March 2020

GSH Journal

GEOPHYSICAL SOCIETY OF HOUSTON
Volume 10 • Number 7

The Epicenter of Geophysical Excellence

TABLE of CONTENTS

MEETINGS

FEATURES

CHECK THIS OUT

LOOK INSIDE

On The Cover...

Seismic Data Processing in the 1980's.

Photo courtesy of WesternGeco.

EDITOR'S NOTE

To ensure your information reaches the GSH members in a timely manner, please note the following deadlines and plan accordingly. Please submit your articles and any questions to Alvaro Chaveste, editor, at AlvaroChaveste@hotmail.com

GSH JOURNAL DEADLINES

May 2020 ..... **Mar 13**
June 2020 ..... **Apr 10**
Sept 2020 ..... **July 13**

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A Word from the Board

By Jennifer Graf, Secretary

As a mid-career geophysicist, I'm not sure our industry has adjusted to the 'new normal' since the recent downturn. So, just what is this 'new normal'? Companies have embraced operating on lean budgets, while building capabilities and investing shrewdly. In addition, economic and political instability is ever present, and we're all left with our heads spinning regarding industry outlook. Lay-offs continue. Energy employees no longer live with peace of mind about job security. I've seen many brilliant and capable colleagues let go. Anything can happen at any moment; you just never know. But that's life I suppose. What can each of us do to manage this situation? The same as the oil and gas companies: operate on lean budgets, build capabilities, and invest in ourselves.

If faced with unemployment, people can experience a renaissance. However, people handle the situation in various ways. I had to resign from a great job in 2017, and let's just say it was challenging for me to be unemployed. Obviously, unemployment necessitates reviewing your priorities and very much operating on a lean budget (as anyone with a family knows). We can also evaluate our weaknesses and emerge a better employee when the right opportunity arises. A major gap for me was relationship-building. Yes, the n-word: networking.

I'm an extrovert and I really do not understand, looking back, how I became so siloed. "If I keep my head down, work hard, and continually strive for growth I'll be fine," I thought when I was employed. Perhaps a bit naïve for the energy industry of today? For many this fortuitously works out, but others Life or their Employer has other plans. I knew, although not as a savvy networking expert, I should make connections, as remaining stagnant would get me nowhere fast. I knew that I was passionate about the geophysics, my career, and wanted to meet others of like mind. This led me to the Geophysical Society of Houston.

Sure, I was already a member. I wanted to be an active member. I began volunteering at events, enjoyed the GSH talks I attended and felt more connected to the industry. I found members and staff to be remarkably generous with their support and guidance. This is when I really understood the value of GSH membership.

It's always nice to be around those that get excited about similar things and, within the Houston community, you also get diverse backgrounds and approaches to the geosciences, which keeps things interesting. The geophysical camaraderie is great. The environment is conducive to collaboration and productivity. I learned that many in the GSH crowd see mentoring as a duty, and this is refreshing and motivating.

During this time, like a ray of sunshine, I got the offer of contract work from a former boss. This man is directly responsible, through mentoring and the chances he gave me (which as a female can still be strikingly rare), for my career trajectory. And, here again, he stepped in and offered me a chance to get back on track and continue my pursuit in the oil and gas industry. Maintaining existing relationships and building new ones is key in both rich and lean times.

Careers in our industry can be blustery but being a part of the GSH has been extraordinarily grounding and I am grateful to serve after being asked to run. Since becoming Secretary, I have had the honor of working with extraordinary people with whom I get to attend the Board meetings and functions. I have also seen where the GSH has opportunities to grow. I had an idea, as others have had through the years, to engage more early career professionals and broaden the diversity of the Society. So, I took a leap of faith that this was the right time and presented the idea to the Board based on feedback I received

Word From the Board continued on page 5.

Word From the Board continued from page 4

from GSH early career professionals. The Board, staff, and other members were supportive of the creation of this new special interest group and recommended others that may want to help. I formed a committee, comprising myself, Chairperson Whitney Blanchard, Lillian Comegys, Drew Jones, Peter Lanzarone, Matthew Romane, and Oscar Vasquez, and we launched NextGen.

Time will tell whether NextGen will thrive and expand the GSH. All I know is that I am investing shrewdly in the Society so that I can help give others more opportunities to build capabilities. Let's embrace this 'new normal', re-energize the remarkable geophysical community, and make the GSH an even more valuable organization. Check out NextGen and GSH events. Get involved. It's working for me. □

Dear GSH Journal readers,

Please feel free to email us with any and all questions or suggestions.

Sincerely,
Alvaro Chaveste, Editor,
AlvaroChaveste@hotmail.com

From the Other Side

By Lee Lawyer

I noticed that Don Heron has recently ended his long tenure of entertaining us with the exploits of the "Interpreter Sam" in TLE. Sam encountered a wide variety of supervisors and managers. He will be missed. Remember Interpreter Sam is fiction, based on experience. FTOS is true (mostly).

I am seriously considering closing my 27 years of writing "From the Other Side", which as you know currently appears in the GSH Journal. Each year the TLE had 12 columns. The GSHJ skips two months in the Summer and requires ten. All of that has produced over 300 columns. When I started back in 1994, a year after I retired from Chevron, I was eager and seemed to have a lot to write about. Some of my columns were entertaining and some not. Some had information content, and some did not. Big deal.

I quote an old soldier (Douglas MacArthur), "The shadows are lengthening for me. The twilight is here. My days of old have vanished." Back in the 'days of old', I got notes from you readers, which gave me subjects for future columns. Global warming, Plate tectonics, Data acquisition etc... Speaking of Global Warming, has anyone pointed out the benefits of Global warming? Mankind has been spoiled over the last few thousand years. Not much has changed in our physical world. Temperatures and the price of oil have been stable or at least predictable. Changing the earth's temperature two or three degrees may cause more frequent hurricanes, tornadoes and more severe thunderstorms, causing flooding but earthquakes will still occur as scheduled. Strike-slip faults will continue slipping and continents will continue to wander. We will still have Winter and Summer.

The biosphere is another issue. Animal and plant life will have to adjust as temperature changes. When will we see direct results that can't be argued? Is it rising ocean waters will cause shorelines to founder? In all probability changes will be gradual. Many suggest that disaster will happen by 2030 or 2050. When we Earth Scientists see these numbers, we reflect on how change has occurred in the past. The incredible die-offs at the close of the Mesozoic and the end of the Permian are obvious to us. Most of the time units were recognized and named because of a large unconformity or more likely a large change in the fossil record. We know what happened at the end of the Cretaceous. Each unit had something catastrophic going on. In Geology, it has been argued that things happen either gradually or catastrophically. Most of the sand along the Gulf Coast is deposited during storms rather than tides. (Don't quote me on that one but I believe it.).

I know we should focus on the downside of Global Warming in order to mitigate damage caused by changes but I also know that mankind will adjust to our environment. I greatly enjoyed Maria Angelo Capello's article on the President's Page in the January 2020 TLE. I liked the numbers showing the carbon emissions of many countries. I think it is fine to recruit individuals to check their own "carbon footprint" to bring a little pressure on our leadership. But we need much more than that. We need doable steps with larger scale objectives.

There is a 'progressive' political group that calls for the downfall of the oil industry. I hope they mean that we should find a way to decrease the oil and gas industry's carbon footprint. It is the burning of hydrocarbons not the production of hydrocarbons that is the problem. What can an oil company do along these lines? Natural gas is still being flared. Some on a grand scale in the Middle East and some by small producers that have no way to handle gas associated with the production of oil. Exactly how much methane is being flared? Government regulation could stop that completely but that would probably raise the price of gasoline. That's a lot more logical way to encourage less travel than a carbon tax. Bah! Anyone who thinks government can tax carbon usage and then 'give' the money back to individuals to compensate them for higher prices is eligible to buy a London bridge, which I can sell at a very reasonable price.

PS: If you haven't donated to the GeoScience Center yet, get with it. □

Technical Luncheons

Register for Tech Lunch Westside

Register for Tech Lunch Downtown

Register for Tech Lunch North

Seismic Reservoir Characterization of the Bone Spring and Wolfcamp Formations in the Delaware Basin with Efforts at Quantitative Interpretation

Satinder Chopra

Speaker: Satinder Chopra
TGS, Calgary

Co-Authors: Ritesh Kumar Sharma, TGS, Calgary
James Keay, TGS, Houston

Westside

Tuesday, Mar. 17, 2020
11:00 a.m. – 1:00 p.m.

Location: Norris Conference Center
816 Town & Country Blvd.
Houston, TX 77024
(Free parking off Beltway-8 northbound feeder or Town & Country Blvd.)

Downtown

Wednesday, Mar. 18, 2020
11:00 a.m. – 1:00 p.m.

Location: Petroleum Club of Houston
1201 Louisiana, 35th Floor
Houston, TX 77004
(valet parking onsite)

Northside

Thursday, Mar. 19, 2020
11:00 a.m. – 1:00 p.m.

Location: Repsol
2455 Technology Forest Blvd.
The Woodlands, TX 77381

** Please allow some extra time to sign in with security, and required escort to auditorium on 2nd floor.

Abstract:

Of the various prospective zones in the Delaware Basin, the Bone Spring and Wolfcamp formations are the most productive and are thus the most drilled. An integrated reservoir characterization exercise was carried out recently on a 3D seismic data volume in the northern part of the Delaware Basin. This talk describes the complete work carried out in three parts. Part one comprises a brief description of the geology of the area, the well-to-seismic ties for the available wells over the 3D survey, estimation of missing shear curves, generation of an accurate low-frequency model for impedance inversion, appropriate preconditioning of prestack seismic data, and use of different lithotrends in inversion. Our endeavor has been to improve the accuracy of characterization for the different zones constituting the rather large litho-units from Bone Spring to the Mississippian.

Technical Lunch continued on page 8.

Technical Lunch continued from page 7.

We believe that the foregoing considerations definitely added value to the subsequent characterization elements.

Rock-physics analysis is usually carried out for estimating the volume of clay, water saturation and porosity using seismic data. While these parameters are easy to compute for conventional plays, there is a lot of uncertainty introduced in the estimation for unconventional plays, especially where multi-zones need to be characterized simultaneously. Part two of the talk elaborates on the challenges and the uncertainties in the characterization of these multi-zones, and how these were overcome. A standard deterministic approach for characterization of target formations (i.e. single rock-physics model) may not be appropriate. We build the case for adopting a robust statistical approach, comprising a graphical crossplot method, and employing Bayesian classification. While the former makes use of neutron and density porosity data for defining the different lithofacies, the latter yields the uncertainty associated with the individual lithofacies. We begin with well-log data and define different lithofacies based on the graphical crossplot method. Thereafter, we correlate these facies with the interpreted mud-log data available for one well. Having gained confidence in defining the different lithofacies, we then determine the lithofacies and their probabilities using the seismic impedance inversion attributes. The resultant facies seemed convincing and correlated well with facies information interpreted from additional mud-log data.

Low permeability formations require hydraulic fracturing for their stimulation and production. Considerable nonuniqueness exists in the identification of favorable zones for hydraulic fracturing. Since brittle rocks fracture better than ductile rocks, identification of brittle pockets in organic shales has become the focus of our industry nowadays. Though different methods have evolved over time for quantification of brittleness, the use of the Rickman et al. (2008) criterion of low Poisson's ratio and high Young's modulus, proposed over a decade ago, seems to be a popular choice, though it is not valid in every formation of interest. In the final phase of the talk, we highlight the challenges in following such a criterion and propose a new attribute that makes use of strain-energy density and fracture toughness. While the former controls fracture initiation, the propagation of fractures is governed by the latter. As hydraulic fracturing comprises both of these properties, we believe the new proposed attribute could be used to highlight favorable intervals for fracturing. Available data by way of well-log curves, production data, along with mud logs have been used to authenticate the proposed attribute. Finally, we implement it on the seismic data and observe; encouraging results.

This talk will attempt to whet the technical appetite of geoscientists as well as engineers.

Biography:

Satinder Chopra has 34 years of experience as a geophysicist specializing in processing, reprocessing, special processing, and interactive interpretation of seismic data. He has rich experience in processing various types of data such as vertical seismic profiling, well-log data, seismic data, etc. He also has excellent communication skills: as evidenced by the massive amount of presentations and talks that he's delivered and by the many books, reports, and papers he has written. He has held the title of the 2010–2011 CSEG Distinguished Lecturer, the 2011– 2012 AAPG/SEG Distinguished Lecturer, and the 2014–2015 EAGE e-Distinguished Lecturer. He has published eight books, over 450 papers and abstracts, and he yearns to make presentations at any beckoning opportunity. His work and presentations have won several awards; most notably: the AAPG Distinguished Service Award (2019), EAGE Honorary Membership (2017), CSEG Honorary Membership (2014) and Meritorious Service (2005) Awards, APEGA Frank Spragins Award (2014), the AAPG George Matson Award (2010), the AAPG Jules Braunstein Award (2013), SEG Best Poster Awards (2007, 2014), CSEG Best Luncheon Talk Award (2007), and several others.

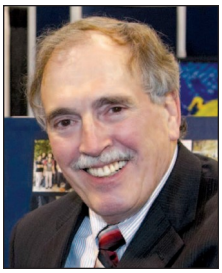
His research interests focus on techniques that are aimed at the characterization of reservoirs. He is a member of SEG, CSEG, CSPG, EAGE, AAPG, and the Association of Professional Engineers and Geoscientists of Alberta (APEGA). □

Technical Breakfasts

How to Quantify the Success of Multiple Suppression

Register for Tech Breakfast North

Register for Tech Breakfast West



Fred Hilterman

Speaker: Fred J. Hilterman
HSB Geophysical

North

Tuesday, Mar. 3, 2020
7:00 – 8:30 a.m.

Sponsored by Oxy

Location: Oxy
(formerly Anadarko Bldg.)
1201 Lake Robbins Drive
The Woodlands, TX 77380

West

Wednesday, Mar. 11, 2020
7:00 – 8:30 a.m.

Sponsored by Schlumberger and WesternGeco

Location: Schlumberger Facility
10001 Richmond Ave.,
Q Auditorium
Houston, TX 77042

Abstract:

This presentation is designed to answer the question, "How do I know if multiple suppression has been successful, especially in relatively flat geology." At well locations, synthetics representing four different processing stages of multiple estimation and suppression are quantitatively matched to PSTM field data to assist in the processing parameterization. No longer will the interpreter be burdened without tools to validate the multiple suppression success.

Two different methodologies are merged; both developed over 35 years ago. The first methodology for estimating multiples from field data was suggested by Anstey in the early 1960s and later mathematically derived with inverse scattering series (ISS). Anstey's suggestion provides computational savings in orders of magnitude over the conventional algorithm. The second methodology creates four different synthetics for processing validation, based on Generalized Primaries (Hubral et al., 1980).

The basic principles of the two methodologies are "cartooned" without the need for "messy" equations. Two case histories from different geologic environments complement the cartooned principles. Each case history easily separates the short-period internal multiples from the long-period multiples and each multiple type is suppressed differently. In numerous multiple environments, the Generalized Primaries provide an estimate of the signal portion of the propagating wavelet. This can then be used to enhance the suppression of the long-period multiples and provide the S/N properties for frequency extension of the signal portion.

In both case histories, an emphasis is placed on the difficulty of visually separate long-period multiples from primary events without the assistance of Generalized Primary synthetics. No blocking of the logs is permitted.

Biography:

Fred Hilterman is Chief Scientist for HSB Geophysical and is a Distinguished University Professor at the University of Houston (UH). He received a Ph.D. from Colorado School of Mines (CSM), worked at Mobil and then UH. In 1976, he founded the Seismic Acoustic Lab at UH which was a consortium supported by 45 oil and gas

Technical Breakfast continued on page 10.

Technical Breakfast continued from page 9.

companies. In 1981, he co-founded Geophysical Development Corporation (GDC) and was VP of Development until GDC was bought by Geokinetics in 1998. He co-founded HSB in 2019.

His services to the professional societies are many and include SEG DISC Instructor, Associate Editor of Geophysics, Chairman of TLE Editorial Board; and, both Technical and General Chairman of SEG Annual Meetings, SEG President, and Continuing Education lecturer since 1976.

He has received numerous awards including SEG Best Paper and Best Presentation Awards and SEG's highest award, the Maurice Ewing Medal. CSM awarded him the Distinguished Alumni Medal in 2005 and the van Diest Gold Medal in 1971 for the significance of his Ph.D. work on Kirchhoff wave theory.

Fred's interests are in petrophysics, reservoir characterization, signal theory, and wave propagation. □

Microseismic SIG

Understanding the Role of Well Sequencing in Managing Reservoir Stress Response in the Permian: Implications for Child-well Completions Using High-resolution Microseismic Analysis

Register for Microseismic

Doug Angus

Speaker: Doug Angus
Director of Data Analytics R&D,
Software and IT
ESG Solutions

Thursday, Mar. 5, 2019
11:30 a.m. - 1:00 p.m.

Sponsored by MicroSeismic, Inc.

Location: MicroSeismic, Inc.
10777 Westheimer,
Suite 110
Houston, TX 77042

Abstract:

In this comprehensive case study, three sequential well pads were designed, stimulated and monitored with downhole microseismic to evaluate

1. Treatment order of stacked wells across multiple benches,

2. Completions' design in proximity to a parent well and

3. A combination of stacked well sequencing and parent-child interaction.

High-resolution microseismic analysis provides a more detailed understanding of reservoir deformation and well connectivity using statistical approaches to microseismic analysis. High-resolution microseismic involves analyzing spatio-temporal trends in seismicity rather than reliance on microseismic event clouds to provide more meaningful assessment of hydraulically-linked seismicity vs. stress-driven seismicity.

The findings from the first well pad suggested that the order in which stacked wells are treated (i.e. top-down vs. bottom up) plays a significant role in the ability of the stimulation program to effectively generate productive fracture networks. Supported by pressure and tracer data, the findings of the second well pad provided valuable guidance on the role of completions design on parent-child well communication. Finally, the findings of the third pad demonstrated the role of well sequencing in proximity to depleted zones and the impacts of completions design in managing well communication. From these three studies, the operator obtained a much more detailed assessment of perceived well interaction not previously visible using cloud-based microseismic analysis, enabling the operator to execute on targeted well stimulation programs optimized for the local geology.

