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November 2016

GSH Journal

GEOPHYSICAL SOCIETY OF HOUSTON

Volume 7 • Number 3

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Well fracture pattern results depicted by MSI software.

Image courtesy of MicroSeismic, Inc.



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

Jan 2017.....	Nov 2
Feb 2017	Dec 3
Mar 2017	Jan 3

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A Word from the Board

Are You Building for the Future?

By David Watts, GSH Editor 2015-2017

The beginning of this fiscal year has been a difficult and challenging time for the GSH. We have continued to see a loss of advertising revenue for our journal and a decision, albeit a difficult one, was made to move to a digital journal in light of these losses. The GSH also has had to deal with an unexpected change in leadership but the dedicated group left over have stepped up and we have kept things rolling in these difficult changes. One of the goals of our past president was to establish a balanced budget for the year. My job as editor has been to look at the overall cost of the printed journal verses the goal of striving to balance the budget for it. It was immediately obvious that the routine running of the journal was not going to be realistic and I worked with the editorial committee to emphasize the need for electronic and then to recommend to the Board of Directors that we move to a digital version immediately.

At the August board meeting, the editorial board presented its financial plan and recommended an immediate change to an online version only. The vote was not without impassioned pleas by several board members but it was ultimately passed for the continuation of the fiscal year of 2016-2017. The date of the board meeting was the date in which the September journal was to go to print and it was decided that we would go ahead and print September but starting with the October journal, we would move to an electronic version only.

We recognized that we needed to plan on this decision quickly and we worked with our publisher to move to this direction. We contacted all of our advertisers to advise them of the decision and we are well on our way in refining and enhancing our publication to assist them in their advertising. Since we are electronic, we are no longer bound by some of the logistical and costly issues that are prevalent in a printed version. With a bound, printed version, we were limited to editions in page increments of four for the binding of our traditional printed material. The October journal was 41 pages long and could have never been like this with a printed journal. In fact, the October journal contained several items that were originally planned for the September journal but we needed to keep our cost in line and therefore, put a hard limit of 32 pages on ourselves for the September journal and just held over everything else for the October edition. An additional benefit of having an electronic publication is that everything can be in color. Due to past cost considerations, we had been limited with the number of color pages printed but now we no longer have this limitation and our advertisers are now receiving a price discount with full color for all. Finally, we do

not have to abide by page limitations themselves. In the past, your word from the board articles has always targeted a full page of content which is typically 800 words. In just this article, I have totaled over 1400 words which in the past would have been too expensive to have such a long article printed. (I guess you can see the order of my writing.)

One of the new and interesting features is that we have begun to activate advertising and event advertisements via full internet links and emails. When you hover your mouse over a website address or an advertisement, you will be able to just click to go directly to that location or automatically email the individual related to that article or advertisement. In this November edition, we have all of our business card advertisers with this capability to allow you to directly contact them by just reading the journal.

Many things have changed with an electronic publication and they are not just for you the readers. The editorial committee as well as the publisher are experiencing learning pains. In the past, we sat with the publisher at the GSH office and we went through the journal page by page on printed paper to review and mark up things that needed to be changed prior to going to press. The electronic version is doubly difficult as we have had to bring out laptops and project the image onto the whiteboard for all to see at once. I can't say how many times one of our committee members said "can you go back a page." Having five sets of eyes on their own paper copies was one thing, but having the same five sets of eyes on one image projected onto the whiteboard was completely another. An additional issue that we had to deal with was the resolution of the projecting laptop, the resolution of the projector, and the lighting in the room which made reviewing the material more difficult than we previously thought. The GSH office manager, Karen Blakeman asked Lee Lawyer if he wanted a Barcalounger brought in for him as he was virtually laying in his chair while straining his neck to see the projected journal we were reviewing. It was actually quite funny and his reply look back to Karen was priceless. For those of you who attend a movie at the theater and are running late resulting in getting the last seat on the far right of the very front row, you can just imagine the look of Lee during the review.

My goal for 2015 was to just continue as we had previously, but in 2016 my goal was to strive to supplement the content



David Watts
GSH Editor
2015-2017

Word from the Board continued on page 6.

of our journal and we have had several new features with more to come. I am reaching out to several universities to work with their students and organizations to offer a forum for new articles, features, and some new interactive videos to allow our future geophysicists and geoscientists a forum to help develop their publication skills. Not only will this help them but it will help us too with new material and in giving the students an opportunity to explore a professional society and to hopefully instill their interest in the local professional society of their future homes around the world. I hope that you will enjoy their future material.

As an assistant editor from 2014-2015 and the Editor from 2015-2017, I have to say that it has been an exciting job as I have always enjoyed reading and editing papers. I have thoroughly enjoyed my time serving the GSH and working with many colleagues to continue the publication; however, it has been a challenge too. The biggest of these challenges has been overseeing the change from a printed journal to an electronic one. While some people see the decision of going electronic to be the end of the journal itself, I see it as a new opportunity for the GSH to possibly move to an entirely web based and interactive organization which you the members can reach out and touch bases with every member no matter where you are in the world.

As the year continues, we will be working to continue to add new content and material, activate new features for the electronic journal experience and to reach out to those of you who might have new ideas and feedback for us to make the electronic version more exciting and user friendly. The electronic version itself is a great change, but I will also say that it is an exciting endeavor for the GSH moving forward. I am always open to your feedback and comments and appreciate them at any time. For those of you who already have passed along comments, I thank you.

As this is my final year as Editor as well as my final Word from the Board article, I wanted to send out my final thanks to Tommie Rape, my predecessor as Editor at the GSH, who guided me and convinced me to take over the position of Editor and to my manager at my real job as a geophysicist at Schlumberger, Matt Brzostowski, for encouraging me to get involved and to explore new avenues for learning. And finally to the numerous, fantastic individuals at the GSH and Prime Source who I have met, worked with, and built relationships with over these last several years. I thank you all.

David Watts, GSH Editor 2015-2017
editor@gshtx.org



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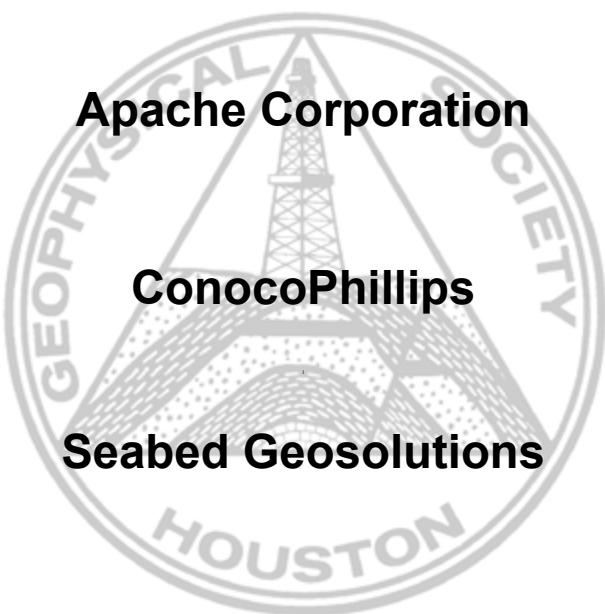
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For more information about becoming a Corporate Member, please contact the GSH office at 281-741-1624, or office@gshtx.org.

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

TECH BREAKFASTS

Velocity Analysis & Update with 3D DAS-VSP to Improve Borehole/Surface Seismic Images

	Speaker(s):	Dr. Yingping Li, Shell Exploration and Production Company
Nov. 1, 2016	7:00 AM to 8:30 AM	Sponsored by Anadarko and Lumina
Northside Breakfast	Location:	Anadarko Petroleum 1201 Lake Robbins Drive The Woodlands, TX 77380
Nov. 9, 2016	7:00 AM to 8:30 AM	Sponsored by Schlumberger
Westside Breakfast	Location:	Schlumberger, Q-Auditorium 10001 Richmond Avenue Houston, TX 77042

MICROSEISMIC SIG

Eagle Ford Microseismic Acquisition Geometry Benchmark

Nov. 3, 2016	Speaker(s):	Dan Kahn, Devon Energy
	11:30 AM to 1:00 PM	Sponsored by Apache Corporation
	Location:	Apache Corporation 2000 Post Oak Blvd. #100 Houston, TX 77056

DATA PROCESSING & ACQUISITION SIG

Estimating Sub-water Bottom Properties Using Marine Guided Waves and Sonar: Physical Modeling, Haitian Lakes, and Atlantis Field, Gulf of Mexico

Nov. 8, 2016	Speaker(s):	Dr. Jiannan Wang, Post-Doc Fellow at Allied Geophysical Lab of University of Houston
	4:30 PM to 6:00 PM	Sponsored by Schlumberger
	Location:	Schlumberger, Q-Auditorium 10001 Richmond Avenue Houston, TX 77042


GEOSCIENCE COMPUTING SIG

Deep Learning Platform for Seismic Data Analytics

Nov. 8, 2016	Speaker(s):	Dr. Lei Huang, Assistant Professor at Prairie View A&M University (PVAMU)
	11:30 AM - 1:30 PM	Sponsored by The Society of HPC Professionals and UDI
	Location:	UDI Houston Banquet Room 10595 Westoffice Dr. Houston, TX 77042

TECH LUNCHEONS

Putting the 'Seismic' in Seismic Rock Physics

	Speaker(s):	Vaughn Ball, Hess Corporation
Nov. 15, 2016	11:00 AM to 1:00 PM	Sponsored by Anadarko and Lumina
Westside Luncheon	Location:	Norris Conference Center 816 Town & Country Blvd. Houston, TX 77024 (Free parking off Beltway-8 northbound feeder or Town & Country Blvd.)
Nov. 16, 2016	11:00 AM to 1:00 PM	
Downtown Luncheon	Location:	Petroleum Club of Houston 1201 Louisiana, 35th Houston, TX 77004 (Valet parking onsite.)
Nov. 17, 2016	11:00 AM to 1:00 PM	Sponsored by Data Direct Networks
Northside Luncheon	 Location:	Southwestern Energy Conference Center 10000 Energy Drive Spring, TX 77389 (Free Parking)

POTENTIAL FIELDS SIG

Using Gravity to Determine Basement Geology Between the Mid-Continent Rift (MCR) and the Southern Oklahoma Aulacogen (SOA)

Nov. 17, 2016	Speaker(s):	Kevin Crain, Oklahoma Geological Survey
	5:30 PM to 8:30 PM	
	Location:	HESS Club (Houston Engr. & Science Society) 5430 Westheimer Rd. Houston, TX 77056

Technical Breakfasts

Velocity Analysis and Update with 3D DAS-VSP to Improve Borehole/Surface Seismic Images

Speaker(s): Dr. Yingping Li, Shell Exploration and Production Company

Northside

Tuesday, November 1, 2016

7:00 – 8:30 a.m.

Sponsored by Anadarko and Lumina

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

Abstract: Shell conducted its first dual-well 3D DAS-VSP survey concurrently with an OBS survey in a deep water environment in the Gulf of Mexico in 2012. This survey produced about 40M picks of the first arrival times (FAT) which were used to diagnose and update velocity models for improvement of both borehole and surface seismic images of subsurface structures. We developed a procedure to use the VSP-FAT to diagnose the velocity models derived from surface seismic surveys and monitor the velocity updating process. The method first was used for selecting a suitable initial velocity model. After the travel-time tomography inversion of FAT, this diagnosis approach was applied again to the updated VTI-inversion model to ensure the velocity updating effort is on the right track. We used the Absolute and Relative Misfits (AM & RM) and apparent velocities to quantify the velocity model uncertainties as functions of depth, azimuth, and offset. Both DAS-VSP data at two wells and OBS data were migrated with the initial VTI velocity model and the updated VTI-inversion model. It is found that both borehole and surface

Westside

Wednesday, November 9, 2016

7:00 – 8:30 a.m.

Sponsored by Schlumberger

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



**Dr.
Yingping Li**

seismic images generated with the VTI-inversion model are improved from those obtained with the VTI-initial model, especially for the seismic amplitudes at a target event.

Biography: Dr. Yingping Li received a B.S. (1982) in Geophysics from the University of Science and Technology, Hefei, China, an M. S. (1984) in Seismology from the Institute of Geophysics, Beijing, China, and a Ph.D. (1992) in geophysics from New York Stony Brook University, USA. Since 2005, he has worked for Shell Exploration and Production Company. He is a senior staff geophysicist and borehole geophysics lead, in charge of Shell Marine VSP programs in North and South America. He is also a Shell global subject matter expert for VSP design and operation. From 1997-2005, he worked as a geophysicist and then a geosciences advisor at Baker Hughes on various VSP projects around the world. He was a postdoctor and then a research scientist at MIT from 1992-1997, working on microseismic and earthquake seismology. He is a member of AGU, EAGE, and SEG.

Microseismic SIG

Eagle Ford Microseismic Acquisition Geometry Benchmark

Speaker(s): Dan Kahn, Devon Energy

Thursday, November 3, 2016

11:30 a.m. - 1:00 p.m.

Sponsored by Apache Corporation

Abstract: Devon Energy conducted a Surface Microseismic Monitoring Project to compare various microseismic acquisition geometries targeting the Eagle Ford (EGFD) formation.

Additional information can be found on the GSH website.

Location: Apache Corporation
2000 Post Oak Blvd.
#100
Houston, TX 77056



Dan Kahn

Data Processing & Acquisition SIG

Estimating Sub-water Bottom Properties Using Marine Guided Waves and Sonar: Physical Modeling, Haitian Lakes, and Atlantis Field, Gulf of Mexico

Speaker(s): Dr. Jiannan Wang, Post-Doc
Fellow at Allied Geophysical
Lab of University of Houston

Tuesday, November 8th, 2016

4:30 p.m. Sign-in, Snacks, Social Time

5:00 p.m. Start of presentation

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

Sponsored by Schlumberger



Dr. Jiannan Wang

Abstract:

This work focuses on estimating sub-water bottom properties (S-wave velocity, density, acoustic impedance, lithology, and structure) and their applications to three cases: physical modeling data, the Atlantis field in the Gulf of Mexico, and Haitian Lakes.

First, three sets of ultrasonic physical modeling experiments are conducted to observe guided waves in the water column. We present a new method to extract the sub-bottom S-wave velocity and density using least-squares inversion as well as a dispersion-curve filter to attenuate the guided waves. Physical modeling tests show both the inversion method and the dispersion-curve filter work well.

Second, using high-resolution sonar data from the Atlantis field in the Gulf of Mexico, we infer the sediment type with a two-step procedure: we perform the envelope inversion to build an acoustic impedance profile of the sub-bottom followed by using the empirical equation to infer the sediment type. The field data test shows the differences

between the inferring result and the real core measurement are less than 15% for the impedance.

