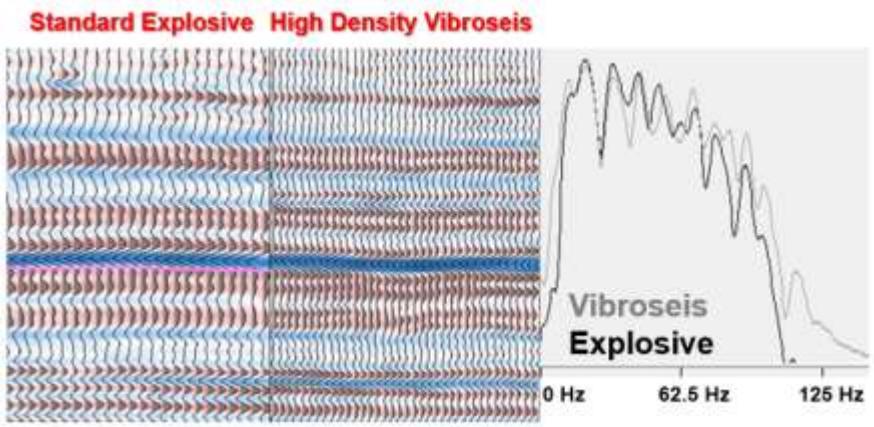
Destination Learning Series Canada (DLSC)
Calgary, Alberta Canada

1. Speaker: Andrea Crook

President
OptiSeis Solutions Ltd.

Abstract: **Innovations in Seismic Acquisition**

Seismic acquisition has changed significantly in the past ten years. Recording systems have switched from cabled to cable-less/nodal systems, vibroseis is beginning to replace explosives even in areas with rugged terrain, new seismic sources are being developed, and high trace density surveys are changing the way This presentation will focus on seismic acquisition innovations that are providing remarkable improvements in data quality, and will include excerpts from Andrea's 2019 GeoConvention presentation, Transitioning to High Density Vibroseis, which won the 2019 Best Oral Presentation award.



Bio:

Andrea Crook, P.Geoph., is the President of OptiSeis Solutions Ltd., a seismic acquisition design and software company focused on developing innovative acquisition solutions for acquiring high resolution seismic data, that she co-founded in 2011. Andrea's previous experience includes seismic processing and geophysical operations at Shell Canada, and geophysical consulting at Boyd PetroSearch. In addition to designing seismic acquisition programs and overseeing software development, Andrea also teaches seismic acquisition courses for the SEG and the CSEG Dooldetrain. Andrea was recently awarded the CSEG Technical Achievement Award for her outstanding technical contributions to Canadian Geophysics.

2. Speaker: John Duhault

Advisor Risk-Mitigator Trainer-Mentor, Principal Consultant
Starbird Enterprises Inc.

"Using Applied Geophysics to influence Business Decisions in the Alberta Oil Patch"

Abstract:
Integrated geophysics has been used to reduce risk and increase profitability in the Canadian oil and gas industry for decades. In recent times the focus has been from conventional plays to unconventional reservoirs and integrated geophysics has adapted to this new environment.
Three examples of how innovative integrated geophysical applications have been applied to influence the company's business decision will be shown. Each example will illustrate:

1. The business problem
2. The workflow to address the problem
3. The impact on the workflow and decision

Scenario 1: Depleted Reservoirs in the Project Area: Drill Hazard Avoidance

a. Business problem: Mitigate the risk of lost circulation while drilling due to depleted reservoirs
b. Workflow: Evaluated all project areas producing wells for total production and reservoir pressures. Identified depleted reservoirs on 3D seismic data. Identified zones that may cause lost circulation. Advised the client to move certain well pad locations.
c. Impact: The client did not have a lost circulation problem that could have cost them over $1-2 MM

Scenario 2: Paleo and Wabamun Karst in Project Area: Drill Hazard Avoidance

a. Business problem: Mitigate the risk of lost circulation due to karst terrain and sinkholes
b. Workflow: Evaluated the project area for karst topography and sinkholes using available 2D and 3D seismic data, geological well logs, and drilling reports. Identified karst trends and sinkholes. Advised the client to move some of the well pad locations
c. Impact: The client moved the problem surface locations and saved $500,000 - $2 MM.