Biography:

Doug Angus is Director of Data Analytics R&D, Software and IT at ESG Solutions. He has over 15 years of experience developing and applying new technology in the field of seismic geo-mechanics to address reservoir production and injection challenges, specifically to improve reservoir characterization and monitoring. He has pioneered practical approaches to integrate microseismicity, time-lapse seismology, rock physics, surface deformation, and coupled fluid-flow and geo-mechanical modelling. He has published up to 60 journal papers and up to 40 conference abstracts on a diverse range of problems, spanning theoretical, exploration and engineering seismology as well as hydrocarbon, carbon storage and engineering scale problems. He has been heavily involved in R&D efforts that are heavily multi-disciplinary, involving the integration of seismology, rock- and petro-physics, hydro-mechanics and geodesy. He was previously Associate Professor of Seismic Geomechanics at the University of Leeds. UK. □

Data Processing & Acquisition SIG

Register for Data Processing

A Model for Fluvial SAND Channel System Reservoir Delineation and Optimal Drill Location Selection Utilizing Post Stack Processing, Precise Amplitude Attribute Analysis and Stratal Domain Visualization and Interpretation

Coerte A Voorhies

Speaker: Coerte A Voorhies, III PG
Gustavson Associates, LLC
Geoscientist

Sponsored by Schlumberger

Location: Schlumberger
Q Auditorium
10001 Richmond Ave.
Houston, TX 77042

Tuesday, Mar. 10, 2020
4:30 p.m. Sign-in, Snacks, Social Time
5:00 p.m. Start of presentation

Abstract:

A model was created utilizing InsightEarth software to lower risk with selecting well locations for optimal reservoir stratigraphic, structural and production constraints. Results were used to delineate and create maps for a productive fluvial sand channel system in the Client's Kazahstan project area and analogous to fluvial systems in other basins. Project data is provided by Gustavson Associates, LLC, Boulder, CO and consists of 350 square kilometers of 3D seismic. The production is from a fluvial sand system where the numerous channels conceal the continuity of the reservoir and contributed to drilling non-productive wells.

Acquisition footprint and random noise were eliminated from original data to condition the seismic volume. Accurate dip-guided amplitude attributes were generated from the conditioned volume. The stratal domain transform process was used to convert the conditioned time and attribute volumes into paleo-surface stratal volumes. The objective was to obtain an accurate structural and stratigraphic interpretation of the productive "D" sand. Structural relationships were corrected in the time domain volume and the new stratal domain volume yielded horizontal events (stratal slices) that imaged the intricate fluvial systems to represent the depositional environment of the reservoir.

Stratal domain volume results and structural analysis indicate that the reservoir and associated complex faulted structure of a previously selected well location were not ideal. The new reservoir interpretation provided the required risk analysis to recommend the selection of an alternate well location.

By utilizing volume conditioning (acquisition footprint removal), attribute analysis and stratal domain visualization and interpretation, a model was created to accurately map the recognizable morphologies of fluvial sand channel systems to provide precise reservoir delineation and optimal well location selection for the Client's project and project development in analogous geographic locations.

Biography:

Coerte is a geophysical and geological interpreter with over thirty years of international and domestic experience. Coerte is an expert user of the CGG InsightEarth® 3D Visualization, Processing and Interpretation Software Technology (CGG: InsightEarth) and is currently providing InsightEarth® consulting services for Gustavson Associates, Boulder CO (Gustavson – Oil Gas and Mining Consultants Colorado USA). He holds a Master of Science (M.S.) in Geology from the University of Louisiana – Lafayette. He is a SIPES member, GSH member and is a professional geoscientist in Texas. □

Potential Fields SIG

A Crustal Investigation of the Gulf of Mexico: Using Voxet-based Gravity Inversion to Model Radiogenic Crust

Register for Potential Fields

Laura Huebner-Diaz

Speaker(s): Laura Huebner-Diaz
Chevron Energy
Technology Company.

Co-Authors: Laura Huebner-Diaz
and Elizabeth Johnson,
Chevron Energy Technology

NEW LOCATION:

Location: Churrascos
2055 Westheimer Rd.
Houston, TX 77098

Thursday, Mar. 19, 2020
5:30 p.m. - 8:00 p.m.

Abstract:

Crustal architecture is a fundamental input to basin analysis on attenuated continental margins. Estimates of crustal thickness and composition from seismic refraction data provide constraints on crustal architecture but are sparsely distributed in the Gulf of Mexico. Modeling of global refraction-based crustal layers, which utilize Vp-Density relationships for density of crustal layers, often leave significant long wavelength gravity residuals. To create a crustal architecture model that is consistent with both seismic refraction and gravity we have performed a seismic-constrained voxet-based 3D inversion of the crustal density using Seequent's VOXI software. Allowing crustal density to vary vertically and laterally within density bounds, we have created a crustal architecture from which we can extract radiogenic crustal isopachs and better estimate radiogenic contributions to heat flow. The results from voxet-based gravity inversion compare favorably with those obtained from a more traditional density-constrained layered inversion.

Biography:

Laura Huebner-Diaz is a potential fields geophysicist at Chevron Energy Technology Company. She has a BS degree in geoscience from the University of Arizona and a MS degree in geophysics from the University of Nevada, Reno. Laura has experience in applying potential fields for oil and gas, geothermal, and mineral exploration. Having lived in Houston for the past 7 years, she has reluctantly gotten used to flat-lands, but is always excited to explore mountains and basins whenever she can. □

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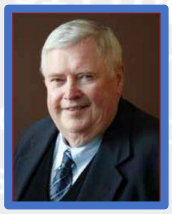

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Permian Basin Processing and Handling Shallow Anomalies and Permit Holes: A Compressive Seismic Acquisition and Reconstruction Case Study

Tianjiang Li, Justin Tan, Wensheng Chu, In-Depth Geophysical; Tao Jiang, Yifeng Jiang, Peter Eick, In-Depth Compressive Seismic; Kevin Woller, Robert Bodziak, Robert Meek, Buzz Davis, Pioneer Natural Resources*

Summary

Shallow gas hazards and acquisition permit holes are common challenges for the oil & gas explorations in the Permian Basin. Compressive seismic acquisition has been adopted to mitigate the issues due to permit holes comparing to conventional seismic acquisitions. Amplitude friendly compressive seismic data processing flows are designed and performed to preserve the gas pocket amplitude anomalies and to resolve the target reservoir interval imaging. Post-migration L1 Frequency Normalization has further improved the image resolution to assist in structural and amplitude interpretations.

Introduction

The Permian Basin has drawn a lot of exploration interest due to rapidly increasing production over the last few years. Widely recognized as the major oil and gas producing region in the U.S., the Permian Basin covers more than 80,000 square miles in New Mexico and Texas and encompasses nearly 50 counties. It consists of three major structural elements with distinctive characteristics and plays. The Midland Basin is the easternmost of the basins. The major producing formations in the Midland Basin are the Spraberry and Wolfcamp. Traditionally, the exploration in this area is primarily driven by well logs due to the abundance of available wells.

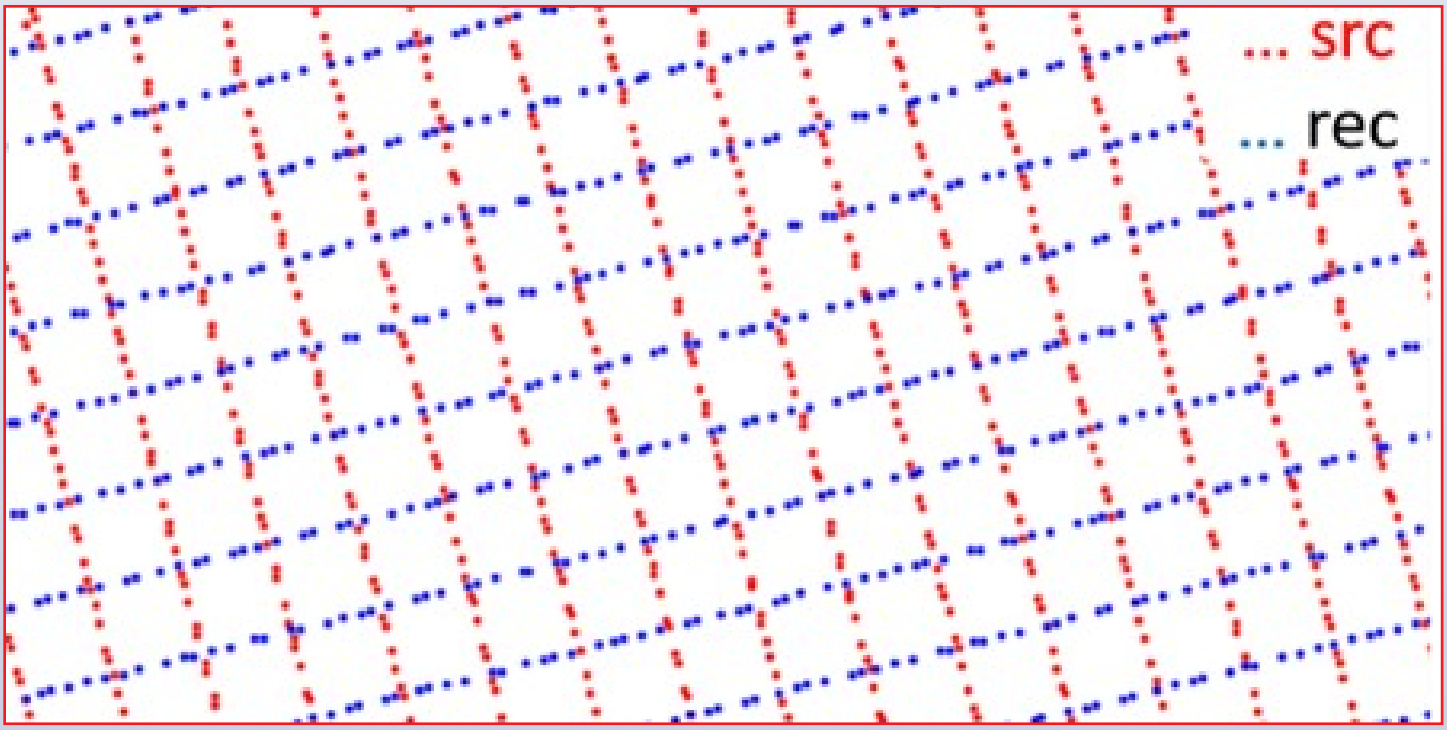

Figure 1: Sample source/receiver layout in the CS-A pre-plot, where red dots are sources and blue dots are receivers

Technical Article continued on page 16.

Technical Article continued from page 15.

However, the use of seismic imaging in exploration and development has increased in recent years.

One such area where seismic imaging has been used is in the detection of shallow hazards such as gas pockets in the Salado formation, which are present in the Midland Basin. It is highly desirable to identify and characterize the gas pockets to help avoid drilling through them. Amplitude- preserving data processing workflows are necessary to properly image the amplitude anomalies associated with the shallow gas pockets.

Along with shallow hazard detection, there is interest in imaging the two main producing formations in the Midland Basin—the Spraberry and Wolfcamp. These formations are typically challenging for seismic imaging due to the complex overburden above these formations and the energy attenuations through the layers with strong velocity variations. Although data processing efforts could optimize the seismic images to a certain extent, the real breakthrough in better seismic data quality is relying on new technologies and higher-quality data acquisitions. The seismic data for the case study has been acquired with compressive seismic acquisition (CS-A) regular-indexed (RI) design (Jiang, et al., 2018). The compressive seismic reconstruction (CS-R) processing workflow has shown its advantages by enhancing the seismic images at the producing layer formations. However, in this paper, we will mainly focus on quality and how we address imaging challenges in the shallow areas in the CS-R workflow.

Compressive Seismic Technology and Acquisition

Compressive seismic acquisition and processing have been drawing an enormous amount of attention in the seismic industry and are often regarded as the next generation for cost-effectiveness. (Jiang, 2017, 2018). The seismic data acquired for this case study are using the pre-plot from the CS-A RI design, based on a conventional orthogonal land survey. *Figure 1* shows a sample of source and receiver layout from the CS-A designed acquisition pre-plot. In the CS-A RI design, first a target nominal regular grid was chosen for sufficient sampling of the seismic data. Second, a subset of locations for source points and receivers from the nominal regular grid are chosen following a deliberately irregular pattern using CS techniques before implementing the survey design. Rather than using just one mutual coherence (MC) value, the whole MC map was optimized to achieve the best chance of recovery. As a result, 50% sources and receivers are reduced in the field, and robust coverage for each local area is guaranteed with the help of the MC map.

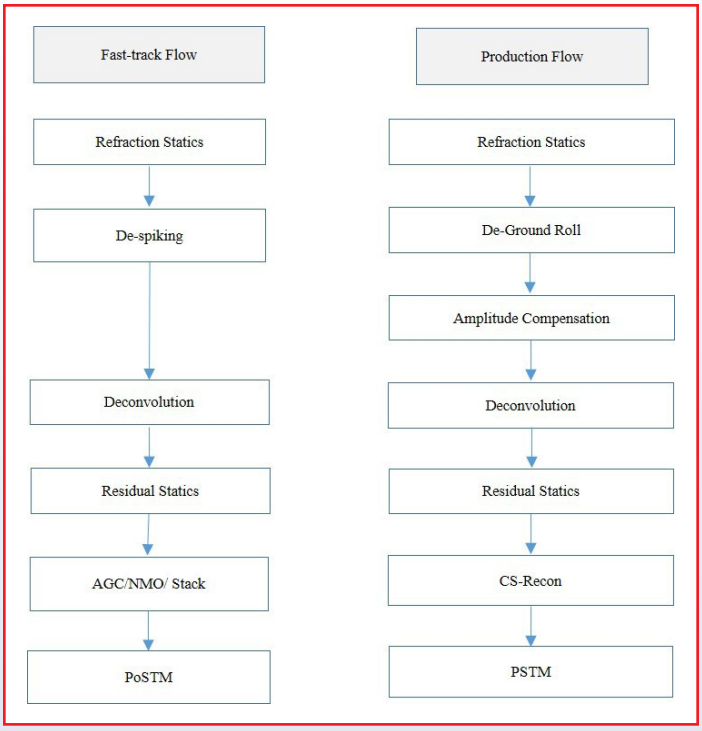

Figure 2: A comparison between fast-track and production flow

The CS-based method enables high resolution in the spatial domain with CS-sampling. To achieve the desired result from compressive seismic acquisition designs, we need a different method for compressive seismic reconstruction. In traditional 5D interpolation, it's normal to output on a regular grid, which typically doesn't maintain original geometry. This step is called "regularization." Because a traditional survey doesn't have optimal CS-sampling along source/receiver lines, but uses regular spacing as much as possible, the result is an acquisition pattern of parallel lines with regular sampling along the lines. Due to obstructions and access issues, this method often has "uncontrolled" irregularity in other domains, such as cdpx, y-offsetx,y, etc. In this study, the CS-A sampling was designed to be along the source/receiver lines;

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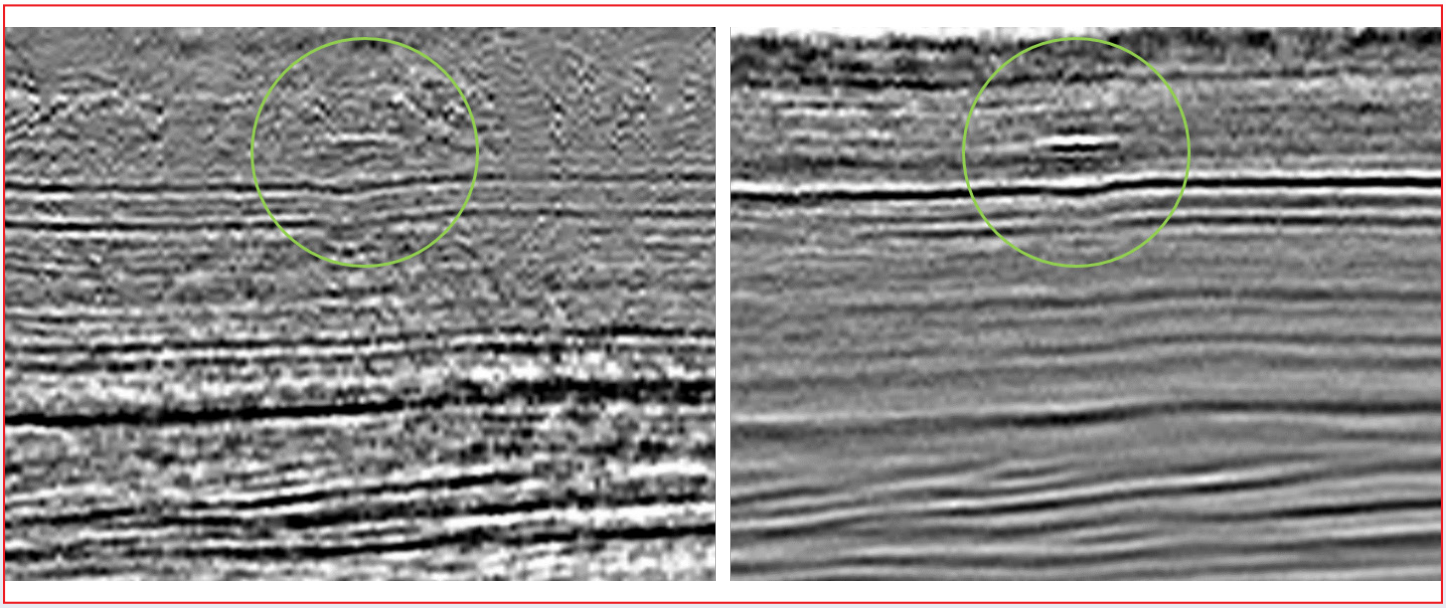

Figure 3: Un-migrated vertical section for fast-track flow (left) and production flow (right)

