March 2017

GSH Journal

GEOPHYSICAL SOCIETY OF HOUSTON
Volume 7 • Number 7

The Epicenter of Geophysical Excellence

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On The Cover...

Seismic acquisition workboat returning to main vessel after in-water equipment maintenance.

Photo courtesy of CGG.

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 David W. Watts, editor, at DWatts1@slb.com.

2016 GSH JOURNAL DEADLINES

May 2017 ..... **Mar 3**
June 2017 ..... **Apr 7**
Sept 2017 ..... **Jul 7**

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A Word from the Board

Challenges and Opportunities in a Low-oil-price Environment

By Xianhuai Zhu, 1st Vice President Elect

While some of you may not recall the details, I was named 1st Vice President Elect of GSH, in September 2016, after Dr. Lee Bell was elected Treasurer of the SEG. Before I accepted the position, Lee explained that my first-year's focus would be concentrated on getting trained and working closely with Lisa Buckner, the 1st Vice President, in order to get familiar with the functioning of the Office.

It has been a great pleasure working with Lisa and I have learned a lot from her, including how to order food for the technical breakfasts and how to invite speakers! I quickly learned that the responsibilities of the 1st VP Elect are not quite as straightforward as one might imagine, and found that this role presents some challenges and opportunities; just like the oil industry always seems to do.

Our industry continues to suffer from low oil prices. At least 90 oil and natural gas companies with more than $60 billion in debt have filed for bankruptcy in 2015-2016, per the Haynes and Boone Bankruptcy Monitor. The oilfield service sector has also been feeling the squeeze of lower prices, with at least 80 service companies declaring bankruptcy with a total debt default of $13.5 billion. More than 350,000 jobs were cut by oil and gas production companies worldwide by May 2016, with the oilfield services sector bearing much of this burden.

Even though the oil price is slightly above $50 as the date of writing this article, it will probably not reach $60 until the 2nd half of 2017. This is because, to a significant degree these days, the price is controlled by the shale oil and gas. Once the price rises above $55 or higher, more rigs move in and produce more oil. Consequently, oil prices go down due to the increased production. Another reason that the price will not move up as quickly as we might like is that historically there has been a delay between oil price increases and the spending of operators and service companies. Maurice Nessim, President of WesternGeco, pointed out at the SEG board meeting in October 2016 that the lag is usually about one year for oil companies and two years for service companies.

While this is indeed challenging, opportunities are also being created. Many startup companies have come into existence during the downturn, including both operating and service companies. In many cases, their vision was that in 2-3 years the oil price would rise beyond $60. At that point, they would have developed their own niche technologies and built good relationships with clients through their cost-effective and good-quality services. I believe that this is a good analysis; in fact, to the point of being one of those entrepreneurs, myself. Supported by venture capital, after having worked for ConocoPhillips for 9 years, I founded a new service company, Forland Geophysical Services (FGS), in early 2016. As the name suggests, we focus on land, providing advanced technologies for imaging through complex near-surface structures in conventional and unconventional resource plays, such as in Permian Basin where statics, multiples and noise associated with surface waves, scattering and guided waves are problematic. One day, I received an email from Mike Graul who is one of my best friends in Houston. He wrote: "Zhu, I was delighted to hear of your daring enterprise in these dark hours of the industry. You are to be commended for bravery under fire. I have a feeling it will prove to be a stroke of genius". Thanks to Mike for his encouragement!

While facing many of the same challenges that all other service companies do, we are nevertheless optimistic about the future and have found that many doors open when one seeks to take control of one's destiny. I hope that other GSH Members with ideas they have nurtured for a long time will also consider seeking investors and bringing their own ideas to fruition.

One of the excellent opportunities GSH Members have is the ability to attend Technical Breakfasts, Technical Luncheons, Special Interest Group (SIG) meetings, and the Spring Symposium. This year we will be honoring David Monk and Malcolm Lansley on April 12 & 13 at the Norris Conference Center during the Spring Symposium. The working title for this year's theme is "Geophysical Acquisition: Advanced techniques revealing challenging targets". As a geophysicist with more than 30 years of industry experience and starting my career from a seismic field crew to data processing and interpretation, I have learned that seismic data acquisition is number one in overall importance. This will be a must not miss event for knowledge sharing and networking!

When not "learning from Lisa", I also serve on the SEG Board as a Director-at-Large and will continue in that role until the SEG annual meeting in Houston in September. In April of this year, I will represent the SEG, and will work with Mr. Shouli Qu from SINOPEC and Mr. Bangliu Zhao from CNPC, to co-organize a "Foothill Exploration Forum" to be held in Nanjing, China. This forum will discuss the challenges and opportunities of geophysical exploration in foothill regions from around the world. I believe that this Forum will provide opportunities for certain individuals and if you are interested in being a contributor, please feel free to contact me.

We appreciate our Corporate Members

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For more information about becoming a Corporate Member, please contact the GSH office at 281-741-1624, or office@gshtx.org.

A Live Webinar

Carbonate Essentials

Christopher L. Liner, PhD

Former SEG President
Storm Endowed Chair of Petroleum Geology
University of Arkansas

April 25 & 26, 2017

8:30 am - 11:30 pm Central Time (USA)

This course is an overview of carbonates from geology to seismic interpretation, with particular emphasis on karst topography and seismic expression thereof. To illustrate key concepts, field sites and case histories are presented from global locations.

Sponsors

SEG SOCIETY OF EXPLORATION GEOPHYSICISTS

Register now at: gshtx.org and seg.org
Major discounts available for groups and students
All sessions are available on-demand to attendees.

Technical Events - See gshtx.org for more details on these events

TECH BREAKFASTS

Migration Velocity Analysis and Waveform Inversion with Subsurface Offset Extension

	Speaker(s):	Lei Fu, Forland Geophysical Services
Mar. 1, 2017	***7:00 AM to 8:30 AM***	Sponsored by Anadarko Petroleum and Lumina Reservoir Inc.
Northside Breakfast	**Location:**	Anadarko Petroleum 1201 Lake Robbins Drive The Woodlands, TX 77380
Mar. 22, 2017	***7:00 AM to 8:30 AM***	Sponsored by Schlumberger and WesternGeco
Westside Breakfast	**Location:**	Schlumberger, Q-Auditorium 10001 Richmond Avenue Houston, TX 77042

DATA PROCESSING & ACQUISITION SIG

Sparse Radon Transform in Extended Domain

Mar. 7, 2017	**Speaker(s):**	Madhav Vyas, BP
	4:30 PM to 6:00 PM	Sponsored by Schlumberger
	Location:	Schlumberger, Q-Auditorium 10001 Richmond Avenue Houston, TX 77042

GEOSCIENCE COMPUTING SIG

Right Sizing HPC Resources for Local and Cloud Resources

Mar. 9, 2017	**Speaker(s):**	Michael Senizaiz, R Systems NA, Inc.
	11:30 AM - 1:30 PM	Sponsored by The Society of HPC Professionals and UDI
	Location:	Unique Digital Inc. Banquet Room 10595 Westoffice Dr. Houston, TX 77042

TECH LUNCHEONS

Why We Should Perform PSDM and Calculate Seismic Attributes in the Depth Domain, Examples from the Woodford Formation

	Speaker(s):	Marianne Rausch-Davies, Devon Energy
Mar. 21, 2017	***11:00 AM to 1:00 PM***	**LIVE SPEAKER**
Westside Luncheon	**Location:**	Norris Conference Center 816 Town & Country Blvd. Houston, TX 77024 (Free parking off Beltway-8 northbound feeder or Town & Country Blvd.)
Mar. 21, 2017	***11:00 AM to 1:00 PM***	**LIVE WEBCAST** Sponsored by Hess Corporation
Downtown Luncheon	Location change this month only **Location:**	Hess Tower 1501 McKinney St. Houston, TX 77010 (Free parking passes for pre-registered attendees only; UH & Rice students are encouraged to use Metro Rail)
Mar. 21, 2017	***11:00 AM to 1:0 0 PM***	**LIVE WEBCAST** Sponsored by Southwestern Energy
Northside Luncheon	**Location:**	Southwestern Energy Conference Center 10000 Energy Drive Spring, TX 77389 (Free Parking onsite)

POTENTIAL FIELDS SIG

Use of CSEM in Exploration: Case Examples Illustrating the Integration of CSEM with Seismic Observations in Various Geological Settings with the Aim of Increasing Exploration Success

Mar. 23, 2017	**Speaker(s):**	Valente Ricoy, EMGS
	5:30 PM to 8:30 PM	
	Location:	HESS Club (Houston Engr. & Science Society) 5430 Westheimer Houston, TX 77056

Technical Breakfasts

Migration Velocity Analysis and Waveform Inversion with Subsurface Offset Extension

Register for Tech Breakfast Northside

Register for Tech Breakfast Westside

Lei Fu

Speaker(s): Lei Fu, Forland Geophysical Services

Northside

Tuesday, March 1, 2017
7:00 – 8:30 a.m.

Sponsored by Anadarko Petroleum and Lumina Reservoir Inc.

Location: Anadarko Petroleum
1201 Lake Robbins Drive
The Woodlands, TX 77380

Westside

Wednesday, March 22, 2017
7:00 – 8:30 a.m.

Sponsored by Schlumberger and WesternGeco

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

Abstract:
Image-domain seismic inversion with subsurface offset extension may converge to kinematically accurate velocity models without the low-frequency data accuracy required for standard data-domain full waveform inversion. However, this robust alternative approach to waveform inversion suffers from very high computational cost, resulting from its use of nonlocal wave physics: the computation of strain from stress involves an integral over the subsurface offset axis, which must be performed at every space-time grid point. Additionally, under prototypical conditions of acquisition geometry, the existence of artefacts is very likely to deviate the velocity update from its path to the correct velocity. I show here three new approaches that significantly improve both efficiency and robustness of subsurface offset extended waveform inversion and migration velocity analysis (MVA). The global convergence property of the extended waveform inversion is achieved by adaptively determining the penalty weight. It is also shown that a combination of data-fit driven offset limits, grid coarsening, and low-pass data filtering can reduce the cost of extended inversion by one to two orders of magnitude. Lastly, a taper in angle domain depending on acquisition geometry and imaging point is introduced. The application of taper directly on extended image makes migration velocity analysis becomes more robust. I illustrate these new methods in the context of constant density acoustic waveform inversion, by recovering background model and perturbation fitting band-limited waveform data in the Born approximation.

Biography:
Lei Fu is Project Lead of Development & Imaging at Forland Geophysical Services. Lei studied seismic imaging and waveform inversion at Rice University (Ph.D., 2016), under the supervision of Prof. William Symes. He received his M.Sc. from University of Utah, where he developed a keen interest in geoscience. In addition to his expertise in exploration seismology, Lei has broad interests in geology, High-performance computing, machine learning, etc. In his free time, Lei enjoys hiking and road trips with his family.

Data Processing & Acquisition SIG

Sparse Radon Transform in Extended Domain

Register for Data Processing

Speaker(s): Madhav Vyas, BP

Author(s): Madhav Vyas
John Etgen
Qingqing Liao

Tuesday, March 7, 2017
4:30 p.m. Sign-in, Snacks, Social Time
5:00 p.m. Start of presentation

Abstract: The problem of signal and noise separation has been worked on for the last few decades and it still continues to remain very relevant. One way to distinguish signal from noise is on the basis of curvature. Radon transforms enable us to do that by mapping the input data as a function of moveout. In order for the process of signal and noise separation to be effective, we require high resolution in the Radon domain. Although we have access to methods that can increase the resolution by imposing sparsity constraints, these methods seldom preserve the amplitude nuances present in real data. In this abstract, we propose an algorithm that can deliver sparse high resolution Radon domain representation without compromising the amplitude information. We also share a field data example to demonstrate the effectiveness of the process.

Sponsored by Schlumberger

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

Madhav Vyas

Biography: Madhav Vyas received his BS (2003) and MS (2005) degree in Exploration Geophysics from Indian Institute of Technology, Kharagpur, INDIA. He then pursued an MS degree (2007) from Stanford University. During his stay at Stanford, he was advised by Biondo Biondi and was part of the Stanford Exploration Project (SEP). Madhav then worked as a Research Scientist with WesternGeco, Schlumberger from 2007 to 2011. Since 2011, he is employed with BP as a Research Geophysicist in the Complex Imaging team. He has worked on different topics including multiple elimination, wave-equation tomography, wave-equation based angle gathers, optimized stacking and signal enhancement. His research interests include signal processing algorithms, inversion, imaging codes and velocity model building.

Geoscience Computing SIG

Right Sizing HPC Resources for Local and Cloud Resources

Register for Geoscience Computing

Speaker(s): Michael Senizaiz,
R Systems NA, Inc.

Thursday, March 9, 2017
11:30 a.m. - 1:30 p.m.

Sponsored by The Society of HPC Professionals and UDI

Location: Unique Digital Inc.
Banquet Room
10595 Westoffice Dr.
Houston, TX 77042
www.google.com/maps

Abstract: Historically Moore's Law has helped the application performance and the HPC industry in broad strokes, but this has changed over the past decade to include a dizzying amount of CPU, Network, and Storage choices that make architecting any sized systems difficult at best.

