September 2018

GSH Journal

GEOPHYSICAL SOCIETY OF HOUSTON
Volume 9 • Number 1

The Epicenter of Geophysical Excellence

Webinar
Extracting Geology from Seismic Data – Page 14

GSH-SEG Webinar Series is Online – Page 21

A Conversation With...Robert Stewart, Ph.D. – Page 31

Doodlebugger Diary: Eritrea - What Happened To Thee?– Page 48

Upcoming Events:
GSH Icebreaker – Page 25

TABLE of CONTENTS

• MEETINGS •

•• FEATURES ••

•• CHECK THIS OUT ••

•• LOOK INSIDE ••

On The Cover...

Covers from last years Journals

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 Dmitry Kulakov, editor, at dkulakov@slb.com

GSH JOURNAL DEADLINES

Nov 2018 ..... **Sept 13**
Dec 2018 ..... **Oct 12**
Jan 2018 ..... **Nov 9**

GEOPHYSICAL SOCIETY OF HOUSTON ORGANIZATION CONTACTS

Karen Blakeman, Office Director • Kathy Sanvido, Webmaster/Membership Manager
14811 St. Mary's Lane, Suite 204, Houston, TX 77079 • Office Hours 8 a.m. - 5 p.m.
Phone: (281) 741-1624 • Fax: (281) 741-9364 • Email: office@gshtx.org • Website: http://www.gshtx.org

GSH Board of Directors = GSH Executive Committee + SEG Section Representatives

PRESIDENT	Dennis Yanchak	713-296-6109			Dennis.Yanchak@apachecorp.com
Sponsorship	Haynie Stringer	281-491-2045		832-606-3993	hayniestringer47@yahoo.com
Doodlebugger Fund	Paul Schatz	713-975-7434		713-829-5254	Paul.Schatz@int.com
Editorial Board	Lee Lawyer	281-531-5347		713-628-3513	llawyer@prodigy.net
Historian	Art Ross	281-360-9331			artross@airmail.net
Office	Dave Agarwal	281-920-4450			dave0836@aol.com
	Glenn Bear	832-624-9950		281-250-4013	glenn.w.bear@exxonmobil.com
Outreach	Lisa Buckner			713-252-9665	outreach@gshtx.org
Scholarship Liaison	Jim Schuelke	713-296-6801			Jim.schuelke@apachecorp.com
PAST PRESIDENT	Tommie Rape			713-829-5480	tommiedr@aol.com
Advertising Committee	TBD				
PRIOR PAST PRESIDENT	Paul Schatz	713-975-7434		713-829-5254	Paul.Schatz@int.com
MEMBERSHIP					
PRESIDENT ELECT	Craig Beasley			713-689-6818	cbeasley@slb.com
GSH/SEG Membership	Fernando Enrique Ziegler	832-413-1260			fernando.ziegler@gmail.com
Volunteer Coordinator	Nicola Maitland	713-972-6209		281-507-6552	nmaitland@resolvegeo.com
Diversity & Women's Networking	Nicola Maitland	713-972-6209		281-507-6552	nmaitland@resolvegeo.com
TECHNICAL EVENTS					
FIRST VICE PRESIDENT	Maitri Erwin	713-380-4800		281-785-5814	maitri.erwin@gmail.com
FIRST VICE PRESIDENT ELECT	Peter Wang	713-393-4013			pwang01@gmail.com
Tech Luncheons	Maitri Erwin	713-380-4800		281-785-5814	maitri.erwin@gmail.com
Tech Breakfasts Northside	Glenn Bear	832-624-9950		281-250-4013	glenn.w.bear@exxonmobil.com
Tech Breakfasts Westside	Michael Obriain	713-689-6913		713-829-5238	obriain1@slb.com
	John Gilbert	713-689-7803		832-655-4197	JGilbert@exchange.slb.com
Continuing Education	Mike Graul	713-465-3181		713-248-3562	mgraul@texseis.com
Webinars	Haynie Stringer	281-491-2045		832-606-3993	hayniestringer47@yahoo.com
Spring Symposium	Maitri Erwin	713-380-4800		281-785-5814	maitri.erwin@gmail.com
Geoscience Day	Haynie Stringer	281-491-2045		832-606-3993	hayniestringer47@yahoo.com
SEG DISC	Peter Wang	713-393-4013			pwang01@gmail.com
SPECIAL INTEREST GROUPS (SIGS)	(Peter Wang)				
Data Processing and Acquisition	Clement Kostov	713-689-5752		832-506-6026	kostov1@slb.com
Microseismic	Scott Singleton			832-524-8382	Scott.Singleton@comcast.net
Potential Fields	Daniel Minguez	832-854-3249		626-818-2114	xdminguez@gmail.com
Rock Physics	Ratna Sain	832-624-8716			ratnanabha.sain@exxonmobil.com
SEG Wavelets	Jackson Zerrerr			830-931-7400	jacksonzerr@yahoo.com
SOCIAL / FUNDRAISING EVENTS					
SECOND VICE PRESIDENT	Denise Dorsey			713-397-4487	denise.dorsey@katalystdm.com
SECOND VICE PRESIDENT ELECT	Kenneth Mohn	713-485-9696		713-485-9696	Kenneth.mohn@mcg.no
Icebreaker	Tony LaPierre	713-482-3845		281-733-5281	Tony.Lapierre@rpsgroup.com
Salt Water Fishing Tournament	Bobby Perez			281-787-2106	rdphtx@aol.com
	Nathan Lenz			281-468-5459	nathaniel.lenz@tgs.com
Tennis Tournament	Russell Jones	832-295-8350			rjones@Seitel.com
Sporting Clays	Ryan Marshall	713-917-6772		713-962-9414	ryan.marshall@dawson3d.com
Golf Tournament	Wes Tyrrell	281.529.3246		713.485.9502	wesley.tyrrell@katalystdm.com
Annual Meeting & Awards Banquet	Katherine Pittman	713-972-6206			kpittman@resolvegeo.com
SECRETARY	Sara Davis	832-554-4314		713-256-8737	sdavis@seimaxtech.com
TREASURER	Gabriela Suarez			832-818-6832	suarezc2001@yahoo.com
Finance Committee	Katie Baker			713-822-5886	Kathleen.lizabeth.baker@gmail.com
COMMUNICATIONS					
EDITOR	Dmitry Kulakov			832-525-7815	dkulakov@slb.com
Assistant Editor	Courtney Anzalone			713-689-5741	canzalone@slb.com
Assistant Editor	Chirag Parekh			713-689-2388	cparekh@slb.com
Assistant Editor	Kara Shiflett			713-689-6226	kdetro@slb.com
Assistant Editor	Christopher Walker	281 787 8764			cwalker@sbgs.com
Technical Article Coordinator	Scott Singleton			832-524-8382	Scott.Singleton@comcast.net
Publications	Haynie Stringer	281-491-2045		832-606-3993	hayniestringer47@yahoo.com
Website Coordinator	Paul Schatz	713-975-7434		713-829-5254	Paul.Schatz@int.com
Social Media Coordinator	Liza Yellott	713-881-2894		713-204-0998	lyellott@Seitel.com
SEG SECTION REPRESENTATIVES	Sofia Campbell	713-668-5406		713-443-4436	sofia.campbell@comcast.net
	Tommie Rape			713-829-5480	tommiedr@aol.com
	Maitri Erwin	713-380-4800		281-785-5814	maitri.erwin@gmail.com
	Haynie Stringer	281-491-2045		832-606-3993	hayniestringer47@yahoo.com
	TBD				
	TBD				
SEG ALTERNATE REPS	TBD				
	TBD				
	TBD				
	TBD				
GEOSCIENCE CENTER	Bill Gafford	281-370-3264			geogaf@hal-pc.org
SPG-NA Rep.	Dave Agarwal	281-920-4450			dave0836@aol.com
ECH liaison	Bill Gafford	281-370-3264			geogaf@hal-pc.org
HPAC	TBD				
NeosGeos	Sean Kimiagar			817-727-6424	seankimiagar@gmail.com