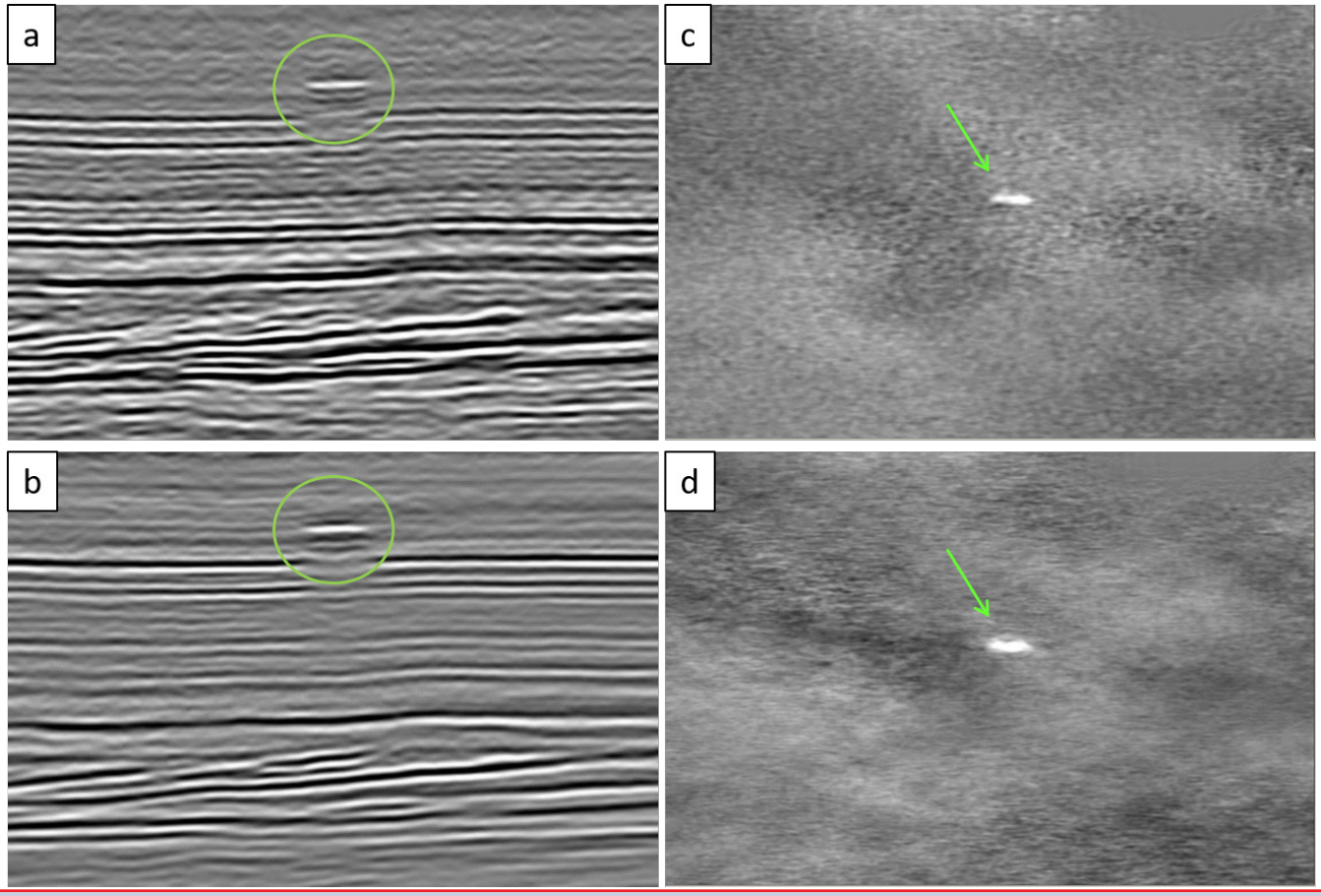

Figure 4: A vertical section and time slice comparison between fast-track PoSTM (a, c) and Final PSTM (b, d) with shallow anomaly preservation

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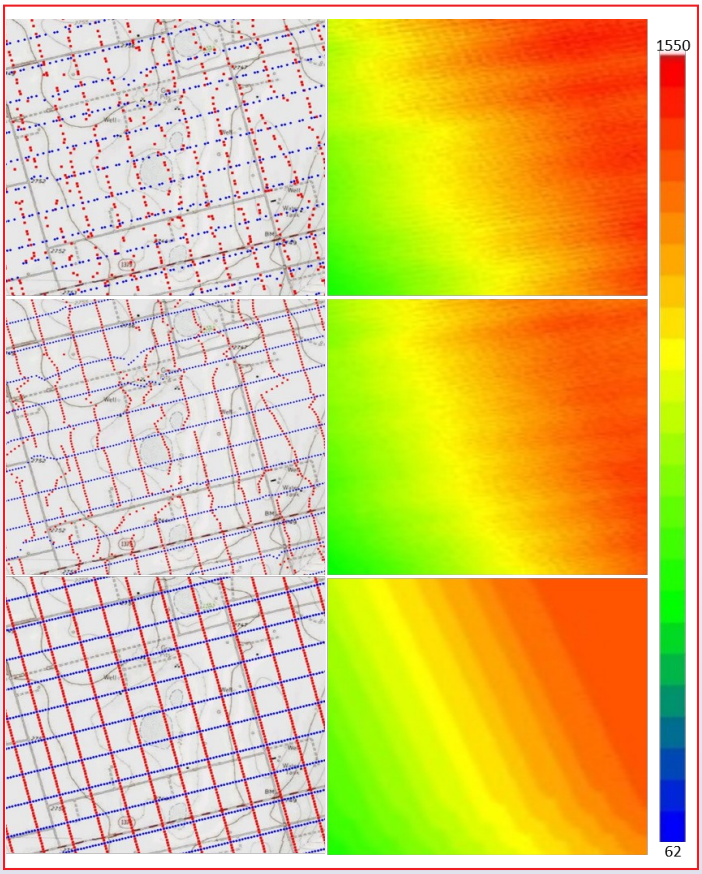

Figure 5: Shot receiver distribution and fold map of before CS-R (top row) on 82.5 ft x 82.5 ft grid spacing, CS-R DTL (middle row) and CS-R GRID (bottom row) on 41.25 ft x 41.25 ft grid spacing

thus, it's natural to exploit the densest domain with CS-sampling, which is the cross-spread domain. As a result, we used a CS-R Down-the-Line (DTL) technique and will compare it with industry standard reconstruction to a regular grid. Note that the two methods converge when the post-plot is a perfectly regular grid.

Data Processing

The seismic data processing workflow should be designed to preserve the shallow gas anomalous amplitudes. While those amplitude anomalies on the seismic data are acquired from near offsets, there is also a very strong amplitude near-surface ground roll noise in the near-offset range shallow seismic data. Without consideration of these amplitude anomalies, simply removing the ground roll could also attenuate the gas amplitudes.

Conventional land seismic data processing includes key components such as refraction statics, ground roll noise attenuation, surface consistent amplitude balancing, and surface consistent deconvolution. In addition, a fast-track workflow is designed to run in parallel to the production workflow. This fast-track workflow has less impact on the gas pockets amplitude anomalies and produces an imaging product adequate for shallow amplitude anomaly identification. *Figure 2* shows the comparisons between the production and fast-track data processing flows.

In the production data processing workflow, ground roll attenuation is achieved using a 3D eigen-image filter-based method (Chiu, 2008) with carefully tuned parameters to preserve shallow gas amplitudes. Other processing steps are also applied with amplitude preserving features. *Figure 3* shows pre-migration stacks generated from the fast-track and production processing flows, with the shallow gas anomalies highlighted. *Figure 4* shows migration seismic images highlighting the preserved amplitude anomaly in both section view and time slice view.

CS-R Experiments and Shale Reservoir Imaging

Based on the controlled irregularity nature from the CS-A designed acquisition, CS-Recon has proven to increase the data fold coverage accurately (Jiang, 2018). Two distinctive CS-Recon schemes have been tested from different perspectives for achieving better data reconstruction.

The CS-R Down-the-Line (DTL) approach honors the original source and receiver geometry and doubles sources and receivers along the original source and receiver lines. The other method, CS-R GRID, moves sources and receivers to pre-defined regular grids with half source and receiver spacing from the nominal acquisition spacing. Both methods have their advantages. The CS-R DTL scheme keeps data fidelity from the original acquisition with minimum movements on sources and receivers. In this way, seismic data are reconstructed with the true acquisition geometry, which is technically robust to reconstruction artifacts. The CS-R GRID approach is compatible with most industrial widely used interpolation schemes, and the reconstructed gathers are convenient for processing requiring input on regular grids such as 3D f-kx-ky filtering.

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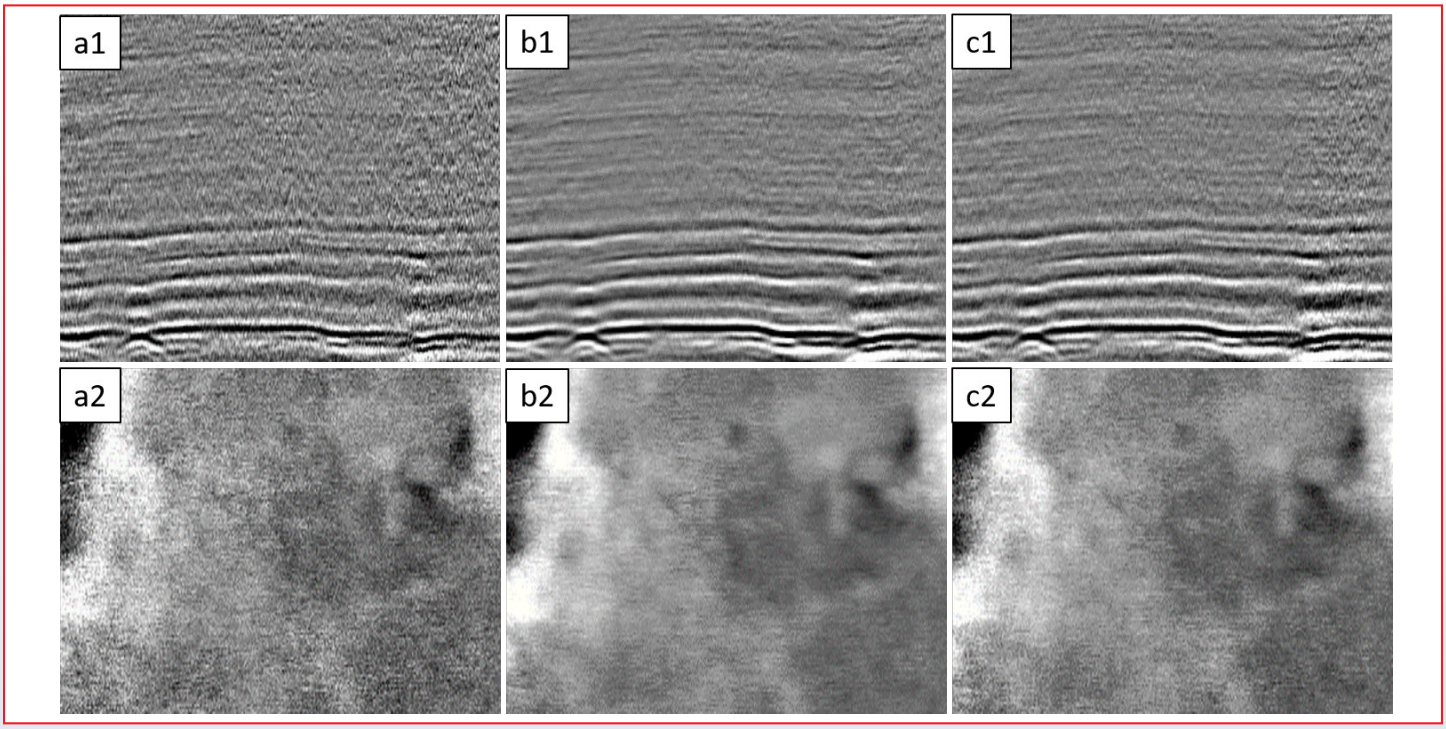

Figure 6: Pre-migration stack and time slice comparison of before CS-R (a1, a2), CS-R DTL (b1, b2) and CS-R GRID (c1, c2)

Figure 5 shows the source and receiver layout from the acquisition post-plot and after each CS-R application. The CDP fold maps show that the fold coverage and values are comparable for the original acquisition on the 82.5 m bin spacing and CS-R on the 41.25 m bin spacing. CS-R DTL is comparable to the original acquisition while the CS-R GRID showed some anomalous patterns due to source and receiver movement. *Figure 6* shows the full fold pre-migration stack comparisons. It illustrates the superior signal-to-noise ratio improvement from both versions of CS-R, while CS-R DTL is slightly cleaner due to its similarity to the actual source-receiver layout. At the producing shale reservoir formations, as shown on *Figure 6*, CS-R processing provides better signal-to-noise imaging, which should increase ease of interpretation and picking and amplitude accuracy.

High-resolution seismic images help interpreters by reducing uncertainty and assisting in accurate well planning. To improve the seismic image resolution, L1 Frequency Normalization (LFN) has been applied to enhance the image bandwidth. The LFN is based on 3D sparse-blind deconvolution with structurual and phase-preserving features (Chiu, 2018). *Figure 7* shows the comparisons of time migration images before and after the LFN process, illustrating an enhancement of the shallow gas amplitude anomaly and deeper reflectors.

Conclusions

This integrated case study consist of the compressive seismic acquisition RI design, the compressive seismic data reconstruction and amplitude preserving processing flows. The shallow gas amplitude anomalies and target reservoirs are well imaged for structural interpretation and drilling planning. The post-migration L1 Frequency Normalization has further extended the seismic image bandwidth for better image resolution.

Acknowledgements

We would like to thank our colleagues for their valuable discussions and suggestions. We thank the management of Pioneer Natural Resources and In-Depth Geophysical for the support and permission to publish this result. We especially thank Pioneer Natural Resources for the courtesy of seismic data show rights. □

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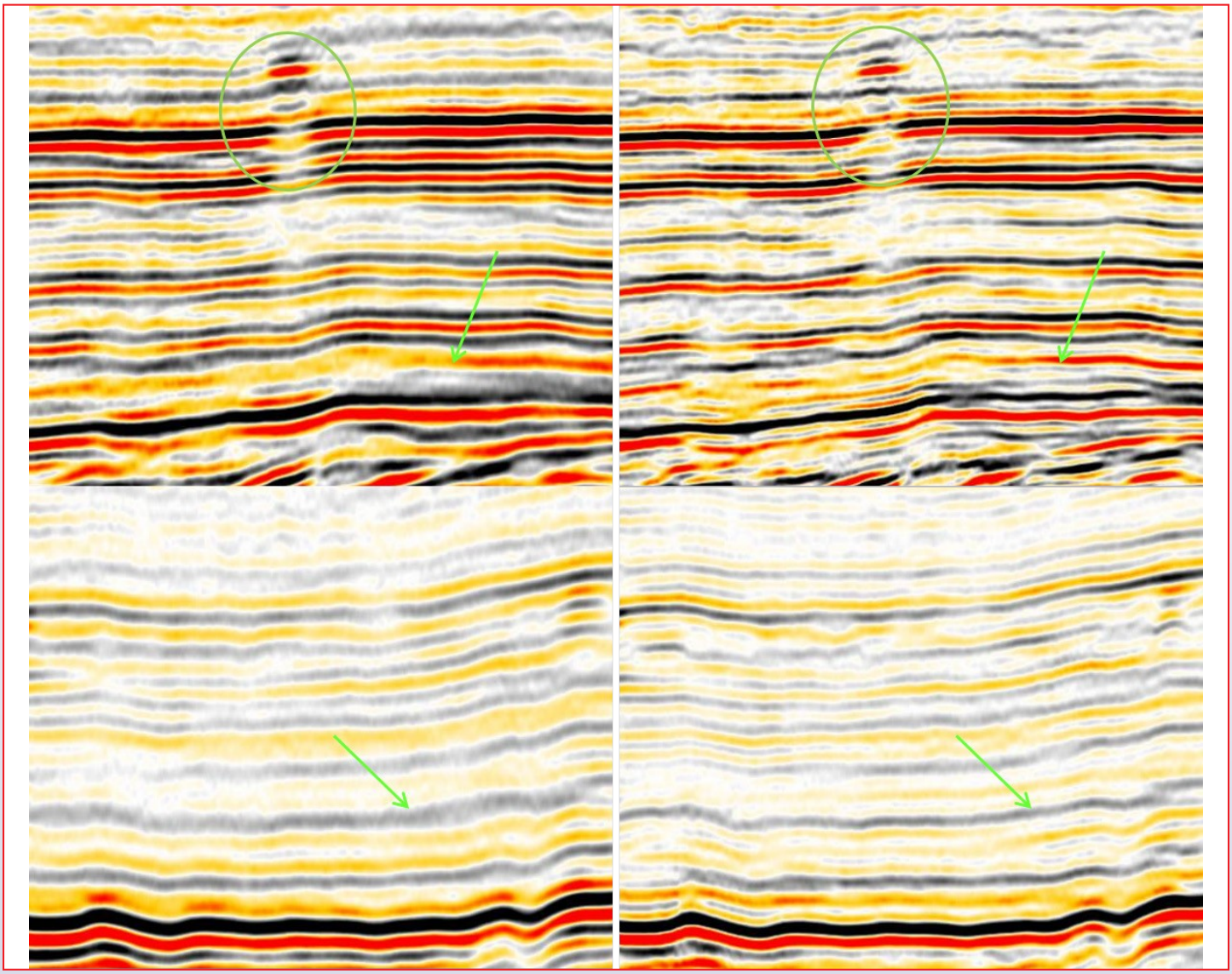

Figure 7: Stack Comparison before (left) and after (right) applying LFNa

References

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Chiu, S. K., and J. E. Howel, 2008, Attenuation of coherent noise using localized-adaptive eigenimage filter: 78th Annual International Meeting, SEG, Expanded Abstracts, 2541–2545

Chiu, S. K., P. Duggan, and Y. Jiang, 2018, Bandwidth extension using 3D structure preserving sparse blind deconvolution: 88th Annual International Meeting, SEG, Expanded Abstracts, 4181-4185

Permalink: https://doi.org/10.1190/segam2019-3214775.1

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- Henry Ford

GSH Media Kits

Item Of Interest

In 1580, William Gilbert called the earth a gigantic magnet and in 1589, Galilei Galileo established the first principles of dynamics, including the law of free fall and of pendulum motion. The CGS unit of gravity is called a 'Gal' in honor of Galileo.

NextGen
Geophysical Society of Houston

An exciting new group has emerged from GSH this year for early career & young professionals, called NextGen. NextGen is focused on developing the "Next Generation" of geoscientists and beyond, by organizing events for young professionals to engage the broader geophysics community in Houston. These events will serve to promote professional networking through social, educational and outreach events.