Understanding your applications need in both the small and the large scale help significantly when selecting next generation platforms, or sometimes last generation platforms when it makes better sense. Fastest wall time? Number of concurrent jobs? Power consumption? What is most important to you? We'll go over testing methods and benchmarks with ISV and Open Source software that help ensure the best computing for your buck.

Biography: Michael Senizaiz is the Chief Technology Officer at R Systems NA, Inc., where he is responsible for technology roadmaps, HPC systems architecture, and right- sizing client needs with available HPC resources. He has almost 20 years' experience in IT with the last nine years focused on HPC support, consulting, and systems architecture.

Technical Luncheons

Register for Tech Lunch Westside | Register for Tech Lunch Downtown | Register for Tech Lunch Northside

Why We Should Perform PSDM and Calculate Seismic Attributes in the Depth Domain, Examples from the Woodford Formation

Speaker(s): Marianne Rausch-Davies, Devon Energy

Marianne Rausch-Davies

Westside - **LIVE SPEAKER**

Tuesday, March 21, 2017
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 - **LIVE WEBCAST**

Sponsored by Hess Corporation

Tuesday, March 21, 2017
11:00 a.m. – 1:00 p.m.

Location change this month only

Location: Hess Tower
1501 McKinney St.
Houston, TX 77010
(Free parking passes for pre-registered attendees only; UH & Rice students are encouraged to use Metro Rail)

Northside - **LIVE WEBCAST**

Sponsored by Southwestern Energy

Tuesday, March 21, 2017
11:00 a.m. – 1:00 p.m.

Location: Southwestern Energy Conference Center
10000 Energy Drive
Spring, TX 77389
(Free Parking onsite)

Abstract: We are commonly challenged to generate a drill plan in depth from time migrated seismic. In order to meet the needs of interpreters and drillers, PSTM volumes are frequently converted to pseudo depth volumes by stretching. This process affects every part of the drill planning procedure as these pseudo-depth data are input into earth modeling packages and used to design lateral well paths. Our study shows that even using a sophisticated velocity model, the drilling interval does not have the correct thickness and/or interlayer structuring on a depth-stretched dataset; making it difficult to achieve the primary geologic goal of staying in zone.

We examine the difference between time to depth stretch and anisotropic PSDM on a 3D dataset. The selected 60 mi2 3D seismic survey is located in the Anadarko Basin, Oklahoma, with the main target being the Woodford formation that varies in thickness from 100ft to 400ft but the actual drilling window is around 30ft. The seismic velocity within the Woodford is much slower than in the overburden (13,000ft/s and 16,000ft/s respectively). Because it violates the Dix equation, this large velocity contrast cannot be corrected through a time processing sequence and the apparent layer thickness is too large. On the PSDM data, a geologically meaningful velocity model incorporating anisotropy, produces a more accurate thickness estimation and better reflects the inter-formation geology. A comparison between the anisotropic PSDM and the depth-stretched data along a lateral well path demonstrates why drilling on depth-stretched data results in inconsistencies between the predicted and encountered geology.

The detailed anisotropic, amplitude preserved PSDM dataset was used to investigate the possibility to perform impedance inversion in the depth domain. The main challenge is the complexity of the depth wavelet but by focusing on the target interval, a balanced result is achieved.

The inversion test consists of 3 phases; first, the anisotropic PSTM stack is inverted using log data of 3 wells. This was done to produce a base result with a well understood technology. Next, the amplitude preserved PSDM stack is inverted. Lastly, the PSDM stack is stretched to time using the final PSDM velocities, inverted to impedance and the results are stretched back to depth, using the same velocity field. All 3 results are compared to each other and analyzed for accuracy and resolution. The products reveal that the depth inversion is not affected by any artifacts and actually has a higher resolution compared to the other two inversions as the PSDM input data has a longer frequency bandwidth.

Last but not least let's look at azimuthal velocity attributes that are being used to map fractured intervals

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Technical Luncheons continued from page 10.

within the shale reservoir units. Wide-azimuth 3D seismic data are suitable for anisotropic/azimuthal processing in both, the time and depth domain. Adjusting for the vertical and horizontal transverse isotropy (VTI and HTI) during the pre-stack time/depth migration improves the final image. By-products of this process are azimuthal velocity attributes, which in theory could be used to predict inhomogeneous areas within the target interval. As this is becoming increasingly common, we wanted to investigate the repeatability and actual usefulness of these attributes. We designed a study that awarded the same project to 4 individual seismic processing companies and compared and analyzed the results in the time domain. Following this study, a similar analysis in the depth domain was performed.

Our findings show that the migrated seismic image clearly benefits from HTI corrections if a sinusoidal behavior is present in the COCA gathers. However, the resulting velocity attributes are of varying quality and only conform to the geological attributes when those are filtered back to represent larger scale features. This made the attributes less useful for mapping smaller scale discontinuities such as localized fracture corridors/swarms within the Woodford interval. When interpreting the azimuthal velocities in depth, the velocity difference between Vfast and Vslow became insignificant which confirmed our previous learnings.

In conclusion, we believe that it is more accurate to perform PSDM processing instead of stretching the time migrated data to depth. Our post and pre-stack inversion tests indicate that it is doable to perform inversions in the depth domain, which again, eliminates stretching the data. When investigating the usefulness of azimuthal velocities we conclude that they can help sharpening the image but azimuthal velocity variations are most likely related to geological changes and not to fracturing. When this analysis is performed in depth, most of the azimuthal velocity differences become so small that they are considered to fall within the noise.

Biography: Marianne received a Ph.D. in theoretical physics from the Karl Franzens Universitaet in Austria in 1985. Since then, she has performed a large number of geoscience/multi-physics studies worldwide in on-shore and off-shore settings. Her main area of interest is developing and applying new technologies and promoting techniques that will increase the exploration success rate. End of 2014, she joined Devon Energy as a Geophysical Advisor and her latest passion is depth imaging and performing seismic attributes in depth to avoid the pitfalls of time-to-depth stretch. Marianne is a seasoned presenter at national and international conventions and has published a good number of articles on a wide range of geoscience subjects.

Potential Fields SIG

Use of CSEM in Exploration: Case Examples Illustrating the Integration of CSEM with Seismic Observations in Various Geological Settings with the Aim of Increasing Exploration Success

Register
for Potential Fields

Valente Ricoy

Speaker(s): Valente Ricoy, EMGS

Thursday, March 23, 2017
5:30 Registration / Cash Bar
6:30 Dinner Served
7:30 Presentation Begins
8:30 Adjourn

Location: HESS Club
(Houston Engr. & Science Society)
5430 Westheimer
Houston, TX 77056

Abstract: The use of Controlled Source Electromagnetics (CSEM) surveys has evolved significantly over the last decade. The progression has advanced from two-dimensional workflows to three-dimensional integrated studies. CSEM methodologies for acquisition and processing began as attribute analysis of anomalies on 2D profiles and progressed to fully integrated 3D processing, multi-azimuth CSEM inversions, and integration with seismic interpretation workflows.

After conducting nearly 800 surveys in different geologic settings around the world, in many of the most important offshore basins (Mexico, Canada, Brazil, and others), Electromagnetic Geoservice companies (EMGS) have gained significant experience which has enabled us to enhance the understanding of geological processes using results from both seismic data and CSEM resistivity derived. This understanding has enabled EMGS to carry out risk assessments, resulting in technical and economic successes, as well as to develop workflows that help E&P operators determine when EM data will benefit their exploration efforts and how to extract exploration information from the integration of seismic and CSEM.

EMGS will present key case examples of deep water turbidite geological settings with strong stratigraphic trapping mechanisms and those with structural trapping mechanisms. The presentation will also illustrate how CSEM has helped exploration success in rotated fault blocks settings, improved understanding of fluid type distributions, and through observations derived from seismic and resistivity, enhanced understanding of seal character to differentiate exploration areas of high vs. low risk in seal capacity.

The aim is to demonstrate how through the integration of CSEM with seismic and geological information, exploration understanding can be enhanced, while into consideration that CSEM and seismic are complementary and independent earth measurements whose results should converge to a common geological model. By carrying out a successful integration of data the chances of exploration success are significantly achieved.

Biography: Valente Ricoy – Valente is a 3D seismic and CSEM interpretation expert and has led integrated interpretation projects for play evaluation and prospect maturation in the deep water Mexico basins since 2011. He holds a PhD (2005) in structural geology and basin analysis from Cardiff University, UK, and a BSc (1996) in geology from the University of Texas San Antonio, USA. He joined EMGS in Mexico as Exploration Advisor in 2012 providing interpretation services to Pemex for their deep water exploration program. Prior to joining EMGS, Valente held various senior technical positions in the field of 3D seismic interpretation and geology at Envision and Statoil, Norway, and the Mexican Institute of Petroleum, Mexico. He has broad geographic experience in diverse petroleum systems including faulted rift basins, salt tectonics, carbonates, and deep water settings.

Price List:		
	Pre-Registered	Late/Walk-Up
Member	$30	$40
Non-Member	$35	$45
Student Member	$15	$25

Geoscientists Without Jobs: A Guide to Surviving the Downturn

Part Seven: Résumé-Reading Robots and Other Dystopian Job Search Nightmares

By Paul E. Murray (paulm@fipgeophysical.com)

Job searching is difficult under the best circumstances. After a few weeks navigating job search sites, one begins to spot the usual traps and pitfalls. A job listing for a major oil company that sounds too good to be true usually is. When you notice the address for correspondence is not the same as that on their website, you call their HR department to confirm the job listing is not legitimate. If you're inclined to follow this version of the Nigerian email scam down the rabbit hole for a diversion, you will discover someone wanting you to pay an "application fee", a "recruiting fee" or other such nonsense. Or perhaps you find a great job listing in an out-of-the-way business journal and not the customary job sites. When you reach out to your colleagues at that company, you find the job listing is a formality for a visa application for some favored employee from another office outside the US. Such minor tragedies are de rigueur for a geoscientist without a job in 2017.

When you're unemployed and the job search is one of necessity, the stakes are higher and your stress levels go up; your frustration increases, and sometimes your mental firewalls come down, so your ability to maintain civil discourse all but disappears. When this happens, it's best to find a useful way to channel that energy. If you're reading this, then you're a willing participant in one of my outlets. I can't afford a therapist on my income, so in today's installment of Geoscientists without Jobs, I explore my corollary to the famous equation, "comedy equals tragedy plus time", which asserts that comedy also equals tragedy plus someone else's perspective, and you can judge for yourself.

As evidence, I offer the most pernicious and vexing aspect of the modern job search: the applicant tracking system (ATS). Far from the sophisticated AIs of the kind envisioned in Ex Machina, the ATSs behave as though designed by the same minds of the Sirius Cybernetics Corporation that brought us clinically depressed androids. After dozens of encounters with ATS systems, I can unequivocally state that Skynet, even with its murderous penchant for genocide, has a better user experience than the average ATS.

I do admit I understand how the niche for ATS has arisen. In one anecdote from the downturn, more than 600 people applied for a single open position at an oil company in Calgary. I have compassion for anyone (still) working in an HR department at an oil company tasked with wading through that many applications, so the desire to automate the process of culling out a manageable list of top candidates is understandable. Thus, at the dawn of the 21st century, we now have the first iterations of human resource AIs.

ATS software systems are nominally designed to scan your résumé using the same type of algorithms as web search engines to help employers identify the best candidates for jobs. I wonder why, though, after uploading a résumé into each one of these systems, I am then required to spend the next two hours entering by hand every detail of said résumé, my work history, references and complete educational records.

Every time. Without exception.

ATS software systems are nominally designed to scan your résumé using the same type of algorithms as web search engines to help employers identify the best candidates for jobs.

I know that in 2017, many white-collar professionals fear losing their jobs to artificial intelligence. If my encounters with AI on the job search are any indication of the current state of the art, you have little to fear, but you will need blood pressure medication if you ever plan to change jobs.

If you find that troubling and you haven't had to look for a job recently, it gets worse. In the past, you may have tailored your résumé for a specific job or employer. In addition to those you created for humans to read, you now also need to maintain separate set of "machine-readable" versions for the corresponding ATS. Most

Geoscientists Without Jobs continued on page 15.

Geoscientists Without Jobs continued from page 14.

ATSs cannot comprehend lofty word processor formatting commands, so they are quite likely to render a painstakingly-crafted CV into an unintelligible word salad and rank you at the bottom of the pile because of their lack of intelligence, not yours. If you are incredulous and doubt me, just type, "formatting résumés for ats" into Google, sit back, and spend the next few minutes trying to wrap your mind around the cognitive dissonance of deliberately creating a résumé that looks like you typed it on an IBM Selectric circa 1978.

Of course, it comes as no surprise that searching for a job in a downturn is going to be an uphill battle. I didn't realize that I'd have to fight the machines as well as other applicants just to get my application seen by a hiring manager. One even wonders who is responsible for analyzing the output of an ATS. I surmise it would be someone in HR, but every time I slog my way through another digital job application, I hear the song "Brazil" in my head, and I can't help but wonder if it's being routed to the Ministry of Information instead. In either event, I just imagine that I am a man alone and I came into the game for the action, the excitement, and hope I don't wind up humming that tune to myself in a straight jacket.