A Word from the Board

Happy New GSH Year!

by Dennis Yanchak, GSH President

A year ago Houston was experiencing Hurricane Harvey and its after affects. Like so many Houston organizations, the Geophysical Society of Houston had to work even harder to reorganize and get back to work. Other organizations faced difficult decisions. For example, the Society of Exploration Geophysicists, after serious deliberation, moved ahead and held their annual convention in Houston. Likewise, the GSH quickly rescheduled and/or resumed our technical, social, and outreach programs. It has taken the better part of the year to get everything working as before, but it looks like we are there and ready for new (and, I hope, less devastating) challenges in the coming year.

Call me an optimist, but from my viewpoint, it finally feels like we are slowly emerging from the industry downturn. With that in mind, we have set a number of aspirations for this coming year. The first is to keep the GSH financially afloat. If anyone remembers my last Word from the Board column, I wrote that we were working through the 2018-2019 GSH budget. Dare I say, we don't have a balanced budget at the outset, but I believe the new board is up to the challenge of righting the fiscal ship before we end this year's geophysical journey in June 2019. As we now stand, there is an 8% budget shortfall so we will each have to do our part to finish in the black.

How can you help, you ask? That dovetails nicely into the second and third goals. The second is to increase membership to 2000. Please encourage your coworkers and friends to attend the many GSH events this coming year and, if they aren't GSH members yet, to join our society. There are numerous technical events as well as fun, social events starting with the annual GSH Icebreaker at Saint Arnold's Brewery on September 27th. Of course there will be other technical and social events earlier in September, so mark your calendars, tell your friends and coworkers, and come out to network, learn something new, challenge something old, and just have fun.