Committee members running NextGen consists of several early career professionals that work within the realm of geophysics from various industries.

NextGen's first event was held at the Boheme on January 30th, 2020. The Norwegian Geotechnical Institute (NGI) sponsored this premier networking event.

To support and distribute information about NextGen, the committee has also started several social media platforms on LinkedIn and Instagram.

LinkedIn: https://www.linkedin.com/company/nextgen-gsh (NextGen GSH)

Instagram: @nextgen_geophysical

Overall, the event was an incredible success. There were some 67 attendees, and the committee received great feedback from those that attended the event.

"Great effort NextGen GSH! Amazing turnout. Looking forward to the next one." – Sean S.

"This was a great event! I really enjoyed getting to meet everyone in a nice, relaxed environment." – Sandra M.

From left to right: Oscar Vasquez, Drew Jones, Whitney Blanchard, Jennifer Graf, Peter Lanzarone, Matthew Romane (Not pictured: Lillian Comegys)

GSH president Craig Beasley with attendees of event.

NextGen continued from page 22.

NextGen will be planning its next event for some time this spring. This will be another networking event, but with some fresh weather fun – a barbecue with family, friendly games & outside activities!

Activities & initiatives to launch between these events include study groups and a mentoring outreach program. It is the mission of NextGen to try and facilitate as many needs possible for its members in terms of career development, and they are excited to get started with the support of GSH! □

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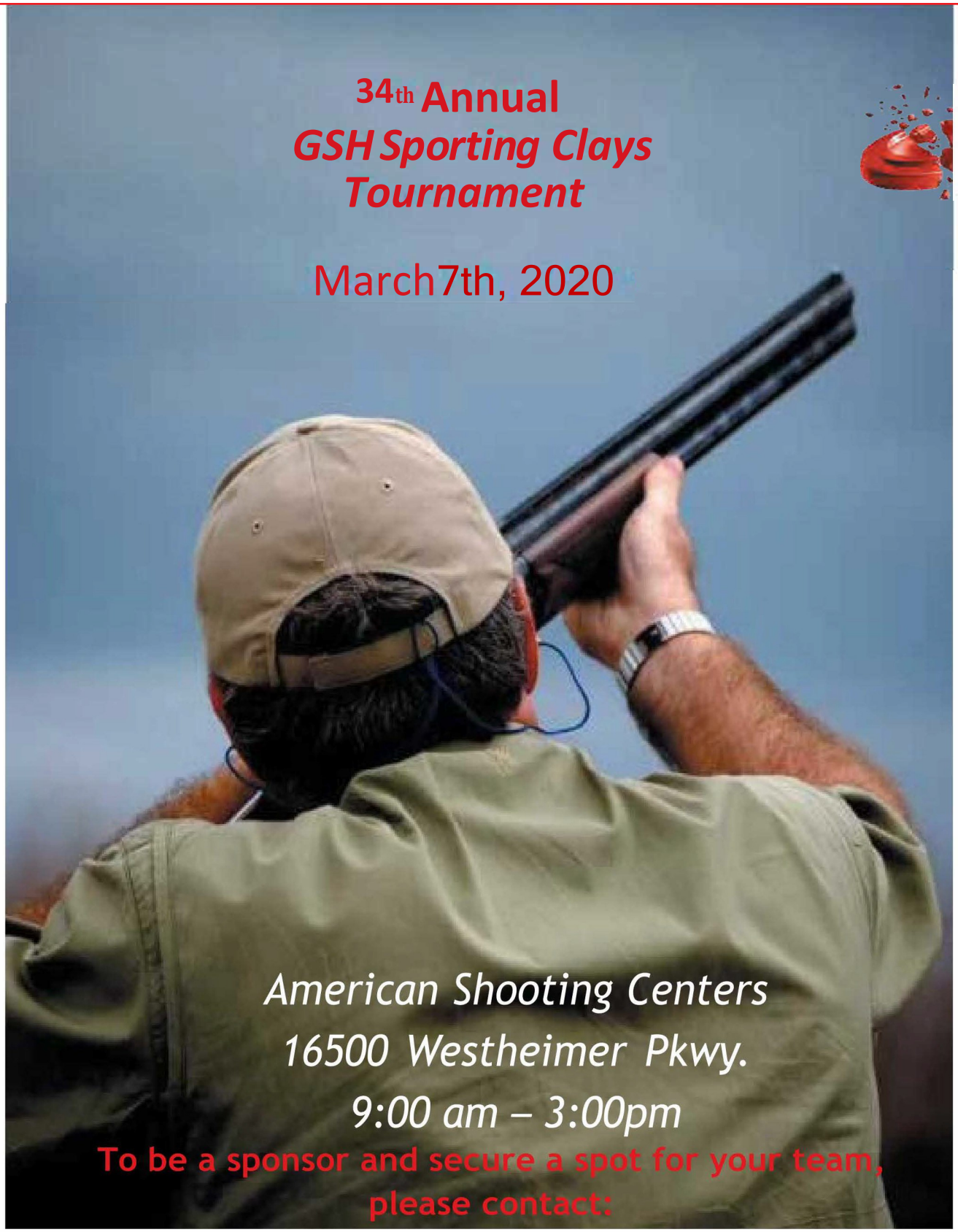

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Register NOW on-line @ the **www.gshtx.org** events calendar

MEET THE CANDIDATES

A Note From the President

Dear Fellow GSH Members,

Each year the GSH President is tasked with the selection of candidates for the election to the GSH Board of Directors. This process started in December, working with the Nominations Committee to identify appropriate individuals with the skills and interest to serve the GSH in achieving our strategic goals while maintaining a business focus. It is my pleasure to introduce the candidates for the 2020-2021 term. Each candidate offers a unique set of backgrounds, experiences and skills. Take a few minutes to read their biographies. Watch for announcements about the upcoming election.

We generally nominate two candidates for each position, with the exception of Editor, but this year, one of our candidates for Secretary had to withdraw at the last moment. That position will thus run unopposed this year. Please note that our bylaws allow GSH active members to submit write-in candidates for any office. Check the bylaws for specific guidelines.

Craig J. Beasley

Klaas Koster

(Occidental)

GSH Candidate for

President-Elect

2020-2021

Klaas Koster is the Worldwide Chief Geophysicist at Occidental. In this role, he oversees the entire international geophysical function and directs Oxy's team of geophysical experts in acquisition, processing, and quantitative interpretation.

Klaas brings three decades of technical and managerial experience to his current role. Before joining Occidental in

Klaas Koster Biography continued on page 27.

Alexander Mihai Popovici

(Z-Terra Inc..)

GSH Candidate for

President-Elect

2020-2021

Alexander Mihai Popovici is CEO and Chairman at Z-Terra Inc. He holds Ph.D. (1995) and M.Sc. (1991) degrees in geophysics from Stanford University. He escaped from Romania in 1986, crossed two borders at night and spent a year in a refugee camp in Austria, before coming to the US in 1987. Before founding Z-Terra Inc., Dr. Popovici was co-founder and CEO of 3DGeo Inc. Dr. Popovici's industry

Alexander Mihai Popovici Biography continued on page 27.

Marianne Rauch

(TGS)

GSH Candidate for

1st VP-Elect

2020-2021

Marianne Rauch received a PhD in physics from Karl Franzens University in Graz, Austria in 1985. Shortly afterwards, she immigrated to Australia and started her career in geophysics at Curtin University, Perth. Early 1999, she made her move to Houston, which she now calls home. Since then, she has spent around one third of her work life in academia, one third with operators and one third

Marianne Rauch Biography continued on page 27.

Simon Voisey

(Apache Corporation)

GSH Candidate for

1st VP-Elect

2020-2021

Simon Voisey is a staff geophysicist working at Apache Corporation specializing in QI with 15 years of experience. He holds an MSc in Petroleum Geoscience from the University of Aberdeen and a BSc in geophysicist from University College London.

Organizing the GSH spring symposium is one of the primary responsibilities of the GSH. As

Simon Voisey Biography continued on page 28.

Alvaro Chaveste

(TraceSeis)

GSH Candidate for

Editor

2020-2021

Alvaro Chaveste is currently a Senior Geophysical Consultant at TraceSeis, which he founded and presides. He holds a BSc. Degree in Geophysical Engineering from Montana Tech and has attended graduate courses in Geophysics at the University of Houston. He has been involved in training and services for the oil industry in reflection seismology, high resolution 2D/3D seismic data processing, AVO, inversion, rock

Alvaro Chaveste Biography continued on page 29.

MEET THE CANDIDATES

Katja Akentieva
(TGS)

GSH Candidate for
2nd VP-Elect
2020-2021

Katja serves in a leadership role at TGS where she is responsible for the onshore multi-client portfolio. She is relatively new to Houston, coming from Calgary with her family in 2015. Katja joined TGS in 2012 with the acquisition of Arcis Seismic Solutions and was appointed Managing Director of TGS Canada with focus on the onshore and the offshore geophysical data growth. Katja

Katja Akentieva Biography continued on page 30.

Russell Jones
(Seitel Data Processing)

GSH Candidate for
2nd VP-Elect
2020-2021

Russell Jones is President of Seitel Data Processing, a Houston based provider of 3D and 2D seismic data covering active hydrocarbon plays in the US and Mexico.

Russell graduated from Oxford University in the UK in 1992 with a bachelor's degree in Geology and subsequently from Leeds University in 1993 with an MSc in Exploration Geophysics.

Russell Jones Biography continued on page 28.

Laurie Geiger
(ION)

GSH Candidate for
Secretary
2020-2021

Laurie Geiger holds the position of Technical Sales Geophysicist on the Imaging Services sales team at ION. She has 25 years of experience in the seismic industry, where she has held a wide variety of positions, including roles in depth imaging, marketing, seismic quality control, software documentation, technical sales, and geophysical training. Laurie graduated from Texas A & M University in 1986, with a

Laurie Geiger Biography continued on page 28.

Chris Egger
(TGS)

GSH Candidate for
Treasurer
2020-2021

Chris Egger is an Account Manager for Processing and Imaging Services at TGS. His career in Geophysics started at Western Geophysical as an intern where he took interest in seismic processing. After graduating from Texas A&M with a Bachelor of Science in Computer Science he gained additional industry experience from a 3D Imaging company. There he specialized in time and depth imaging,

Chris Egger Biography continued on page 30.

Oscar Vazquez
(Deep Imaging)

GSH Candidate for
Treasurer
2020-2021

Oscar is a Geophysicist at Deep Imaging. He turns EM field measurements into actionable frac insights for operators to improve their processes. He also explores cloud computing and data science applications for geophysical and petroleum production data. Experiences have spanned North American unconventionals such as the Eagleford shale, and the Permian, Anadarko, and Powder

Oscar Vazquez Biography continued on page 29.

Whitney Blanchard

GSH Candidate for
Secretary
2020-2021

WITHDRAWN

Whitney Blanchard received her Bachelor of Science degree in Geophysical Engineering from Montana Tech in 2009. She then went on to complete a Master of Science in Geophysics at Montana Tech, and a second MS in Geology at the University of Alabama (UA). During this time, she interned for Oxy and Chevron doing 3D seismic interpretation, velocity model building, and field level well log

Whitney Blanchard Biography continued on page 29.

Klaas Koster *Biography continued from page 25.*

2016, Klaas was the Forties Development Manager at Apache and later went on to build Murphy's technical subsurface capabilities. Klaas started his career in 1989 at Amoco's research center in Tulsa, working as an acquisition and processing geophysicist, and then worked 15 years for Shell as a quantitative interpretation geophysicist and time-lapse seismic specialist in The Hague, Stavanger, Perth and New Orleans offices.

Klaas holds a Doctorate in Applied Geophysics from Delft University and is a past-president of both SEG and ASEG as well as a life member of the Society of Exploration Geophysicists. □

Alexander Popovici *Biography continued from page 25.*

experience includes work in the seismic processing research department for Halliburton Geophysical Services in Dallas and Houston, and EM acquisition and processing in Romania.

Dr. Popovici holds nine patents in the field; has authored over 100 publications in conference proceedings, books, trade journals, and research reports; and has given numerous invited talks at conferences, geophysical associations, and geophysical workshops. He has been a member of the SEG Research Committee, served as Associate Editor (Seismic Migration) for Geophysics, and is past Chairman and founding board member of Geoscientists Without Borders, an SEG Foundation program that funds humanitarian applications of geophysics around the world. He served on SEG Board as Second Vice President, served First Vice president on the SEG Foundation Development Committee, and was the 2017 SEG Houston Technical Chairman.

Dr. Popovici and his wife, Catherine, have four sons and one daughter. Together with Catherine, he established an SEG scholarship endowment fund that provides scholarships to students. In his downtime, he is a scuba diving instructor, an active fencer, and he has played paintball with one of the first established pro teams. Nowadays, he mostly plays with his kids, practices karate, rock climbs, hunts, and is working on his private pilot license. He is the Honorary Consul of Romania in Houston, which helps to assist and protect Romanian citizens and facilitates trade and friendship between the people of Romanian and the US. □

Marianne Rauch *Biography continued from page 25.*

with service companies. In her various roles, she was in leading technical management and research positions.

Passionate about taking core research findings and making them applicable for industry use, she likes to mentor and has been fortunate to see many of her mentees succeed and fill important positions in the oil and gas industry. Currently the Principal Technical Advisor, Onshore, Multi Client for TGS here in Houston, Marianne is a prolific presenter, author, and co-author of a many technical articles. In the last few years, she has become involved in various geophysical societies as a way of giving back to the larger community. Presently, she is the vice chair of the SEG potential fields and the Development and Production committees, and she will be chairing both groups soon. While always making time to be available as reviewer for the Interpretation and Geophysics journals and SEG, EAGE and URTeC abstracts, she also chairs sessions at various industry events.

In her role as first Vice President of the GSH, she is responsible for putting together the technical program. Marianne is an excellent networker, and as such, has many contacts in the technical community, which serves her well in this role. She believes that sharing knowledge and findings is an important part of our geoscience group, and this is most effectively done through presenting to its members and through publishing in our peer reviewed journals.

When not working, Marianne likes to travel, play with her puppies, explore Houston's fantastic food scene, and drink some good wine. □

Meet the GSH 2020 - 2021 Candidates continued from pages 25 & 26.

Simon Voisey *Biography continued from page 25.*

First VP, Simon has the first-hand experience with being on the technical committee of last year's successful spring symposium honoring Dan Hampson and Brian Russell. Simon participated in securing technical speakers, composing the agenda, and chaired a session. In particular, he devised and lead the student speaker section of the event by working directly with Houston universities to obtain student speakers. Also, in 2019 Simon was on the technical committee for the SEG annual conference with responsibility for the AVO and seismic inversion technical sessions. In this role, he recruited technical reviewers and organized the technical sessions by appointing session chairs and structuring the agenda of the technical talks. Simon has reviewed technical papers for the SEG's annual conference and the SEG "Interpretation" journal. Lastly, Simon is an SEG DISC committee member with the responsibility of proposing and voting for DISC program instructors.

Simon's professional career began when he was hired by Scott Pickford's London office in 2008. In 2009 he moved to Hampson-Russell London office managing their EAME technical support desk. Later in 2009, Simon moved to Houston with Hampson-Russell to work on QI based projects for oil companies. In 2014 he moved to Apache Corporation's EPT group and is now primarily focused on providing QI support for Egypt exploration and development. Throughout Simon's professional career he has been focused on knowledge share. At Hampson-Russell he assisted with public workshops and taught the class in both public and onsite settings. In Apache, he was involved with organizing and speaking at internal workshops held in Houston, Midland, and Egypt. Also, he has been a mentor for Apache staff by sharing QI knowledge and experience.

In Simon's free time he is a season ticket holder for the Houston Dynamos and Houston SaberCats. He enjoys walking and last year hiked in the North Cascades (Maple pass is a fantastic trail by the way). □

Laurie Geiger *Biography continued from page 26.*

Bachelor of Science degree in Wildlife and Fisheries Sciences. Following university Laurie taught high school introductory chemistry and physics courses for five years. Her passion lies in education and communication, and she has held several training positions in the industry, where she has created her own courses and programs for depth imaging. Additionally, she has given multiple depth imaging classes at Geoscience Day, volunteering with the GSH. She has also given a large number of geophysical talks at schools, fairs, professional conferences, and universities. Over the years, Laurie has co-authored many technical articles and papers, involving both the geological and geophysical aspects of marine seismic processing. She has held almost every office in the College Women's Club of Houston, an educational group that gives scholarships to high school students. In her spare time, Laurie likes to participate in a wide variety of sports, with water skiing and football at the top! □

Russell Jones *Biography continued from page 26.*

He worked as a seismic data processor for Ensign Geophysics in Surrey from 1993 until 1997 before being transferred to Houston to help start up their new office as a Project Geophysicist. Following Geotrace's purchase of Ensign, Russell headed the Houston marine processing department. Then in 2008, he joined Seitel as a Processing Manager, and now oversees the processing and delivery of seismic from Seitel's vast library. The position also involves engagement with marketing efforts and technical support of the new and vintage seismic datasets.

Outside of the technical aspects, Russell volunteers for the GSH as the tennis tournament chair (please sign up for the 2020 event!). Additionally, through Seitel, he participates in the Spring Branch School District outreach program, which includes mentoring at a local middle school, volunteering at the yearly Field Day and performing in the 'Cat in the Hat' at Panda Path School, a pre-K and Early Learning school.

He is a strong advocate of engaging young geophysicists and professionals by introducing them to the GSH organization. □

Alvaro Chaveste *Biography continued from page 25.*

physics and reservoir geophysics for over 30 years.

He started his career in GSI as field QC for vibroseis crews in Mexico. When transferred to Halliburton Geophysical in Houston he worked in borehole geophysics and land & marine seismic data processing. In 1994 he joined "The Andrews Group International" (AGI) where his duties included preparing and teaching Geophysics courses for Mexico and South America. He was technically responsible for Houston's and Mexico's data processing operations. In 1999 AGI was acquired by Core Laboratories where Alvaro started and managed the Advanced Reservoir Geophysics group. From 2000 and until 2012 he managed groups specializing in well-seismic calibration and estimation of rock properties to help reduce risk in the estimation of reservoir and geomechanical properties. During this period, he worked at Core Laboratories, Paradigm Geophysical and Geokinetics.