How Things Have Changed: GSH Elections – 1969 to 2017

By David W. Watts

As a new concept within our GSH Journal publication, I wanted to start to access and research the historical material at our Geoscience Center which is open to the public on Wednesdays from about 8am until noon. The Geoscience Center is well documented in Bill Gafford' s monthly article on the center itself as well as the monthly 'Mystery Item'. In thinking of new material to begin hosting within the Journal, I visited the center and was researching their library, and literally, the second document that I picked up was the GSH Newsletter from 1969 that contained the Board of Director elections from for the term of 1969-1970. Since this March journal edition has our 2017-2018 BoD election material, I wanted to showcase this new article on how things have changed over the years by showing how the BoD elections have changed since 1969. It has been almost 50 years ago this month and this random, old newsletter was very pertinent as compared to this month's Journal which I equally describe as one of the most important editions of the year.

Niels Esperson building in Houston which housed GSH office in 1969

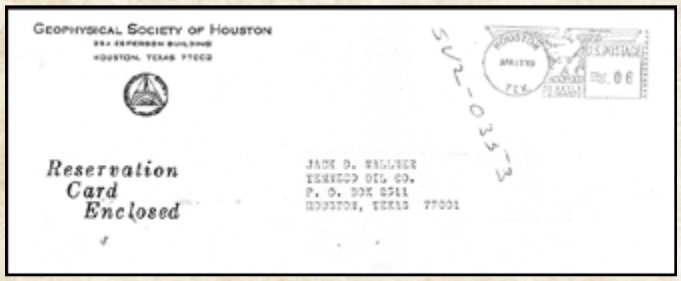
Back in 1969, the GSH was housed in the Esperson Building in downtown Houston which was completed in 1927 and named after the real estate and oil tycoon, Niels Esperson. Today, our GSH office is along the Energy Corridor off St. Mary's Lane in a modest office building that you would expect to see anywhere in Houston. Back in 1969, there were no personal computers, iPhones, or email. Everything was done by hand and the GSH Board of Director elections procedure was no different. In 1969, the GSH Newsletter, the predecessor to the GSH Journal was a bi-monthly publication and was maintained by a Mr. L.L. Hammial. He was the 'News-Letter' committee chairman. Other interesting committees that existed in 1969 were Awards, Continuing Education, Golf Tournament, Museum, Publicity, Radio Facilities, SEG Membership, and Student Chapters, amongst others. (While some are very different than today, others just keep on going.) The GSH mailed out the newsletter with all the pertinent information regarding the happenings of the GSH as well as some industry news and for the April 1969 newsletter, the BoD elections material.

Office building off Energy Corridor and Dairy Ashford housing our current GSH office

How Things Have Changed continued on page 17.

How Things Have Changed continued from page 16.

The following image was what Mr. Jack D. Wallner received in his mailbox in April of 1969. (Note the postage of 6 cents.) Upon opening, unfolding and within the newsletter, was the 'reservation card' in which the recipient would have checked their choices for President, 1st Vice President, 2nd Vice President, Secretary, and Treasurer. (Back then there was no Editor.) Unfortunately, that 'reservation card' was not available to showcase.


GEOPHYSICAL SOCIETY OF HOUSTON

Reservation Card Enclosed

JACK D. WALLNER
TENNECO OIL CO.
P. O. BOX 2511
HOUSTON, TEXAS 77001

GSH Newsletter as delivered by US Postal Service in 1969


NOMINEES FOR THE COMING 1969 - 1970 OFFICERS

For President - - - - - - - - - - - - - - WILLIAM W. BUTLER, Getty Oil Company

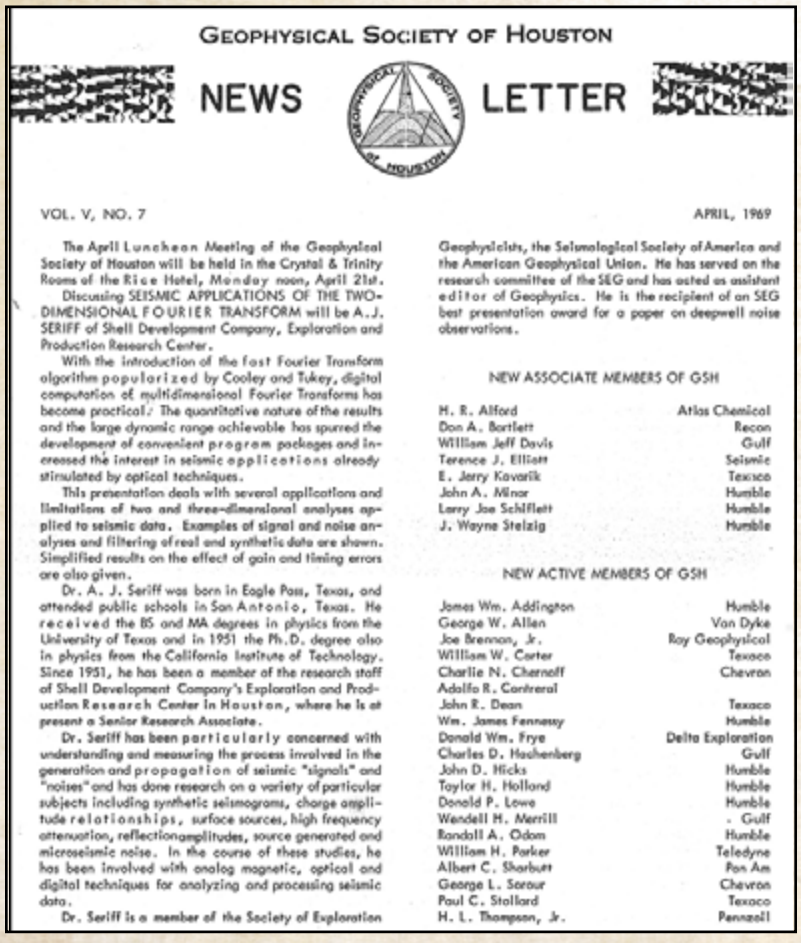
Member of Geophysical Society of Houston since 1947.
Member of Society of Exploration Geophysicists since 1937; awarded Life Membership in the Society in 1952 for the design of the official crest for the Society.
Graduated with honors, The University of Colorado, 1932, B. S. degree in electrical engineering and elected to membership in Tau Beta Pi, Sigma Tau, and Eta Kappa Nu.
Began geophysical work in 1934 with Geophysical Research Corporation; joined Barnsdall Oil Company in 1937, serving as assistant to chief geophysicist; from 1941 to 1944 was with Gulf Research and Development Company as a seismic interpreter at their Pittsburg Laboratory; employed by Superior Oil Company of California as party chief in 1944.
He began his present employment in 1945 in Houston with Tidewater Oil Company, which has now become Getty Oil Company. He was Division Geophysicist in Tidewater's Tulsa office from 1954 to 1959; served two years in the company's office in Calgary; returned to Houston in 1961 as Assistant Division Geophysicist. 1958-1959 - Secretary of the Geophysical Society of Tulsa; 1963-1964 - Second Vice President of Geophysical Society of Houston.

For President - - - - - - - - - - - - - - JACK D. WALLNER, Tenneco Oil Company

Jack D. Wallner graduated from the University of Texas in 1949 with B. S. in geology, with graduate work in geophysics. He was with General Geophysical Company, Sinclair Oil Company in Jackson, Mississippi, and Seaboard Oil Company in Dallas prior to joining Tenneco Oil Company in Lafayette in 1958; and in 1964 he was appointed Chief Geophysicist of Tenneco, the position Mr. Wallner now holds.
He has been a member of SEG for 20 years, during which time he has served two terms as district representative; as 1966 Houston SEG convention housing vice-chairman; 1966-67 SEG membership vice-chairman, and has been SEG membership chairman for the past two years, 1967-1969.
Also active in local SEG sections, Mr. Wallner was on the charter organization committee for the Jackson Society and served two terms as President of the Lafayette Section (one term shortened by transfer.) He has served the Geophysical Society of Houston as Membership Chairman 1965-1966, Secretary 1966-1967, and First Vice-President 1967-1968, [illegible] 1969-1970

Nominations for GSH President

In reading the newsletter, the recipient would see on page one the upcoming schedule for the April Luncheon Meeting in which Mr. A.J. Seriff from Shell Development Company would present a discussion on 'Seismic Applications of the Two-Dimensional Fourier Transform' as well as a list of new active and associate members.


GEOPHYSICAL SOCIETY OF HOUSTON

NEWS LETTER

VOL. V, NO. 7 APRIL, 1969

The April Luncheon Meeting of the Geophysical Society of Houston will be held in the Crystal & Trinity Rooms of the Rice Hotel, Monday noon, April 21st.
Discussing SEISMIC APPLICATIONS OF THE TWO-DIMENSIONAL FOURIER TRANSFORM will be A.J. SERIFF of Shell Development Company, Exploration and Production Research Center.
With the introduction of the fast Fourier Transform algorithm popularized by Cooley and Tukey, digital computation of multidimensional Fourier Transforms has become practical. The quantitative nature of the results and the large dynamic range achievable has spurred the development of convenient program packages and increased the interest in seismic applications already stimulated by optical techniques.
This presentation deals with several applications and limitations of two and three-dimensional analyses applied to seismic data. Examples of signal and noise analyses and filtering of real and synthetic data are shown. Simplified results on the effect of gain and timing errors are also given.
Dr. A. J. Seriff was born in Eagle Pass, Texas, and attended public schools in San Antonio, Texas. He received the BS and MA degrees in physics from the University of Texas and in 1951 the Ph.D. degree also in physics from the California Institute of Technology. Since 1951, he has been a member of the research staff of Shell Development Company's Exploration and Production Research Center in Houston, where he is at present a Senior Research Associate.
Dr. Seriff has been particularly concerned with understanding and measuring the process involved in the generation and propagation of seismic "signals" and "noises" and has done research on a variety of particular subjects including synthetic seismograms, charge amplitude relationships, surface sources, high frequency attenuation, reflection amplitudes, source generated and microseismic noise. In the course of these studies, he has been involved with analog magnetic, optical and digital techniques for analyzing and processing seismic data.
Dr. Seriff is a member of the Society of Exploration Geophysicists, the Seismological Society of America and the American Geophysical Union. He has served on the research committee of the SEG and has acted as assistant editor of Geophysics. He is the recipient of an SEG best presentation award for a paper on deepwell noise observations.

NEW ASSOCIATE MEMBERS OF GSH

H. R. Alford	Atlas Chemical
Don A. Bartlett	Recon
William Jeff Davis	Gulf
Terence J. Elliott	Seismic
E. Jerry Kovarik	Texaco
John A. Minor	Humble
Larry Joe Schiflett	Humble
J. Wayne Stelzig	Humble

NEW ACTIVE MEMBERS OF GSH

James Wm. Addington	Humble
George W. Allen	Van Dyke
Joe Brennan, Jr.	Ray Geophysical
William W. Carter	Texaco
Charlie N. Chernoff	Chevron
Adolfo R. Contreral	
John R. Dean	Texaco
Wm. James Fennessy	Humble
Donald Wm. Frye	Delta Exploration
Charles D. Hashenberg	Gulf
John D. Hicks	Humble
Taylor H. Holland	Humble
Donald P. Lowe	Humble
Wendell H. Merrill	Gulf
Randall A. Odom	Humble
William H. Parker	Teledyne
Albert C. Sharbutt	Pan Am
George L. Sarour	Chevron
Paul C. Stallard	Texaco
H. L. Thompson, Jr.	Pennzoil

First page of GSH Newsletter describing event for month.

Page two of the newsletter contained industry news related to personal and company particulars and page three began the images and biographies of those gentlemen running for GSH office. I have included the image for the two candidates for President of whom I can say that Jack D. Wallner was in fact elected for the years of 1969-1970.

The means of election is quite different today as is the Journal itself verses the newsletter. Back in 1969, everything was done manually by receiving the 'reservation cards' back in the mail and tabulating the votes. Today everything is electronic and you as a GSH member can just log on, click a few buttons and have your votes recorded. Nothing could be easier. Bill Gafford told me that in 1969 the GSH had about 6 events a year. Today, we have on average 10 events a month. In 1969, we had a 3 page newsletter which was mailed to members and today we have on average a 40 page electronic journal that is emailed to you. How things have changed.

Going back and doing this research has been a very enjoyable and I plan on continuing this as a regular article in the Journal. If you have any ideas for research or material which may help me out, please contact me at editor@gshtx.org or dwatts1@slb.com.

MEET THE CANDIDATES

A Note From the President

Dear Fellow GSH Members,

An important responsibility of each GSH President is the selection and introduction of candidates for election to the Board of Directors. Beginning in December, a Nominations Committee starts working to identify and attract individuals who are interested in serving the Society and who possess the skills and attributes that will assist the Society in achieving its strategic plan and business objectives.

It is my pleasure to introduce the candidates for the 2017-2018 term. Each candidate offers a unique set of backgrounds, experiences and skills. Take a few minutes to read their biographies. When you see them at various functions throughout the year, thank them for their willingness to serve the GSH.

Please note that our bylaws allow GSH active members to submit write-in candidates for any office. Check the bylaws for specific guidelines.

Klaas Koster

(Oxy)

GSH Candidate for President-Elect 2017-2018

Klaas Koster currently holding position of the Chief Geophysicist for Oxy. He started his career in 1989 at Amoco's research center in Tulsa as acquisition and processing geophysicist after graduating with a PhD degree from Delft University. Klaas then worked for Shell as quantitative interpretation geophysicist and time-lapse seismic specialist in The Hague, Stavanger, Perth, and New Orleans. He became the development manager for Apache in Aberdeen in 2008. Klaas transferred to Apache's head office in Houston

Klaas Koster Biography continued on page 20.