Third, we characterize a major fault zone using high-resolution sonar profiles in two Haitian Lakes: Lake Azuey and Lake Miragoâne. We found previously unknown, active north-dipping thrust faults in southern Lake Azuey and Lake Miragoâne which is the deepest lake in the Caribbean region.

Biography:

Jiannan Wang is Post-Doc Fellow at the Allied Geophysical Lab of University of Houston. Jiannan earned his B.S. in Geophysics from China University of Geosciences (Beijing), M.S. in Geophysics from Chinese Academy of Sciences, and Ph.D. in Geophysics from University of Houston. In 2015, Jiannan earned both the Best Poster Award and the recognition of presenting one of the Best 31 Papers at the SEG 85th Annual Meeting in New Orleans, Louisiana.

A Live Webinar

Everything You Always Wanted to Know About Microseismic

Peter M. Duncan, PhD

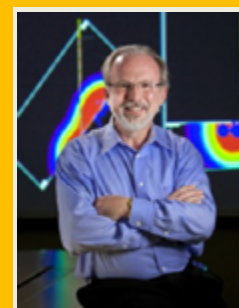
President & CEO, MicroSeismic, Inc.

November 9 & 10, 2016

10:00 am — 2:00 pm



Sponsored by



This one-day course will introduce you to the technology of microseismic monitoring, its roots in earthquake seismology, how data are acquired and how event locations and mechanisms are imaged. Building upon this work, the course will then describe how the microseismic data can be used to estimate the local stress field in the treated reservoir, the permeability enhancement created by the fracture, how the stimulated reservoir will likely perform and even provide an estimate of stage, well or pad ultimate recovery.

Register now at: gshtx.org and seg.org

Major discounts available for groups and students
All sessions are available on-demand to attendees.

Geoscience Computing SIG

Deep Learning Platform for Seismic Data Analytics



The Geoscience Computing - Special Interest Group (SIG).

This SIG was established with the goal to be **a vendor neutral, user centric**. The benefits that will be derived by the members will come from the two-way communications provided through open forum meetings that will bring the geophysicists support community together to share technology, user experiences and maintain dialogs among its membership.

Meetings will address the areas of interest that have been defined by the high performance & supercomputing community and will be conducted in a round table discussion format.

Technical presentations NOT SALES!!!

Now meeting every month during lunch. A lunch will be served.

Speaker(s): Dr. Lei Huang, Assistant Professor at
Prairie View A&M University (PVAMU)

Tuesday, November 8, 2016
11:30 a.m. - 1:30 p.m.

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



Dr. Lei Huang

Sponsored by The Society of HPC Professionals and UDI

Abstract:

The Cloud Computing Research Lab at Prairie View A&M University has been working on developing a scalable cloud platform for seismic data analytics to facilitate a variety of interpretation scenarios. The recognition of 3D complex geological features in noisy seismic datasets is a daunting challenge in pattern recognition. Early experience shows that traditional machine learning techniques such as Support Vector Machines (SVMs) and Logistic Regression may be insufficient for this task. We will present our experience of building a deep learning based seismic data analytics platform on top of Apache Spark and Google TensorFlow, and demonstrate the early results of applying Convolutional Neural Networks (CNN) on a geological fault detection case study. Moreover, we will also present the collaborative work with FEI on applying remote visualization technology to large seismic datasets that are distributed in the Spark environment. The work is sponsored by National Science Foundation.

Biography:

Dr. Lei Huang is an Assistant Professor at Prairie View A&M University (PVAMU), where he is leading research at the Cloud Computing Research Lab. He also serves as Associate Director of Research in the Center of Excellence in Research and Education for Big Military Data Intelligence at PVAMU. He currently has several active research projects sponsored by NSF and DOD in Big Data Analytics, Cloud Computing and High Performance Computing areas. He joined the university in 2011 having previous experience in HPC research at the University of Houston. Huang has a Ph.D. from the Computer Science department at University of Houston in 2006.

Technical Luncheons

Putting the 'Seismic' in Seismic Rock Physics

Speaker(s): Vaughn Ball, Hess Corporation

Co-authors: Michelle Thomas, JP Blangy,
and Mark Kittridge

Westside

Tuesday, November 15, 2016

11:00 a.m. – 1:00 p.m.

Sponsored by Anadarko and Lumina

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

Downtown

Wednesday, November 16, 2016

11:00 a.m. – 1:00 p.m.

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

Abstract:

We're coming up on the twentieth anniversary of Wayne Pennington's turning point definition of *seismic petrophysics* in the 1997 edition of *The Leading Edge*. In this article, Pennington refers to seismic petrophysics as, "the purposeful application of rock physics theory, as calibrated by laboratory and well measurements, to the interpretation of seismic data. . ." With this definition, we visualize a line connecting rock physics on one end with seismic on the other. Pennington's emphasis was squarely on the rock physics side of the line, and addressed the need for a new type of petrophysical analysis. This 'new' petrophysics focused less on traditional formation evaluation related to fluid volumetrics and movability, and more on rock physics related to factors that might influence the seismic response. Most often we also place an arrow on the line that points from the rock physics side to the seismic side. This is the *forward model*, and it includes both rock physics modeling and seismic modeling.

During this luncheon, we will shift the emphasis from the rock physics end of the line to the seismic end, and place an arrow that points from seismic back to rock physics.

Wayne D. Pennington (1997). "Seismic petrophysics: An applied science for reservoir geophysics." *The Leading Edge*, 16(3), 241-246.

doi: 10.1190/1.1437608



Northside

Thursday, November 17, 2016

11:00 a.m. – 1:00 p.m.

Location: Southwestern Energy
Conference Center
10000 Energy Drive
Spring, TX 77389

Sponsored by Data Direct Networks



**Vaughn
Ball**

This is the *seismic inversion line*, and it is an essential but often neglected component of seismic rock physics. It's not that seismic inversion isn't being done. Rather it's that seismic inversion is a routine commodity—a service—that takes place at the fringes of quantitative seismic projects. We will emphasize aspects of seismic inversion that are often unfamiliar to QI workers in the trenches of a project, but that could have significant impact on the technical conclusions of the project. We might call this perspective, *inverse seismic rock physics*.

Biography:

Vaughn Ball holds B.S. and MSc degrees in Geophysical Engineering from Colorado School of Mines. His career has been split about half and half between stints in oil company research organizations and operating business units. His career began in the ARCO research center in Plano TX where he was involved in emerging AVO technologies. This was followed by seven years in Jakarta Indonesia with ARCO where he worked as seismic processing coordinator, plus various seismic interpretation roles. He then joined the Phillips Petroleum technology organization in Bartlesville OK, working on rock physics inversion and modeling. At the merger of Conoco and Phillips he returned to Jakarta where he was the chief geophysicist for 5 years. For the last 8 years he has been working for the Hess Corporation technology organization in Houston.

Potential Fields

Using Gravity to Determine Basement Geology Between the Mid-Continent Rift (MCR) and the Southern Oklahoma Aulacogen (SOA)

Speaker: Kevin Crain, Research Scientist,
Oklahoma Geological Survey

Thursday, November 17, 2016

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 Rd.
Houston, TX 77056



Kevin Crain

Abstract:

In this study, the upper crystalline basement lies between the basement topography and 16 km below mean sea level. The residual gravity anomaly of the upper basement is estimated by stripping the gravity effects of known and geologically consistent 3D model density distributions of known and expected geologies above and below the upper crystalline basement. Modeling the geology as piecewise continuous density distributions allows me to model 100 square degrees of mapped and expected surface and subsurface geologies from the topographic surface to 100 km below sea level. Inverting these expected density distributions allowed me to minimize the misfit between the observed and estimated free-air gravity. This residual free-air anomaly reflects the density distribution in the upper basement.

The observed gravity data are 3D free-air gravity point data collected at unique spatial locations and times, and the free-air gravity measures the gravity effect of the Earth's unique 3D density distribution. Modeling the Earth's 3D density distribution consist of representative 3D geology models containing observed, expected, and geologically consistent 3D formation and lithology boundaries. Then using lithology to density relationships, I built an expected 3D density distribution. The gravity effect of the model 3D density distribution is calculated at each 3D gravity data point using SIGMA, a recently developed gravity and gravity gradiometry algorithm.

Using a geologically and statistically constrained density inversion, the expected density model is adjusted to minimize the misfit between the observed and estimated free-air gravity. The residual free-air anomaly, RFAA, represents the basement geology mass distribution and indicates a complex basement geology and geologic structure that appear to be consistent with earthquake

seismicity and thermal maturity sources as reflected in the Woodford Shale vitrinite reflectance data.

Biography:

Kevin Crain earned his B.S. in geophysics from New Mexico Institute of Mining and Technology and his M.S. and Ph.D. in Geosciences from The University of Texas at El Paso. His research interest have focused on atmospheric electric-field studies, then later studying surface wave and ultrasonic non-destructive test techniques of geomedia, as well as 3D gravity modeling for minerals, and petroleum exploration. Currently he is working as a Research Scientist for the Oklahoma Geological Survey focusing on 3D gravity modeling associated with Oklahoma earthquakes.

Price List:

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



GSH Tennis Tournament



*Chancellors
Family Center*
November 18, 2016

Indoor Doubles Tournament

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Houston, TX 77096
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"Beat the Weather"

\$80.00

Registration Fee

REGISTER ONLINE @ gshtx.org or Call Kathy @ 281.741.1624

Agenda:

12pm.....Registration
12:30pm.....Door Prizes
1pm.....Tournament
4pm..Champion Matches
5pm.....Happy Hour

Sponsorship:

Wimbledon.....\$1,000
Court Sponsor....\$500
Ball Boy.....\$250



Event Chairperson

Russell Jones

President Data Processing
Seitel
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GSH Event Contact

Karen Blakeman

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Geoscientists Without Jobs:

A Guide to Surviving the Downturn

Part Three: Networking IRL and Growing your Comfort Zone

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

You've heard the adage, "It's not what you know, but who you know." Being a professional geoscientist for more than 20 years, I can say both are important, and discounting the latter is something one does at their own risk. The geoscience community is on the cutting edge of technology in many ways, but has not yet made substantial use of social media. Perhaps this is a reflection of our demographics, but there is no denying the majority of us only do professional networking IRL. (For those unfamiliar with web shorthand, that's "in real life.")

Geoscientists seeking jobs can glean a great deal of information from the Internet—and we'll get to that in a later installment. For casualties of the downturn, real-world networking is far more valuable. An intelligence agent will tell you human intelligence is more important than chatter on the Internet. Perhaps more important than keeping tabs on the industry is the need for you to be marketing yourself, and nothing beats doing that in person. When the time comes for a manager to make a hiring decision, the best way for you to be top of mind is to have been in front of his or her face.

All learning takes place by understanding the boundaries of your comfort zones, and then working to slowly expand them to encompass new knowledge and experiences.

The hardest thing about networking when you're unemployed is getting over the initial embarrassment of advertising your status. Let me be frank about this: it sucks, it's hard, and yet it's absolutely necessary to do. The good news is that it gets easier, and if you struggle with networking skills and suffer from anxiety when meeting new people (as I do), you may want to grow your networking comfort zone with some progressive steps.

I make it a point to go out to lunch at least one a month with different colleagues in small groups, anywhere from one to three people. These are people I've worked with at various times over my career, and I consider the primary function of these meetings to be social. Yes, I'm staying connected to the community, and I'm also learning about their companies and their challenges, but I treat these as primarily social occasions and an excuse to get out of the house. There's no pressure to be "on" in these situations.

The secondary purpose of these interactions is to sharpen how I present myself to strangers. Talking with a colleague from five years ago forces me to talk about what I've done since we last worked together, and it gives me raw material for my "elevator pitch." I've found that I'm not always the best judge of what makes my knowledge and skills unique, and insights from my friends has been both surprising and useful. This is a form of peer review, something we appreciate in the technical aspects of our careers and often under-utilized in other arenas.

After a few of these smaller gatherings, I felt it was time to go up to something bigger, like a GSH luncheon. As someone who is incredibly socially awkward, these events are terrifying, as I do not handle large gatherings of people well under the best of circumstances. Interestingly, I found these events to be both terrifying and supportive. It's a bit like attending a survivors' support group; many of these people have been there before. After attending a few GSH events and working on my introductions with colleagues who were not as familiar to me, my confidence grew a bit, and I decided to take another step outside my comfort zone.

A few months back, the Houston Geological Society held a workshop on geoscience consulting, and I had never attended an HGS (not to be confused with GSH)

event. There were over 100 people at this event, and only two I recognized. I was now forced to meet new people! It turned out to be one of the most productive days I've spent in a long time. I felt a bit like an anthropologist among the natives, as I was one of the few geophysicists in the room. Being something of a novelty, it sparked many interesting conversations, including a few which led to some consulting opportunities about which I would have not otherwise known.

All learning takes place by understanding the boundaries of your comfort zones, and then working to slowly expand them to encompass new knowledge and experiences. Learning to network is no different. For many of us, this is the most difficult aspect of maintaining our careers, but if we take careful steps outside our comfort zones (taking care not to leap off cliffs), we can develop these skills just as we do our technical knowledge.

31st Annual GSH Sporting Clays Tournament

Saturday, August 27, 2016

American Shooting Centers

What a perfect day for a shoot! The previous day's rains and continuing cloud cover meant that we had cooler than normal temperatures for August and no sun in the eyes or glare off the lake. The grounds were also a beautiful background of green. The conditions provided great opportunity for preparing for opening day of dove season. Breakfast tacos, BBQ lunch, lots of door prizes and great scores for winners completed the exceptional day. A great job was done by Ryan, Rick and committee!



2016 GSH Sporting Clays Thanks to Our Sponsors



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Sporting Clays continued on page 16.

Sporting Clays continued from page 15.



