



3rd Annual GSH/SEG
Web Symposium
on
3D seismic survey design



Program

9:00	Introduction and Welcome		
9:10	Survey design for azimuthal AVO	Dave Monk	DUG, ACTeQ, GTI Formerly Director of Geophysics at Apache Past President of SEG
9:40	Land seismic survey design should be more "noise aware"	Christof Stork	Land Seismic Noise Specialists
10:10	Remote Terrain Classification for 3D Seismic Survey Design	Andreas Laake	Schlumberger
10:40	VSP pre-survey modelling & acquisition planning A field development land case study	Chris Rudling	RPS
11:10	B R E A K		
11:25	Enabling optimized seismic model building and imaging with an extended frequency source	John Brittan	ION
11:55	New frontiers in low frequency seismic acquisition	Mark Meier	University of Houston Formerly ExxonMobil
12:25	Advances in simultaneous source acquisition and processing	Ray Abma	Bureau of Economic Geology, University of Texas at Austin Formerly BP
12:55	Gulf of Suez Survey Design and Illumination study	Malcolm Lansley	ACTeQ
13:05	Closing remarks		

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Speaker #1

Dave Monk

Survey design for azimuthal AVO

Affiliations

DUG, ACTeQ, GTI. Past President of SEG
Formerly Director of Geophysics at Apache

Abstract

If I know that I want to study the azimuthal response and properties of the subsurface, how should I design a seismic survey". If this question is posed for towed streamer marine surveys, then a search of literature reveals many papers on "Wide Azimuth", "Multi Azimuth" or "Rich Azimuth" configurations, but papers on land acquisition for azimuthal variation studies typically start with "First shoot a full azimuth survey". In this paper we look at various common geometries and try to quantify the appropriateness of the resultant coverage for azimuthal analysis. Given the capability to deploy nodes which are not constrained by connections to cables, we compare typical cabled geometries where receivers are deployed along lines, with grids of receivers. We start by examining how best to deploy receivers should a limited number of channels be available, and then compare the results as trace density is increased.

Speaker Biography

Dave Monk holds a PhD in Physics from Nottingham University (UK), and served as Director of Geophysics at Apache Corporation, until his retirement in October, 2019.

Monk started his career on seismic crews in Nigeria. Throughout his career, he has retained an interest in developing innovative ways to acquire, process, and utilize seismic data to improve final interpretation

An author of over 100 technical papers and articles, as well as a number of patents, Monk has received Best Paper Awards (SEG 1992) and the Hagedoorn Award (EAGE 1994).

He served as president of the SEG in 2012–2013. He was selected as the SEG's Distinguished Instructor Short Course (DISC) for 2020, which was put on hold due to Covid, and is now being delivered as a virtual. As well as work with the SEG, he currently serves as an advisor for several geophysics companies including ACTeQ (survey design software), GTI (node manufacturer) and DUG (processing & cloud computing company).

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Speaker #2

Mark Meier

New frontiers in low frequency seismic acquisition

Affiliations

University of Houston
Formerly ExxonMobil

Abstract

Interest in extending the bandwidth of seismic measurements to lower frequencies has been growing over the last two decades. There are many reasons why geophysicists need lower-frequency information, but the acquisition of lower-frequency seismic data is very challenging. There have been many advancements, and new ideas that may promise more than two octaves over current capabilities have been developed. In the marine environment, the dipole source is one such concept with breakthrough potential for low frequencies. Its primary advantage over existing marine source technologies is that it does not require volume modulation, which becomes prohibitively large at very low frequencies. The dipole volume stays fixed, and it excites seismic waves by translational oscillation. Furthermore, the dipole has no ghost notch at low frequencies, and it produces a comparable far field amplitude for a given amount of applied force. The ability to generate large forces at low frequencies is required.