Dennis Yanchak

(Apache)

GSH Candidate for President-Elect 2017-2018

Dennis Yanchak is currently a Senior Geoscience Advisor for Apache Corporation based in Houston, TX. He has 40 years of industry experience and is a member of the GSH, SEG, and EAGE. His educational background includes an MS in physics from Carnegie-Mellon University as well as undergraduate degrees in physics and mathematics and an MBA in technology management.

Dennis began his career in the oil business in 1977 with Gulf R&D near Pittsburgh, PA, working on seismic

Dennis Yanchak Biography continued on page 20.

Katya Casey

(Actus Veritas Geoscience)

GSH Candidate for 1st VP-Elect 2017-2018

Katya Casey is a member of AAPG, EAGE, GSH and HGS. She has more than 25 years of industry experience in geophysical data interpretation and holds a Master of Science degree in Geophysics from University of Houston. Katya started her career with Russian Academy of Sciences in Moscow and continued it in United States where she worked for Amoco Petroleum, Vastar Resources, BHP Billiton, Apache and Murphy Oil companies. Currently, she is one of four managing directors at Actus Veritas Geoscience, LLC.

Katya Casey Biography continued on page 20.

Maitri Erwin

(CNOOC Nexen)

GSH Candidate for 1st VP-Elect 2017-2018

Maitri Erwin is manager of Global Exploration New Ventures for South America at CNOOC Nexen. She is also founding member and current chair of the Society of Exploration Geophysicists Women's Network Committee.

Maitri graduated from the University of Illinois at Urbana-Champaign in 1998 with a BS degree in geology, and from the University of Wisconsin at Madison in 2003 with a MS degree in structural geology and an interdisciplinary MS degree in computational sciences and geophysics.

Maitri Erwin Biography continued on page 22.

Dmitry Kulakov

(Schlumberger)

GSH Candidate for Editor 2017-2018

Dmitry has 8 years of experience in the Oil and Gas industry. He received a BS degree in Exploration Geophysics from Gubkin Russian State University of Oil and Gas in 2009. In 2011, he graduated from the dual-diploma Reservoir Geoscience and Engineering program holding a MS degree in Geoscience from IFP-School (Paris, France) and MS degree in Reservoir Engineering from Gubkin University (Moscow, Russia). He is an active member of SEG, EAGE and GSH.

Dmitry Kulakov Biography continued on page 22.

MEET THE CANDIDATES

Denise Dorsey
(Katalyst)
GSH Candidate for
2nd VP-Elect
2017-2018

Denise Dorsey began her career in Geophysics in 1979 as a computer operator for Petty Ray Geophysical in Oklahoma City, Oklahoma. While working part time and summers for Petty Ray she also took part in a field crew for one summer with Digicon Geophysical. Denise received her Bachelors of Science Degree in Geophysics from The University of Oklahoma in May of 1983. After graduating, Denise was exposed to various geophysical related activities such as: spec data selling, seismic data processing and field work participation

Denise Dorsey Biography continued on page 21.

Duane Pankhurst
(Edge Geophysics)
GSH Candidate for
2nd VP-Elect
2017-2018

Duane draws upon a diverse background having earned an undergraduate degree in Geology and a graduate degree in Geophysics. His first career was spent practicing soil science as an Engineering Geologist in California and Texas. His second career spans 15 years in Oil & Gas practicing as a geophysicist specializing in Quantitative Interpretation (QI) to define reservoir properties using seismic data as well as amplitude correct seismic processing. During his first career, Duane was formally trained in forensic investigations

Duane Pankhurst Biography continued on page 20.

Hamid Adesokan
(formerly ConocoPhillips)
GSH Candidate for
Secretary
2017-2018

Hamid Adesokan has three years of work experience as a Geophysicist. In 2001, he received a BS degree in Geology from the University of Ibadan, Nigeria. In 2007, he earned his MS in Petroleum Geosciences from The University of Manchester, UK. He received his Ph.D. in Geophysics, in 2013, from Texas A&M University (TAMU), College Station. Hamid's specialty is in Rock Physics. While being a student in graduate school, he interned with BP, Anadarko, and ConocoPhillips. He later joined the

Hamid Adesokan Biography continued on page 22.

Lillian Comegys
(Apache)
GSH Candidate for
Secretary
2017-2018

Lillian Comegys received her bachelor's degree in Geology at the College of Charleston (2010) and master's in Geophysics from Colorado School of Mines (2013). Upon graduation from Mines, she started her career at Apache Corporation. In the 3 years she has been with Apache, she has worked in the Eagleford and Permian Basin asset teams along with assignment in the Exploration and Production Technology (EPT) group.

Lillian worked in the Eagleford asset team providing regional maps with the

Lillian Comegys Biography continued on page 21.

Katie Baker
(Chevron)
GSH Candidate for
Treasurer
2017-2018

Kathleen (Katie) L. Baker received an engineering degree and MS (geophysics) from Colorado School of Mines (CSM). She started her career with Chevron Energy Technology Company in 2006 executing Quantitative Seismic Interpretation with the Reservoir Properties for Seismic Group. As a graduate student she had multiple internships including with Nobel Energy Deepwater Exploration Group and Encana. Also, she worked with the CSM Center for Rock Abuse DHI and Fluids consortia as well as the CSM

Katie Baker Biography continued on page 21.

Marie Clavaud
(PGS)
GSH Candidate for
Treasurer
2017-2018

Marie Clavaud has 15 years of experience in the Oil and Gas industry as a geophysicist. She received a MS degree in Exploration Geophysics from IFP School (1998). Marie started her career in 1998 at Engie in Paris (France) where she first worked in their Research division focusing on Time Lapse seismic studies for underground gas storages and then in the Exploration-Production division where her main area of interest was prospect maturation in the Southern Gas Basin (UK) and northern Africa. She moved to the US in 2001 and entered

Marie Clavaud Biography continued on page 21.

Klaas Koster Biography continued from page 18.

in 2011 and promptly became a member of the GSH. He started building Murphy's technical capabilities in 2014 until the downturn closed one door and opened a better one at Oxy.

Klaas has significant experience in leading professional societies; he served as VP and President of the Australian SEG chapter before taking on a large number of roles in the SEG, culminating in his election to President of the SEG in 2010. Under his leadership, the SEG put its new governance model in place, monetized its significant real estate holding, and founded its Professional Women's Network. Klaas' commitments to the SEG ended at the Annual Meeting in 2016 with chairing the Honors and Awards Committee, and he is available and looking to become involved again.

Dennis Yanchak Biography continued from page 18.

imaging of complex structures. In 1985, he joined Amoco working in their International Technology Group in Houston. Within Amoco and BP, he worked around the world in exploration, development, and production. During this time, Dennis participated in both land and marine projects. His experiences cover domestic assignments in Denver executing production related activities in the overthrust region while he was also working in Houston with imaging R&D and Gulf of Mexico Deepwater exploration. Internationally, Dennis held a position of Chief Geophysicist in Cairo, Egypt for Amoco/GUPCO and more recently Senior Advisor in TNK-BP based in Moscow, Russia.

He served as GSH Treasurer in 2013-14, participated as a member of the GSH Finance Committee from 2013-2015 and presented at numerous GSH technical events. Dennis also has served in many roles in the SEG, formerly serving on the Research, Global Advisory, and Translation Committees and as the country representative for Russia during his posting at TNK-BP. He is currently a District 2 representative on the SEG Council.

Outside of work, geophysical organizations and spending time with a growing family, Dennis participates in many fundraising bike rides including the Houston-Austin MS150 (most years since 1998) and the Tour de Cure. On weekends, he can be found wearing his red Ride Marshal jersey at many of the MS150 sponsored bike rides in the Houston area.

Katya Casey Biography continued from page 18.

She applies her passion, expertise and experience in basin prospectivity assessments, evaluation and development of play concepts, assessments of prospects within the plays, identification and evaluation of play/prospect risks using relevant data and technologies. She developed and applied new method of iterative interpretation of geophysical and regional sub-surface data with plate tectonics reconstructions and integrating results into petroleum systems analysis. Katya has very solid experience in using subject knowledge and technology in regional and sub-regional basin prospectivity assessment projects for new venture exploration focusing on basin definition, play fairway analysis, and development of play concepts along Atlantic passive margin and Gulf of Mexico.

She is known in the petroleum industry for designing and implementing multiple geoscience technologies and innovations and was among early promoters of Geographic Information Systems (GIS) within the petroleum industry. In one of her roles at BHP Billiton, she was a visionary leader of a global geographically spread team of geoscience computing specialists and data management. She developed and implemented GIS based workflows into project evaluations at BHP Billiton Petroleum company and designed an enterprise architecture to support new technology.

She is adept at project definition and optimization of team dynamics and provides mentorship and develops early career geoscientists and colleagues through publications, training, teaching, and industry forum presentations. Katya is a respected technical speaker and has coauthored papers and presented on play based exploration and use of her findings from regional studies in value assessment of exploration blocks. In 2008, she has received an award in "Leadership in Technology" from Association of Women in Computing.

Duane Pankhurst Biography continued from page 19.

for causation (expert testimony) and technical writing having - written 300+ soil engineering reports under the supervision of a licensed engineer. While with a major, Duane developed key aspects of workflows that are considered a 'reliable technology' for booking reserves with the SEC. Mining from a diverse background (working knowledge of depositional systems, expertise in QI, seismic processing, well-log analysis and, rock physics), Duane has evolved workflows specifically designed to find and quantify oil and gas reserves.

Denise Dorsey Biography continued from page 19.

for Digicon Geophysical, Petty Ray Geophysical, and Seisdata Services while located in Oklahoma City, Midland, and Dallas. Since 2006, she has been taking position of a Sales Account Manager for Fusion Petroleum Technologies, Lumina Geophysical, and Blueback Reservoir. Denise is currently a Business Development Manager for Katalyst Data Management located in Houston where she has been working since October, 2014.

Denise is an active member of the SEG and AAPG along with local societies in Houston, Oklahoma City, Tulsa, and Pittsburgh. She is currently serving as the Guest Program Chair for the 2017 SEG Steering Committee. She has been participating in various volunteering positions for the GSH and SEG in the past several years including managing the facilities for the 2015 and 2016 GSH Spring Symposium and working as Volunteer Coordinator for the 2015 and 2016 GSH Golf Tournament.

Denise currently lives in The Woodlands with her husband Dennis who also works in the geophysical industry.

Lillian Comegys Biography continued from page 19.

integration of well top and 2D seismic interpretation. She moved to Midland in 2014 to assume an operations role in the Southern Midland Basin, providing geophysical support for drilling and completions in two project areas. In her current role in EPT, she is focusing on quantitative interpretation using 1D/2D modeling, seismic inversion, and attribute analysis. She also conditions seismic data using Omega and Hampson Russell. Her tenure in EPT has exposed Lillian to the resources within the Egypt, North Sea, Gulf of Mexico, and Oklahoma groups within Apache in addition to the Gulf Coast onshore and Permian regions.

Lillian has been a member of the SEG since 2011 and recently joined the GSH.

Marie Clavaud Biography continued from page 19.

a 5-year career break. She moved to Houston in 2004, and in 2007 joined Ion-GX Technology as a depth imager in the Span Group, building velocity models and interpreting salt for large 2D regional lines across the Congo basin, Brazil Santos and Campos basins and the US Gulf of Mexico. In 2009, she joined ConocoPhillips as a velocity model builder in the Subsurface Technology group where she helped develop

Katie Baker Biography continued from page 19.

Slope and Basin Consortium all of which tied into her thesis publication: "Use of Deepwater outcrop analogs to predict lithology influence on seismic signature".

In 2009, she took on the integrative role of Reservoir Modeler in Chevron. She has built reservoir models for numerous Chevron assets worldwide including Australia, Brazil, Venezuela, Iraq, Angola and Nigeria. These assets all had varying stages of development from early exploration/appraisal to brown-field and Enhanced Oil Recovery (EOR) developments. She is currently working in Chevron's Deepwater Exploration and Production Unit for the Anchor Appraisal Team. In her current role, she enjoys appraisal planning and utilization of geostatistics to capture subsurface uncertainty. This work supports Appraisal decisions in Deepwater GOM overcoming numerous imaging and drilling challenges. Her notable activities and accomplishments include, organizing and Chairing a Chevron Deepwater Modeling Workshop in 2014, and 2016 and mentoring at Rice University young women in Science Technology Engineering and Math (STEM) in 2015. She participated in Chevron's MET (Mentoring Excellence in Technology) program in 2013, in the Chevron Emerging Leaders program 2012, and at the SEG 2009 Poster Session as Chair for the Reservoir Geophysics session.

Katie is a member of the Geophysical Society of Houston (GSH), The Society of Exploration Geophysicists (SEG), and The American Association of Petroleum Geologists (AAPG). As a longstanding member of GSH, she would be happy to give back to the Society by serving as Treasurer.

Katie lives and works in Houston Texas. In her free time, she enjoys running and training her Labrador retriever. She also enjoys traveling to remote and beautiful places to ski, backpack and enjoy the outdoors.