WINNERS:

**HIGHEST OVER ALL MEN'S
WARREN DALTON – 80**

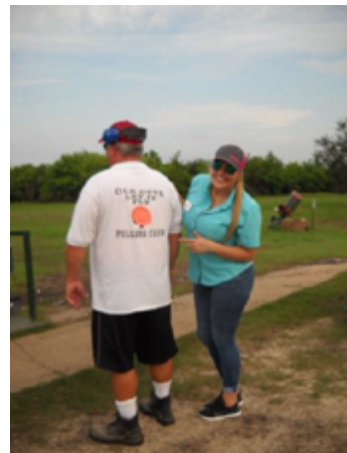
**HIGHEST OVER ALL WOMEN'S
AMY VANDERHILL – 77**

**1ST CLASS AA
JIM VANDERHILL – 76**

**1ST CLASS A
JOHN CRAWFORD – 57**

**1ST CLASS B
ANDY COLE – 50**

**1ST CLASS C
JAMIE DOZIER – 43**



**SEE Y'ALL
NEXT YEAR!**

Haiti Subsurface Imaging Project

By Eray Kocel (WesternGeco, formerly University of Houston), Robert R. Stewart (University of Houston), Paul Mann (University of Houston), Jiannan Wang (University of Houston), Li Chang (University of Houston)

On 12 January 2010, the area of Port-au-Prince, Haiti, and a zone extending some 30 km westward from Port-au-Prince were severely shaken by a magnitude 7.0 earthquake. Initial evaluations suggested that a fault rupture occurred on the nearby and geomorphically conspicuous, active, left-lateral strike-slip, plate boundary fault (Mann et al., 1995) — the Enriquillo Plantain Garden fault zone (EPGFZ) shown in **Figure 1**. However, subsequent detailed studies in the aftermath of the 2010 earthquake (Calais et al., 2010; Prentice et al., 2010; Hashimoto et al., 2011; Douilly et al., 2015) proposed that the main slip of the 2010 Haiti earthquake actually occurred on a previously unrecognized, north-dipping reverse fault, named the Léogâne fault, that was a separate fault from the adjacent and high-angle strike-slip fault (EPGFZ) several kilometers

to the south. Aftershocks indicated that co-seismic, north-dipping reverse motion on the Léogâne fault occurred at a depth of approximately 4–18 km beneath the surface of the Léogâne fan delta (Douilly et al., 2015). There was no unambiguous rupture to surface, thus its description as a “blind fault” (Prentice et al., 2010; Koehler and Mann, 2011).

We undertook near-surface geophysical methods to investigate the subsurface in the Léogâne fan delta (Kocel et al., 2016), in the area of maximum coastal uplift, highway damage, and aftershock clustering (**Figure 1 and 2**). Our reflection lines used north–south-oriented dirt roads and trails to collect geophysical data. Our transects are largely perpendicular to the east–west trending axis of co-

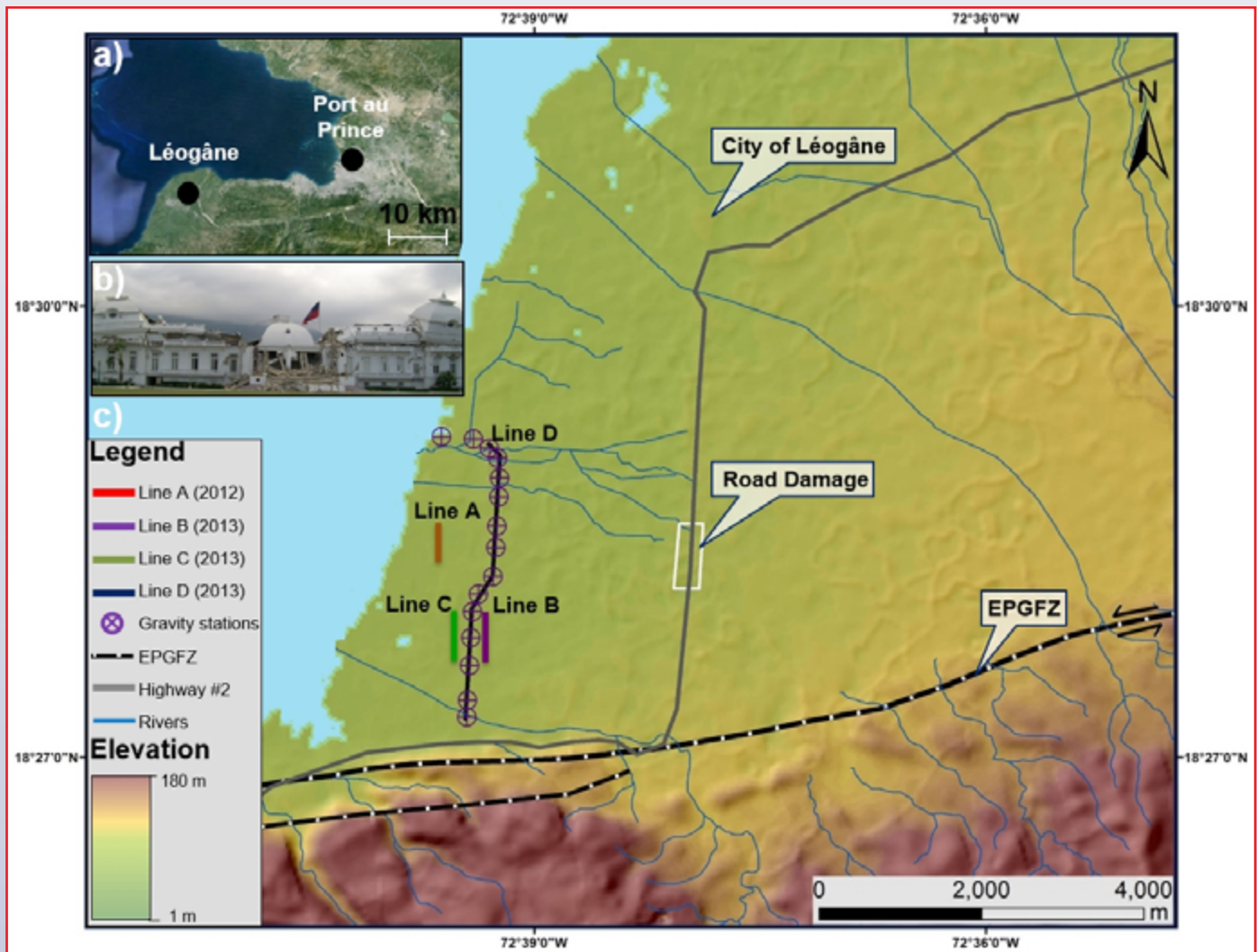


Figure 1

Technical Article continued on page 18.

For Information Regarding Technical Article Submissions, Contact GSHJ Coordinator Scott Singleton (Scott.Singleton@comcast.net)

seismic uplift and intense shaking that connected the area of maximum coastal uplift to the zone of cracking observed along the north–south highway (Bilham and Fielding, 2013). To our knowledge, there has been no land reflection seismic survey in Haiti prior to this study. In this work, various remote sensing surveys have been combined with seismic and gravity data to further understand the complex subsurface structures activated by the 2010 Haiti earthquake in the Léogâne fan delta area. The primary goals of our studies were to (1) measure near-surface sediment properties, (2) image the near-surface structure, and (3) attempt to reveal possible displacements in the uppermost sediments caused by the proposed blind thrust fault (Léogâne fault), thought to lie below the Léogâne fan delta. In this study, results from surface seismic and gravity analyses are integrated to examine the potential causes and effects of the earthquake in the Léogâne fan delta area.

Hashimoto et al. (2011) use satellite radar data to show that the surface deformation related to the 2010 earthquake does not correspond to the present topography: the Léogâne fan delta north of the EPGFZ was uplifted, whereas mountains south of the EPGFZ subsided (Figure 2). Immediately after the earthquake, field observations reported that no primary surface ruptures along the main EPGFZ in the Léogâne area, or within the Léogâne fan delta itself (Prentice et al., 2010; Koehler and Mann, 2011; Bilham and Fielding, 2013). Satellite-based surface-deformation

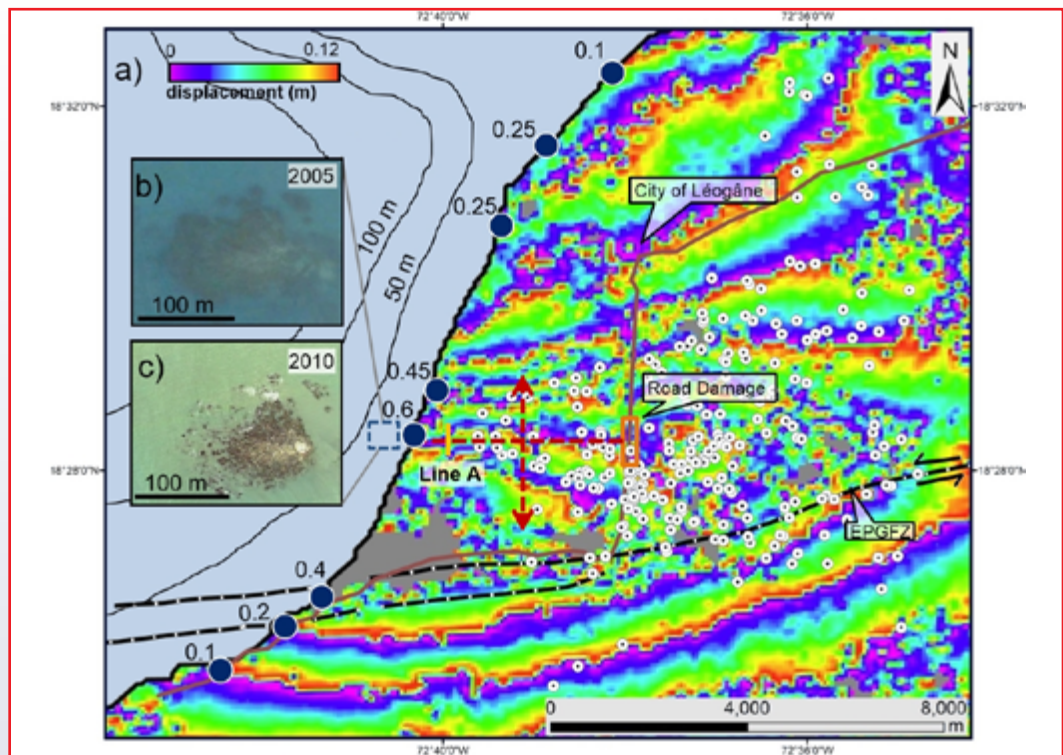


Figure 2

results combined with the location of the main shock and its aftershocks also supported the interpretation that the main 2010 earthquake was not accommodated by simple, left-lateral strike-slip displacement on the EPGFZ (Calais et al., 2010; Hashimoto et al., 2011; Bilham and

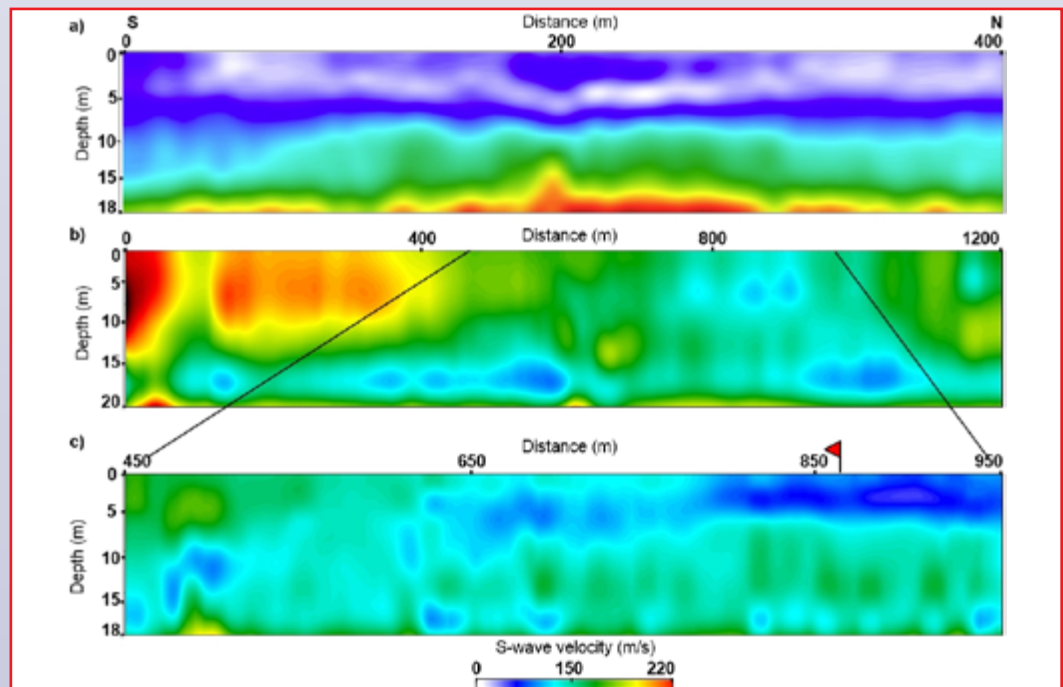


Figure 3

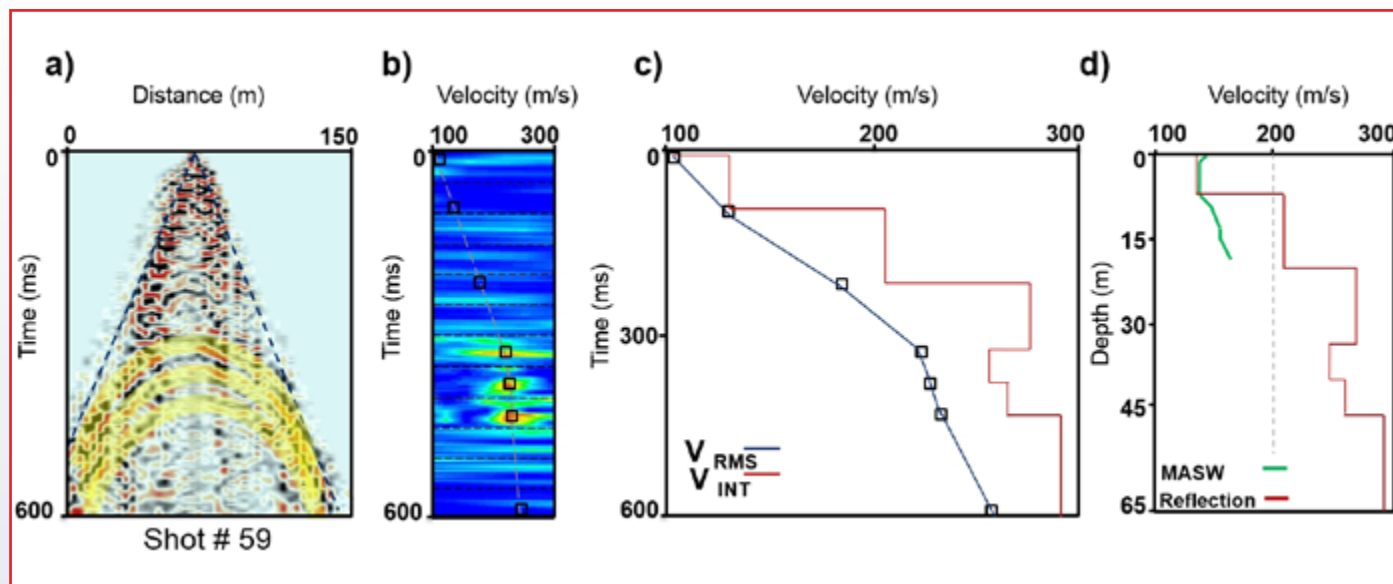


Figure 4

Fielding, 2013). Instead, these interferograms along with the field observations of the living coral reef along the western coastline of the Léogâne fan delta indicate a 14 km wide and 4 km long east–west axis of co-seismic uplift extending into the Léogâne fan delta, 2–3 km north of the surface trace of the EPGFZ (dashed red line in [Figure 2](#)). Surficial deformation was also noted along a paved north–south highway crossing the epicentral area. Intense cracks on the highway align with the zone of maximum coastal uplift and are consistent with a temporary, co-seismic uplift of the ground surface (Bilham and Fielding, 2013).

