WesternGeco Ltd	340
Society of Exploration Geophysicists of Japan (SEGJ)	1200	TNO	662	WesternGeco Ltd	1031
Society of Petroleum Engineers (SPE)	196	Total	520	WGP Exploration Ltd	190
Society of Petroleum Geophysicists (SPG)	1200	Trelleborg Offshore Barrow-in-Furness Ltd	772	Wiley-Blackwell	213
Soedinitel JSC	194	Troika International	880	Working Smart Ltd.	7 - JC
Sonardyne International Ltd	840	Tsunami Development	500	WorldSensing	1014
Spectraseis AG	733	Ukraine Association of Geologists (UAG)	1200	Worldwideworker.com	13 - JC
SPT Group AS	672	University of Edinburgh	4 - U	Xi'an Senshe Electronic Technology Corporation	151
Statoil ASA	260	University of Pau and Pays de L'adour DRV	1020	xPort Group Inc.	694
Stingray Geophysical Ltd	604	Vehicle Source Products Inc.	694	Zhaofeng (Xushui) Sensor Equipment Co Ltd	155
StratoChem Services	860	Verif-i Limited	123	Zonge Engineering and Research Organization, Inc.	1025

# Breaking Arctic barriers

ION says that it is quickly developing a reputation as the "go to" company for acquiring and processing data in the Arctic, a region the United States Geological Survey (USGS) estimates could contain 25% of the world's undiscovered hydrocarbon resources.

Despite the upside potential, seismic operations in the Arctic are challenging. Harsh weather conditions provide a narrow weather window for acquisition operations and, even then, ice can wreck havoc with in-water equipment and introduce unwanted noise into the seismic data.

Over the past five years, ION has successfully acquired over 25,000 km of seismic data in the Arctic through multi-client programs in the Canadian Beaufort and US Chukchi seas, and offshore Greenland. The company says that, collectively known as ArcticSPAN, these geologically-driven, basin-scale seismic programs help oil and gas operators better understand offshore petroleum systems in the region, more effectively assess the Arctic's hydrocarbon potential & help mitigate exploration risk.

Last year, in one such multi-client program offshore Northeast Greenland, ION acquired the first in-ice long offset marine towed streamer survey. Despite an unusually harsh ice season, the company successfully acquired over 5,200 kilometers of data, exceeding program underwriters' expectations. ION attributes the success to its proprietary [IA] Arctic Solution, which combines the company's program management expertise, its Intelligent Acquisition (IA) marine seismic technologies, and the capabilities of the GX Technology data processing group. This integrated approach gives ION the ability to safely and efficiently gather valuable seismic data in areas once considered off limits.

According to Joe Gagliardi, ION's Director of Arctic Solutions, "One challenge we had to overcome was to protect the seismic equipment from the ice itself. Although we used a Polar Class ice breaker to clear a path for the seismic vessel, some ice still remained in the boats' wakes. We designed a proprietary towing arrangement to deflect any remaining ice from the path of the streamer cables. With the path then cleared, our proprietary streamer steering technologies ensured that the DigiSTREAMER solid streamer remained in the

'fairway' of open water cleared by the ice breaker."

ION says that its [IA] Arctic Solution has enabled the company to dramatically extend its Arctic shooting season. Where acquiring data in the Chukchi Sea was once a two-month prospect at best, the company is now able to extend the shooting season to five months. In Baffin Bay, ION says it is now able to acquire data for up to ten months where previously three months was considered the norm. Having the capability to operate in harsh, icy conditions increases the weather window, survey geography, and likelihood of survey completion.

Based on its success in Greenland, ION plans to acquire two additional under-ice towed streamer programs this season. In October, long past the typical shooting season, ION will deploy a crew to the Beaufort Sea to acquire its BeaufortSPAN West program, the first survey designed to acquire seismic data under the 10/10ths consolidated pack ice cover that is expected to prevail for the duration of the survey. A second crew will acquire the second phase of ION's Northeast GreenlandSPAN program. To learn more about ION's [IA] Arctic Solution, go to [iongeo.com](http://iongeo.com) or visit ION at booth 550. ■



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## Ocean Petrel workflow adaptor

Every interpretation workflow needs to make use of the best data that is available in the enterprise. Sometimes that data is easily available, but more often it is not. Petrel® users are no different when it comes to accessibility of data, especially if the data is spread across multiple project data stores and, more importantly, accessibility to data not readily available on the Windows platform where Petrel operates.