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an integrated model workflow leveraging geophysical and geological data. She then moved back to her early interest of prospect maturation in the western Gulf of Mexico. In 2013, she returned to Geophysical Technology where she led the Deep Water Imaging team, working mainly on internal imaging projects in the Gulf of Mexico, Angola and Senegal. In 2015, her interest moved to quantitative interpretation of seismic for assets in the Alaskan North Slope. As of August 2016, she joined PGS where she is now imaging supervisor. She is an active member of SEG, GSH and AAPG. In her spare time, she enjoys cycling, running, and hiking.

Maitri Erwin Biography continued from page 18.

Since 2003, Maitri has worked at Shell Exploration & Production Company, TechniGraphics and CNOOC Nexen in various capacities in Field Development, Geospatial R&D and Exploration. Her experiences includes various activities such as seismic interpretation, reservoir characterization, subsurface technology, exploration bid rounds, drilling recommendations, team management and business development.

Maitri is also board member and advisor to Project Gutenberg, the oldest publisher of free electronic books and an emeritus member of the University Of Wisconsin Department Of Geoscience Board of Visitors. Maitri's interests include science outreach, women in leadership, writing, languages and travel.

Hamid Adesokan Biography continued from page 19.

Global New Ventures Group at ConocoPhillips in a role of geophysicist. He worked with bid rounds offshore East Africa, South East Asia, South America, Ireland and East Canada. Hamid's current interests lie in the field of machine learning application for deterministic and data-driven probabilistic models synergy exploration. He is an active member of SEG and AAPG and is a technical reviewer for the SEG. Hamid also served as the Vice President of TAMU chapter of SEG from 2010 to 2012. Hamid mentors high school students through the Mumineen Foundation in his spare time. He enjoys a good game of soccer, ping pong, and tennis. Hamid lives in the Energy Corridor with his wife and their first child.

Dmitry Kulakov Biography continued from page 18.

During his educational years, Dmitry actively participated in university student science societies, presenting his works at student conferences and was a team member for Gubkin University in the AAPG IBA competition in 2011. For his contribution to the University, he received an honor scholarship in 2009.

Dmitry took several part time and summer positions during his university time that exposed him to various activities such as offshore engineering, seismic processing on Sakhalin Island with ROMONA, VSP R&E in Schlumberger Moscow Research, microseismic and reservoir data integration in Total E&P (Pau, France) and logistics database design and support in Total E&P Moscow.

After graduation in 2011, Dmitry joined WesternGeco (Schlumberger) in Houston Texas, where he is currently holding a position of Earth Modeling Geoscientist. He supports North America production teams with his experience in velocity model building using the newest up to date technologies such as Full Waveform Inversion, Seismic Guided Drilling, Localized Seismic Imaging, Seismic Tomography and Rock Physics Guided Migrations.

In his free time, Dmitry enjoys life in Houston with his wife and newborn son. He is keen of reading, photography, playing competitive paintball across Texas and snowboarding.

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Patterns of Induced Seismicity in Central and Northwest Oklahoma

By Jeremy Boak, Director, Oklahoma Geological Survey, Mewbourne College of Earth and Energy, University of Oklahoma, Norman OK 73019

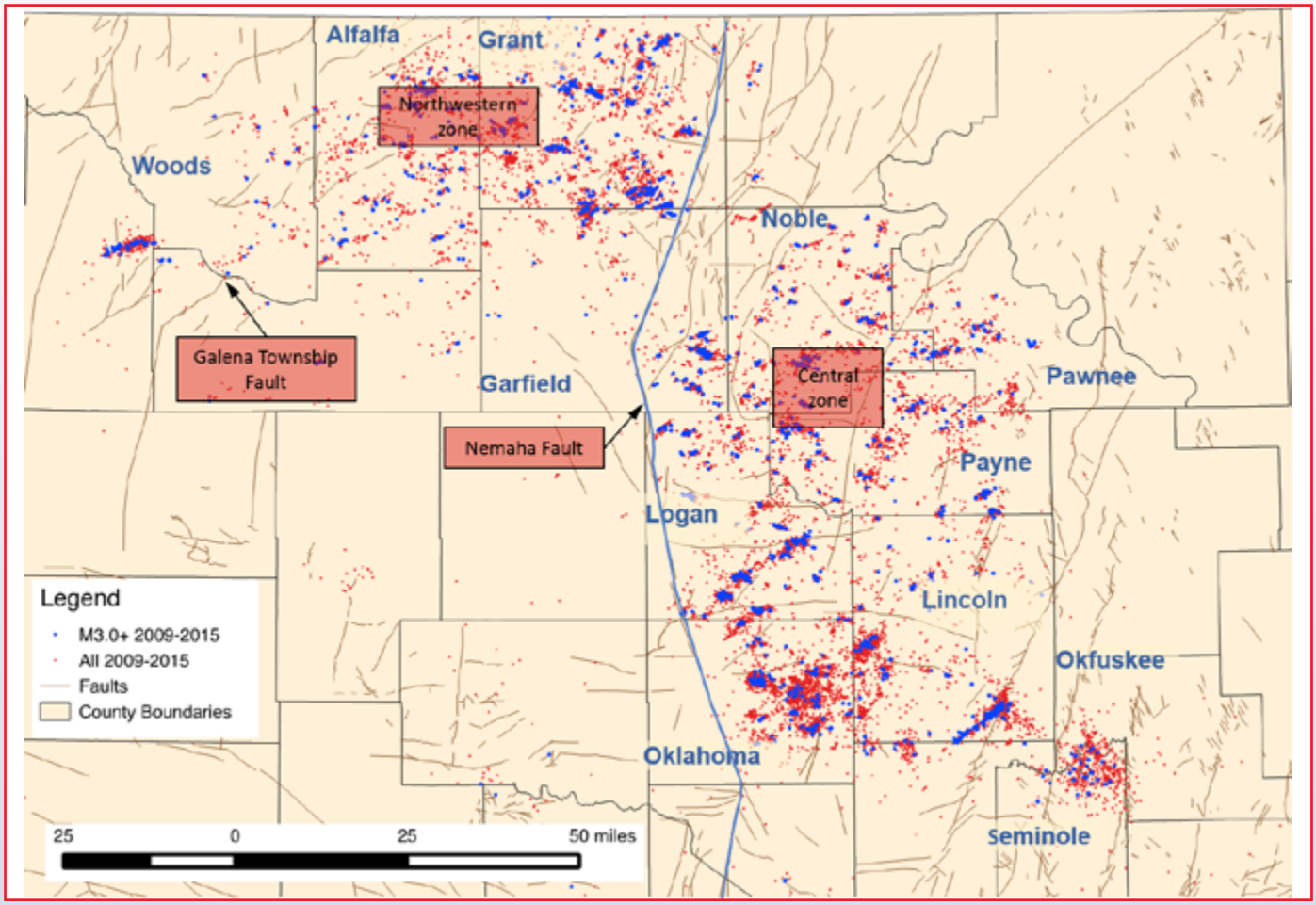

Figure 1: Location of earthquakes in Central and Northwest Oklahoma from 2009 through 2015, from the catalog of the Oklahoma Geological Survey (OGS). The map also shows identified faults from Darold and Holland (2015). Red dots are epicenters of earthquakes of magnitude (M) <3.0, whereas blue dots represent epicenters of earthquakes with M ≥3.0 (M3.0+). Other labeled items are described in the text.

This article was originally written in early 2016 at the peak of a period of high seismicity from manmade activities. Prior to presentation of the article at the SEG Annual Convention in September 2016, the 5.8 M earthquake at Pawnee occurred, focusing even more public attention on oil and gas extraction activities in Oklahoma, including at Dr. Boak's talk at the SEG Convention. For this article in the GSHJ, he updated his SEG Extended Abstract to incorporate the events that occurred in the last half of 2016.

Summary

Oklahoma experienced an average of 1.6 earthquakes of Magnitude 3 or greater (M3.0+) from the 1980s through 2008. Since that time, seismicity has increased to 903 M3.0+ earthquakes in 2015. Earthquake frequency has declined in 2016; however, Oklahoma experienced its largest earthquake, a M5.8 event in September, near Pawnee. Combined with the M5.1 event in northwest Oklahoma in February, and an M5.0 earthquake near Cushing in November, these events ensure more seismic energy will be released in 2016 than in any year in the state's history. More than 95% of these earthquakes occur over only ~17% of the area of Oklahoma *(Figure 1)*. Seismic activity occurred in two main regions, a Central zone to the east of the major Nemaha Fault, comprising parts of nine counties mostly north of Oklahoma City and West of Tulsa, and a Northwestern zone west of the fault, comprising parts of six counties.

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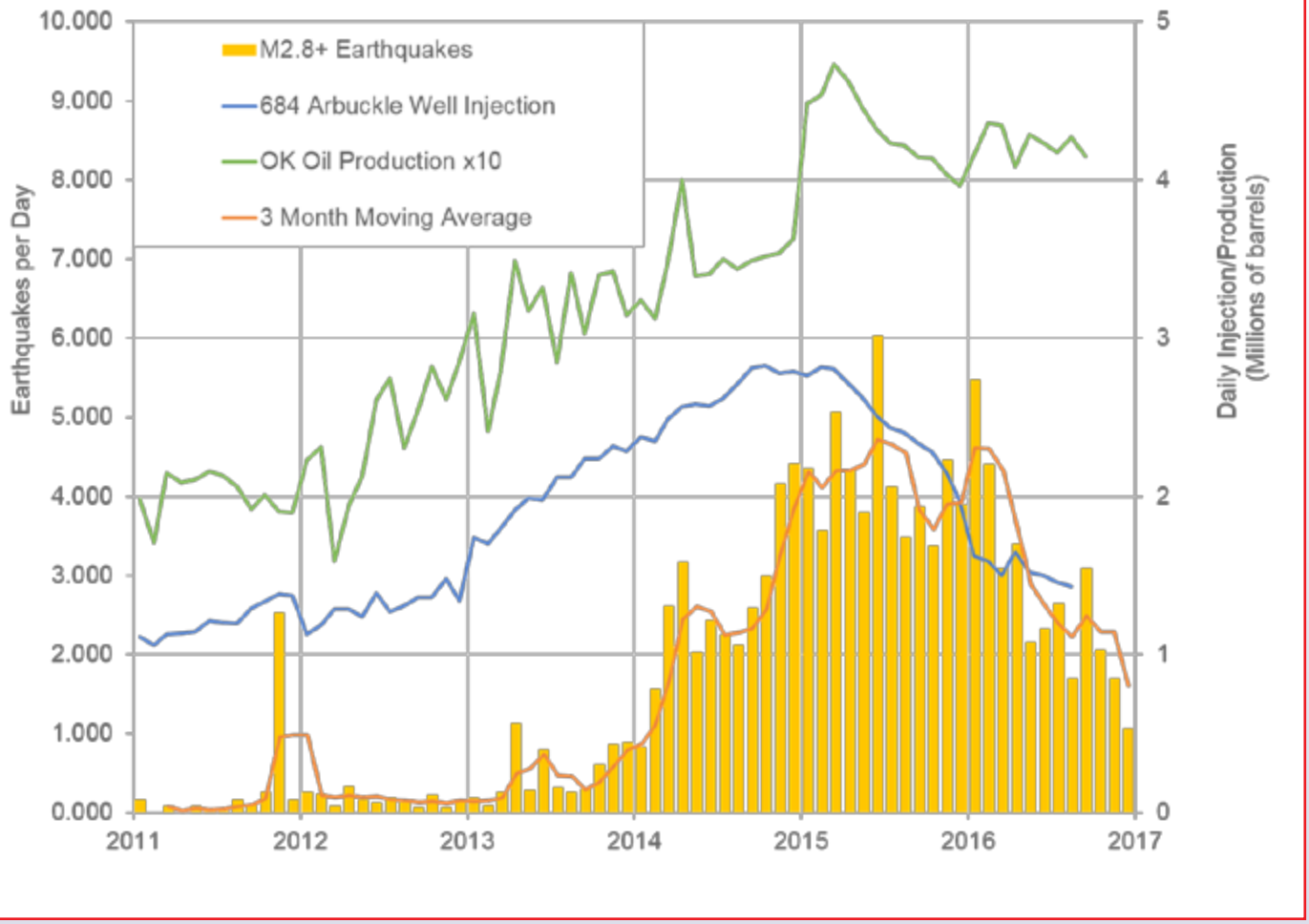

Figure 2: Relationship of produced water injection into Arbuckle Group sedimentary rocks to seismic activity. Bars indicate daily frequency of earthquakes of M2.8+ by month from 2009 through November 2016. Note the Prague earthquake swarm in late 2011. Brown line represents a six month moving average. Blue line is monthly injection into 684 wells completed in the Arbuckle Group in the area of increased seismic activity for 2015 through early 2016. Green line represents Oklahoma crude oil production (multiplied by ten to display trends more clearly).

The pattern of increased earthquake activity is generally attributed to increased injection of saline formation water co-produced along with oil and gas in salt water disposal wells. Most of the injection was into the commonly under pressured and relatively permeable Arbuckle Group, which lies directly on top of Precambrian crystalline basement (for example, Walsh and Zoback, 2015). Pressure communication from the Arbuckle to faults in the basement is interpreted to have reduced effective normal stress on the faults. This stress reduction allows faults aligned favorably with respect to the stress field in Oklahoma (S_{HMax} = N 85° E) to move. This paper discusses the evolution of this seismicity, the regulatory actions taken to reduce seismicity by reducing deep injection, and the importance of declining oil price in reducing injected volumes in advance of full implementation of these regulatory directives.