Geophysical Data

To estimate the near-surface shear-wave velocity structure and classify near-surface soil, the surface-wave inversion method was applied to obtain S-wave velocities, using the Multichannel Analysis of Surface Waves (MASW). Line A is located ~500 m from the coast, and its resulting S-wave velocities are much lower when compared to line B and line D ([Figure 3](#)). The gentle folding of the shallow strata and relatively steeper and southward dipping layers were observed in parallel with the area of maximum coastal uplift and damage to the north-south paved highway.

S-wave velocities are widely used in geotechnical studies and can be used for soil classification. Most of the S-wave reflection data were very noisy, but we undertook velocity analyses on several of the clearest shot gathers. A sample shot gather with interpreted S-wave reflections are shown in [Figure 4](#) (shot location given in [Figure 3](#) with red flag). Velocity analyses over shot gathers along line C gave S-wave interval velocities (VINT) approximately 250 m/s, and these reflectors appeared approximately 40–50 m depths. These deeper S-wave velocities were comparable

with the shallower velocities obtained from the surface wave inversion.

When the results from travel time tomography (Kocel et al., 2016) and MASW studies are integrated, the V_p/V_s values were as high as eight for the top 30 m. These high V_p/V_s values are consistent with those expected from unconsolidated, saturated sediments with high-clay content.

Integrated Interpretation

S-wave velocities are widely used in geotechnical studies and can be used for soil classification (NEHRP, 2014). We integrated the results from surface-wave inversion with reflection velocities from the S-wave line ([Figure 4](#)). The MASW studies from line B indicate an average S-wave velocity of 150 m/s for the top 18 m. From the velocity analyses of the shot gathers along line C, we estimated the average S-wave velocities as approximately 215 m/s for the top 30 m. For the zone between 30 and 50 m, the average interval S-wave velocity is estimated to be 250 m/s. These velocity values suggested that the near-surface soil at Léogâne fan is most likely class D-type soil (NEHRP, 2014). An average V_p/V_s value of 8, for the top 30 m, was approximated using the velocities obtained from the P-wave traveltimes tomography and S-wave velocity analyses (Kocel et al., 2016). These anomalously high V_p/V_s values are consistent with weak soil conditions and possible amplification of ground motion from earthquakes. Class D soils are susceptible to ground shaking during an earthquake (NEHRP, 2014). The unconsolidated, soft, seismically low velocity soil in the Léogâne area was a likely factor for the enhanced devastation on the Léogâne fan delta. Similar results were obtained from a recent study over the Léogâne area that also confirmed the

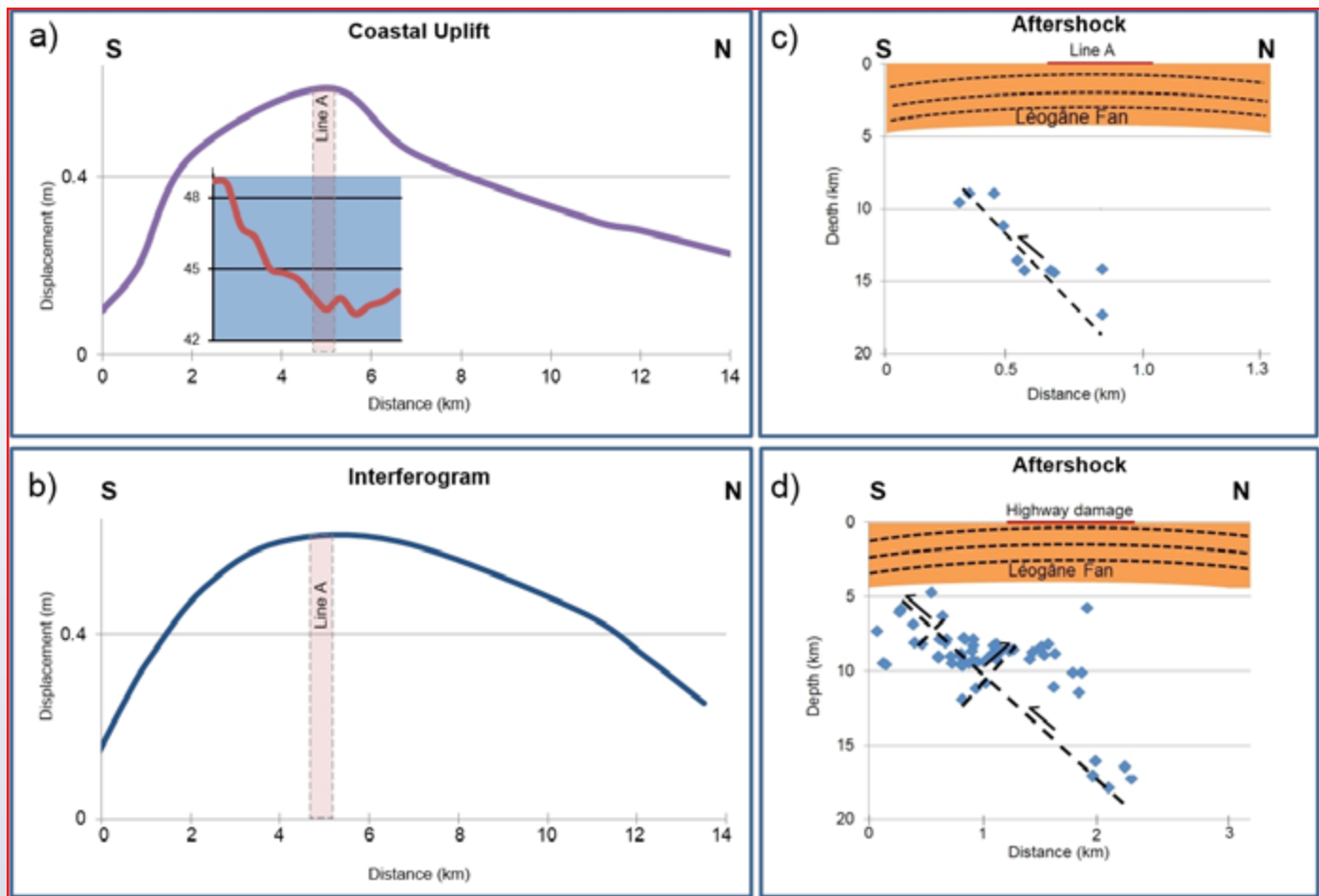


Figure 5

existence of class D types of soil within the region (Kalinski et al., 2014).

Figure 5 integrates the results of remote sensing techniques with uplift observations, gravity data, and the aftershock studies on the Léogâne fan delta area. These results are consistent with (1) a similar asymmetrical shape of the coastal uplift (**Figure 5a**) and (2) the similar asymmetrical shape of the uplift inferred from satellite radar data (**Figure 5b**). **Figure 5a** also integrates the gravity survey results with the coastal uplift studies. Our 4000 m gravity line suggests a decrease in the gravitational field between the southern end of the fan and line A and the increase of the gravitational field from line A to the north. There is an interesting correlation between the gravity anomaly and uplift observations. The initial reduction in the gravity may be related to the thickening of the south-dipping seismically low velocity and low density subsurface layers. The increase of the gravitational field starting from line A may be related to possible subsurface thrusting and folding. Thrusting along the Léogâne fault may have caused the uplift of relatively higher density materials, which could cause the positive gravity anomaly. We expect that the limbs of the fold would

steepen with depth, which might indicate that the fold could be formed by a series of similar folding events overlying the blind Léogâne thrust fault. A previous folding event might have included the historical event of 1701 earthquake described by Bakun et al. (2012) as having similar deformational effects as the 2010. Aftershock data in the vicinity of seismic line A were selected to investigate the depth of the seismically active zone beneath our survey area. These aftershock events were mostly concentrated at depths of 9–17 km and suggest a steep northward-dipping reverse fault plane with an estimated dip of 60°–70° (Douilly et al., 2015). When the aftershock cross section was generated using aftershocks beneath the damaged highway area, we noted that the shallowest reverse fault slip occurred at a depth of approximately 4 km. **Figure 5c and 5d** shows the proposed fault geometry from selected aftershock events with the main fault plane dipping northward. The existence of the northward-dipping thrust fault may explain the uplift observed over the featureless plain of the Léogâne fan delta and is discussed at length by Hashimoto et al. (2011). Relatively shallower and smaller antithetic faults dipping toward the south are also inferred by Douilly et al. (2015).

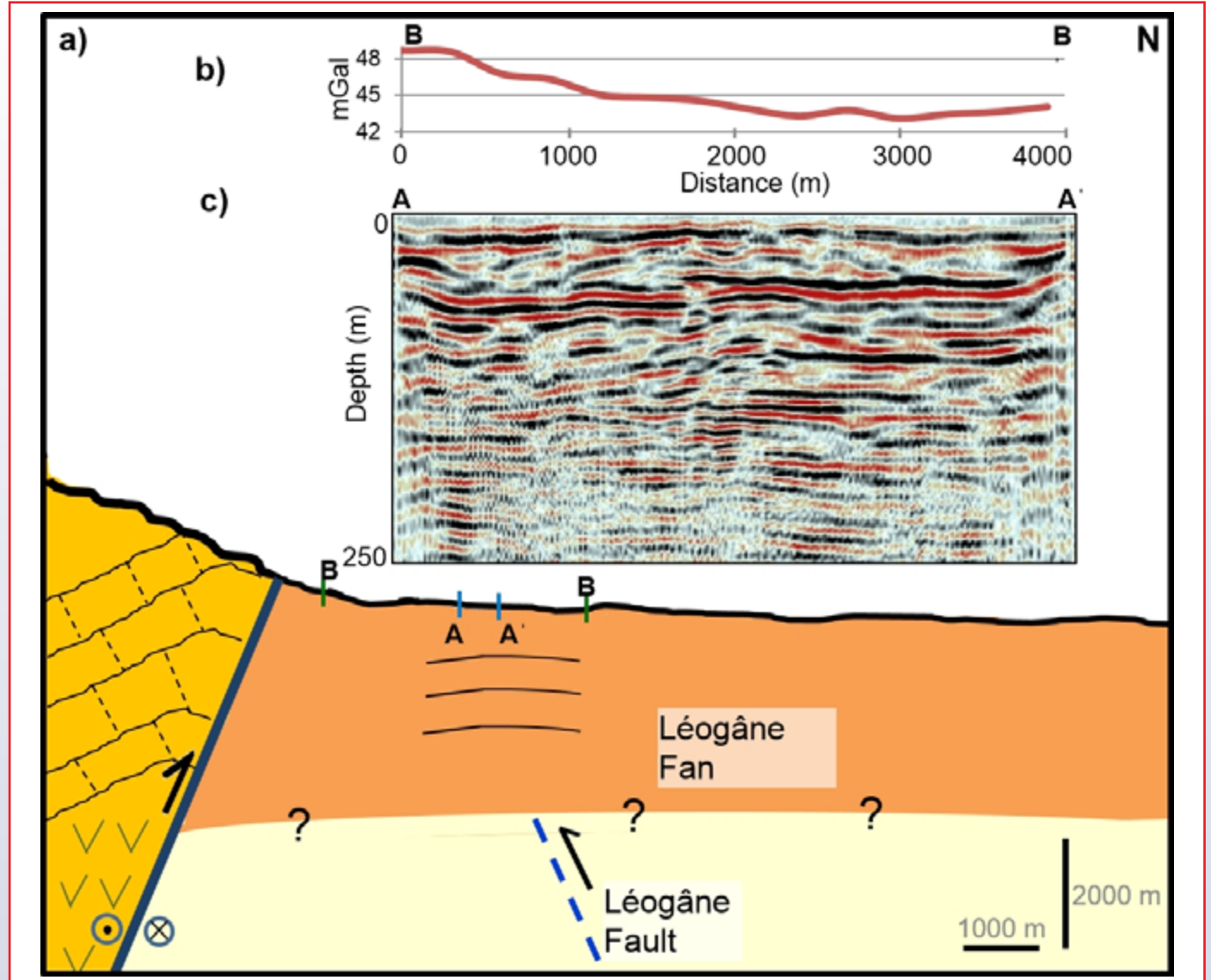


Figure 6

Figure 6 summarizes the results from our geophysical surveys with remote sensing studies to provide an interpretive cross section for the subsurface structure in the Léogâne area. When P- and S-wave analyses are combined (Kocel et al., 2016), the top shallow layers are interpreted as seismically slow and weak soil. Our integrated results over the Léogâne fan are consistent with the proposed thrust blind fault, which may have caused uplift. Aftershock studies over this area indicate that the shallowest event below our study area occurred at approximately 4000 m. Therefore, it may be that the boundary between the seismically weak fan material and basement occurs at approximately 4 km in depth. Indications of a broad anticline in the subsurface layers were observed on multiple seismic lines, which may be the result of deeper structural deformation either related to this event or previous events on the proposed blind Léogâne thrust fault.

Upon analyses of the various geophysical data, we believe that the S-wave results provide the most critical information for characterization of the near-surface materials and sediment properties. However, due to the presence of substantial cultural noise, the quality of data was reduced. Selection of the survey area is constrained by many factors including roads, permissions, settlements, creeks, and vegetative barriers. Possible improvement of data quality could be achieved by acquiring seismic data during the night, but this brings other difficulties into play. The use of larger sources and greater offsets will undoubtedly provide better images. The larger sources and offsets will also be necessary to image to 4 km depths (where the shallowest aftershock hypocenters are located). Larger far-offset sources would also be useful to develop a deep refraction model. Further gravity data (longer lines in a grid over a larger area) would also be helpful to develop more detailed structural images.