Scenario 3: Water flooded fairways identified in legacy oil pool

a. Business problem: Maximize profitability in a legacy water flooded oil reservoir
b. Workflow: Evaluated the geology and reservoir engineering data of the property. Identified reservoir attribute characteristics, including waterflood fairways, using 3D seismic. Recommended conversion of some existing down dip producers to injectors.
c. Recommended a future 4D seismic shoot to aid in mapping water flood fairway changes.
d. Impact: Increased longevity and profitability of the legacy oil property.

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Bio:

Mr. Duhault is an “Advisor Risk-Mitigator Trainer-Mentor” Geoscientist who has over 40 years of industry experience including over 50,000 hours as a geoscience interpreter in Canada and internationally. He is passionate about teaching the business value of integrated geophysics through the “storytelling” of case histories and has presented papers in North America, Europe, and New Zealand. He has found significant reserves of oil and gas for senior exploration companies and numerous junior independents. He founded and led two private junior oil and gas companies. Mr. Duhault is currently the Principal Consultant for Starbird Enterprises where he specializes in conventional exploration and unconventional resource-play seismic interpretation. Mr. Duhault is a Past President of the Canadian Society of Exploration Geophysicists (CSEG) and is currently the Vice-Chair for the Society of Exploration Geophysicists (SEG)

3. Speaker: Amanda Hall

CEO and Founder
Summit Nanotech Corp.

Abstract:

Energy Innovation: Combatting "Everyday-ism"

Innovation keeps us on our toes. It can yank us out of our everyday routines forcing us to operate differently, whether we like it or not. Innovation has brought us to a place of energy transition, and it has not been easy. However, if we look at patterns of innovation from the past, analyze energy systems today and position ourselves adaptively for the future, then we can explore the exciting new opportunities that come with change.

Bio:

Amanda Hall is the CEO of Summit Nanotech, a company developing lithium extraction technology for the growing lithium ion battery sector. She is a recognized leading Canadian innovator and a selected finalist in the Women in Cleantech Challenge, offered by MaRS Discovery District and Natural Resources Canada (NRCan).

A professional geophysicist, Amanda has 13 years of experience working in the oil and gas and mining industries in Calgary, Alberta and four years in an industrial laboratory in Toronto, Ontario. Amanda graduated from the University of Toronto with an Honours Bachelor of Science degree majoring in Biology and with minors in Physics and English. After moving west, she attended the University of Calgary to obtain a second Bachelor of Science degree in Geophysics, while raising her three young daughters.

Amanda is passionate about growing a humancentric company, employing innovative, resourceful people who feel responsible for rapidly creating the change that is needed in our energy landscape today using wisdom, technology and adaptive solutions.

4. Speaker: Steven Lynch

Chief Geoscientist
Visual Wavefield

Abstract:

Using Wavefield Reconstruction to Reinterpret Legacy Seismic

The most cost-effective and efficient way to explore is to use seismic we already own over leases we have already acquired. But once we have exploited an area, there is little motivation to re-examine the seismic in the region because it is unlikely to tell us anything new. This can change if we believe that reprocessing the data may significantly improve its quality. However, reprocessing is expensive and its benefits, if any, rarely lead to new prospects.

There is, however, a more cost-effective way of getting significantly more information out of our existing seismic. Missing in our historical treatment of seismic is an appreciation that it is an analog acoustic wavefield and that before we interpret it, we must reconstruct its analog nature. Simplistically, this means creating and visualizing a three-dimensional surface formed from the seismic amplitudes. Regardless of the seismic involved, when we do that, we discover that it contains a massive amount of relevant information that was previously unobserved and uninterpreted.

Reconstructing the analog wavefield is a real-time process and does not require reprocessing of the data. It produces visualizations that are massively more informative and in doing so, provides motivation to take another look at your seismic library.

Bio:

Dr. Lynch is the Chief Geoscientist for "The Visual Wavefield Project". He received his B.Sc. in Biophysics (with Distinction) from the University of Guelph in 1975 and his M.Sc. in Geophysics from the University of British Columbia in 1977. Following a 26-year absence from academia, Steve returned to University in 2003 to study seismic visualization and received his Ph.D. from the University of Calgary in 2008.