Brief History of Induced Seismicity in Oklahoma

The pattern of rising earthquake frequency is shown in *Figure 2*, which covers the period from 2011 through early November 2016. It shows the daily frequency of M2.8+ earthquakes averaged monthly. A six-month moving average of these values is also plotted. Activity had increased beginning in 2009, from an annual average of 2.9 M2.8+ earthquakes to 24 in 2009, to 60 in 2010, and to 110 in 2011. The sharp increase was associated largely with the M5.7 Prague earthquake in November 2011, which damaged numerous homes, injured several people, and aroused a significant debate about the origin of the earthquakes. After the Prague swarm, earthquake activity slowed in 2012 (2.8+ = 63), but rose again in 2013 (M2.8+ = 184) and still more in 2014 (M2.8+ = 951), leading to strong political debate and protests.

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Seismic activity clearly developed in two main areas, one in north central Oklahoma, and the other to the northwest, across the Nemaha Fault. Both areas have seen development of oil and gas plays that produced very large amounts of water, which was disposed of in Underground Injection Class II Salt Water Disposal wells in the same area as the production. Injection volumes reached 1.5 billion barrels in 2014 (Murray, 2015). The rapid increase in injection in the 14 counties where >95% of the seismic activity occurs is also illustrated in Figure 2. Seismicity increased first in the southern part of the central area, then expanded northward then westward into the northwestern area.

By the end of 2014, when 1,533 M2.8+ earthquakes had occurred, the Oklahoma Corporation Commission (OCC) began to act to shut in some disposal wells, and to reduce injection in others in sensitive areas. In early 2015, they requested that operators of about 500 injection wells in the area of greatest seismic activity show they were not injecting directly in to the basement, plug back out of the basement, or cut injection by 50%. Also in early 2015, the Oklahoma Geological Survey (OGS) put out a position statement that clearly attributed the increased seismic activity to deep injection of produced water through pressure communication to the deep basement (Andrews and Holland 2015). Additional actions taken generally in response to earthquakes of M4.0+ called for reduction of injection in many of these same wells.

Figure 2 also illustrates injection rates from 684 wells completed in the Arbuckle Group within the seismically active zone that reported injection data for 2011 through 2016 in response to accelerated reporting requested by the OCC. It documents a substantial decrease in injection beginning at the end of 2014, largely driven by market forces reacting to the sharp decline of oil price through 2014. Also shown on the chart is the monthly Oklahoma crude oil production from the U. S. Department of Energy's Energy Information Administration (U. S. Energy

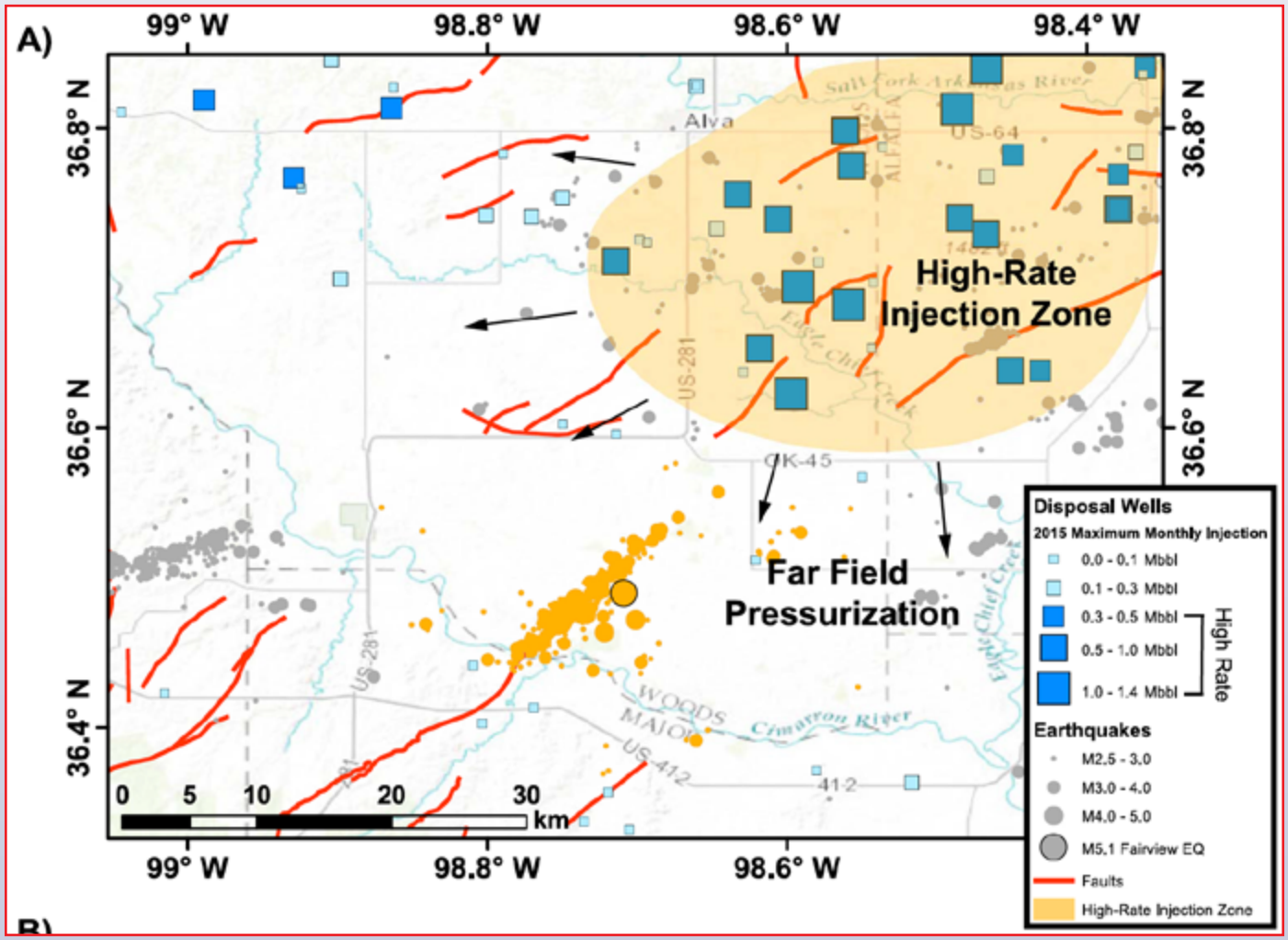

Figure 3: Location of Galena Township Fault and earthquakes of the Fairview cluster (in Woods and Major Counties), as well as zone of high rate injection wells in Grant and Alfalfa Counties, ~12km away. From Yeck, et al., (2016)

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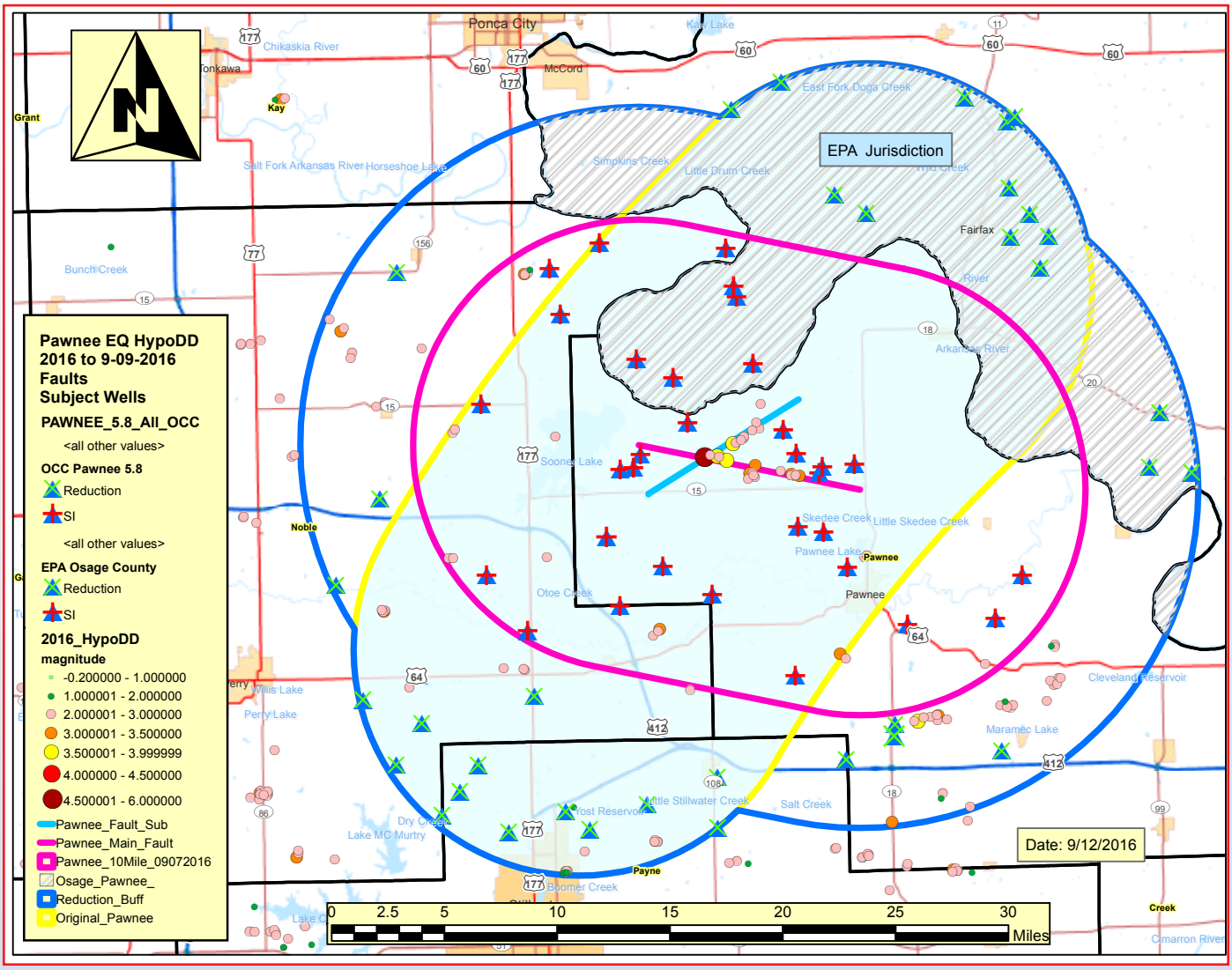

Figure 4: Locations of earthquake epicenters (circles) of the September 3, 2016 Pawnee earthquake and its aftershocks, as well as salt water injection wells (triangles) directed to shut in (area outlined by pink line) or reduce injection (area outlined by blue line) by Oklahoma Corporation Commission. Shaded area is the portion of Osage County (administered by the Osage Nation and the U. S. EPA) affected by changes in injection. Figure from Oklahoma Corporation Commission.

Information Administration, 2016). It shows a very modest decline in crude oil production in Oklahoma, in 2015, but increasing production in 2016. This trend suggests that other plays are taking the place of production lost in the water-rich plays that generate much of the salt water disposed in the seismic area of interest.

Despite reductions directed by the OCC, the earthquake count climbed to 1533 M2.8+ earthquakes by the end of 2015. In November 2015, a surge in seismic activity began on a fault in southern Woods County more than 12 km away from the main area of injection in northern Woods, Alfalfa, and Grant Counties. About 75% of all seismic moment released in Oklahoma in January and 85% in February came along what has been labeled the Galena Township Fault (see Figure 1). Three M4.0+ earthquakes in the first week in January, an M5.1 earthquake in February, and three M4.0+ aftershocks of that earthquake in July were the most significant events through August 2016.

Figure 3 (Yeck et al., 2016) shows the epicenters of earthquakes on the Galena Township Fault, as well as the area of higher injection rate wells to the north. Yeck et al. (2016) concluded that seismic activity in this area was driven by injection in the high rate disposal wells shown in the northern part of the area. They also point out that, whereas seismic events occurred near the high injection rate wells, no earthquake was as large as the main shock on the Galena Township Fault. They conclude that the magnitude of induced earthquakes is determined

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by the characteristics of the fault, and not the degree of pore pressure enhancement from injection. This inference suggests that changes in injection rate will most likely affect the frequency of earthquakes, not the magnitude.

Elsewhere in the earthquake Area of Interest, earthquake frequency declined. The decline began in mid-2015 in the central area, and somewhat later in the northwest area. In the Central area, which experienced 14 M4.0+ earthquakes in 2015, an M4.2 earthquake on New Year's Day 2016 was followed by an interval of 88 days with no M4.0+ earthquakes. The northwest area experienced a pulse of larger earthquakes in late 2015, amid a trend of generally decreasing activity. However, activity on the Galena Township Fault led to an overall increase in M2.8+ earthquakes. Beginning in May 2016, the rate of M2.8+ earthquakes began a rapid decline. The 180-day running average of M2.8+ earthquakes per day peaked in mid-2015 at a value near 4.5. It had declined to about 4.0 by late April. From there, it declined to about 2.3 by the end of September, despite bursts of activity in the Northwestern zone in July and the Pawnee earthquake swarm in September.