Speaker Biography

Mark Meier retired in 2016 from his position as a Research Specialist for the ExxonMobil Upstream Research Company in Spring, Texas. During his eighteen years there, Mark worked in Acquisition Research, pursuing a number of areas including low frequency seismic acquisition. After retirement, Mark joined the University of Houston as a Professor of Physics. At UH, Mark negotiated a licensing agreement with ExxonMobil for access to research and patents in low frequency acquisition and is launching a consortium on low frequency seismic technologies. With ExxonMobil as an opening member, Mark hopes to welcome many more companies who share an interest in the development and commercialization of new low frequency technologies.

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Speaker #3

John Brittan

Enabling optimized seismic model building and imaging with an extended frequency source

Affiliation ION

Abstract

As a result of the need to image complex three-dimensional geobodies with high-impedance contrast boundaries, there has been considerable recent interest in improving the signal-to-noise output at low frequencies from seismic sources. In this paper, we report on the development of a new extended-frequency source that can provide an increase in signal-to-noise ratio in the key frequency range 2-4Hz over conventional multi-gun air gun arrays. This source may be characterised as a pneumatic seismic source as it is based on airgun technology. The new source, while designed to optimise the signal to noise ratio at frequencies less than 4 Hz, also provides significant signal across the full seismic bandwidth typically used in modern imaging projects. At high frequencies (150 Hz and upwards) the amplitude levels output by the new source are considerably less (15 dB or more) than that of a conventional air-gun array, which means the new source has considerably smaller behavioural threshold distances for marine mammals than conventional sources. We will discuss the use of this source in sparse acquisition scenarios designed to provide an uplift in the underlying velocity models, as well as in areas where low-frequency signal penetration is key.

Speaker Biography

John Brittan received a BSc in Physics from the University of Birmingham in 1992 and, thanks to a Shell Scholarship, a PhD from Imperial College, London in Geophysics in 1995. He is currently Vice President, Strategic Technology Development for the E&P Technology and Services Division at ION and manages the geophysical research into acquisition, processing and imaging.

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Speaker #5

Christof Stork

Land seismic survey design should be more "noise aware"

Affiliation

Land Seismic Noise Specialists

Abstract

Much of land seismic survey redundancy and cost is for addressing the noise. Yet, the noise generally plays a small role in survey design despite that the noise varies dramatically in amplitude and character. Moreover, the noise generally varies significantly within a survey based on surface geology.

Today, interpretation needs are more demanding, and acquisition hardware is changing dramatically and offers much flexibility that was not available before. This provides a need and opportunity to significantly customize a survey. A more noise aware survey design offers the potential to reduce costs, avoid noise holes, and provide more predictability.

Noise should affect conventional acquisition parameters such as sweep type, source/receiver inline/crossline spacing, etc. But also, it makes sense to use irregular acquisition to counter the often-irregular issues of irregular, such as access, costs, and noise. This is a large global, multi-variable optimization problem that computers can handle well.

Speaker Biography

Christof Stork is a theoretical research geophysicist who has worked on easy problems such as sub-salt imaging, tomography, and wave-equation migration/FWI. For the last 15 years, he has been one of the few theoretical researchers tackling the tough problems with land seismic noise. His work shows that land seismic noise is complex, but not random and surface scattering can be measured and inverted.

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Speaker #5

Andreas Laake

Remote Terrain Classification for 3D Seismic Survey Design

Affiliation

Schlumberger

Abstract

The understanding of the terrain is an important ingredient for 3D seismic survey design. The placement and coupling of sources and receivers as well as the logistics to move them around determines a significant portion of the overall survey cost. Optimizing 3D seismic survey design depends, therefore, largely on the accuracy of information on the terrain that can be included into the survey modeling. The talk comprises an overview of the terrain characteristics that determine source and receiver coupling and acquisition logistics and reviews remote sensing methods to obtain terrain data prior to survey modeling. Technical approaches and methodologies include satellite, airborne and autonomous vehicle remote sensing and their consideration in the survey design workflow for onshore and offshore environments.