Steve has a wide range of experience in both geophysical research and software development. Early in his career he managed seismic processing centers and developed techniques for such varied subjects as refraction statics, depth migration, ray trace structural modeling and stratigraphic modeling.

In the early 2000's, realizing that that our ability to perceive seismic was not keeping pace with our ability to acquire and process it, Steve returned to his biophysical roots and began to study visualization as a science. His research led him to pioneer the field of Perceptive Seismic Interpretation. He now splits his time between developing software for it and teaching courses about it.

5. Speaker: Carl Reine, Ph.D., P.Geoph

Chief Geophysicist
Sound QI Solutions

Abstract:

Quantitative interpretation of seismic data - A key component for optimal field development

Structural interpretation of seismic data has been the main contribution of geophysics since its early development. Mapping the subsurface elevation of potential reservoirs along with thickness changes and fault activity provides useful information for certain reservoir types. However, there is much more information contained in the seismic reflections and using this information to characterize the subsurface is increasingly important in more complex reservoirs. Quantitative interpretation (QI) provides information about the measured elastic properties of the rocks, which in turn can be directly related to geological parameters such as porosity, lithology, or fluid saturation. In this presentation, we will look at an overview of how the quantitative information is obtained, and more importantly, how it is turned into geologically useful information, providing more insight than conventional interpretation on its own.

Classic interpretation takes into account the structural changes of the reservoir in conjunction with analysis of the amplitude variations and integration of the well-log data. QI does not ignore these principles but rather considers them in a more analytical manner. AVO inversion is one of the backbones of QI, using the effects of the rock properties on the reflected amplitudes. By analyzing the amplitudes in prestack data, AVO inversion provides volume estimates of P-impedance, S-impedance, and density. These, in turn, can be transformed into a multitude of other elastic parameters as necessary.

Interpreting elastic properties is a crucial function of the geophysicist to explain the results in a geological context. The link between geological properties and elastic properties is found through well analysis and rock-physics modelling. In well analysis, the sonic, dipole sonic, and density logs are used to generate the equivalent elastic properties measured from AVO inversion. These log calculations can then be compared with additional petrophysical data, such as porosity, lithology, or saturation, providing a recipe for how to interpret the seismic results. Similarly, rock-physics modelling produces estimates of the same elastic properties based on theoretical models. These are calibrated to the known well data to ensure appropriate behaviour but can then be altered in a systematic way to discover the properties of rocks that may not have been encountered by wells.

The final output of QI is a geologically classified volume. Often created in the crossplot domain, seismic inversion attributes are compared to those from well analysis and rock-physics modelling and clusters or trends are identified. The resulting volume contains meaningful classes that can be used across disciplines for field development, geological modelling, and general planning purposes by geophysicists and non-geophysicists alike.

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Bio:

Carl Reine has been a geophysicist for 20 years with experience, interest, and publications in quantitative interpretation topics including rock-physics modelling, converted-wave AVO, inversion, azimuthal analysis, and attenuation. He graduated from the University of Alberta in 2000 with a B.Sc. in geophysics and received his Ph.D. from the University of Leeds in 2010. Carl has experience covering most major plays in Canada, as well as international projects, working for both Oil and Gas companies and the service industry. Carl is currently the Chief Geophysicist at Sound QI Solutions, where he is responsible for quantitative interpretation projects. He is an active member of the CSEG, SEG, EAGE, and is a professional member of APEGA.

6. Speaker: Joy Romero

Vice President Technology & Innovation
Canadian Natural Resources Limited

Abstract:

Clean Resource Innovation Network (CRIN) - The "Network of Networks"

The Clean Resource Innovation Network (CRIN) is a group of forward-thinking oil and gas industry professionals, innovators, financiers, policy makers, incubators & accelerators, academics and students committed to the success of the hydrocarbon energy sector, the people and communities that it touches, and a strong, carbon-competitive and diversified Canadian economy.

CRIN aims to enhance innovation effectiveness by:

- Better priority setting and alignment on key game changing technologies to pursue;
- Broader source of ideas and more entrepreneurs engaged from across Canada and the world;
- Focus on deployment phase (field pilots to commercial roll out) where current system falters;
- Better connectivity between all participants (academics, entrepreneurs, funders, customers, governments);
- Expand "path to deployment" and customer centered objectives for the technology work across sectors.