Alvaro has authored and co-authored several papers in topics mostly related to estimation of rock properties and their application in estimating reservoir and geomechanical properties. He is a member of GSH and the Society of Exploration Geophysicists for which he often reviews papers and chairs technical sessions. When time permits, he mentors starting Geophysicists through the American Geophysical Union (AGU). In his spare time, he enjoys practicing kickboxing as well as the occasional glass of wine with friends. □

Oscar Vazquez *Biography continued from page 26.*

River basins, as well as brief experience in the Canadian tar sands. He holds a BSc from Texas A&M University where he worked with an undergraduate research group using electromagnetics for the identification of unexploded ordnances under the guidance of Dr. Mark Everett. He received his MSc from Memorial University of Newfoundland where he collected, processed, and interpreted seismic and gravity data in a study of the Howley Basin in western Newfoundland led by Dr. Charles Hurich.

Oscar aims to improve his public speaking skills. He presented, in 2019, published papers and abstracts at the Hydraulic Fracturing Technology Conference and the SEG Annual Meeting. He volunteers for the GSH in various areas including office work and hosting the North Tech Breakfast and Lunch.

He is a committee member of NextGen, GSH's young professionals branch, where he aids his networking skills and helps others build meaningful and lasting relationships with industry colleagues. □

Whitney Blanchard *Biography continued from page 26.*

interpretation. While completing her thesis at UA, she started working with shallow borehole monitoring arrays and pursued an internship with Schlumberger (SLB) at the Gould Research center in Cambridge, U.K. During this internship, she evaluated SLB's microseismic processing software and transitioned into a full-time role in Houston after completing her degree. At Schlumberger, she processed downhole microseismic data on the Petro Technical Services team. In this role, she monitored and processed data in key resource plays including the Wolfcamp, Avalon, Utica, and Eagle Ford formations. She also helped develop SLB's moment tensor inversion tool and processed various Vertical Seismic Profiles (VSPs). Before taking on a role with Sigma Cubed Inc. At Sigma Cubed Inc., she continued processing downhole array data, helped with python-based software development and testing, and worked as a Project Manager with responsibilities including QA/QC of deliverables and interacting with clients.

Whitney has been extensively involved in volunteer work with the Geophysical Society of Houston's main office. She was awarded the President's Award as "Rookie of the Year" and chaired the geophysical unemployment forum in 2017, while also starting a family. Most recently, Whitney has joined the Special Interest Group (SIG) GSH Committee and is also the Chair-Person for the early career group NextGen. □

WITHDRAWN

Katja Akentieva *Biography continued from page 26.*

took over the onshore seismic data business for TGS in 2015 and recently gained additional responsibilities for well data products. Her previous industry experience includes 11 years with Schlumberger where she held various positions based in the UK, Norway and Canada. Katja received her Master's degree in Geology and Geophysics from Moscow State University, she also holds an MBA from Erasmus University in the Netherlands.

Katja's first introduction to the seismic industry was in the late nineties. Working a four-week rotation on a seismic vessel in the North Sea, it soon became apparent that there was a big difference between learning about seismic and practicing it. Katja believes that it is important to bring knowledge about geophysics to the communities we live in. She serves on the Board of the IAGC, the global trade association representing all segments of the geophysical and exploration industry. Katja is delighted to be able to contribute to the growth of the GSH organization, learn about its members, challenges and, ultimately raise the visibility of innovative and modern ways we conduct our highly technical business. □

Chris Egger *Biography continued from page 26.*

advancing to Senior Processing Geophysicist and Project Lead over the course of 16 years. Over that time, he processed onshore data all over the world, including United States, South America, and Canada, and also undertook account management responsibilities, working closely with operators t o meet their processing objectives. Next, Chris joined TGS, where he initially provided geophysical technical training for the imaging division, and worked on multi-client, proprietary, and special seismic processing projects including Illumination studies. At TGS he gained marine processing experience working on some of the largest multi-client projects globally. These challenging and data rich projects enabled him to coauthor a few papers, including presentations at GCAGS on several imaging topics covering Gulf of Mexico.

The combined experience of his past sparked his present passion where he utilizes his processing background to better address clients' geophysical challenges by tailoring creative solutions to address imaging challenges. As all of Chris' industry experience has been on the service side of the business, he brings a technically-rooted and service-oriented approach to his daily endeavors.Chris holds active memberships in the GSH and SEG. Currently, he is actively volunteering as a GSH Unconventional Special Interest Group committee member, fishing tournament volunteer, and GSH membership chair. Notably, he has assisted in promoting member benefits and encouraging GSH membership throughout the local community. In his spare time, he enjoys fishing, hunting, traveling and supporting our local community of Geophysicists. □

Voting begins April 1.

Ballots must be submitted by April 21.

Election results will be announced at the Annual Meeting / Honors & Awards on May 7th and in the June Journal.

REGISTER NOW

2020 Distinguished Instructor Short Course | Dave Monk

Survey Design and Seismic Acquisition for Land, Marine, and In-between in Light of New Technology and Techniques

1 April 2020 | Houston

Description

Seismic surveys are subject to many different design criteria, but often the parameters are established based on an outdated view of how data can be acquired, and how it will be processed. This course is designed to highlight what is possible using modern methods, and how they impact seismic survey design.

Survey designs are subject to a limited set of operational and geophysical considerations. What frequencies do we require (in the source), and what will or can we detect? What geometry will be utilized, and what record length will be recorded?

However, new techniques and processing methods require that we understand and answer a new and different set of questions:

- Are classic survey geometries outdated? What geometry is optimum given almost limitless availability of channels, and how are these best deployed if they are not constrained to be connected together?
- How do you QC data from a system that doesn't permit real time views of data?
- How do compressive sensing methodologies fit into classical geometry requirements, and can these significantly impact how data is acquired and processed? Is random "optimum" and is optimum unique?
- Do offset and sampling requirements change if processing will utilize FWI and/or least squares migration?
- Can very low frequencies be generated, detected and used for improved inversion?
- How should simultaneous sources be utilized, and can subsequent data be separated from the continuous records that will be required if this technique is used? If two sources are better than one, are four better than two?
- What should we expect of seismic data five or ten years from now?

This course is designed to cover some of the fundamentals of survey design, but will highlight the changes in technology that we have seen in the past five years, and those that are likely to develop in the next five years with a view to allowing seismic surveys to be designed and acquired to optimize technology efficiencies and interpretation requirements in light of new technology.

Goals

This course will not describe specific survey designs for particular geologic objectives, but after attending this course, the participant should:

- Understand the basic geophysical requirements of a seismic survey, based on geologic objectives
- Have a much-improved knowledge of the differences between classic survey design, and what is required for modern high-end processing techniques including FWI
- Understand the concepts of simultaneous sources, compressive sensing, node acquisition, and broadband data, and see how these fit into survey design techniques
- Understand that there is a relationship between acquisition parameters and seismic image quality
- Understand how the basic requirements tied to modern acquisition and processing ideas can fundamentally change the data that is presented to an interpreter, and why final data volumes can look significantly different from legacy data

Who should attend

All those interested in seismic surveys should attend. Geophysicists involved in acquisition may discover new techniques and concepts which with they are unfamiliar. Geophysicists involved in processing seismic data will better understand the shortcomings of the data that they are given to process, and better understand what techniques will, and will not, work for a particular survey. The interpreter may better understand the difference between modern seismic volumes presented for interpretation, and the legacy data that he is accustomed to interpreting. For those directly involved in survey design, the concepts will open up the potential for acquiring better images of the subsurface more efficiently, and at less cost.

The course does not require extensive mathematical knowledge or background. Concepts will be explained in a way that the layman or manager can understand. Students will be able to follow and understand the course from the basics to the level of asking knowledgeable questions of those actually involved in seismic acquisition and processing.

Instructor biography

Dave Monk holds a PhD in Physics from Nottingham University in the UK, and served as director of geophysics and as a distinguished advisor at Apache Corporation, until his retirement in October 2019. Monk now acts in an advisory capacity to several companies including DownUnder Geosolutions.

Monk started his career on seismic crews in Nigeria and has subsequently been involved in seismic processing and acquisition in most parts of the world. 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 from the Society of Exploration Geophysicists (1992), the Canadian SEG (2002), and the Hagedoorn Award from the European Association of Exploration Geophysics (1994).

Monk received Honorary Membership in the Geophysical Society of Houston in 2008 and Life Membership in the SEG in 2009. He served as president of the Society of Exploration Geophysicists in 2012–2013.

Pricing

SEG members $270, SEG nonmembers $390, SEG students $80

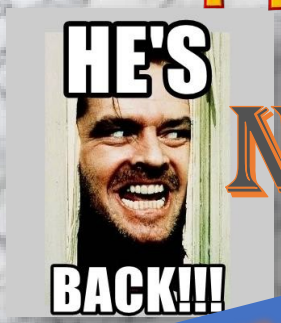
SEG SOCIETY OF EXPLORATION GEOPHYSICISTS

Connecting the World of Applied Geophysics

seg.org/DISC

The GSH Journal Editorial Board Reluctantly Announces

The Return of the Guru in NUGGETS REDUX



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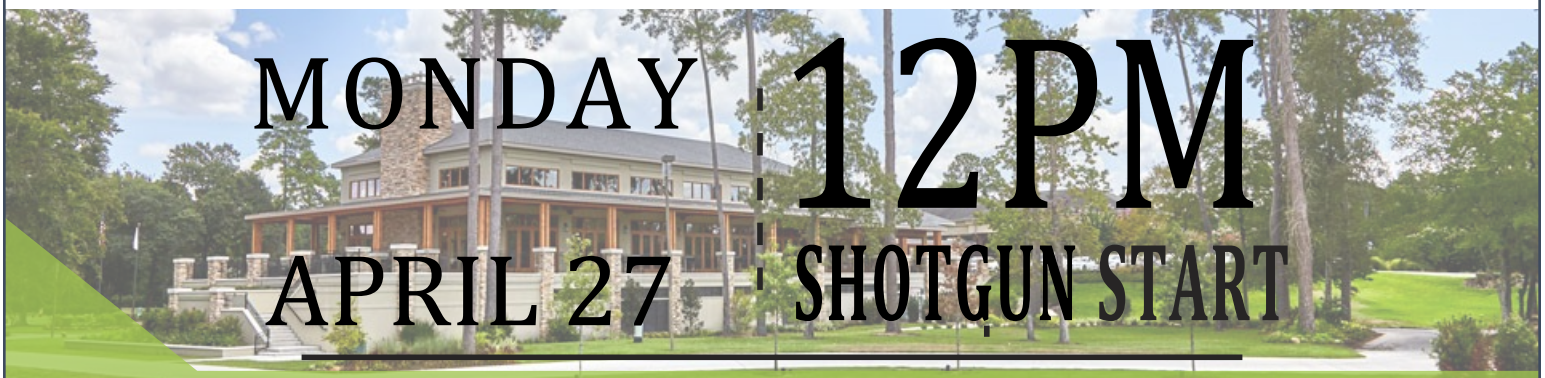

MONDAY
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U of H Wavelets - Geoscience Article

A Deeper Look at Shallow Sediments: Crosswell Seismic Surveying at La Marque, TX

By Zohreh Souri and Robert R. Stewart

Figure 1. Participants in the UH Geophysics Field Camp at La Marque, Texas in front of the drilling rig

Introduction

A key component of the University of Houston's (UH) educational and research programs in geophysics is making measurements in the field with a variety of instrumentation. One type of survey conducted in the 2018 and 2019 UH Geophysics Field Camps *(Figure 1)* at the La Marque Geophysical Observatory used the cross-well geometry (downhole source and receivers). In addition to training students in this subsurface method, we were interested in testing a new seismic source, the Scorpion, generously loaned to us by Trident Research. There are several reasons to acquire cross-well data; such as making measurements directly in depth, getting the seismic source and receivers beneath the surface to avoid attenuation and heterogeneity problems, and imaging with broad range of angles. We can use vertical wells or pairs of horizontal wells. With the advent of hydraulic fracturing in horizontal wells, cross-well methods may have a resurgent future. Of course, the requirement of having two wells makes the method somewhat special.

Location and Geology

Our training, and test site is located near Interstate 45 in La Marque, Galveston County, Texas. We have two shallow test wells, and proximity to many producing oil and gas wells. The geology of the area is characterized by numerous flat-lying reflectors without complex structures (Turolski, 2013). The terrigenous sediments, deposited by rivers on the continental shelf, are of Quaternary to Triassic age *(Figure 2)*. Since this study is concerned with the upper 120 m, only sediments from Pleistocene Beaumont formation - characterized by dense clay

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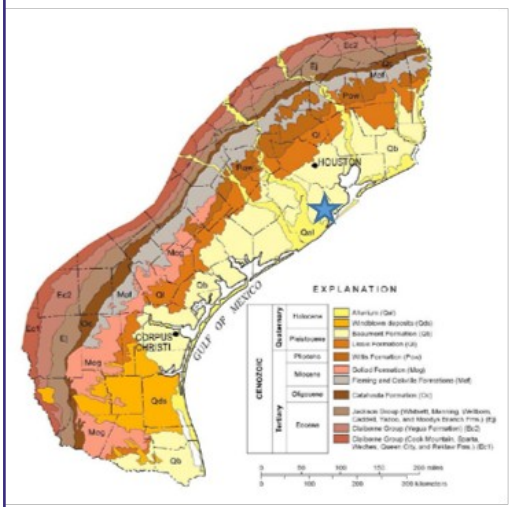
Wavelets continued from page 33.



Era	Period	Epoch	Stratigraphic Units	Hydrogeologic Unit	Lithology	Approx. thickness (in study area) (m)
Cenozoic	Quaternary	Holocene	Alluvium	Alluvium (Incised Valley Fill)	Coarse grained	0
		Pleistocene	Beaumont	Beaumont clay	Dense clay with interbedded sands	55
			Lissie	Chicot Aquifer	Sand, silt, clay, minor amounts of gravel	600
	Paleogene (Tertiary)	Pliocene	Willis			
		Miocene	Goliad	Evangeline Aquifer	Sand	1200

Figure 2. Left: Geologic map of the Texas Coastal Plain, adapted from Young et al. (2010). The area of study is marked with the blue star. Right: Geologic stratigraphy of the area of study, adapted from Ross (2017). The blue curly bracket marks the interval of study.

with interbedded sands- and Lissie formation – comprised of sand, silt, clay, and minor amounts of gravel- are encountered. (Baker 1995; Knox et al. 2006; Young et al. 2010; Ermolaeva 2017; Ross 2017)

Well Logs

As mentioned, there are two shallow cased wells available at our La Marque Geophysical Observatory, each drilled to the depth of 120 m. We undertook gamma ray, conductivity and temperature logs during summer 2019 field camp *(Figure 3)*. The main sand zones are highlighted in the figure, and the water table at depth of 25 m (the middle zone) is of interest.

Acquisition

The Scorpion borehole source *(Figure 4)*, used for this survey, is an impulsive pressure source developed by Trident Research based on sparker technology. It's basically a large spark plug that can provide a high amplitude pressure pulse in the borehole fluid which then propogates into the formation. To first test the source, we used a 24-channel hydrophone array deployed in one of the two wells at our test site. *Figure 5* illustrates the acquisition geometry. The two wells are separated

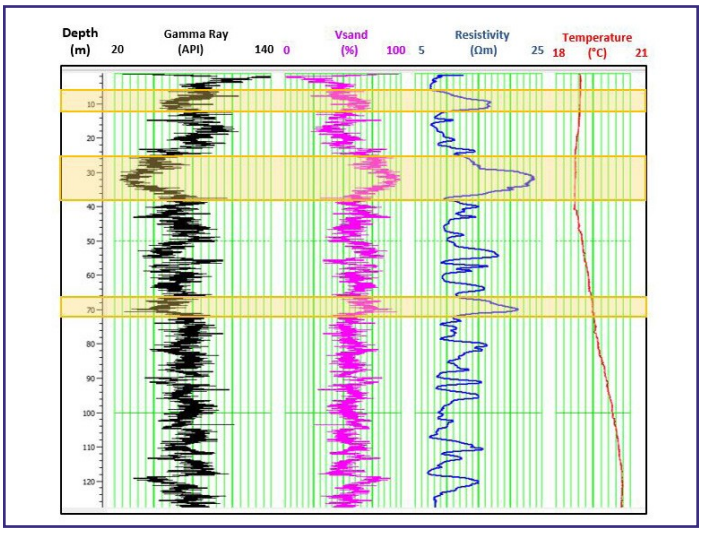


Figure 3. Gamma Ray, Vsand, Resistivity, and Temperature log. The highlighted zones are the main sand intervals.

by 18 m. Receiver spacing was 4m with the shallowest being at 28 m and the deepest at 120 m. With this receiving array two differerent source configurations were used over the depths of 26 m depth to 86m: one with medium output, 5 vertical stacks, and interval spacing of 4m, and one with high output, 3 stacks, and source interval spacing of 12m. Recording length was 1s, and sampling interval was 0.25s.

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Wavelets continued from page 34.

Figure 4. Scorpion downhole sparker

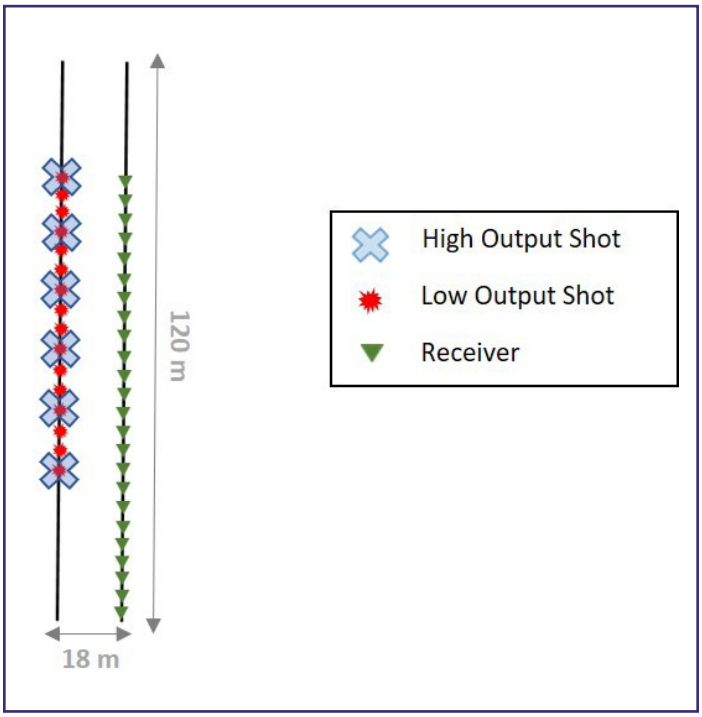

Figure 5. Schematic diagrams of the acquisition geometry for the two surveys: one with dense shot spacing on medium output and one with sparse shot spacing with high output.