Technical Article continued on page 22.

Conclusion

Multiple geophysical surveys were performed in 2012, and 2013 over the Léogâne fan delta. We have acquired 2D seismic data along multiple lines and gravity data along a longer line to understand the sediment properties and image near-surface structures around Léogâne fan delta.

A near-surface S-wave velocity section was generated, with an average velocity of 215 m/s for the first 30 m. S-wave studies suggest weak soil conditions over the Léogâne fan, indicating weak class D sediments. We see no conclusive evidence for brittle faulting penetrating the upper 350 m of the Léogâne fan delta in the areas of our seismic lines. The proposed blind reverse fault may have created a change in shape of the ground surface during broad folding of the poorly consolidated sediments of the Léogâne fan delta. This deformation appears to be located above the inferred blind reverse fault, with estimated northward dips of 60°–70° from the distribution of aftershocks. The anomalous gravity field along the seismic line bears an interesting resemblance to the uplift profile. Further gravity measurements and a deeper seismic image could constrain possible subsurface density models.

These reconnaissance geophysical measurements provide further background information for additional geohazard work in the Léogâne area as well as parameters for designing deeper geophysical surveys to directly image the proposed blind reverse fault responsible for the 2010 Haiti earthquake.

Acknowledgements

We enthusiastically thank the SEG's Geoscientists Without Borders program for supporting this project. We are grateful to Global Geophysical in Houston for kindly loaning their land node recording system used during the 2013 field campaign. We appreciate the efforts of Nicole Dieudonne and Sophia Ulysse of the Haiti Bureau of Mines and Mr. Alexander von Lignau of the Haiti Ministry of Finance. Special thanks to Dr. Nikolay Dyaurov (University of Houston) for assistance with the laboratory measurements and Mr. Anoop William (formerly UH) for providing equipment logistics and data management. We thank Eric Calais and Roby Douilly for discussions and for providing the relocated earthquake aftershock data. We also express our appreciation to Schlumberger (GEDCO) for their software donations. We thank the Allied Geophysical Lab and its sponsors for their ongoing efforts in geophysical outreach and humanitarian application.

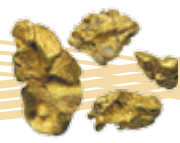
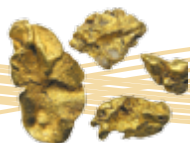
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Tutorial Nuggets

By Mike Graul



A Continuation of the Learned Discussion on Converted Wave AVO



Learning Machines

Before you go on, Murphy and I are a little confused. Could you summarize and maybe tell us where we are and how we got here?

But of course, my Little Learning Machines, I will be happy to enlighten you and Murphy.

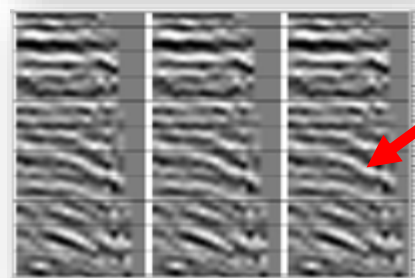
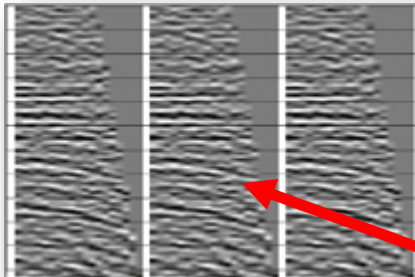
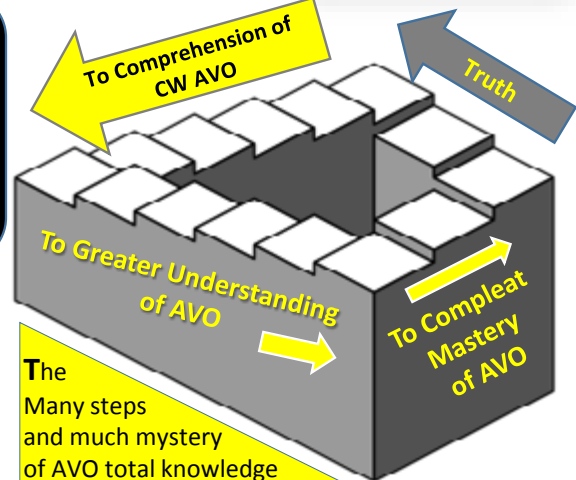


Guru in Interesting Mode

First you must know that the path to full and complete knowledge of all things AVO-ish, including and especially those pesky Sv-P reflections, has many steps and much mystery. Tutorial Nuggets become Clusters and only those with Mental Mettle will prevail.

[The Guru will now speak outside the (black) box.]

Our **Motive** is that these **Sv-P** converted waves carry information about rock properties that is essentially independent of the normal **P-wave AVO**. The confirmation or contradiction provided by comparing **Rpp** with **Rsp** becomes a major **Risk Reducer**.



Garden Variety P-Wave data

The good news – and key point to remember – is that there is no special acquisition required, the converted wave data is already there -- right in your regular everyday **PP** reflection data with **P-wave sources** (dynamite, Vibroseis, Bill and Harry stomping around the receiver line) and **P wave receivers** (geophones).

Pictured at the left are **PSTM** Common Image Point Gathers revealing flattened P wave reflections and the ever-present **Sv-P** reflections with residual **NMO**. An important point to keep in mind is that while we recognize the presence of the converted waves in the data, they are neither properly positioned nor time corrected. In order to do right by the converted waves we must do a **Sv-p Migration**.

Yes, **SvP PSTM** or better yet, **SvP APSDM**, since both anisotropy and depth migration will be needed to produce a valid comparison of **Rpp** and **Rsp AVO**.

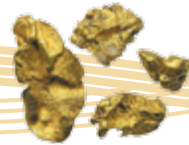
OK, what needs to be done to get to our new goal line? Here's partial list:

Statics

The **Source statics** are a real problem since **Vs** at the near surface is highly variable and largely an unknown quantity. There are some clever techniques using Rayleigh waves (ground roll), but much work remains. We'll discuss this murky subject in the near future. In the meantime, rest assured it's in good hands.



Tutorial Nuggets continued on page 24.



Continuing with A Partial List of Issues for Sv-P processing

Velocity

Ultimately we must determine both **S and P velocities**. Let's call them β and α to avoid extra subscripts (V_s and V_p). Specifically, we will need interval velocities, $\alpha_{INT}(z)$ and $\beta_{INT}(z)$, for depth migration, but in the meantime, we'll have to deal with such velocities as $\alpha_{RMS}(TC)$ and $\beta_{RMS}(TC)$, where TC represents the zero offset time of the converted wave (S down, P up). The velocity ratio, $\gamma(z) = \alpha(z) / \beta(z)$, is a vital piece of information, but rarely available unless you're operating in a forest of dipole sonics. We may start the velocity analysis process with a ballpark estimate, typically a constant $\gamma = 2$, and whittle away, iteratively, until we converge to an acceptable solution characterized by **flattened PSDM gathers** and **depth registration** of the independently migrated **P** and **SvP** events. At that point, we can compare the respective **AVO** events.

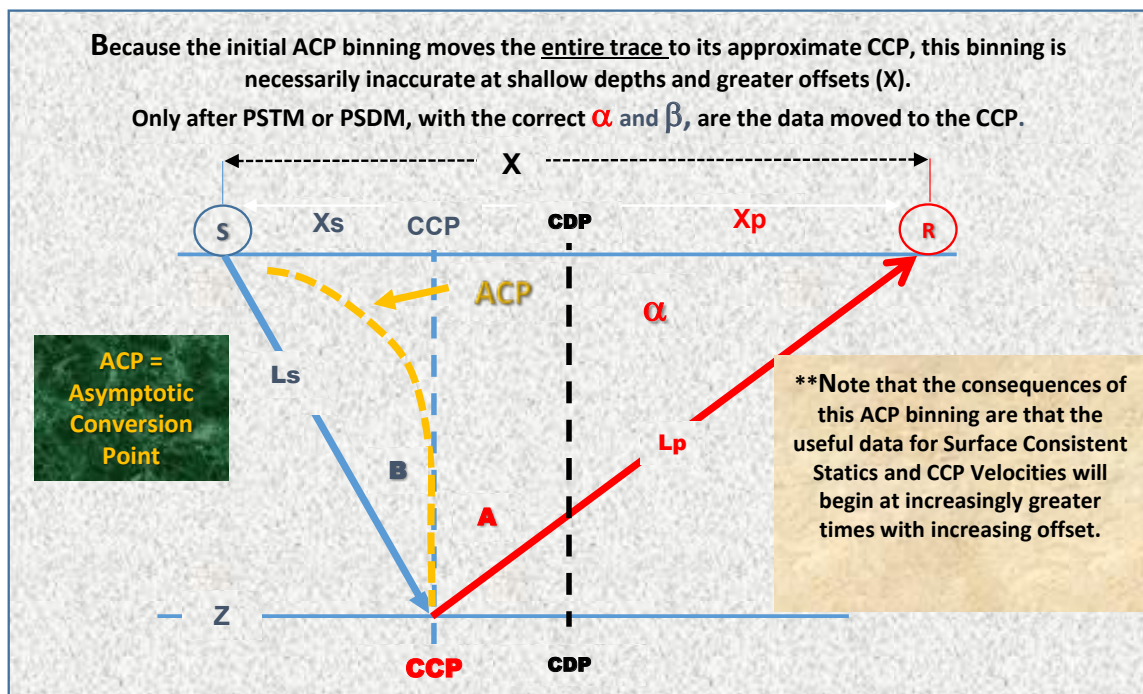
Conversion Point Binning

In order to do pre-stack processing (e.g., **statics** and **velocity analysis**), we usually assemble a collection of traces best called a Common Mid-point Gather (**CMP**). We know the distinction between a **CMP** and a **CDP**, but for surface consistent statics and initial stacking velocity estimates, it serves well.

The **Sv-P** events are not so lucky. We can compute the position of the **CCP** (Common Conversion Point), but we can't collect a set of traces that comes close to the approximation of **P-wave** data that **CMP \approx CDP** (which is close for low dip data).

The problem with **Sv-P data** is that the reflection point (where it converts to a **P-wave**) doesn't have a constant relationship to source-receiver offset, **X**, such as the **Mid-Point** does for the **P-wave**. The contribution to the **CCP** comes from different traces with different offsets (**X**) at deeper depths (**Z**). This is a consequence of the fact that the angle of reflection is not equal to the angle of incidence:

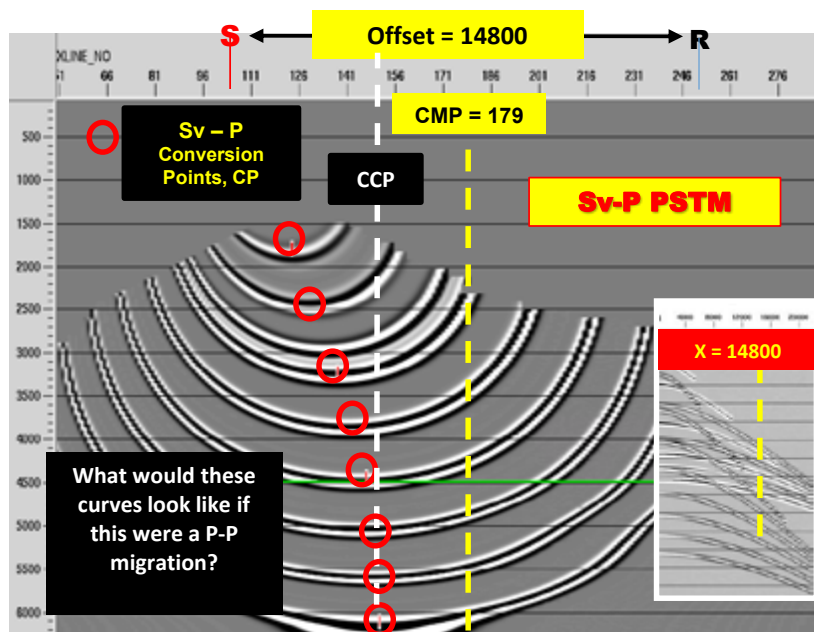
[**A \neq B**]. In spite of these obstacles, processors will treat a trace at location **CCP**, in a **CMP** gather, as if it were a trace in a **CCP** gather with its offset, **X**. As **B** decreases with depth, **Z**, this self deception approaches reality, and we may use the data for pre-migration processing which requires surface consistency. This asymptotic binning, **ACP**, is worrisome.



Tutorial Nuggets

Tutorial Nuggets continued from page 24.

One method to evaluate over what time length a given offset (X) trace falls within an acceptable range of **CPs**, is the migration **Impulse Response** shown here. In this case a single trace ($X = 14800$) from **CMP 179** has been migrated. Only the **Sv-P** reflections are migrated. Events are moved up in time (removing **NMO**) to the true vertical time, $TC(0) = [Ts(0) + Tp(0)]/2$. They are moved laterally toward the position of their real **CP** (red Circles). The white dashed line, **CCP**, shows that deeper events (say, 4 to 6 s) are close, while shallow events deviate from this pseudo **CCP** significantly.



October Nugget Puzzle. Three brothers (Tad, Tommie, and Lee) are peddling two prospects at NAPE, in Houston. One of the two prospects is a known to the boys as a **duster**, but the other is known (by them) to be gushingly **productive**. The catch is that while **two** of the brothers are scrupulously honest **truth tellers**, the other is a **pathologic liar**.

Here's your Puzzler: What **one question** can you ask of one brother that will guide you to the productive prospect unerringly?

[Spoiler Alert] You simply go up to **Tad** and ask him, while pointing at **Tommie**, "What would **Tommie** say when asked what **Lee** would say is the sure-fire producing prospect?"

NB: any combination of the bros will work. If this answer doesn't cause an immediate epiphany, see the neighboring **Nugget Puzzles** on this site.

November Nugget Puzzle

With Thanksgiving on the horizon, the Guru has magnanimously agreed to make this puzzler easy and perhaps useful. It may, however, cause unrest among those who missed that day in school.

In the model at the right, what is the average velocity, V_{ave} , for the vertical reflection off the bottom layer? In other words, the average of the four given velocities traveling the same distance at each, respectively. Pretty obvious, eh?

ΔZ	Vint
1000 ft	2000 ft/s
1000 ft	3000 ft/s
1000 ft	4000 ft/s
1000 ft	6000 ft/s

This little puzzle is a kissin' cousin of the old childhood teaser about a trip up and back down the other side of **Piker's Peak** (a parsimonious version of the famous Colorado mountain). From ground level to the Peak, the distance is precisely **1 mile**. From peak to ground level on the other side, the same. You're driving a 1999 Ford 150 and can manage a swift **30 mph** on the steep trip up.