Bio:

Joy Romero, P.Eng, MBA PM, ICD.D, FCAE Vice President Technology & Innovation, Canadian Natural Resources Limited. Joy has worked in steel, iron ore, coal and oil and gas. She joined Canadian Natural in 2001 to develop the Horizon Oil Sands Project. She has served as a School Trustee, Chair of the Governing Council of Athabasca University, and advisor to several NSERC chairs. Joy is currently Chair of the Clean Resource Innovation Network, https://cleanresourceinnovation.com/about/, and Vice Chair of the Petroleum Technology Alliance of Canada, https://www.ptac.org/, as well as past Board Chair of Canada's Oil Sands Innovation Alliance, https://www.cosia.ca/ . She is a member of the Business Leaders Advisory Council for Athabasca University and the Faculty of Science Dean's Circle for the University of Calgary. Joy is a Fellow of the Canadian Academy of Engineers, an inductee of the Canadian Petroleum Hall of Fame and a past member of the Science, Technology & Innovation Council for Canada.

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7. Speaker: Brian Russell

Vice-President
CGG GeoSoftware

Abstract:

Machine Learning Applications in Petroleum Exploration Brian Russell, CGG GeoSoftware, Calgary, Alberta

Although the theory of neural networks, or machine learning as it is now more commonly called, dates back to the backpropagation algorithm of the 1980's, it is only recently that the computer hardware has caught up to the algorithms, turning the promise of machine learning into reality. There has therefore been a reawakening of interest in neural networks and machine learning in every field of endeavor. The purpose of the talk is to look at the basic algorithms used in machine learning and show how these algorithms can be applied in a practical way to petroleum exploration problems, especially in the area of exploration seismology. Examples come from various basins around the world, with the emphasis being on the Western Canadian Sedimentary Basis (WCSB) in Alberta. As an example, Figure 1 below shows various approaches to locating a sand channel on a seismic section taken from a 3D seismic volume, with a well log superimposed. The image in the right-hand panel shows a typical seismic inversion for impedance, which is the product of density and velocity, where the yellow zone at the bottom of the log shows the channel. In the middle panel we have transformed to density using multi-linear regression from seismic attributes, and in the left panel we have used a newer deep neural network. Notice the increase in detail as you go from left to right in the figure.

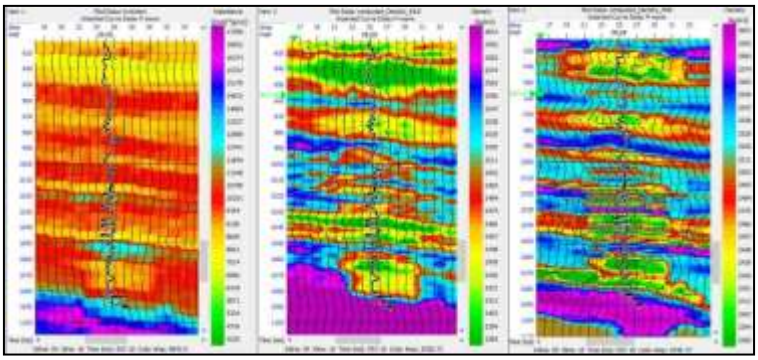

Figure 1. Locating a sand channel on a seismic section, where the left-hand panel shows impedance from seismic inversion, the middle panel shows density from multi-linear regression and the right-hand panel shows density from a deep neural network.

Bio:

Brian Russell holds a B.Sc. from the University of Saskatchewan, a M.Sc. from Durham University, U.K., and a Ph.D. from the University of Calgary, all in geophysics. He joined Chevron in Calgary as an exploration geophysicist in 1975 and subsequently worked for Teknica and Veritas before co-founding HampsonRussell Software with Dan Hampson in 1987. HampsonRussell is now a subsidiary of CGG, where Brian is Vice President, GeoSoftware. Brian is involved in the research of new AVO, rock physics, inversion and seismic attribute techniques as well as giving presentations and courses throughout the world. Brian is a Past-President of both SEG and CSEG and has received Honorary Membership from both societies. He also received the Cecil Green Enterprise Award from SEG (jointly with Dan Hampson) and the CSEG Medal. Brian is an Adjunct Professor in the Department of Geoscience at the University of Calgary and registered as a Professional Geophysicist (P.Geoph.) in Alberta.

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