Data

A shot gather of the recorded data with the source at 78 m depth using a medium output intensity is shown in *Figures 6a and 6b*. The data are AGC'ed and cropped to the first 200ms. We note the largely symmetric moveout of the arrivals around the source depth. We find that the recorded frequency is in the 0 – 1700 Hz band, with the dominant frequency of about 1000 Hz. Basic velocities from the cross-well transit time are between 1600 m/s to 1900 m/s. We are currently using tomographic and reflection processes to fully analyze the data.

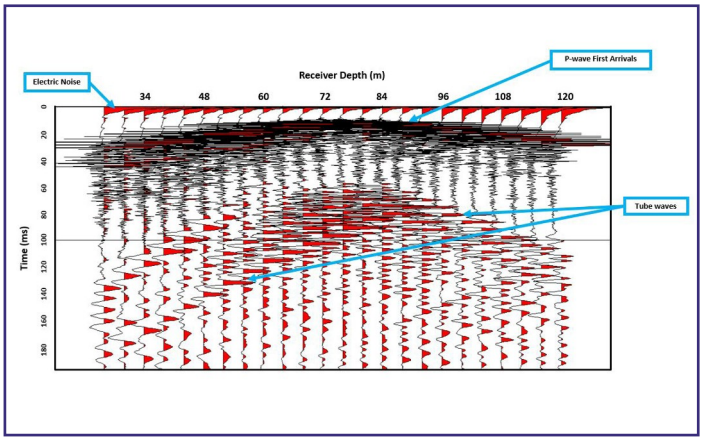

Figure 6a. An example of an AGC'd shot gather with the source at 78 m depth

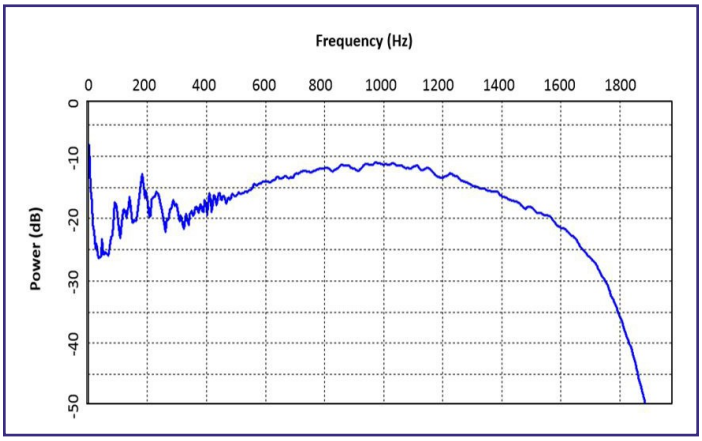

Figure 6b. Frequency spectrum of data in Figure 6a

Wavelets continued on page 36.

GSH Outreach

Committee Activities *By Lisa Buckner,* **outreach@gshtx.org**

We hosted a Community Booth at the **Girls Exploring Math and Science (GEMS)** event for Girl Scouts on **Saturday, February 15 at the Houston Museum of Natural Science**. We told the Girl Scouts and museum visitors about geophysics & geology and gave them a GSH logo coiled toy spring. They also enjoyed playing our Drilling for Oil game.

Project judging for the **Science and Engineering Fair of Houston** was also conducted on **Saturday, February 15** at the George R. Brown Convention Center. GSH volunteers coordinated by Gokay Bozkurt selected four winners for GSH special awards. GSH volunteers also served as Place Award Judges to help select winners in the Earth Science, Physics and other categories. Top students will compete at the **Texas State Science Fair** and the Grand Place Award winners will go directly to the **INTEL International Science Fair**. The awards ceremony was held **February 22** on the University of Houston main campus where the GSH special awards were presented to the students in attendance.

UPCOMING EVENTS – Volunteers Needed

Saturday, April 4, 2020 – Scout Fair (NRG Arena) - Science Exhibit Booth

Saturday, April 18, 2020 - HISD When I Grow Up Career Expo (Houston) – Career Exhibit Booth

If you are interested in volunteering for any events, please contact Lisa Buckner at outreach@gshtx.org. □

Wavelets continued from page 35.

Summary

Initial tests of the Scorpion downhole source are encouraging with its ease of operation, portability, and consistent signature. We will repeat the crosswell tests with the same source, and different receivers such as a well-clamping geophone and DAS, as well as with a different downhole source (Ballard). We are currently processing the acquired datasets to build a high resolution 2D image of the area between the two wells, as well as study the source radiation pattern and attenuation. Surveys as this are engaging and instructive for students as well as useful for developing processing procedures and outputting interesting mages.

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U of H Wavelets

SEG wavelets held the 1st Annual Software Bootcamp

By Zhongmin Tao, University of Houston

Group photo at the end of the Bootcamp.

During winter-break, SEG wavelets collaborated with Schlumberger and StructureSolver. We held the 1st Annual Software Bootcamp inside the College of Natural Sciences and Mathematics at the University of Houston! The 4 days of intensive training helped in preparing students in the O&G industry by giving them the opportunity of experiencing the tools they will likely be using after graduation. With the collaboration of AAPG Wildcatters, we hosted instructors from Schlumberger and StructureSolver who taught over 30 students the software workflows and capabilities. Software used included Petrel, PetroMod, and StructureSolver. The Bootcamp had slides' lectures, as well as hands-on exercises. The students mastered the software and generated products.

Particularly benefited were the undergraduate students who might not have had a dedicated course that included the software. Graduate students, whose research fields might not necessitate this type of software, were greatly benefited as well.

SEG wavelets plans to continue the Bootcamp every winter-break. □

Students are practicing Petrel under instruction.

Recognizing Outstanding GSH Volunteers...

Kat Pittman *By Tommie Rape*

The many social and technical opportunities offered by the Geophysical Society of Houston (GSH) for the geophysical profession of Houston and beyond are due largely to many dedicated volunteers. The GSH wants to recognize some of these dedicated volunteers and will do so through this series of articles where we will present a selected volunteer and provide our readers with some of the volunteer's professional and volunteer background. Hopefully this will increase our readers' appreciation of these volunteers and encourage them to join the GSH volunteer ranks where they can partake of the many benefits that this work provides.
— Tommie Rape

Kat Pittman was born and raised in Houston, amidst the oil industry. Her father worked at Schlumberger as a design engineer. Kat remembers going to her father's office as a child and being inspired by the action and type of work. Her mom owned her own advertising agency, which also inspired her. Kat loved marketing, sales, and advertising. Both of her parents' work inspired her in different ways, and after achieving a BS in Business Administration and Marketing from Trinity University in 2008, she went to work for Resolve GeoSciences as a Marketing Representative. Her talents and dedication led to a quick rise to the position of Vice President of Sales and Marketing at Resolve. Kat loves sitting down and interfacing with customers. She always "thinks about the why;" she tries to understand not only what a customer wants, but "why" they want it, so that together they can build out solutions and workflows that help them meet their goals. Kat's love for learning led her to expand her job beyond the marketing aspect; she learned a lot about geophysics. She dove into geology and geophysics courses, read industry textbooks, and was mentored by Don Robinson, President of Resolve, and her father-in-law, Doug Pittman, a geophysicist who spent his career at ExxonMobil. These mentors took the time to sit down with dusty textbooks and talk her through the basics and "never scoffed at her questions." Kat also has many fond memories of customers excitedly sharing their passion and knowledge with her along the way. Before long, Kat was providing geophysical training in seismic attribute technologies and software and giving high-level presentations to clients of Resolve, and continued to do so for many years. Kat's knowledge and discourse in geophysical topics has frequently led to her being mistaken for a graduate geophysicist. This past year she changed employers, and her desire to remain in the oil industry and in the realm of geophysics and analytics led her to Enverus Drillinginfo, where she is now a Strategic Account Director here in Houston. There she partners with her accounts to help them utilize both Enverus's data and software platform, and manages their entire customer experience. She gets to work closely with a variety of disciplines within an organization and enjoys interfacing with geophysicists, geologists, engineers, land, A&D, BD, accounting...sometimes all in one day! She has loved learning more about how analytics is revolutionizing the way we do our business and is excited at how quickly the industry is evolving.

Kat's passion for the science part of her job and her love for interfacing with intellectual groups of people is what led her to the GSH. She started this involvement by attending technical meetings where

Volunteers continued on page 39.

Volunteers continued from page 38.

she could increase and broaden her knowledge of geophysics and of the oil industry. These meetings also provided her with the opportunity to meet people in the industry. She soon offered to help with the registration at these events, which would also benefit her by getting to meet and know even more geophysicists. And as history would recognize, thus began Kat's distinguished career as a volunteer for the GSH. Her dedication to the task at hand and her pleasant personality led to Kat being asked to chair the GSH Honors and Awards Banquet in 2012. This effort entailed planning and organizing the event, coordinating with the venue, the very ominous task of solicitation of sponsors for the event, and even doing some of the decorating when needed. She has continued the leadership effort of this important annual GSH event to the current day, even after changing employers. The recognition of Kat's planning and organization skills led to her being elected 2nd Vice President Elect of the GSH in 2016. The following year she served as 2nd VP. In this position she was responsible for overseeing the planning and organization of all the GSH social events. As 2nd VP during a downturn in the industry, Kat worked hard to organize the numerous GSH social events to make sure that they worked together vs. stepping on each other, particularly in GSH relations with sponsors and supporters. She also organized historical information of all the social events that helped future transition of GSH officers and volunteers. Her efforts in the 2nd VP position were critical in two years of GSH events.

As is typical with renowned volunteers of the GSH, her efforts extended beyond her role as an officer of the GSH. Kat was chair and primary organizer of the very popular 2017 SEG-GSH Icebreaker. Her professional marketing skills were also valuable in her participation in the Advertising Committee and the Sponsorship Committee of the GSH. Always willing to help in any manner, Kat has volunteered to operate the GSH booth at NAPE, the SEG Convention, and other technical gatherings. And, perhaps one of her most enjoyable, but useful, effort is assisting at the GSH Golf Tournaments. I doubt that she will ever give up entertaining participants at this very enjoyable event.

Kat is quick to recognize the many benefits she gained from her volunteer efforts. She feels great satisfaction in contributing to a non-profit organization that is working hard to move the industry forward. She feels the GSH has been a cornerstone/safe haven for many during the downturn, and she was glad to serve on the Board during this pivotal time. Her efforts gave her the opportunity to meet many people that she never would have met otherwise. But most of all, Kat says it was just enjoyable to network and have fun with such high caliber peers in relaxed environments.

Kat's volunteer efforts have also generated reciprocal benefits between the GSH and her past and current employers. Her professional marketing skills helped the GSH attract more participants at the many social events. Her organization skills were beneficial in the planning of many complex and varying events. Kat's experience at her company's trade show booths helped improve the GSH booth. Kat also was instrumental, along with her professional colleague – Nicola Maitland (who is also a great GSH volunteer), in building a strong relationship between Resolve Geosciences and the GSH. Resolve was a very generous sponsor for many GSH events, providing a critical component of our organization's financial sustenance. Kat and the GSH are very appreciative of the support that Resolve gave with Kat's volunteer time and with its financial sponsorships. From the tech events, she learned new concepts and approaches within the geophysical industry. Her networking generated many connections between geophysicists and her employer. Kat says that her work on the annual

Volunteers continued on page 40.

Volunteers continued from page 39.

Honors and Awards Banquet improved her event planning skills, which she then utilized in organizing company functions.

Kat highly encourages others to get more involved in the GSH, by attending both technical and social events, and then by stepping up and offering to assist the GSH in its activities. It is often difficult for individuals to justify the time spent in volunteering for the GSH, much less just attending events. However, once you step into volunteering, you quickly realize the many ways it benefits you personally as well as professionally. Giving back to an organization whose mission is to further our industry allows you to stay at the forefront of changes in our industry and in geophysical technology. It's also an important outlet for networking with peers outside of your immediate circle.

Kat Pittman has been, and continues to be, a tremendous asset to the GSH. The next time you see Kat at a GSH event, or at a booth at any event, or driving the cart around the GSH Golf Tournament, please stop her and thank her for her many efforts and for being such a wonderful person. □

Mystery Item

This is a geophysical item...

Do you know what it is?

This month's answer on page 47.

GSH GEOSCIENCE CENTER
CHALLENGE

Match donations by Scott Petty. Jr., Lee Lawyer, Tom Smith, and Dick Baile

DONATE NOW at https://www.gshtx.org/ or send a check to the GSH office.

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GEOSCIENCE CENTER

2019 – 2020 CHALLENGE

Challengers:

Dick Baile, Lee Lawyer, Scott Petty, Jr., Tom Smith

Matching:

Gary Hoover, Robert Wyckoff, Craig Beasley, Bruce Blake, Frank Dumanoir, Michael Forrest, Bill Gafford, Karl Schleicher, J Haynie Stringer, Kenneth Mohn, Tommie Rape, Lisa Buckner, Marie-Helene Clavaud, Peter Duncan, Abhijit Gangopadhyay, Randy Keller, James Medlin, Barry Rava, Tom Smith, Liza Nell Yellott, Bee Bednar, Matt Blyth, Carlos Cabarcas, Helen Delome, Bill Goodway, Jennifer Graf, Mike Graul, Louis Hebert, Don Herron, Fred Hilterman, Heloise Lynn, Ruben Martinez, Enders Robinson, Paul Schatz, Fred Schroeder, Gene Sparkman, Leon Thomsen, Sven Treitel, Bob Wegner, Harold Yarger & Gene Womack

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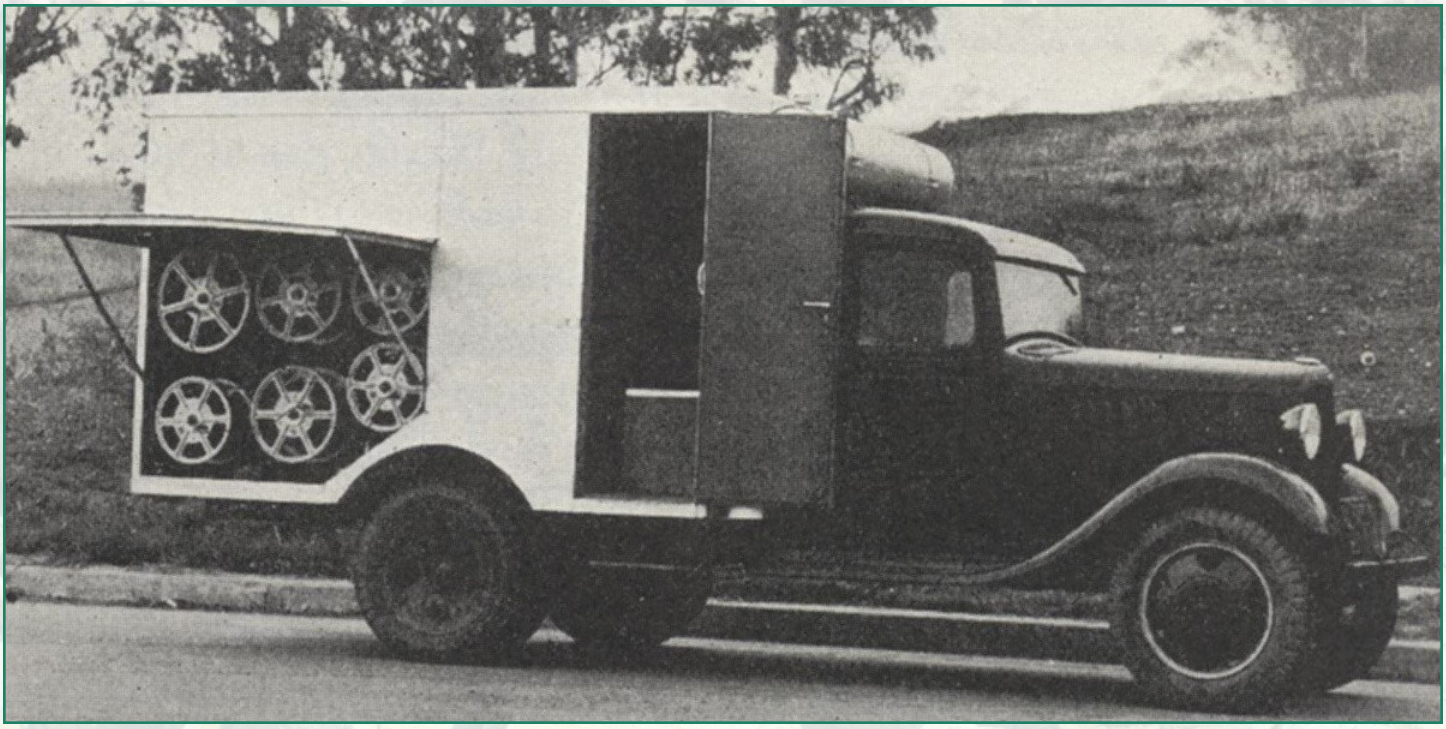
Geoscience Center

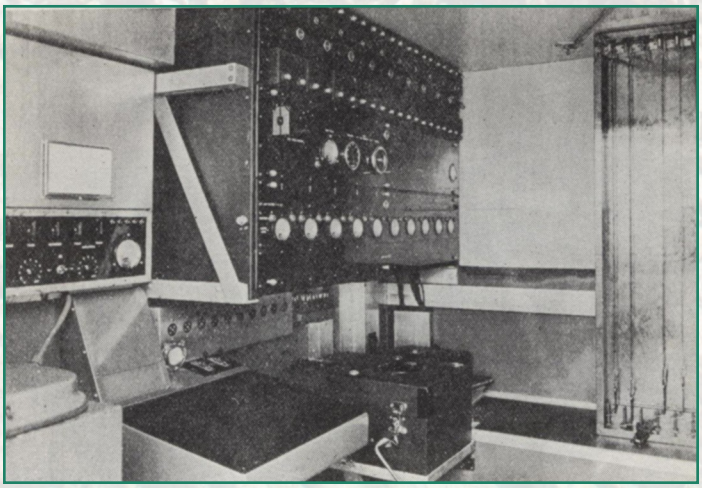
The History of Geophysics By Bill Gafford

1790 W. Sam Houston Pkwy. N. (Right on Shadow Wood)



Rieber seismic recording truck

In our collection of geoscience artifacts, we have components from a variety of early seismic recording systems. One of the more interesting systems was developed by Frank Rieber in the 1930's. This system was significant because the seismic data was recorded on reproducible film. This advancement allowed him to develop subsequent schemes to manipulate individual seismic traces. He applied analog filters, individual trace static corrections, and determined dip with his analysis tool, which he called a sonogram. For these inventions and others, he has been called the first seismic processor. His recording system was described in "Geophysics", Volume 1, in 1936, and the pictures below come from that publication. The recording truck with the seismic cable reels is shown in one picture, and an inside view of the recording system is shown in the other picture. The inside view shows the amplifier units, gain control, volume control, and other instruments for the ten channel system. The developing tank, film drying rack, and the operator's desk are also shown. At the Geoscience Center, we have some of the instruments from this recording system on display.