OpenSpirit says that its Ocean-Petrel Application Adapter (OPAA) offers an easy solution to address this issue. Petrel users can now interpret with more data than ever before. OPAA makes maximum use of the OpenSpirit SOA-based integration framework by bringing live data access to all the industry-standard project data stores, including OpenWorks, GeoFrame, Finder, PPDM, Recall, KINGDOM, Epos, ArcSDE and others. Users can work with data types ranging from well data, interpretation data, seismic data and culture data. At the same time, users benefit from OpenSpirit's powerful coordinate transformation abilities coupled with automatic unit conversions. OPAA performs all the required unit and coordinate conversions to present the data in a user-preferred unit and coordinate system.

Built using the Ocean developer's kit, OPAA integrates seamlessly into the Petrel environment. A standard Petrel user interface makes OPAA easy to use for all Petrel users. In fact, users do not even have to leave the Petrel environment at all. As an example, a seismic volume may exist on a Linux server, but OPAA brings that data seamlessly into the Petrel environment in Windows. A user has a choice to either browse the volume line-by-line or bring the entire volume into Petrel. OPAA brings in a variety of options to the interpretation workflow.

OPAA's intuitive user wizards prompt users during critical steps such as setting up the right cartographic reference, and seismic reference datum, thereby ensuring data validity and eliminating errors that stem from incorrect project setup. A standard Match-and-Merge dialog offers the user a familiar interface to synchronize (import/export) data between Petrel projects and project data stores. Users can also customize and set appropriate matching criteria between objects in Petrel and data types in data stores. OPAA automatically enables history tracking by maintaining an audit trail on all Petrel objects synchronized via OPAA. This ensures integrity of data residing in Petrel projects regardless of the source or destination. It also allows users to work with data from multiple data sources simultaneously thereby ensuring consistency in interpretation workflows.

Application interoperability with other geotechnical applications is another important feature of OPAA. Making full use of OpenSpirit's event services, OPAA can interact with other OpenSpirit-enabled applications, such as Paradigm's GOCAD, ESRI's ArcMap, Ikon's RokDoc, Google Earth, and more than 40 other applications. Sending well information from GOCAD to Petrel or sending culture data from ArcMap to Petrel are typical workflows that allow a user to work with data simultaneously in multiple applications. In addition, the GIS integration abilities of OPAA now allow Petrel users to access spatial/culture data selected in a variety of desktop or Web-based geospatial browsers. OpenSpirit is showcasing the Ocean Petrel Application Adapter on Booth 670.

# Enhanced geological & geophysical applications

Since its mid-summer 2009 release, Paradigm's next-generation Interpretation and Modeling suite has enjoyed a full year of exposure in the oil and gas industry.

Developed to run on the Paradigm Epos® open and distributed data management system, this synchronized release of geophysical and geological applications has, according to Paradigm, lived-up to its ability to scale to hundreds of users, operate efficiently with multiple survey data and repositories, and serve a broad spectrum of exploration and development communities. Collectively, these design goals encouraged the deployment and application of the suite to projects requiring high levels of operational and technical complexity.

In addition to expanding its infrastructure and data management footprint, the 2009 release broadened the reach of the seismic interpreter with new application enhancements. New data connectivity links were created to support an interpretation (Paradigm SeisEarth®) to modeling (Paradigm GOCAD®/SKUA®) continuum for tasks such as validation of spill points, fault seal analysis, fault frameworks, and horizon positions. The validations are performed with easy 3D restorations of model data and 3D paleo-flattening of seismic data. This new data connectivity extends this continuum to reservoir modeling and simulation, facilitating the inclusion of reservoir properties from seismic inversion, seismic facies classifications and electrofacies classifications, while broadening the understanding of the reservoir description on production.

To enable better communication between geologic and seismic interpreters, this release also introduced a new well log correlation and sectioning window (Paradigm StratEarth™). This new tool shares common views and data objects, such as traverses, to create a more unified, stratigraphic interpretation that is not constrained to the primary survey grid directions.