Speaker Biography

Andreas has more than 30 years industry experience in seismic, remote sensing, geological modelling and exploration with focus on data visualization, integration and interpretation from global to prospect scale. In cooperation with the European Space Agency he developed a technique for characterization and modelling of the near-surface by integrating satellite data with geological and geophysical data. Presently he works on geological interpretation of surface and sub-surface data and their integration into the seismic and reservoir workflow as well as their applications for exploration from data to discovery and advises the Schlumberger digital subsurface platform on geoscience.

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Speaker #6

Chris Rudling

**VSP pre-survey modelling & acquisition planning
A field development land case study**

Affiliation

RPS

Abstract

VSP data is an important geophysical method used in describing the properties of the subsurface and in improving seismic processing and geological interpretation. It is used in a wide range of applications including oil and gas developments to refine drilling and help avoid dry wells, in mineral exploration and as a monitoring tool for geological sequestration projects. VSP pre-survey modelling, acquisition planning and processing is key to optimizing subsurface imaging. A field development land case study is presented with shows the role of design and collaboration in delivering cost-effective and successful projects.

Speaker Biography

Chris Rudling has 22 years' experience as a geophysicist including 10 years with RPS and 12 years combined with leading contactors CGGV and PGS . He worked for CGGV both as a field geophysicist and an office-based geophysicist during which time he attained the role of data processing manager for their flag ship Angolan office. He has worked on a large number of seismic projects both 2D and 3D from a variety of regions incl. West Africa, North Sea, South America and GOM. He has run a large number of survey design and data processing projects for external clients. Chris manages RPS' seismic processing and survey design group.

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Speaker #7

Ray Abma

Advances in simultaneous source acquisition and processing

Affiliations

Bureau of Economic Geology, University of Texas at Austin
Formerly BP

Abstract

Simultaneous sourcing has made a significant impact in improving the sampling of seismic surveys while lowering the cost. While dense 3D receiver gathers allow very accurate source separation, less dense 2D surveys, including towed-streamer acquisition and sparse ocean-bottom surveys presently have poorer separation quality. We are working to improve 2D source separation as well as improving 3D source separation.

Speaker Biography

Ray Abma is a research geophysicist working at The University of Texas at Austin in the TCCS (Texas Consortium for Computational Seismology). His research focus is simultaneous source seismic acquisition and coded source acquisition. He received a Ph.D. at Stanford University while in Jon Claerbout's group, the Stanford Exploration Project. He has worked for Western Geophysical, Shell, ARCO, and BP.

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Speaker #8

Malcolm Lansley

Gulf of Suez Survey Design and Illumination Study

Affiliations

Consulting Geophysicist
ACTeQ



Abstract

The authors present a survey design case history from the Gulf of Suez, in which a diverse and geographically distributed team of operations and geophysical experts collaborated to deliver a pragmatic solution to a complex challenge in a short time.

Previous attempts to image targets beneath the shallow salt and anhydrite layers using narrow azimuth streamer had proven largely unsuccessful, and a wide azimuth OBN survey was proposed. The project faced significant operational and environmental challenges that constrained the survey design. A number of survey geometries were considered. A wave equation illumination study was conducted for the most cost-effective candidate geometries.

New, processed imaging results will be presented.

Speaker Biography

R. Malcolm Lansley retired in 2015 from his position as VP Geophysics at Sercel in Houston. He remains active in the industry as a consulting geophysicist advising on 3D survey design for onshore, offshore and transition zone projects. He also teaches courses for SEG and others on a variety of subjects including basic geophysics, 3D survey design and acquisition, data processing and vibrator theory and usage. He received a B.Sc. in Physics/Math./Geophysics from Imperial (London) in 1969. Over a long career, he worked with GSI, PGS and Sercel. Although he began his career in data processing, he soon realized it was important to ensure that survey design, acquisition and processing were fully integrated. Malcolm has authored more than 70 papers on seismic exploration. He also has been granted several US and Canadian patents related to 3D survey design.

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