Inside view of Rieber seismic recording truck

Frank Rieber's early research and experimentation was in electricity, radio, and x-ray machines. He

Geoscience Center continued on page 46.

Geoscience Center continued from page 45.

later became interested in seismic refraction work. His early refraction prospecting was conducted in California, but it was mostly unsuccessful, largely because of the complicated geology and structure. In 1932, he started developing his reflection equipment, including amplifiers and seismometers. This spurred him to find a way to capture seismic data in the field in a way that would allow the data to be reproducible. Then came his sonograph. By using 35mm film and producing variable density field recordings that could be played back later and "processed". He then began to display corrected traces on the screen of a cathode-ray tube. The system was called Geovision and was the forerunner of projection TV technology. While the use of film allowed trace reproduction, the quality control of temperature and chemistry for developing the film was difficult for the field crew. This difficulty and the unwieldy heavy equipment may have been part of the reason industry waited over 10 years for the introduction of reproducible magnetic tape recording. Frank Rieber was an interesting and effective speaker and always drew crowds at presentations of his technical papers, which were usually controversial. He was a major drawing card at many SEG and AAPG meetings, and he usually presented the most colorful and provocative papers. His influence on seismic advancements was substantial. He passed away in 1948. □

The Geoscience Center is open on Wednesday mornings from 9:00 am to 12:00 pm or by appointment, and visitors are always welcome.

Please contact me at:
geogaf@hal-pc.org or by phone at: 281-370-3264 for more information.

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The Mystery Item on page 41 is a **circular slide rule from 1936.**

Join us for our end of the year party!
The Geophysical Society of Houston's Annual Meeting and

Honors and Awards Banquet

Thursday, May 7, 2020
Norris Conference Center
Magnolia Room

Cocktails | 6:00 pm
Dinner | 7:15 pm
Spouses and guests welcome.

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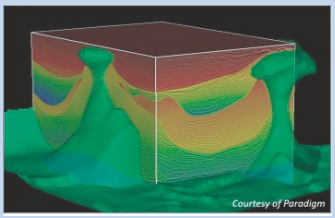
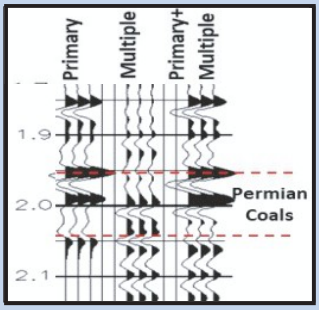
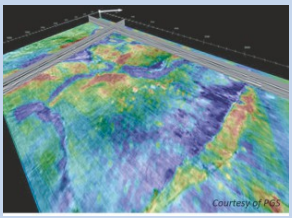
Access the recordings of these webinars originally presented live from the convenience of your home or office and according to your own schedule.







Title	Presenter
Seismic Modeling, Migration, and Inversion	Bee Bednar
Beyond AVO to Quantitative Inversion Interpretation QII	Bill Goodway
Affordable S-Wave Reflection Seismology	Bob Hardage
Simplifying and Lowering the Cost of S-Wave Reflection Seismology	Bob Hardage
Carbonate Essentials	Chris Liner
Basic Seismic Interpretation	Don Herron & Bob Wegner
Basics and UPDATES on Anisotropy: Azimuthal P-P for better Imaging, Fractures & Stress Analysis Acquisition, Processing & Interpretation	Dr. Heloise Lynn
Geophysical Signal Processing 101	Enders A. Robinson & Sven Treitel
Seismic Amplitude 20/20: An Update and Forecast	Fred Hilterman & Mike Graul
Extracting Geology from Seismic Data	Fred Schroeder
Applied Azimuthal Anisotropy-Azimuthal 3D P-P Seismic: Why Bother?	Dr. Heloise Lynn
Understanding Seismic Anisotropy in Exploration and Exploitation	Leon Thomsen
An Introduction to Borehole Acoustics	Matthew Blyth
Topics in Land Seismic Data Acquisition, Processing, and Inversion	Oz Yilmaz
EverythingYou Always Wanted to Know about Microseismic Monitoring	Peter Duncan
Full-Wave Seismic Exploration: Acquisition, Analysis, & Applications	Rob Stewart
Introduction to Applied Depth Imaging	Ruben D. Martinez
The Interpreter's Guide to Depth Imaging	Scott MacKay
Machine Learning Essentials for Seismic Interpretation	Tom Smith

View more details & access the recordings by visiting
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HGS Shrimp Peel & Crawfish Boil

Friday April 17, 2020 12:00 – 6:00pm

Bear Creek Pioneers Park, Pavilion 6

3535 War Memorial Street, Houston, TX 77084

(Pavilion #6 is located off Bear Creek Dr.)

Boiled Shrimp
Cajun Crawfish
Corn & Potatoes
Beer & Beverages
DJ Music!

Ticket Cost

HGS Member- $30
Non-Member- $35
Walk-Ups- $45

Register online at WWW.HGS.org
www.hgs.org/shrimp_peel_2020

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Shrimp Sponsor $2000.00 - 6 Complimentary event tickets

Crawfish Sponsor $2000.00 - 6 Complimentary event tickets

Beer & Beverage Sponsor $1000.00 - 4 Complimentary event tickets

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Doodlebugger Diary

Training Operation in Syria

Story by Charles Boyer, Anthony Edwards, Christopher Baker; Western Geophysical, 1979; Photos by Anthony Edwards, Eric Gaylor, Richard Graves, John Ivanitz; Western Geophysical, 1979; Originally published in the 1979 Winter Western Profile; Recounted by Scott Singleton; Prolog by Scott Singleton

The Doodlebugger Diary recounts the experiences of geophysicists during their working lives. I've published extensively on my own experiences and encourage those of you with experiences of your own to also contribute. Your fellow industry professionals would love to hear your stories.

Last fall I started reprinting a series of early 1980's articles from the GSI Shotpoints that can be found at http://gsinet.us/. *This month I'm shifting to reprints of archived Western Geophysical Profile articles. These can be found at* https://seg.org/Publications/Journals/Western-Profile.

The Syrian civil war was officially begun on March 15, 2011 with major unrest in Damascus and Aleppo that began as peaceful demonstrations associated with the 2011 Arab Spring protests throughout the Mediterranean area, but which was violently suppressed by the Assad government lest they inadvertently were to lead to a more democratic and representative form of government (https://en.wikipedia.org/wiki/Syrian_Civil_War). I do not wish to recount the sad and tragic sequence of events that unfolded in the last nine years involving the rise of the brutal and inhumane ISIS group (also known as ISIL for Islamic State of Iraq and the Levant) which conveniently slid into the vacuum created by a weak Assad government and a similar counterpart in Iraq, and whose reign and the resulting battle to oust them resulted in a half million people killed and five million refugees in Syria alone.

Instead I'll merely remind readers of the current situation on the ground in that country *(Figure 1)*. Without degenerating into a complaint-laden recounting of how the Kurds ended up sharing a substantial part of their homeland in Rojava (the Kurdish autonomous province in northeast Syria) with the Syrian army (shown in orange in *Figure 1*) and the Syrian Opposition (or Syrian

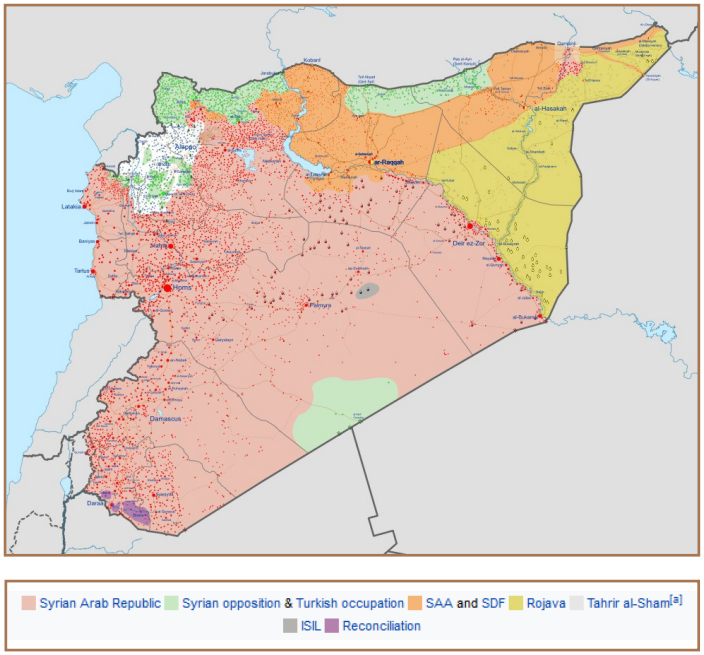


Figure 1: Military situation in Syria in December, 2019. Population centers are denoted by dots with size proportional to the population size and colored by the current occupying force. Of note in context of this article are the oil and gas fields, denoted by droplets, colored by the current occupying force. Legend definitions: SAA = Syrian Arab Army (main armed force in Syrian Arab Republic), SDF = Syrian Defense Forces (composed of Kurdish, Arab and Assyrian militias), Rojava = the de facto autonomous region in northwest Syria controlled by the Kurds, Tahrir al-Sham = the agglomeration of all Salafist jihadist militant groups currently concentrated in the Idlib province by the Assad regime.

Doodlebugger continued on page 54.

If you would like to add stories to the Doodlebugger Diary, send them to: Scott Singleton at scott.singleton@comcast.net ***or mail them to Box 441449, Houston, TX 77244-1449***

Doodlebugger continued from page 53.

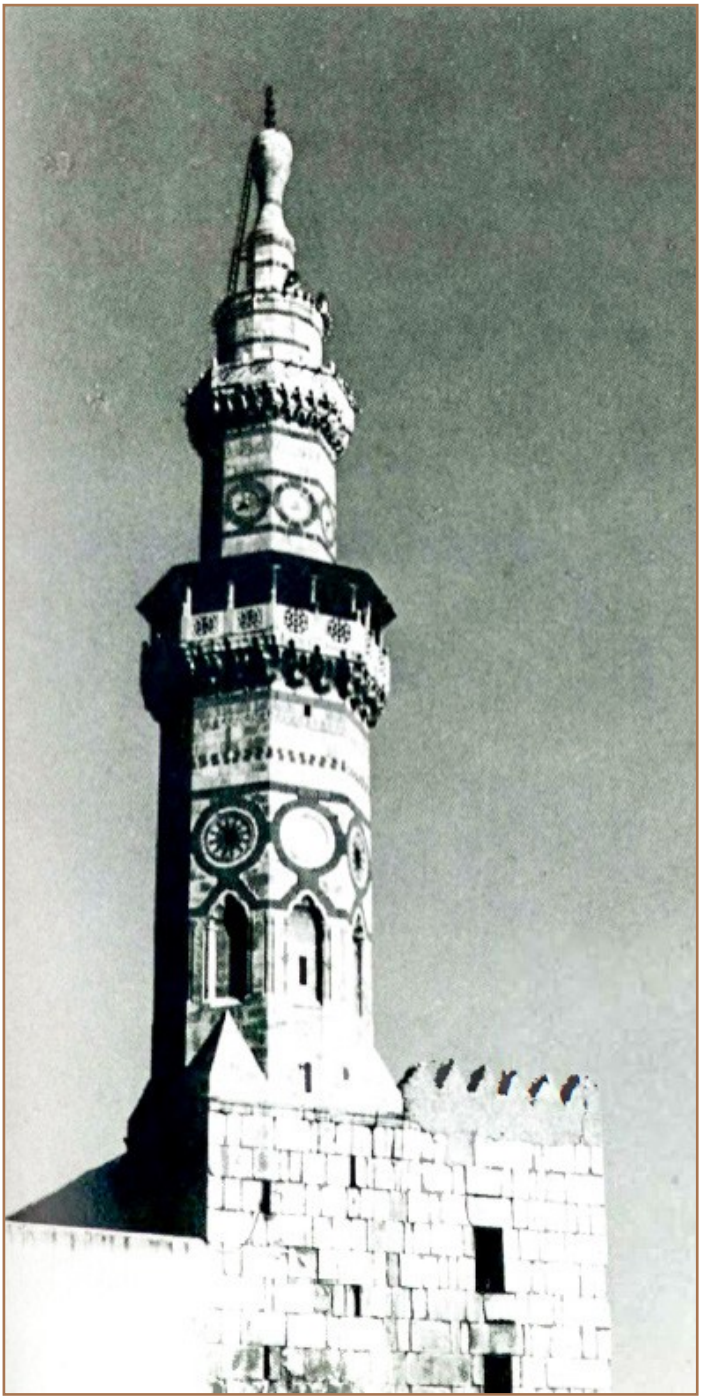


Figure 2: The Omawe Mosque in Damascus is an example of the Syrian culture. (Ed note: The correct spelling is Umayyad Mosque, also called the Great Mosque of Damascus. The portion of the mosque shown in this picture is the Minaret of Qaitbay, built in 1488).

National Coalition, which basically functions as Turkey's proxy in northern Syria and whom are enemies of the Kurds, shown in green in *Figure 1*), I'll merely concentrate on the limited role the US has been relegated, despite years of attempting to help the Kurds push back ISIS.

You'll note the cluster of oil fields to the east of the Euphrates River in the easternmost portion of Syria in the Deir ez-Zor province, colored in yellow since they are in territory held by the SDF. To the northeast of this is the al-Hasakah province where oil was originally discovered in Syria in 1956 although due to Mideast unrest oil didn't start to be produced until 1968 (https://en.wikipedia.org/wiki/Petroleum_industry_in_Syria). These two provinces contain the most prolific oil fields in Syria. It is this area that US troops repositioned after their withdrawal from the Turkish border region, ostensibly to protect them from "various state and non-state actors" seeking to take control of them. But in reality, consensus is that the main purpose of the presence of the US military is to assure that the Kurds maintain control of these fields and the revenue they generate, rather than to have them taken over by the real power brokers in the region, which are the Syrians, Russians and Turks ("Not over yet: New US Syria mission after al-Baghdadi death". Associated Press, Oct 29, 2019).

With this current state of affairs in mind, the following story, written 40 years ago, may seem oddly surreal.

Syrian Background

THE SYRIAN ARAB REPUBLIC covers an area of 188,348 square kilometers (72,702 square miles) and has a population of around eight million. Syria is an extensive limestone plateau sloping down towards Mesopotamia with a series of mountain chains to the west. The Jebel Zawlye and Ansariye, surrounding the southern ghab depression, is drained by the Orantes River. The narrow Mediterranean Sea coastline comprises a series of small plains. The climate in the coastal area is Mediterranean, but further inland and toward the east it becomes dry and hot, especially in midsummer.

By virtue of its very position on the globe, Syria has been, from time immemorial, both a crossroads and an active center. Discoveries made at the Paleolithic

Doodlebugger continued on page 55

Doodlebugger continued from page 54.

site of Lattamnch on the Orantes River and in caves near Palmyra attest to the fact of human activity in Syria more than a half million years ago. Excavations in the basin of the Euphrates River have brought to light the oldest Mesolithic house dating from the ninth millenium. Syria, the passage between the Mediterranean Sea and the Indian Ocean and between the Black Sea and the Nile River, has always been and still remains a meeting place and a home of civilization. The oil pipelines of today follow the ancient "Silk Road," and the craftsmen of Damascus are still some of the most skilled in all of the Middle East.

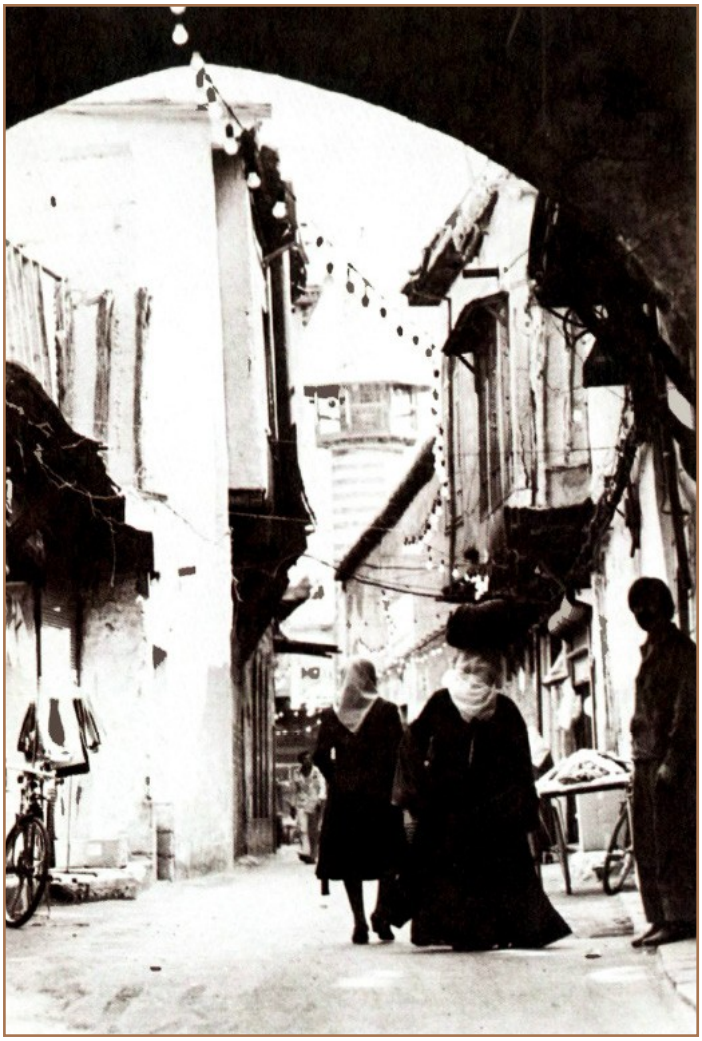


Figure 3: The Souq in Damascus, Syria, is a mixture of new and old. (Ed note: this is a general term in Arabic-speaking countries meaning bazaar or marketplace. There are several marketplaces in the old city of Damascus where this picture could have been taken).