Over the Labor Day weekend 2016, a M5.8 earthquake occurred in Pawnee County, on the eastern edge of the earthquake Area of Interest, in a county that had experienced relatively few earthquakes over the period of increased activity, and whose neighbor, Osage County (administered by the Osage Nation) had experienced almost no earthquakes *(Figure 4)*. This earthquake caused localized damage in Pawnee, but was felt throughout much of the U. S. mid-continent. The location of the main shock and early aftershocks placed it on a previously identified fault (see Darold and Holland [2015]). However, subsequent aftershocks defined an additional previously unidentified fault, and the OCC was forced to revise its initial order, shutting in some additional wells, but also changing the wells that were directed to cut back on injection. Additional wells in Osage County were also shut in. The U. S. Environmental Protection Agency, which regulates salt water disposal in the County, followed the lead of the OCC in its action.

Subsequently, a M5.0 earthquake occurred on November 7, 2016 near the town of Cushing Oklahoma, bringing the total of M5.0+ earthquakes for 2016 to three, a number unprecedented in the state's history. All four M5.0+ earthquakes in recent times (including the M5.7 Prague event of 2011) have occurred near the edges of the Area of Interest. The occurrence of three M5.0+ earthquakes against a pattern of decline for nearly all other magnitude groups raises puzzling questions about the trend, at least in the public eye. For example, the number of M2.8+ earthquakes as of November 22 was 967. Simple linear extrapolation would estimate the year end value at ~1100, a reduction of nearly 30% from 2015. For Magnitude 3.0 earthquakes, the current count is 591, which would extrapolate to ~660 by the end of the year – a reduction of more than 200 from the 2015 value of 903.

Actions of the Corporation Commission

The Oklahoma Corporation Commission (OCC) has taken numerous steps to reduce injection of produced formation water across most of the earthquake-prone area. The team addressing the earthquake issue defined an earthquake-prone Area of Interest that encompassed a very large fraction of the earthquakes. This area increased in size as the earthquakes continued, although it has been stable since early 2016. The OCC has issued a series of directives calling for changes in injection practices and quantities in response to the evolving seismic activity *(see Table 1)*. Average depth of the earthquakes has generally been 5.4-5.5 kilometers, indicating that most of the seismicity occurs within the crystalline basement of Oklahoma (Darold et al., 2015). Injection into the Arbuckle Group, the stratigraphic unit that lies directly on the crystalline basement, has been identified as the likely cause of the earthquakes. The largest fraction of the volume of injection has been into this horizon, and increases of pore pressure in the Arbuckle are interpreted to have been transmitted to blind faults in the crystalline basement.

Conclusions

The elevated seismic activity resulting from earthquakes interpreted as induced by oil and gas operations in Oklahoma is highly likely to continue at least through 2017. How much the number of earthquakes will decrease in 2016 is likely to depend upon the activity on the Galena Township Fault and on faults responsible for the Pawnee and Cushing earthquakes. As the largest earthquakes since 2011 happened in February, September and November of 2016 in these zones, there remains large uncertainty about the frequency and magnitude of earthquakes, and their potential for damage. Each of the M5.0+ events has resulted in some damage. However, the results of initial damage from a moderate (say M4.0+) earthquake that is aggravated by cumulative shaking from the numerous smaller earthquakes has not been evaluated, and remains a significant issue for the state.

Acknowledgements

The author acknowledges the support of many members of the staff of the Oklahoma Geological Survey, particularly hydrogeologist Kyle Murray and acting lead seismologist Jefferson Chang. The work of Austin Holland and Amberlee Darold, who built much of the present OGS seismic network and established the framework for understanding Oklahoma earthquakes, can hardly be overstated.

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Table 1: Directives of the Oklahoma Corporation Commission for the earthquake prone area of Oklahoma, with numbers of wells affected and reductions in injection volume

Directive Date	*# Wells Affected*	*Shut In*	*Reduced*	*Total Reduction (BPD)*	*Action Area*
March 18, 2015	347				Full Area of Interest
June 17, 2015	1	1	0	375	Olmstead
July 15, 2015	211				Expanded Area of Interest
July 28, 2015	3	1	2	x	Crescent
August 3, 2015	23	0	23	x	Logan-Payne Trend
September 17, 2015	13	3	10	6,126	Cushing 3.7
October 16, 2015				x	Cushing 4+
November 16, 2015				x	Fairview
November 19, 2015				x	Cherokee Carmen
November 19, 2015				x	Crescent
December 3, 2015				x	Byron
December 3, 2015				x	Medford
December 29, 2015				x	Edmond
November 7, 2015				x	N Medford
January 12, 2015				x	Fairview Cherokee Trend
February 16, 2016	195		195	400,000	OK Western Reduction Area - reduction to 2012 levels
March 7, 2016	398		398	400,000	Ok Central Reduction Area - reduction to 2012 levels
March 7, 2016	77		77		Wells added to expanded AOI
August 17, 2016	21	2	19	20,000	Luther-Wellston
September 3, 2016	48	27	21	40,000	Pawnee 5.8
November 3, 2016	20	4	16	12,000	Pawnee 4.3
November 7, 2016	72	7	65	33,000	Cushing 5.0
				911,501	

x = Plan Removed with regional plan implementation; Shut-in wells remained shut-in

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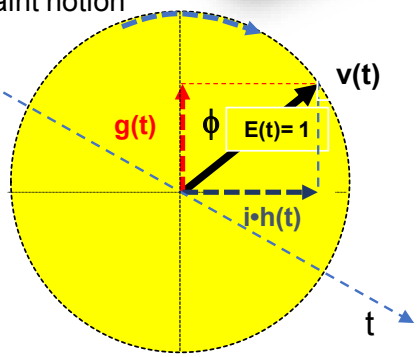
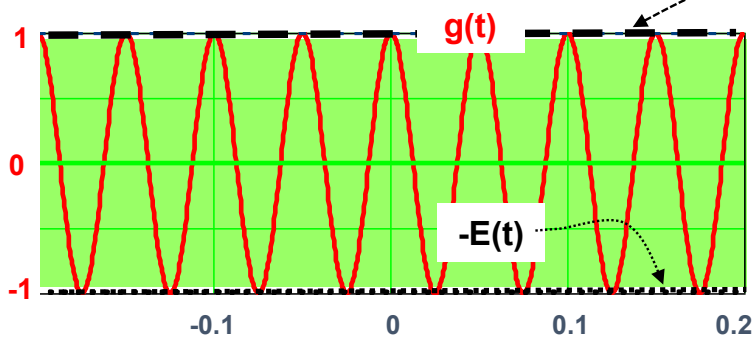
http://dx.doi.org/10.1190/segam2016-13960154.1

Mysterious Attributes of The Vector Trace
Today Featuring The Envelope

In our February exposé, we revealed for your amusement and viewing pleasure the quaint notion of the Vector Trace, **V(t)**, so called for its qualities of **Length** and **Direction** at any instant of time. In the snapshot at the right, we see **V(t)** of length **1**, pointing away from the vertical axis at an angle of **45° (C)**. Note that the length is labelled **E(t) = |V(t)| = 1**. This is done with malice of forethought.



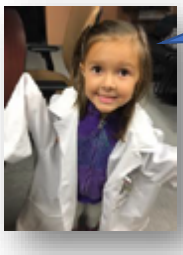
With E(t) **= 1,** and remaining constant throughout its trip down the time line, while merrily spinning at a constant rate, the projection on to the vertical, which we mortals would see as the seismic trace, **g(t),** would be a simple sinusoid, such as the cosine wave shown below. Its frequency, **Fd**, depends on how fast V(t) is spinning (more on that in a moment or two or maybe next month).



This function is commonly known as the **Envelope.** It is the vector length, **|V(t)|** and maximum excursion of **g(t).** A plot of **–E(t)** is added below to demonstrate how g(t) is encased in the envelope.

Of course most seismic traces have a little more pizzazz than the excruciatingly dull trace above. We note for example that most traces are not of uniform peak amplitude. How do we account for that in this model of the Vector Trace?

In terms of the spinning vector, Is there any reason why **E(t)** must be constant?



Little Doctor

I'm going to hazard a "No reason at all." Am I close?

Well, since E(t) has to do with peak amplitude, and that has to do with reflection strength, I'll bet it's all about E(t) and reflectivity, r(t), being related.

You are indeed, Little Doctor. Now, can you guess what causes the E(t) to vary?

Once again, you are startlingly correct, Oh Miniature Wise One!

A seismic trace, **g(t)**, is modelled as being the convolution of the reflectivity, **r(t)**, with a wavelet, **w(t):** $g(t) = r(t) * w(t)$ Let's look first at the wavelet, **w(t)**.

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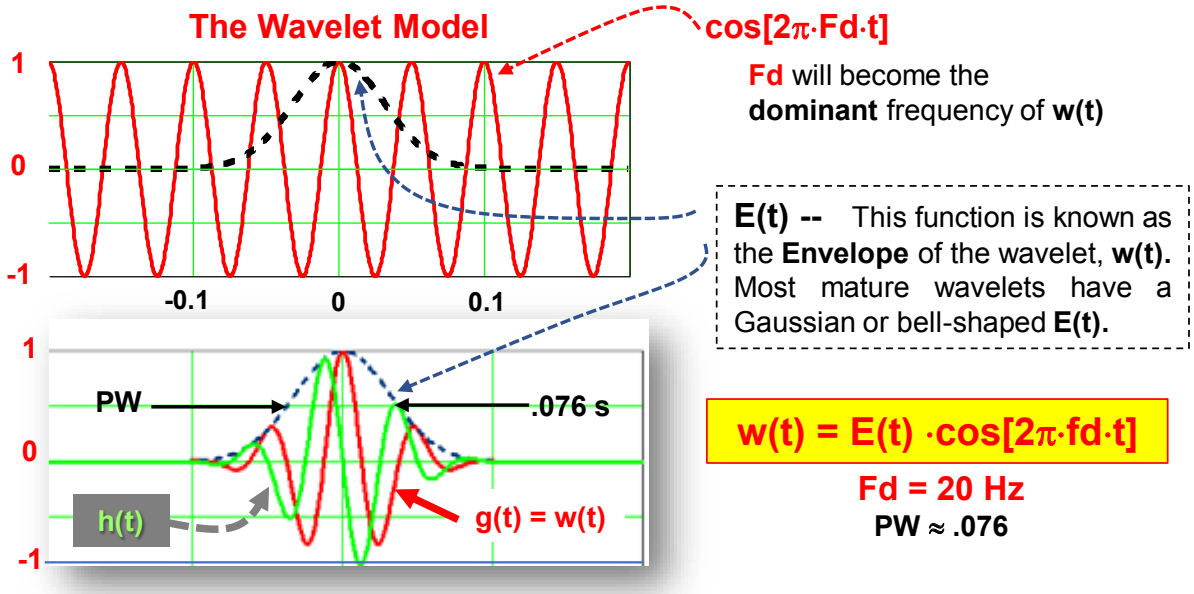
Tutorial Nuggets continued from page 30.

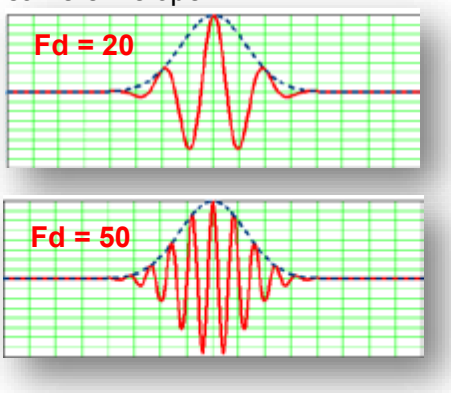
Many Moons ago, the Guru revealed to his knowledge-thirsty Nugget public, that the wavelet may be constructed in an insightful manner by simply multiplying a pure cosine wave, **cos(2π·Fd·t),** with a simple curve, **E(t)**, which defines the **shape** and **pulse width**, **PW**, of the wavelet.



We have added, for your consideration, **h(t)**, the **Hilbert Transform** of **g(t) = w(t).** It is obtained by either using the **Vector Trace** arithmetic **h(t) = E(t)·sin(2π·Fd·t),** or equivalently, shifting the cosine wave **90°** (F) before multiplication by the envelope**, E(t).** Ties together rather nicely. Note, by construction, that g(t) and h(t) have the same envelope.

E(t), is a measure of **Reflection Strength** building up to a peak amplitude, **E(0)** for the symmetrical envelope around its mid-point at **t = 0**. For a reflection at **t = Tr**, the envelope would be shifted: **E(t – Tr).** The peak appears **t = Tr**.

The envelope is a very **robust measure** of reflection strength. As we infer from the diagram of **g(t)** and **h(t),** with a 90° phase rotation angle, it is independent of wavelet phase. Furthermore it is independent of dominant frequency, as shown by the graphs at the right.



Envelopes: carefree with respect to dominant frequency

Resolution

What does count with respect to frequency content of the wavelet and its envelope's shape is the **bandwidth of the wavelet's spectrum |G(f)|.** In a major way, this dictates the width of **E(t)** which is nominally measured at its half-amplitude point, shown above. For a given bandwidth (**BW**), the **PW** is fixed regardless of a phase rotation or dominant frequency. This all goes to make the **Envelope** an **ideal measure** of the **seismic resolution** with a given wavelet. **Resolution** may be defined as the interpreter's ability to resolve or distinguish two closely spaced reflections, separated by **ΔT.** This resolving power depends on the faticity (PW) of the envelope. The specifics will be revealed in the next ***Tutorial Nuggets.***

Tutorial Nuggets continued on page 32.