The problem: **How fast** must you travel **down** the mountain in order to **average 60 mph**? (Tighten your seatbelt). Let's kick it around next month.

GSH Outreach

Committee Activities - *By Lisa Buckner*

October was a very busy month for the GSH Outreach Committee and member volunteers. We participated in earth science events on two consecutive Saturdays and a HCC Career Expo. More information and photos from all events will be included in a later issue. Earth Science Week (ESW) is sponsored by the American Geological Institute and it's Member Societies (including SEG) on behalf of the geosciences community. "Our Shared Geoheritage" was the theme of Earth Science Week 2016. Geoheritage is the collection of natural wonders, landforms, and resources that have formed over eons and come to this generation to manage, use, and conserve effectively. Geoheritage locations are valued for many reasons, including scientific, economic, ecological, educational, cultural, aesthetic, artistic, and recreational purposes.

The first event was held on Saturday, October 8 was the 13th Annual Earth Science Celebration at the Houston Museum of Natural Science organized by our friends & colleagues, the Houston Geological Society. The festival consisted of volunteer demonstration stations with hands-on activities from area earth science related professional societies including GSH and the UH SEG Wavelets.

The second event held on Saturday, October 15 was the 6th Annual Energy Day Festival presented by Consumer Energy Alliance. This free, family-friendly downtown festival was held in partnership with the City of Houston at Sam Houston Park. It was intended to educate K-12 students and the general public about all forms of energy. Please visit the Energy Day website at <http://energydayfestival.org/> for more information. The GSH had a tented booth with several activities.

On Friday, October 28, GSH volunteers hosted a career booth and gave classroom presentations to community college students at the HCC STEM in "Real Life" - Career & College Exploration Expo.

Female role model volunteers are needed the evening of November 15 on the Houston Baptist University campus to talk to high school girls at the Young Women Energized event organized

by the Women's Energy Network (WEN). You do not have to be a member of WEN to volunteer. A box dinner is provided and you will speak to 11th & 12th grade girls at their table about your career in the energy industry.

If you are interested in volunteering for any future outreach events, please contact Lisa Buckner at lbuckner@hess.com or 713-496-4256.

Are you interested in volunteering? Do you know of a school that has a career day, seeking speakers or a career fair at which GSH might be able to host an exhibit booth? Or have you been invited to give a classroom presentation at your child's school? We can work together to bring awareness to the students & their educators of the many rewarding and fun careers in the geosciences. Please contact Lisa Buckner at lbuckner@hess.com or 713-496-4256.

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The GSH Annual Icebreaker Recap ———

The Importance of Connecting as a Community

By Kat Pittman

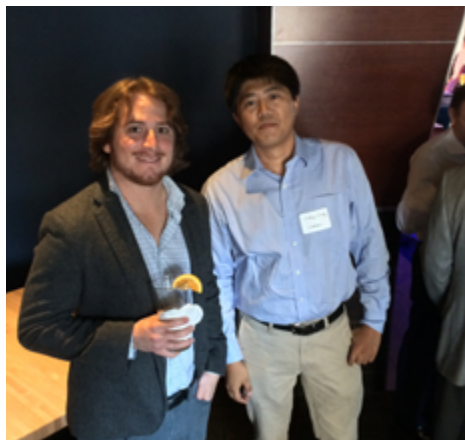
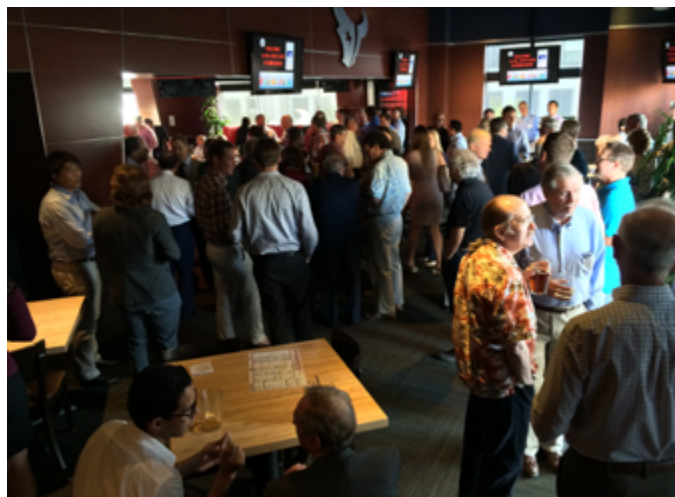


Reconnecting at the Icebreaker

The Geophysical Society of Houston puts on a number of technical and social events throughout the year, but we always kick off a new season by reconnecting after the summer at the annual Icebreaker. The 2016 Icebreaker was held in a private area at the Houston Texans Grille in CityCentre. This year's Icebreaker had a strong turnout at 150 attendees and the party lasted long after happy hour was over. The incoming Second Vice President, Dennis Sump, introduced the new 2016-2017 Board of Directors and President Amy Rhodes raised a toast to the year to come.

Despite the current industry climate, I am proud to say that the event remained free for members. The vibrant energy in the room was a great reminder that though the industry is in a downturn, it is important to band together as a community of professionals. Business connections were

made on the spot and the feedback from the event has been overwhelmingly positive. There were many familiar faces in the crowd, but I was pleased to meet quite a few



Icebreaker continued on page 27.

people that said this was the first society event they had attended in years. There were many new and renewing members as well; twelve new applications for membership were submitted at the event alone.

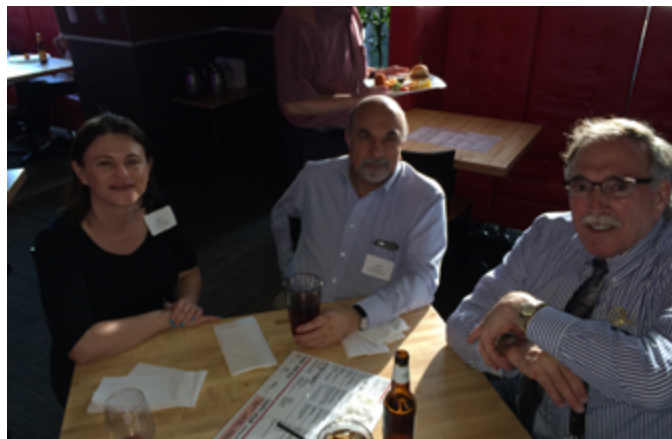
Become Part of the Community

If you are a member that hasn't attended a GSH event in a while, I encourage you to become more active in the society. There's no time like the present. There are opportunities available almost every week to expand both your knowledge and your network. We truly have something for everyone. If you love the great outdoors

and missed our Saltwater Fishing Tournament in October, and if you like golf or tennis, we have tournaments to come in the spring. You can learn alongside colleagues at monthly technical breakfasts and lunches, attend a Special Interest Group (SIG) meeting, or mingle with some of the greatest minds in our industry (many within our own community) at the Spring Symposium in April. Volunteer opportunities are readily available for both technical and social events and offer another great way to get involved. If you do not know anyone in the society at this time, grab your coworker, friend, or spouse and bring them along with you. Reach out to one of the board members, introduce yourself, and I assure you that you will quickly feel right at home.

Our Commitment to Members

This is an important time for the GSH to step up and serve its members by providing ample opportunities for community and growth. Our key purpose is to support our profession by supporting each other. Do you have a vision for something that the society could be doing to support you or the industry? We would love to hear what is important to you during this unique time. I encourage you to utilize the resources available to you within the Geophysical Society of Houston and I hope to see you at one of our events soon.



A Conversation With ...

Heloise Lynn

By Lee Lawyer

I want the readers of this conversation to understand and try to visualize the hand gestures and the waving arms used when Heloise describes layering and azimuthal affects found in various geological settings. It is too bad we can't do this interview for a viewing audience rather than just a reading one. But use you're your imagination. How would you illustrate a rock velocity that varies in all directions? How would you describe a thin bedded limestone with vertical fractures? As you will see, Heloise is an enthusiastic advocate of Azimuthal Anisotropy. I have used those words many times in this conversation. I think we could have saved much time and space had we used "AZ AN" (as an) instead of Azimuthal Anisotropy. Anisotropy is pronounced in the U. S. as "an-eye-sot'-ro-pea" with emphasis on 'sot' which rhymes with 'pot'. In Europe, they pronounce it "an-eye-so-tro-pea" where 'tro' rhymes with throw or row or go..... Aw...just go ahead and say Azimuthal Anisotropy. (Lee Lawyer)

Give us some idea of your background.

'71-'75 were my college years. I majored in geology-math at Bowdoin College. From '75-'76, I worked for Texaco in Houston processing seismic data. The important part of the 1970 to 1975 years were the summers I worked in earthquake seismology in the Los Angeles Basin. Earthquake seismology uses three component recording involving p-waves and shear waves, so I was working seismology even during my bachelor's degree.

So wiggle traces were well known to you?

I knew about earthquake seismology. When Texaco interviewed me for a job of processing seismic data, I asked, "Can you tell me about processing?" And Texaco gave me a little 10 second spiel. I asked what was CDP or NMO as I didn't know the terminology but they hired me anyway! I was familiar with seismology but reflection seismology has its own vocabulary. Anyway, Texaco provided on-the-job training and they did a great job.

The Stanford years were from '76-'79: I still hold the record of three years and three months for entering with a BA and departing with a PhD. From 1980 to 1984 I worked for Amoco in Houston. In 1984, our first child was born and that year I became a consultant. Carl Savit hired me to be the ghost editor for Milt Dobrin's updated textbook on Geophysics, so I was "back in the saddle again."...

Recall that I started in the early fifties. There was very little geophysical knowledge at the University level. Very little. On-the-job training was everything. Standard Oil Company of Texas gave me the experience needed to



function in the geophysical world. I wonder if oil companies provide broad enough training today or do they expect graduates out of college to immediately contribute value? As I recall my major subject in geophysics had a lot to do with the Torsion balance. The cadre of professionals teaching seismology was very thin in those days.

All the companies do training. I can't imagine how you could hire someone directly out of college and expect good results. Maybe out of the Colorado School of Mines. With a Master's degree from Mines, the chances are good that you will understand reflection seismology. My husband, Walt Lynn, teaches Seismic Data Processing in the fall at CSM, so I am biased, of course.

Interestingly, the AAPG is preparing to publish the history of Exploration for oil and gas. They are looking for milestones.

Peter Vail, et al's work would clearly qualify as a milestone.

You are right but I chose Turbidites, maybe because it opened up new plays for exploration. Plate tectonics was extremely important from a geological perspective but didn't contribute very much to exploration for oil or gas.

I recall plate tectonics -- Walter (husband) went to Princeton where 'plate tectonics' was very big in the early 1970s.

Interview continued on page 30.

My professor at Bowdoin included plate tectonics in his course but started out by saying that this was controversial and that some claimed it made a lot of sense and others were holding back saying 'we don't know' and remained skeptical. And then there were those who violently opposed it suggesting that the advocates must have been smoking something.

It is amazing how that important breakthrough developed. The skepticism mainly revolved around how the continents could plow their way through all of that oceanic crust. That didn't make sense. It was when Hess published his paper on sea floor spreading along with all of the work done to validate that idea that plate tectonics was accepted as a fact.

I think the Exploration and Development arc needs to be studied and shown how they fit in to the arc of Western Civilization for the last 150 years. Alistair Brown at the GSH spring symposium had discussed historical development. He stressed that before we talk about what we are doing today, we have to understand how we got to "here." There was the confluence of hardware development and then processing, then visualization, how you interpret 3D data. In the field of azimuthal anisotropy we are coping with inadequate visualization tools. We in azimuthal anisotropy are seeking to add – comprehensibly – another dimension. Just like the industry went from 2D seismic to 3D seismic. We physically had to add another dimension. Alistair Brown made the point eloquently. Anytime you add another dimension you have to have the interpretation tools and the processing tools to exploit and understand what is going on.

I like the idea that you are calling azimuth another dimension.

Because we understand dimension. You have been in the seismic business all your life and all geophysicists of our age fully comprehend the swing from 2D to 3D.

Analog to digital.

That's right. I started with Texaco in 1975. We were doing 2D seismic and it was dynamite. I processed dynamite data for nine to 12 months. And then the Vibroseis data showed up. I was part of the division that processed Texaco's first Vibroseis line, at least in the Gulf Coast on shore. I was working in Houston in the Bellaire office of Texaco in the processing group for South East Texas, Onshore. I learned dynamite data processing. It was very straight forward. And then Vibroseis data came in. The data was not demultiplexed or cross correlated. The raw records looked "pretty hopeless".....but were not! That made a big impression.

That was a great way to learn the ins and outs of Vibroseis. The early Vibroseis was not what you would call 'really great'.



The point is that everyone understood two-D with offset. Then you go to three-D. It is best understood when you have a square patch of data in which you have all azimuths and all offsets. Because that is what we need to make an image especially in complex structure. You need the full azimuth to identify the reflectors in order to make a map. Obviously to make a map, you need reflectors. And to identify reflectors you need to image the data correctly. Our industry is making big strides in acquisition with "random" simultaneous sourcing: this could give a big uplift to azimuthal anisotropy – provided that full azimuth and full offset is the goal.

Azimuthal Anisotropy is the term you use?

That's right. That is my specialty.

It seems to me that Azimuthal Anisotropy is different than just handling data with different azimuths. Let's say I acquire data from all directions.

That's right. Full azimuths and all offsets.

But when you said, 'anisotropy' that is more than just azimuths and offsets. Say you had an area that was isotropic. That is different than including anisotropy in the mix.

It is true that there are places in the world where variations in velocity is not dependent on azimuth. An example is in the Midland Basin. Amoco sent their research crew in the early 80's to 13 different places across North America that included the areas where the Conoco group shoot went in the late 1970s. (The Conoco group shoot was organized around horizontal vibrators used to acquire

shear wave data. LL) Amoco research shot an eight arm star using both horizontal source components (SH, SV), and recorded with both horizontal geophones (inline and crossline), looking for shear wave splitting. Surprisingly, in one place in the Midland basin, there was no evidence of shear wave splitting, which indicates there was no evidence of azimuthal anisotropy. Today that would be interpreted that the horizontal stresses were equal at the depths of those reflectors at that location. The earth is layered – that's why reflections exist. The earth may be under unequal horizontal stress or it might have vertical line fractures: that causes the azimuthal variations in velocity. If you have azimuthal variations in velocity, you have azimuthal variations in amplitude also.