Figure 4: Ruins of the city of Palmyra are in central Syria. (Ed note: this is the Temple of Bel, one of the more famous archeological sites in Palmyra, the whole city of which was a World Heritage Site. Unfortunately, in ISIS' wanton destruction of these sites, the entire temple was blown up with explosives on Aug. 30, 2015).

Different peoples have made their way up the age-old Euphrates River, have descended from Anatolia, have emerged from the sands of Arabia, or have galloped down from what was Macedonia or from Vezelay; and all of them have left a part of themselves behind in Syria as time moved on. Their gifts consisted of the crafts, the skills, the stories, the gods, and all that goes to make up a culture and civilization. The natives of the area, the men of Ugarit, Mari, Aradus, and Palmyra, Aleppo, and Damascus, the ancient Arameans and Amairites, and their present-day Arab descendants, have always managed to maintain their own culture and originality. From the unknown inventor of the world's oldest alphabet in the 14th Century B.C. in Ugarit to the architects of Queen Zenobia and the scholars of the Omayyads and up to the present day, the line remains unbroken. The Syrian personality has a recognizable face all of its own.

Seismic Exploration

So it is from the land of Syria, with its long history and fascinating historic sites and monuments, that our story begins. It was in Damascus, one of the oldest, continually inhabited cities in the world, that

Doodlebugger continued on page 56

Doodlebugger continued from page 55.

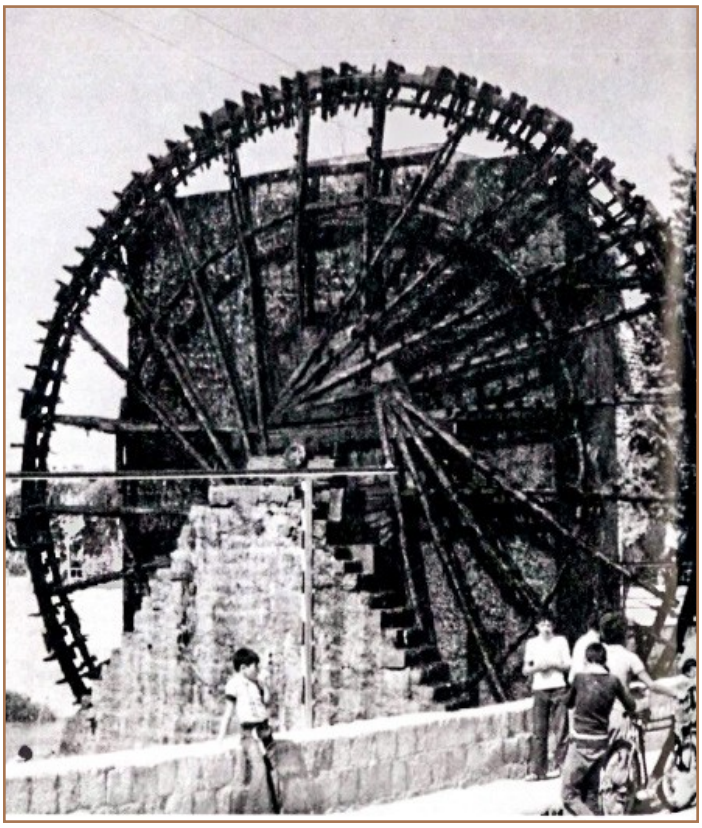


Figure 5: This ancient water wheel in Hama is on the Orontes River. (Ed note: These are called the Norias ("wheels of pots") of Hama. They are no longer in use and maintained for aesthetics only. They were submitted by Syria for consideration as a World Heritage Site in 1999. Fortunately, it is reported that they survived the civil war).

the director of the Syrian Petroleum Company (SPC) and his staff decided to form a seismic division of their exploration studies department. Eventually the contract was awarded to Western Geophysical Company and signed in March 1977. Western was to supply two complete seismic crews and provide a training program in America for the Syrian engineers and technical personnel who would be associated with the project. Rather than Western's men operating the crews as is our standard procedure, the trained Syrian personnel would run the crews under the direction and supervision of the Westerners, and the training and learning experience would continue during the first 12 months of operations.

The Syrian technical personnel arrived in Houston on March 1, 1978, and the training period began, covering every phase of the seismic operation, from surveying through processing and interpretation, not to mention the extensive electronics courses. This was all handled from both a theoretical (classroom lectures) and practical point of view and varied from a disk school in San Diego to work with a Western crew in west Texas. The training program was completed on September 1, 1978, at which time the Syrian personnel departed for home with their supervisor, Samir Moura.

At about the same time, the Western group was being brought together from various countries to Syria under the direction of Resident Manager John M. Ivanitz. Drill crew Party Manager A. J. (Tony) Edwards had a foreshortened honeymoon in Spain with wife Leyla after their marriage in England on September 19, 1978, before traveling to Damascus and Aleppo to join the other Westerners.

The equipment arrived in the port of Tartous, Syria, on June 26, 1978, and was trucked to a five acre site about 30 kilometers from Aleppo, where it was all stacked. The first acts were to separate and assemble two working seismic crews (one "Vibroseis" and one explosive) and to establish an operational warehouse from the assorted pile of boxes, cases, trailers, and trucks packed in the yard. Trailers had to be unpacked and an

Figure 6: Syrian Chief Observer Mouhamed Fourani (left) and Western Party Manager Tony Edwards (right) are on line in the doghouse instrument room.

Doodlebugger continued on page 57

Doodlebugger continued from page 56.

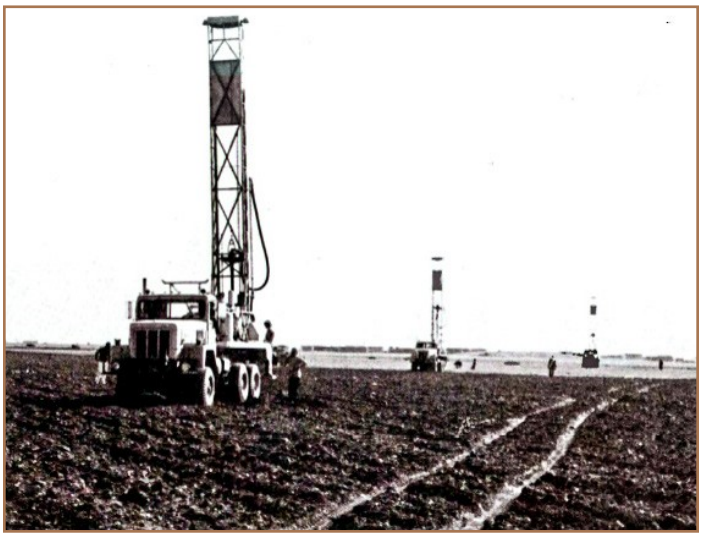


Figure 7: The drills work on down the line on the Syrian prospect.

inventory made, equipment had to be installed and checked, and the trucks, drills, and vibrators had to be serviced. This commenced on September 13, 1978, when both crews were provisionally set up at Tai Hajar under the direction of their respective party managers. This also gave Western Party Managers Tony Edwards and Steve Moorley the opportunity to meet their SPC counterparts, Party Managers Osman Khalid and Yousef Marie, and work out ideas for a suitable camp layout and the necessary provisions to accommodate the rest of the Western and SPC personnel. Communications Engineer W. M. (Bill) Quinlan, from London, was on hand and did a great job of installing all of the communications equipment for the entire operation. Checking and servicing the trucks and equipment and preparing them for the initial camp move were two very busy Western mechanics, Marvin Kalina on the drill crew and Eric Harris on the Vibroseis crew. Checking out the COBA I and COBA II electronics, as well as the peripherals for both systems, wiring up the camps' generating sets, and helping to supervise the overall start-up procedures were Western Instrument Supervisor C. E. (Chuck) Boyer and his SPC counterpart, Electrical-Electronic Engineer Jamil Bashour.

After a few last moment delays with the radio licenses, the two crews finally departed from the

Figure 8: Running a final check on a vibrator before production begins are Syrian Vibrator Mechanic Kamel Jarkas (from the left) and Vibrator Operator Jabber Hussain, Western Party Manager Chris Baker and Instrument Supervisor Chuck Boyer, Syrian Vibrator Operator Mohammed Akap, Western Observer Karl Grech, and two unidentified helpers.

Aleppo area on October 7, 1978, heading for their respective prospects. In the meantime unpacking, cataloging, and storing of all of the various materials that make up a year's supply of spare parts for two seismic crews began in Aleppo.

Figure 9: Syrian Drillers Ninos Babajim (center) and Assad Kasam (right) are "training" the crew's party managers, Westerner Tony Edwards (left} and Syrian Osman Khaled, in the precise art of drilling.

Doodlebugger continued on page 58

Doodlebugger continued from page 57.

Figure 10: Counting the geophones at a Syrian prospect are Driver Adnan Buttal (from the left), Helper Ali, and Party Manager Yousef Marie.

While this office work was in progress, the two crews were nearing their destinations in the northeastern region of Syria. Having less distance to travel than the vibrator crew, the drill crew reached its camp site first. Western Surveyor Dave Briggs, and his SPC counterparts, Ibrahim Salemeh and Kalif El Ahmad, soon had a test area marked out and were able to start locating landmarks in an irrigated region literally covered with cotton fields and numerous small village.

Back in Damascus after both crews had completed their startups, John Ivanitz, with his secretary, Sahar Issac, began organizing the Damascus office, which was the necessary liaison between Western and SPC's administration and geophysical departments. Equally important for the Western personnel was John's contact with a local travel agency that enabled all concerned to travel home during breaks without the often frustrating delays. The Western personnel have made good use of Syria's central geographical position to visit places all over Europe and the Near East. Some persons have spent their breaks in Syria immersing themselves in the local history and traditions.

Because of the supervisory nature of their work, the Westerners have had much time

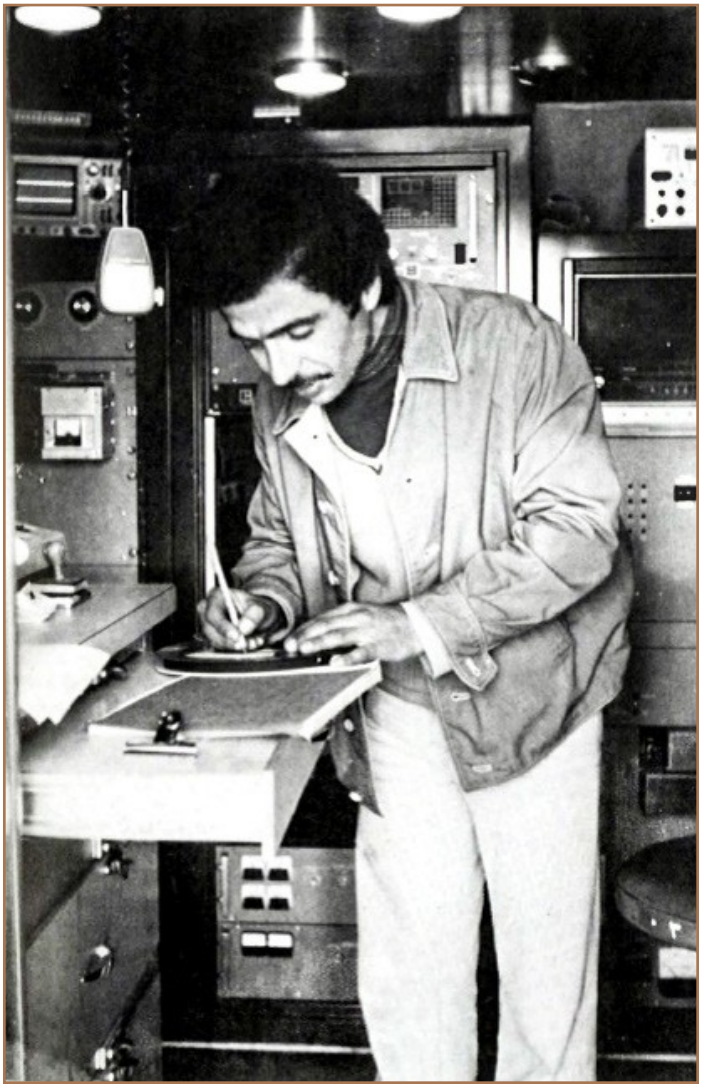


Figure 11: Logging in the observers' reports while working at the prospect during the Syrian operation is Syrian Observer Najib Al-Khouri.

to establish "post graduate" courses for the Syrians and in so doing have initiated their counterparts into the mysteries and skills of such arts as shelf building, trailer painting, and domestic wiring. Chris Baker, while on the drill crew and later on the Vibroseis crew, has introduced the game of darts, and this essentially English game is now played by many nationalities. There are high hopes that dart boards will soon become standard equipment on all Western crews.

While the crews were working toward a full production basis, so was the Aleppo office, despite the semiarctic conditions that persisted

Doodlebugger continued on page 59

Doodlebugger continued from page 58.

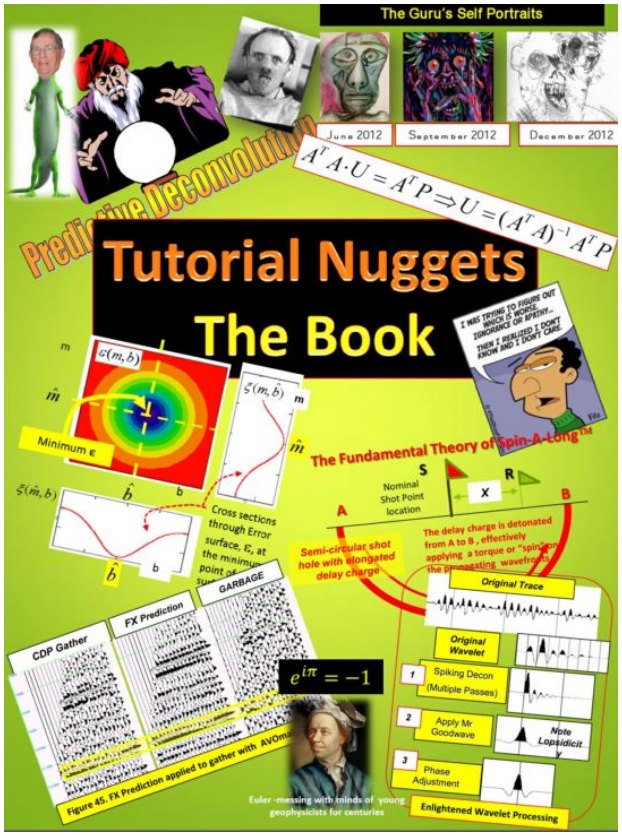
Figure 12: Ready to check out vibrators on the line during Syrian operations are expansively gesturing Chief Observer Richard Graves (from left), Party Manager Chris Baker, and Vibrator Mechanic Mahmoud El Menyawi.

until the central heating installation was finally operational. An engineering technical section was established to cope with the ever-increasing work load with regard to nearly all aspects of the operation. This section was organized and set up under the direction of Chuck Boyer and Jamil Bashour, with the assistance of Syrian Instrument Technician Akoub Kouloumayan, who now supervises the warehouse operation and the parts orders.

During the first six months of operation the crews have traveled extensively throughout northern Syria, and in some cases camps have been very close to ancient archeological ruins. Rasafa, which is a Christian Roman city built about 310 A.D. and is very well preserved, was only 5 kilometers from the drill crew's camp. In the center of Aleppo stands the Citadel, one of the best examples of medieval military architecture surviving to this time. It first appears in recorded history at the beginning of the third millennium under the name of "Khalpu"-present-day Hallep or Aleppo. Ancient ruins are to be found everywhere. Working in such historical surroundings has been a fascinating experience for all of the Western personnel.

Figure 13: Westerners visited the Citadel in Aleppo during their break time. (Ed note: Good thing they did because this structure received considerable damage in the Battle of Aleppo during the Syrian civil war, especially after it became a base for the Syrian army. However, it was reopened to the public in 2017 as repairs were steadily being made to the structure).

Due to the nature of our contract the number of Westerners is being slowly reduced over the year's term. By the end of September 1979, when the last Western personnel are due to leave, we hope to leave behind two fully operational seismic crews. We would like to take this opportunity in wishing the SPC men the best in all of their endeavors. □



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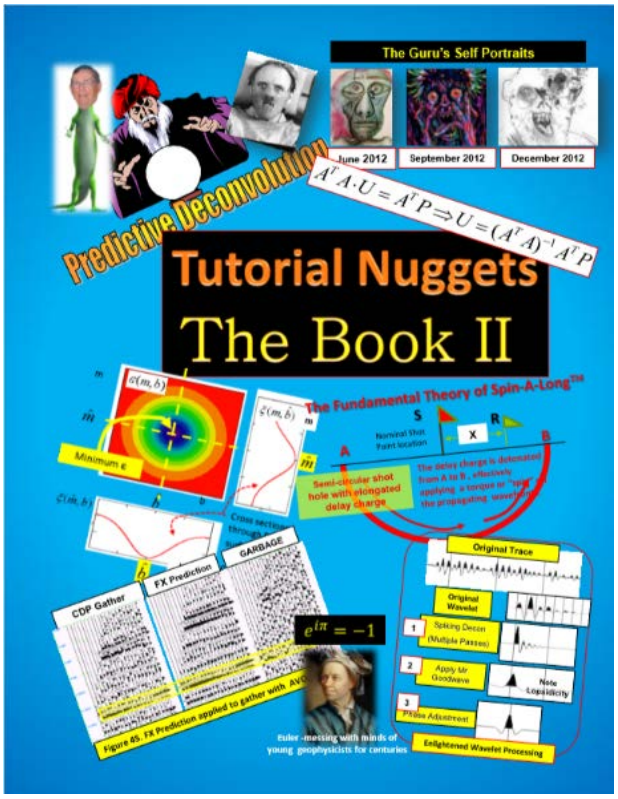

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