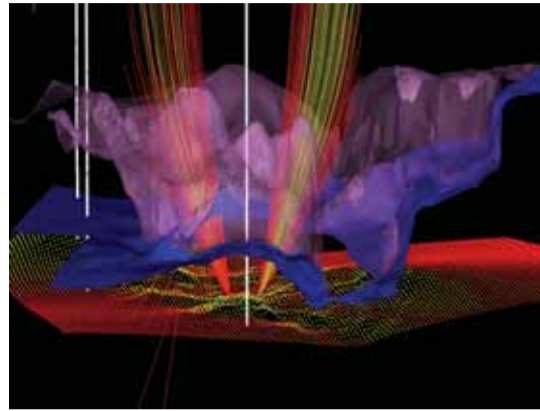
## Improved data driven pre-stack inversion

Over the past 30 years, seismic inversion has become an integral part of exploration and production activities. Inversion methodologies can generally be broken into two camps: data-driven and model-driven. Data-driven inversion is based on the recursive method in which  $V_p$ ,  $V_s$ , and density reflectivities, derived through a pre-stack simultaneous AVO/AVA inversion based on a 3-term approximation such as Aki & Richards', are integrated to relative rock properties before being combined with low frequency models. Model-driven inversion starts with initial geological models for absolute  $V_p$ ,  $V_s$ , and density. From those initial models, a model AVO/AVA response is generated using a 3-term approximation, then perturbed to create different AVO/AVA model responses, and compared with the real seismic data. When the perturbed AVO/AVA model responses match the real seismic data, the perturbed inverted absolute values of  $V_p$ ,  $V_s$ , and density are output from the inversion. Both methods of inversion provide geoscientists with  $V_p$ ,  $V_s$ , and density information for lithology and fluid prediction and further reservoir model building and simulation analyses.

One major obstacle often still exists in maximizing the potential of seismic inversion: the limited vertical resolution of seismic data. In practice, the quality of model-driven inversions can be impacted due to limited well controls and the non-stationary characteristics of propagating wavelets. According to Geotrace, a data-driven method, combined with resolution enhancement technology, provides a powerful and often preferable approach to derive rock property volumes that show improved vertical resolution and support better stratigraphic and structural interpretation of thin reservoirs and other subtle geological features.

Geotrace has extensive experience in the utilization of resolution enhancement and data-driven inversion workflows for the derivation of high quality, high resolution inversion solutions, and in conjunction with Repsol, is presenting two papers on the subject: "Characterization of Thin Turbiditic Sands in the Cantabrian Sea through Bandwidth Extension" on Tuesday June 15 at 09:55 hrs and "Is Thin Turbiditic Sand Winning - A Case Study on High Resolution Processing and Interpretation?" on Wednesday June 16 at 14:30 hrs. To learn more about Geotrace Reservoir Services, visit booth 710.

Paradigm says that it is not resting on its laurels, but is already defining and previewing its future interpretation and modeling platform, which includes broadened support for new data objects (e.g. microseismic data, stratigraphic markers, well targets, velocity pencils), and support for pre-stack data. The system provides one canvas for the visualization, interpretation, and analysis of pre- and post-stack data to better audit interpretation deliverables and to bridge the gap between processing and imaging professionals and seismic interpreters. Additionally, the system is being equipped with a novel full azimuth angle domain subsurface illumination system so that interpreters can better understand the dependencies of the velocity model(s) and seismic acquisition on



Optimizing interpretation knowledge

the seismic image. This system combines high levels of interactivity with high densities of directional ray sampling, allowing interpreters to qualify reflector or reflector patches during the interpretation process rather than as a post interpretation activity. Advanced interpretation options such as multi-attribute displays, operations, and synthetic generation will greatly expand the interpreters experience with seismic attributes. Users of Paradigm's interpretation suite will soon have the freedom of platform choice, as the Paradigm SeisEarth™ interpretation system will be available on Microsoft Windows™. This new offering allows customers to choose between Linux and Windows operating systems for both its interpretation and modeling suites. ■

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UNDERSTAND



DELIVER

Our clients face unique geophysical challenges at every stage of their field life cycle, from reservoir identification and characterization to development and management. We understand these challenges and offer technology and expertise to provide tailor-made solutions.

Powered by Q<sup>+</sup> point-receiver seismic acquisition methodology, which supplies fundamentally better measurements, WesternGeco has launched Exploration<sup>Q</sup>, Complex Illumination<sup>Q</sup>, 4D<sup>Q</sup>, and Carbonates<sup>Q</sup> solutions packages to address efficient exploration, difficult imaging, time-lapse, and carbonate reservoir projects respectively.

We **listen** to your challenges.  
We **understand** your needs.  
We **deliver** value.

[www.westerngeco.com/pofq](http://www.westerngeco.com/pofq)