That means that azimuthal anisotropy is due to fractures?

Correct. In the presence of vertically aligned fractures, the p-wave that travels parallel to the fractures travels faster than the one that travels across the fractures. Note: The word "fracture" in English contains two sub-groups of fractures: a) stress-aligned micro-fractures whose apertures are too thin to flow fluids; b) macro-fractures with apertures wide enough to flow fluids. If you are in

a conversation with an anisotropist and she/he uses the word "fracture," inquire which type of fracture is being specified. In this paragraph, both types of fractures are being discussed.

We tried that in Michigan but didn't use 3D techniques, just 2D. That was where the technique first started.

The first public presentation of shear wave splitting (azimuthal anisotropy) in the oil and gas industry was at the 1986 Annual SEG Meeting (I was one of the session chairs) by Rusty Alford with Amoco. Upon the basis of his work and presentation, the SEG awarded him the Kaufmann Gold Medal (1990). Chevron also had a very illustrious history of anisotropy: Don Winterstein and Don Meadows worked in your research group.

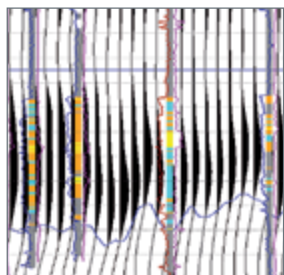
West Africa also has a lot of anisotropy.

Offshore West Africa had the largest magnitude of layer anisotropy ever seen. Just to image the data, you had to specify the magnitude layer anisotropy by flattening "the hockey sticks" at the far offsets after NMO. Now that was basically a revolution.

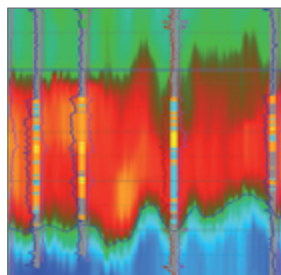
Interview continued on page 32.

Optimize Unconventionals

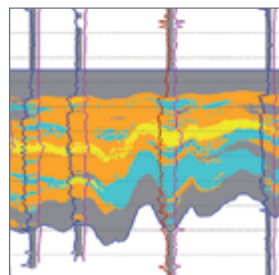
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Passion for Geoscience

What do you consider to be one of the most important advances you've seen in the industry?

I like the computer doing all of the work picking horizons and faults. Once the horizons are in hand, then the evaluation of azimuthal travel times and azimuthal amplitudes (prestack) can proceed. Azimuthal interval velocities are the starting point for azimuthal anisotropy studies. Lithology, porosity, pore fluids, fractures and in-situ stress, as learned from azimuthal interval velocities and azimuthal amplitudes, affect hydrocarbon production.

With what interval are you trying to calculate these measurements?

Today, fifty to one hundred milliseconds is a stable time window. If you try anything smaller, instability often occurs. The reason that I care about travel times is it gets you interval velocities azimuthally and that tells me about velocities, the pore fluids, porosity, stress and fractures. And then once I get the events picked in the prestack domain, I can do amplitude, amplitude by offset and azimuth.

It took two years to acquire and process the first commercial 3D survey. GSI conducted the survey as an example. Several large oil companies signed up but the oil company that owned the field that was to be covered by 3D data declined but gave permission to conduct the survey. Interestingly that same company bought the finished product a couple of years later. I think that was Conoco but I am not sure of that.

I have heard that the survey was just very closely spaced 2D lines laid out parallel to each other.

I believe that is what it was. Although, they had the knowledge and the experience to layout several geophone lines for one Vibroseis line. Surely they took advantage of that. Perhaps that is why the processing was so difficult at that time. That was in 1972. I can research that item easily. Bill Schneider was the person responsible for migrating the data.

That is fascinating. Because....

Remember our objective was structure not azimuthal anisotropy.

You wanted a 3D image of the earth. The point is the industry has come a long way from 1972 to 2016. We rode on coat tails of the computers, the electronic industry so to speak.

Computers doubled in speed every ten years or something like that. Many people predicted that that couldn't last. We were going to hit a wall or a glass ceiling. Something

about the speed of light in wires but that didn't happen. We went right past that problem by miniaturizing. We got smaller and smaller. This is getting beyond my pay grade but electronics has allowed us to manage and store these massive amounts of data. I haven't calculated the storage and speed in 1972 over the then current data requirements versus the storage and speed today over today's massive amount of data acquired. There may be a universal constant there but I don't know which came first, the storage and speed or the data size, probably storage and speed came first. I know that geophysicists kept even with every advancement in electronics, regardless of size and speed. You could turn that around and say that geophysics was limited by the electronics available, which is correct.

I am so happy we no longer hang tapes here and there. That shuts us down. What we do today, we could never do if we had to hang tapes. I would like this article to draw a parallel between how our industry has grown from 2D to 3D, to how our industry has grown from isotropic to azimuthally anisotropic. I think that is great. I am totally in favor of 3D seismic. I say that most idea geophysicists today have a pretty good grip on 3D seismic. They are perfectly comfortable taking a volume of data from a contractor, loading it up, picking horizons and making structural maps. That is their day-to-day bread and butter. The next big step is going to be industry acquiring the tools to look at prestack azimuthal seismic, to interactively process azimuthal seismic and then to interpret azimuthal seismic.

What about 3C?

3C- 3D Full azimuth, full offset: provides more information about the relationships between P-wave anisotropy, S-wave anisotropy, fractures, in-situ stress, and hydrocarbon production. Now that's really the frontier that will be crossed in the next decade. Especially with Bob Hardage's idea that P-wave sources generate enough S-wave energy to be processed and interpreted. In 20 years, I believe our industry will be doing this routinely.

Isn't that more than we can assimilate?

No, no. That is a done deal. Where we need more development is in the interpretation software tools that help us track all these measurements. With 3C P-wave source we get the P-P and P-SV, full offset. The azimuth that the wave travels determines whether the P-SV travels as P-S1 (the fast shear wave), or P-S2 (the slow shear wave), or due to shear wave splitting, both P-S1 and P-S2 propagate.

What does the interpreter do with it? You are going to overload the interpreter with data. Consider a person out of college for a few years and then they dump something

that huge and ask for an interpretation. He is not going to be able to do anything with it.

The Hampson and Russell programs ProMC and Pro4D are very useful in this context. Pro4D understands time lapse seismic – PP seismic. But, it works equally well if you load it up with PS1 and PS2. Pro4D compares these two volumes to determine time shifts and amplitude difference, and then it spits out for every time interval and/or horizon, the maps of these values.

You are not telling me we don't need an interpreter, are you?

We will need an interpreter. We care about the difference in amplitudes. We care about the difference in times. It tells us about the earth. It tells us about stress and fractures. Now I will grant you that there is training involved. Companies that routinely record three component 3D would have to train their staff to deal with that data. You know about Bob Hardage who says that a vertical vibrator produces S-S. Do we process for it? No. Should we process for it? Yes.

There are multiples.

Multiples are problem. That's why we acquire zero offset VSPs – to identify the multiples.

There are converted waves. That is all you have in the marine environment. I don't think you can expect an air gun to produce s-waves.

Air guns don't produce S-waves. That is right. Bob Tatham published reflection data from offshore Florida that appears to be P (water) –S- (rock) – S (rock) –P (water), or, P-S-S-P. I say that people working hard water bottom P-P seismic ought to be looking at this and reprocessing their data because there is a lot of information in the S-S.

They haven't done that because of time. You conduct a survey that is designed to find oil in a given lease or area. It may take you five years to do all of the analysis. You have to admit that some of it may not directly relate to finding oil and gas.

We need to step back a little bit. I enjoy talking about the science end of our business but this interview is about you. Our readers can research mode conversions and the like in published literature. Do you hand-contour maps?

While I focus on Azimuthal Anisotropy, my current job duties do not require a lot of hand contouring. My skills get challenged because each dataset is different. I am looking at velocities and azimuthal velocities and how they relate to hydrocarbon production. There still is

the human element. The story we write is based upon measurements. We still make maps. The very best maps are those that are self-explanatory. Any experienced manager can look at those maps and draw his own conclusions.

It turns out that the maps I make for a given 3D project are usually on paper or on a screen. But you are still looking at a map. Each bin would have nine or ten numbers and you are interested in how those numbers relate to their neighbors and how they relate to hydrocarbon production.

I would not like nine or ten maps.

Nine or ten maps take too much time to go through. And so I use colored glyphs, or icons; a colored triangle or a colored bar or colored arrow or a bar. Each icon holds 3 numbers: an azimuth, a length and a color.

What do you do for color blind clients? You women don't have to worry about these things.

Some of my clients are color blind. I have to be careful not to use red and green. As you know, the rainbow color scale is the most widely comprehended. Warm colors are "good", or more prospective for hydrocarbon production. Cold colors are "bad" or less prospective. Managers want to know where the prospects are. The interpreter uses warm colors for the prospective areas knowing the managers will understand the interpretation.

I wrote a column on color blindness. I got a response from a manager who was color blind. None of his fellow employees knew he was color blind until they read it in my column. He compensated somehow and got away with it for years. I am sure others get by the same way.

Colors are very important to my work. I have worked for many different oil companies. Universally, oil is green and gas is red.

In the past all Chevron's leased acreage was shown in yellow and probably still is.

You are actively working and will probably continue doing that for some time to come. You really enjoy your work?

I do enjoy my work. It is an intellectual challenge. It is fair to say that I was in on the beginning of azimuthal anisotropy because I was a colleague of Rusty Alford and Leon Thomsen at Amoco. There was pre-anisotropy and post-anisotropy. The dividing point is the 1986 SEG Annual Meeting in Houston where five Amoco papers and two Exxon papers were presented. I was the session chairman and helped pick the papers for that session. Leon advocated inside Amoco to keep my name on my paper, which I greatly appreciate (to this day!). The point

is that 1986 was a ground zero for anisotropy inside the hydrocarbon industry.

Stuart Crampin had been publishing on shear wave splitting and azimuthal anisotropy for years but the industry didn't seem to take him very seriously. Post 1986, the industry signed on and effectively said yes, we agree with you.

If you could accomplish anything, what would your dream be?

My dream is to figure out a way to download (share) what I know to all interested geophysicists. Because if I can equip geophysicists to understand and do 80% of what I know and do, then they will be able to continue to discover new relationships inside anisotropy. Perhaps some might call on me for the other 20%. Even if they feel they don't need the additional 20% that is okay too. Everything I have learned about seismic data, I have learned from field data. My attitude is that I need to be looking at as much data as possible. My clients bring me quite a bit of data. Earlier we discussed some terabyte data sets. The point is, I have looked at data from the Middle East, Australia, China, North America and South America but there is a lot more data to look at.

We have hit the technical aspects of your career. Let's get a little more personal. Do you have children?

Yes, Walt and I have two, Justin (32 years old) and Everett (30 years old).

What are they doing? Any geophysicists?

No, the oldest one is in commercial real estate. The youngest one was in commercial real estate, but he has just started a new company (Amenify).

But they knew what mom and pop did. When Justin was six years old, Walt took him aside and quietly told him that mom was having a rough day. Go tell your mom, "Mom, you look like you have had a hard day. Tell me all about azimuthal anisotropy." I laughed and that has become a family story.

If you had to do it all over again. Would you change anything?

No, I would not change a thing, and yes. I would do it all over again.

Right now, the younger generation in earth science are having a tough time. If you had to give advice to young people, what advice would you give? Would it be go into the geoscience world?

Oil and Gas is a stepping stone that humans use to get into the renewal energy age. I feel that I am a buggy whip maker in the early 1900's. I may be the best buggy whip maker in the world but after Henry Ford rolled out those automobiles there was not much demand for buggy whips. The humans living on this planets need to get into renewals. Renewables will drive or power much of our civilization. Solar, Wind, geothermal, hydroelectric – the mix depends on where you are in the world. So I would advise a young college student to get into renewables. Different people have different skill sets so one piece of advice won't fit everyone. They could choose the part of renewables that best match their abilities and background. The burning of hydrocarbons is putting more carbon dioxide into the atmosphere and warming the climate. I think that countries or communities that make themselves self-sufficient with renewable energy will do very well. For example the San Luis Valley, Colorado, where Alamosa is located, has wonderful sun and wind. So they are making their whole valley 'hydrocarbon neutral' so to speak. They want to show others that self-sufficiency is really possible. They have had the will power to actually get to that point. Of course, they are lucky to have the sun and the wind. The people there realize that if they can build the infrastructure and harvest the energy, they won't be dependent on hydrocarbons. I think that is a good idea. They are struggling to get enough water. They have to focus on the intelligent use of water.

It feels as if we need some new technology to actually and realistically achieve those energy goals. For the youngsters, the horizons we choose are important. Are we talking 20years or 50 years? It makes a difference. It surely will be a gradual process unless that newly discovered technology is cheap and readily available.

I can see future generations complaining that we burned all of the hydrocarbons and left them walking or riding a horse, back to the buggy whip days. But I don't believe that. As earth scientists, we have great knowledge of what is down there. The earth generates an enormous amount of energy without any interference from humans. We just need to harness it effectively.

The young generation may not look that far into the future. They are interested to see who pays the largest starting salary. But interestingly, just as you did, they can get valuable knowledge and experience by going initially into the oil business, postponing the renewables a little bit.

Thank you Heloise. I have enjoyed talking with you.

What Lies Beneath Sugar Land?

By Christopher L. Lovely, Robert R. Stewart, and Li Chang



Figure 1

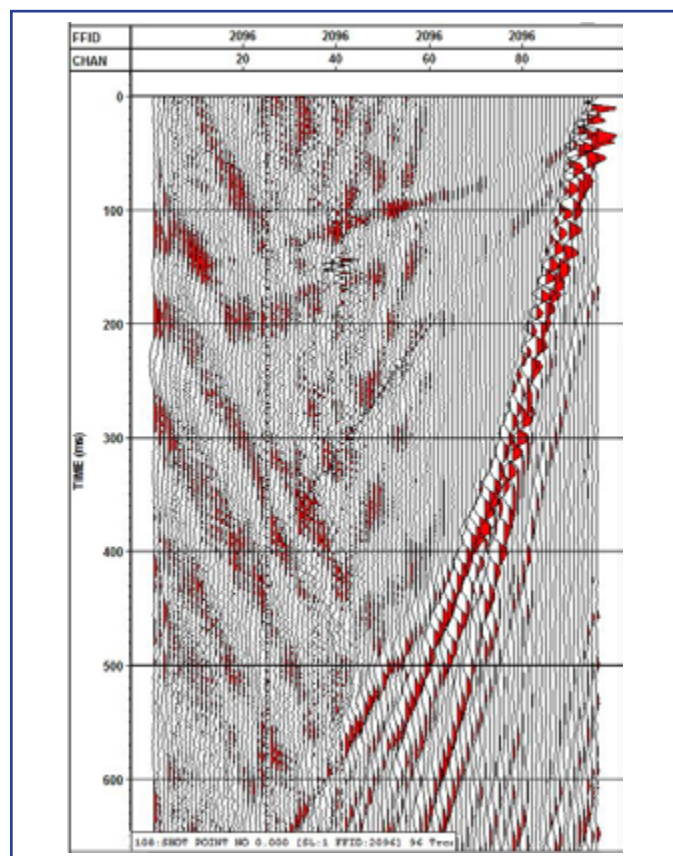


Figure 2A

The University of Houston (UH) System has a number of sites and affiliates. Joining the UH family this year is the attractive, newly developed Sugar Land (UHSL) campus. What could be better than to see what lies beneath it? In addition, geoscience faculty and staff at Sugar Land were keen to have seismic data for hands-on processing in their classes. As anytime is a good time to do a seismic survey and our Allied Geophysical Lab is always looking for a reason to “shoot some seismic,” we began by scouting the UHSL campus to find an appropriate area (*Figure 1*).