Tutorial Nuggets continued from page 32.

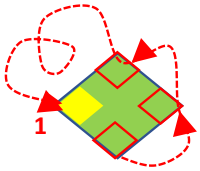
The Improbably Possible and Probably Impossible

In February's Nugget Puzzle, dedicated to the noble science of baseball, we posed a problem that differed from the original, simpler version in a significant way. In our version, **K.K. Casey** pitched in the ***top*** of the **9th**, and no statement was made as to the winner of the game. Using the same game scenario to answer the puzzle, the subtle differences will be illuminated.

The February Puzzle (with a twist)

K.K. Casey

In honor of the rapidly approaching **baseball season**, we offer the following for your consideration. Ace pitcher, **K. K. Casey**, faced **only 4 batters** in the **bottom of the 9th**. He registered four strikeouts (**K K K K**), yet **lost the game** with **one run being scored**. Is this a misprint? How is it possible, if true? (Would The Guru lie?) Tune in on March 1 for the answer.



Spoiler Alert – answers ahead. Batter **1** strikes out, but Pete "Rock Glove" Rupert drops the 3rd strike and the promptly over throws the 1st baseman with the ball ending up deep in right field. The Batter arrives safely at first and continues his merry way to **3rd base**.

Batter **2** comes up, strikes out, where upon Rock Glove drops it, but this time throws the batter out at 1st . **One out, man on 3rd**. The **3rd batter** comes up and repeats the performance of **Batter 2. Two outs, the winning run on 3rd base.**

And now appears **Batter 4**, **Shifty Swift**, a man with an **.867** on-base average. The crowd is tense, but **K.K**. is up to the challenge, and strikes him out on 3 pitches. But wait, the fans gasp in unison as "Rock Glove" drops the 3rd strike and stumbles around for 2 seconds trying to find it. With the help of the fans, the other 8 guys in the field, the dug out, and even (it is rumored) the umpire, he locates it, scoops it up and fires a frozen rope to the hapless **right fielder**. **Shifty** steps safely on first and takes a big turn toward 2nd. In the meantime, the runner on 3rd comes **home scoring the winning run**. **Game over** – if this took place in **the bottom of the 9th.** But what about the original puzzle in which K.K. pitches in the **Top of the 9th**. In that case, it would be necessary to get the **3rd out before another batter comes to the plate.** Understanding the problem, the right fielder fires the ball to 2nd base where Shifty is tagged out to end the inning for the visitors.

The April 1st Puzzle (An easy one – No Foolin')

Howdy, my name is Ferdinand-The-Fish.
The Guru says I weigh 10 pounds
plus ½ my weight.
So, how much do I weigh?

Geoscience Center News

By Bill Gafford

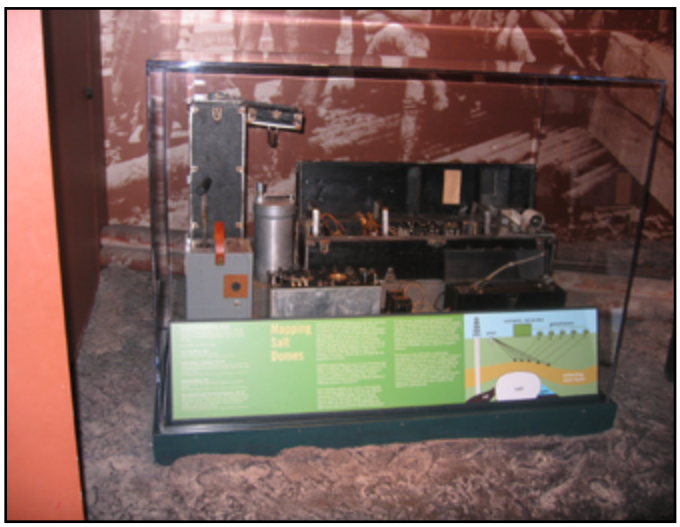
1790 W. Sam Houston Pkwy. N. (Right on Shadow Wood)

I typically use this column to report on recent activities at the Geoscience Center but this month I thought I would give a little background information about our collection of geoscience artifacts. A GSH Museum Committee was established in 1960 with C. C. Hutchinson as Chairman. Hutch, as he was called, had a lengthy career in geophysical field operations and is shown above with his seismic recording truck in 1927 in one of the photos from our collection. The mission of the Museum Committee has always been to "preserve and educate". In order to preserve some of the instruments used in early exploration, the committee began to collect, through donations from companies and individuals, items that were no longer being used due of the continued development of seismic and potential fields acquisition, processing, and interpretation instruments. Some of the early donors of items include Humble, Shell, Sun Oil, Texaco, Keystone, Petty Geophysical, and the Geophysical Research Corporation. Some of these instruments are still in good condition and are good examples of technology for their time period. Other items in our inventory need to be cleaned or refurbished before being placed on display. There are also a few items in our collection that require research and description of their use and purpose on information signs. We still welcome donations of items related to geoscience that add to our inventory and may fill in gaps of our collection.

Our collection is also being used to educate the public, including adults and youth, in a number of ways. The displays we have at a variety of locations around Houston and in Austin, are seen by the general public as well as students. One picture below shows a portion of the display at the Bob Bullock Texas State History Museum. The other picture shows part of a larger display at the Lone Star College North Harris campus in Houston. Various items from our collection are also used by the GSH Outreach Committee at school career days, and other outreach events where students can learn about geophysics and geoscience. We have hosted workshops and tours for science educators at the Geoscience Center also.

We had another successful Living Legends Doodlebugger social event on February 9 and hosted the GSH Education and Development for Unemployed Professionals event on January 25.

If you would like to visit the Geoscience Center, and see some of the Mystery Items from the GSH Journal, see some of the items previously mentioned in the Geoscience Center News, or volunteer to help with some of our projects, please contact me at geogaf@hal-pc.org or at 281-370-3264.



GSH Outreach

Committee Activities - *By Lisa Buckner*

February was another busy month for the GSH Outreach volunteers. We were invited to participate for the third time in two events: **Family Science Night** in Bellville, TX and the **25th Annual Expanding Your Horizons in Science and Mathematics**. The Bellville Engineering Science Technology (BEST) Booster Club sponsored the Family Science Night at the Bellville Junior High School gym on Monday, February 13 and there were a number of interactive and informational booths at the event. It was a like a mini version of Energy Day. We made a big impression in a small town. Bellville is located between Sealy and Brenham and close enough that a number of parents work in Houston.

The American Association of University Women (AAUW) West Harris County Branch sponsors the annual Expanding Your Horizons (EYH) in Science and Mathematics event which provides career information and role models for Houston area middle school girls. It was held on Saturday, February 25 at Spring Forest Middle School, SBISD. Professional women share their enthusiasm, education requirements and remuneration working in scientific, technical and financial careers with more than 400 girls, their parents and teachers. New GSH Outreach volunteers, Lisa Vinson Neelen and Laura Younker, presented two geophysics hands-on workshops. The purpose of the event is to inspire young women to pursue STEM related courses in high school and college and ultimately STEM careers.

Project judging for the **58th Annual Science and Engineering Fair of Houston** was also conducted on Saturday, February 25 at the University of Houston Main Campus Alumni Center. GSH volunteers coordinated by Gokay Bozkurt selected six winners for GSH Special Awards. More GSH volunteers 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 or the INTEL International Science Fair. The awards ceremony was held on Sunday, February 26 where the GSH awards were presented to the students in attendance.

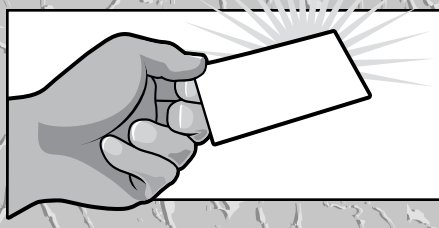
If you are interested in joining the Outreach Committee or volunteer at any event, please contact Lisa Buckner at lbuckner@hess.com or 713-496-4256.

Mystery Item

This is a geophysical item...

Do you know what it is?

This month's answer on page 39.



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Doodlebugger Diary

The Odyssey of a Doodlebugger (The life and times of Ed Lengel) Part 3 of 4

As told to Lee Lawyer (Serialized to prevent total fatigue)

This Doodlebugger story is part 3 of 4 from Ed Lingell. As you can see, Ed has had several 'adventures' along the way of his Doodlebugging career and we hope that you enjoy. We are always welcoming others to use the Diary to tell us of their start in the industry or of some anecdote that happened along the way. Email to Lee Lawyer, llawyer@prodigy.net or David Watts, dwatts1@slb.com.

Episode 3 of 4: More Good Times in Gaspe

The ocean spray would freeze on surfaces. We had to work in this environment. We put into several ports, the best being Gaspé, Quebec on the Eastern coast. To get into port, a draw bridge had to be raised on the St. Lawrence into Gaspé. We went in for fresh water and fuel one evening and the big crown gear on the bridge broke with the bridge in the down position while closing. It was the weekend and we located the bridge mechanic who we convinced to have a few drinks with us. We got him drunk for two days and sick for another two. We were in port for over a week. A good time was had by all.

Every time we went for fresh water in Gaspé, we would get very drunk at various bars. One bar was up a hill and had a long road around to our ship. I decided to take a shortcut and fell down a cliff to the ship. I wasn't hurt badly but was pretty scratched and bruised. Everyone thought I had been in a fight so I left it that way. Another time we were on our way to the ship from a bar, and it was all the way across the bay, so I decided to steal a boat and row across the bay. The boat was down a ways from the dock so I jumped from the pier. Gaspé, has 18 ft. tides, it was low tide! I went clean through the boat and sank it. Jim Schafer, was with me, found a rope to throw to me to get me out of the water. As we walked home, we stole four STOP signs. When we got to the ship, we propped them up beside the vibrator diesels and hung our clothes on the main diesel engine to dry. The cops came by the next morning and took the Party Manager to jail for stealing the signs. This took a while to sort out! If we hadn't had to go to sea, we would have all been fired.

We lived in a steel box which had 20 bunks mounted by chains against the wall like prisoner beds. During storms we had to jam pillows between the walls and the bed fame to keep from rolling out of bed during the swells when the ship was racking back and forth. I was famous for getting into fights I couldn't win. I got beat up in Halifax when I was returning from a portside bar late one night. I was broke and couldn't afford a cab. I had to cross a lot of railroad tracks to get to my ship. A man stepped from between the box cars and hit me in the head. He was hoping to mug me. I passed out but when I woke up, my wallet was upside down on the ground and my ribs hurt badly. The mugger must have kicked me several times when I was on the ground because my wallet was empty and I was broke, but I did eventually get back to the ship. After seeing a doctor, I had three broken ribs and a big knot on my head. We went to sea three hours after seeing the Doctor, we were out for 30 days!

Our main port was Halifax, Nova Scotia, but we traveled to Charlottetown, Prince Edward Island. We shot the Saint Lawrence River from Quebec City to Anticosti Island in the Gulf of St. Lawrence.

We had to shoot seismic lines when the tide was going out because of its speed coming in. We put into port wherever we could during the incoming tide. Within driving distance was Rimouski, Quebec, and Riviere-du-Loup (River of the wolf). Good weekend country dances. We put into port at Trois Riviere between Quebec City and East to Montreal. We always had a good time in our ports of call if you hadn't noticed!

I once acquired a girlfriend at a dance in Rimouski, Quebec. She spoke no English and I spoke no French. I called her Pussycat and she called me Big Dog much to the amusement of the crew.

We had two land crews and one marine crew in Saint Johns. Five of the crew members got married in Saint Johns to local girls that worked in the hospital. The ratio was five females to one male because many of the males, fishermen, had left for Alberta to work in the oil industry.

Next Month: ***Episode 4: Wind Noise and Ice***

If you would like to add stories to the Doodlebugger Diary, send them to: Lee Lawyer at llawyer@prodigy.net or mail them to Box 441449, Houston, TX 77244-1449

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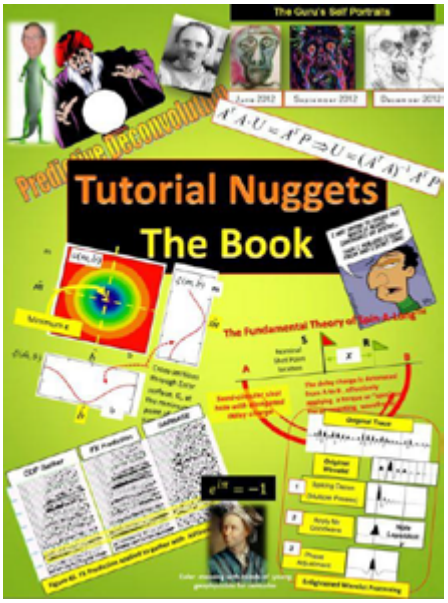

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Proceeds will be used to further scholarships, student memberships, educational outreach, and other activities of the Society.

Mystery Item

The Mystery Item for the March GSHJ is the "2396 Lock". It was a standard lock used on gates, doghouses, or other enclosures where several people required entry. It was sometimes used with the original lock so both parties could obtain access.

Mystery Item on page 34.