The rainy weather we experienced in Houston this summer delayed the start of field work, but it was finally an “all systems go” on August 2nd, 2016. The near-surface geology of the Sugar Land, Texas area consists of Quaternary alluvium and the Beaumont Formation containing clays, clay shale, and sands. We surveyed and flagged a short test line and photographed it with an airborne drone. We then employed an accelerated weight drop source, a Geode recording system, and 14 Hz

U of H AGL continued on page 36.

vertical-component geophones to acquire P-wave data. An example of a resulting raw shot gather (Figure 2A) and after filtering is applied (Figure 2B), we can see a clear direct P-wave arrival with a velocity of about 700m/s and a refraction of 1500m/s. A final brute P-wave stack was created (Figure 3) with coherent reflections to about 300ms (around 250m deep).

We next undertook an S-wave survey by swapping out the vertical geophones for horizontal sensors placed in an SH configuration (receivers oriented perpendicular or transverse to the line direction). The source was a toothed heavy block (also placed orthogonally to the line direction) struck by a sledge hammer from either side. The resulting S-wave data (Figure 4) shows a direct arrival of about 150m/s and a refraction of 300m/s. As an added bonus, ground penetrating radar (GPR) was used to gather additional near-surface information. We used the Noggin Plus 250Mz Smart Cart for three 200m transects.

All in all, the survey was a success. The data collected will be used as a learning tool for students to hone their skills in data processing and interpretation. Special thanks to those who made this happen out in the field (Figure 5). Next, over to UH's Katy campus!

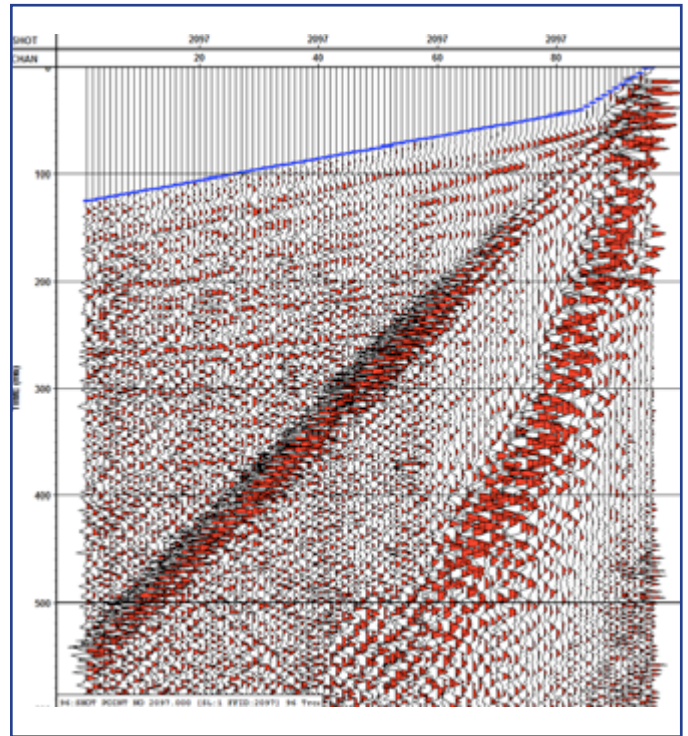


Figure 2B

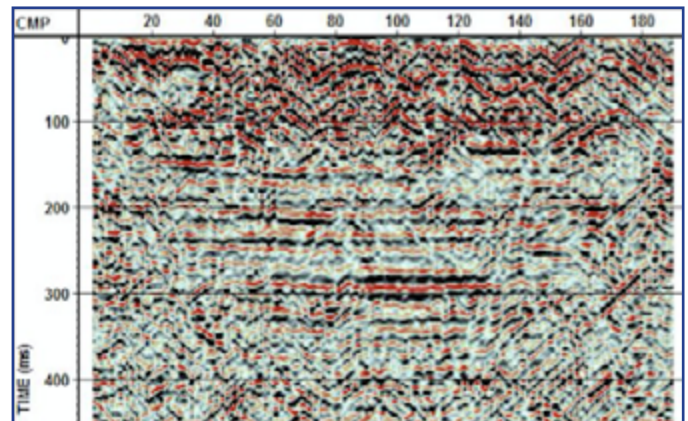


Figure 3

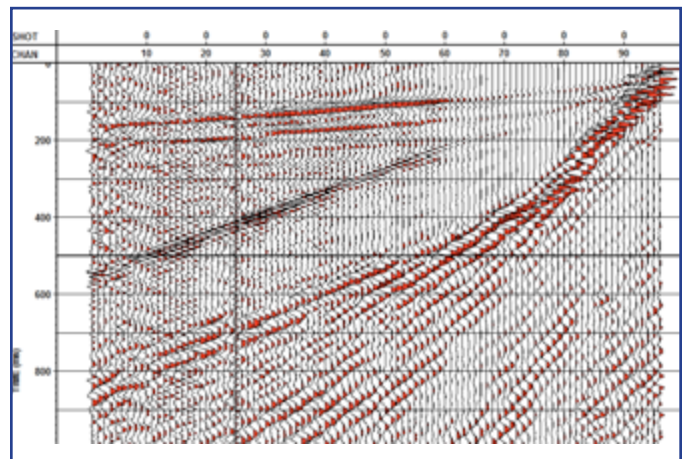


Figure 4



Figure 5

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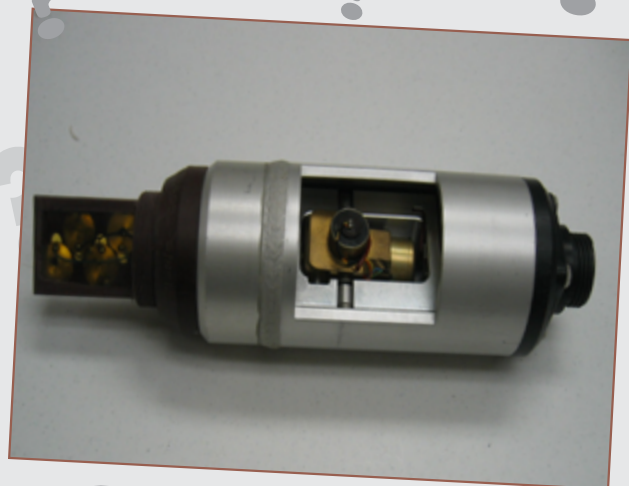
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This is a geophysical item...



Do you know what it is?

This month's answer on page 42.

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Geoscience Center News

By Bill Gafford

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

As I had mentioned in a previous article, we have expanded our Bob Sheriff Library and added more bookcase space in an adjoining area that had been used for storage. This area will now include periodicals and other items. We are missing a number of issues of "The Leading Edge" and "Geophysics," so if you have a collection of these that you might be willing to donate, please let me know. If we have duplicate copies of any donated periodicals we will include them in a program with the AAPG's Publication Pipeline, and they will be sent to educational institutions overseas.

Our next Living Legends Doodlebugger social event will be on Thursday, November 10 from 9:00 until noon. As usual, everyone is invited, not just retired doodlebuggers, and there will be light snacks, coffee, soft drinks, water, and good conversation. Some of our newer displays will be available for enjoyment too.

The following story, from Don Townsend, documents some of the dedication of our volunteers in preserving some of our history:

Charles Lyell's "Principles of Geology" is generally considered the cradle of all geological literature. Published in 1833, it reached completion in four volumes with its fifth edition in 1837, and it was this edition that was discovered in the Bob Sheriff donation of books and publications to the GSH Geoscience Center and Museum.

The four volumes displayed every sign of their 170 years of heavy usage, and "somewhat tattered condition" would be a kindly description. Further investigation showed all pages to be present, just scattered over several bundles. As such they represented a problem, or maybe a challenge for Don Townsend, Gene Womack, and Ed Lengel. The individual volumes were carefully reassembled. Don rebound them in the original color cloth, Ed color-matched the single remaining spine and produced an authentic set of spine labels, and Gene built an impressive 18th century wooden box to protect and display the four volumes.



Barbara Barnes (née Sheriff) the current Sheriff geophysicist has, since 2013 acted as our link to the Sheriff family as well as being a donor to the library. In early August, Barbara, with sisters Jean and Anne spent a long week-end with their mother, Margaret.

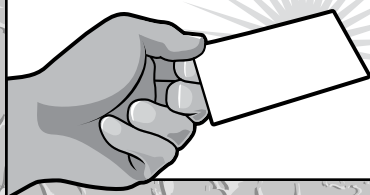
Gene and Don paid them a short visit to express our regards to Mrs. Sheriff, and presented her with a bouquet of yellow roses.

During the visit Gene produced the Lyell set which was much admired. He then presented it as a surprise gift to Barbara in acknowledgment of her assistance to the library.

Lyell's work has been reprinted and is now safely embedded in digital numbers, but it is still nice to have a piece of history sitting on your book shelf.



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



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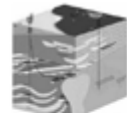
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HPAC Auxiliary News

The Houston Petroleum Auxiliary Council

By Susan Graul, GSH - HPAC Liaison, Srg02@comcast.net

Our HPAC Mission Statement is "to promote and foster social relationships among its members and to assist the Engineering, Geological, Geophysical, and Land Societies in their various requests."

HPAC Book Club meets on the 1st Monday at 10:30 a.m. in November, February, May and April. The ladies will be discussing "A Paris Apartment" by Michelle Gable, on November 7, 2016. Discussion Leader is Matha Lou Broussard and Pauline Sayers is the gracious host. If you are interested in sitting in, please contact Mickey Murrell or Phyllis Carter. The next book to be read is "The Swans of Fifth Avenue" by Melanie Benjamin. They will meet February 6, 2017 for discussion at Pat Thomsen's, hostess.

Martha Lou Broussard led the **Exploring Houston Group** on a wonderful tour of two museums on Tuesday, October 25. A docent led tour of the Degas: A new Vision Exhibit at the Museum of Fine Arts. After lunch at the Jade Stone Café in the Asia Society of Texas Center, the ladies scoured the magnificent building designed by Japanese Architect Yoshio Taniguchi. What a day it was!

The Ashton Gardens, the food, the friends and styles by Scruples was a grand event! Ninety ladies attended to view the new styles for the year. Donna Parish introduced the models for the day which only one was a HPAC Member. Can you guess which one?

Mark your calendars for Wednesday, December 7, 2016, for **THE HOLIDAY EVENT – "A Victorian Tea"** accompanied by harpist is to be held at the St. Regis Hotel. Announcements will be mailed so get your reservation in early.

Bridge Clubs continue to meet on same schedule as last year.



Donna with the models for the day.



Susan Graul, Kathi Hiltermann and Georgeann Massell. Lots of friendships being renewed!

Daniel C. Huston
Holly Hunter Huston



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Mystery Item

The Mystery Item for the November GSHJ is a geophone/hydrophone combination used in shallow water.

Mystery Item on page 37.



Doodlebugger Diary

Living, Working and Learning on the Sea

By Courtney Anzalone

Your GSH assistant editor, Courtney Anzalone, continues recording her life as an InField Geophysicist. This is the third part of a three part series to allow our audience the ability to see how the times have changed in regard to safety and technique. 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.

Greetings from onboard the Amazon Warrior! I have been onboard for about 3 weeks now and have finally settled into a routine. The helicopter ride to the vessel had my heart in my throat, but overall it was an interesting experience. I immediately went to the instrument room to meet my new team and find out what shift I would be working. I didn't realize I would start work at that moment, but it was actually better to jump in right away rather than potentially get lost. I can't count the amount of times I got lost walking around the ship and it took me about 4 days to be able to find my way from the instrument room to my cabin and to the recreation area easily. The crew is mostly men but I hadn't really noticed it because everyone is very welcoming and social. The geophysicists onboard don't just process the seismic data but wear many hats. They can go from processor to IT expert to back deck work in a matter of minutes and are expected to be able to pick up whatever work needs to be done. Although there is shore support for all these aspects, there are limits to what they can help with so it is up to us to get the job done.

Back in the day, I had heard stories of just QCing the navigation on the vessel. Today, the industry expects that full processing is performed on the vessel. As primarily a depth imager in my career, I have to admit that the processing has been very different for me. I have learned a lot about the actual acquisition of seismic by being out here and witnessing it firsthand. I think everyone should see acquisition in person at least once and experience infield processing. What a difference it is.

The Amazon Warrior is like a floating hotel and has all the amenities one could possibly want. There is a massive library of movies, books, television shows, and music to pick from so you never run out of entertainment. They also have a host of sports tournaments on board which helps the crew bond together and boosts morale. The gym is state of the art and there is also a sauna available for use. The food onboard has been consistently good and there are always snacks available. The temptation to constantly snack has probably been my biggest struggle on board. It has been interesting comparing my experience to others who were out on the vessel twenty years ago because of all the luxuries available onboard nowadays. The job seems to have grown to include more roles and more work but the amenities make it easier. You become part of a routine which includes doing your twelve hour shift, working out, possibly watching a movie with some crew members, and then sleep to do it all over again the next day. The days tend to blur together because of the routine and I often forget what day of the week it is. I haven't noticed the lack of days off and the time of day doesn't really have any meaning anymore because someone is always working or sleeping because this is a 24 hour operation. The limited resources out here make you think outside the box and require you to be creative to get the job done. I have enjoyed my time on the vessel so far, and I'm looking forward to another trip onboard.



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