Our third goal is to increase involvement in GSH programs. We would like everyone to become more involved but especially the young professionals in the first years of their careers. There are many opportunities to get involved with the technical, social and outreach events that the GSH runs. Find one that piques your interest and volunteer. I can guarantee that it will be a rewarding experience. As Winston Churchill aptly noted, "We make a living by what we get, but we make a life by what we give." There are many opportunities in the GSH to give back to the society and to the community. Please consider volunteering your time.

Dennis Yanchak

The fourth goal is to continue to expand GSH's contribution to the geophysical community even beyond Houston. We do have cooperation agreements in place with our geophysical brethren and sistren in Denver and Canada. There are other geophysical groups that are interested in sharing with the GSH so we will continue to develop cooperative agreements with neighboring geophysical societies. This includes GSH's growing number of webinars, which, through their very nature, are not bound by physical borders.

My final goal is to increase donations and sponsorship by 10%. That, in itself, would cover the budget shortfall that we currently have. Donations and sponsorship support many of the programs that the GSH organizes. Without the generous support of our donors and sponsors the GSH would be extremely limited in our ability to support the geophysical community. I would like to take this opportunity to thank all of them for their past and future support.

There are a number of other issues that we will be addressing throughout the year. These will be reported as time goes by. Please stay tuned, follow the GSH e-Newsletter, check the website, and follow the GSH on Facebook, Twitter and Instagram. We look forward to you sharing your ideas for improving the GSH and getting involved! Karen and Kathy are ready to help with any GSH issues you may have or contact me – my email address is listed on the adjacent page.

I look forward to seeing you at this year's GSH events!

Dear GSH Journal reader,

Please, feel free to contact any of us with any and all questions or suggestions that you can come up with.

editor@gshtx.org

Sincerely,

Dmitry Kulakov, Editor

From the Other Side

By Lee Lawyer

This is the first GSH Journal in the 2018-2019 fiscal year and the first "From the Other Side" this year. I attended the first GSH Board meeting (July 2018) with the newly elected officers, the GSH has "Elect" positions which means the newly elected officers were "Elect" positions. This gives continuity to the Board from year to year. We received reports from each member of Excom and from committee chairs, if present. In the past we have had telephone board attendance but there was no way for the absent members to see the displays shown to rest of the board. In the future, the board meetings will utilize full webinar connections with displays shown on the computer screens. In the past we killed several trees by passing out a lot of paper at the start of each meeting. Perhaps the board will be able to see the attachments prior to the meeting and utilize virtual attendance if unable to attend in person, the displays will also be archived for future access.

Dennis Yanchak, our newly promoted President from President-Elect, emphasized the need for virtual attendance at the board and committee meetings. He also wants more emphasis on increasing membership numbers, which is easier said than done. The GSH has many functions during the year, most are technical such as SIG meetings, Luncheons, Spring Symposium, Tech breakfasts, but there are four annual social functions including fishing, shooting, tennis, and golf. We have an Ice Breaker in September (check your calendar.) To build membership, we need companies to allow and encourage members to attend technical meetings, this is a win-win for the attendee as well as their company.

I will give you an example, you missed another great presentation. The way I select the "great presentations" is simple, they are subjects that interest me. This presentation was a few months ago and the presenter was Dario Baturan with Nonometrics. Unfortunately, there were just a few of us who listened to Dario's talk.

He said, "What we've learned from 3 years of doing ISM: Five big lessons that can help oil and gas operators better mitigate risk" of man-made earthquakes. He postulated that earthquakes can be induced by human activities such as mining, reservoir or dam impoundment, geothermal reservoir stimulation, wastewater injection, hydraulic fracturing or CO2 sequestration and he has data to prove that claim. He referred to the increase of low amplitude earthquakes in Oklahoma. We know this increase was a result of waste water injection rather that hydraulic fracturing, but it was related. I assume that anything that changes formation pressure near existing faults will possibly cause an earthquake. I like that better than the idea that fluid injection can lubricate a fault and I think that lubricating a fault is probably a "false fact", so to speak.

This presentation did not affect the job performance of any of the attendees, but It gave broad understanding to an important issue that touches all of us. "Attend all of the technical meetings" is my philosophy, don't pick and choose but learn how others are applying geophysical methods. Who knows when you may become the 'other guy'.

. . . . . .

"I hold every man a debtor to his profession." Francis Bacon wrote this back about the same time Shakespeare wrote his greatest plays, some think that Bacon wrote some or all of Shakespeare's plays. That is still debatable, but to understand his statement we need to define the word, "profession".

There are several ways to describe a profession, the dictionary describes it as "A vocation that requires advanced education and training". There are sports that utilize the name, i.e., Professional football player', but they are paid money for an activity that is normally for amateurs. One caution is that we shouldn't confuse our profession with a professional society. We may belong to several professional societies but we only have one profession. Bacon had the right of it, we owe a debt to our profession and I agree with that but how does one go about paying that debt? Get involved with a professional society? Maybe we just live with it. Perhaps the debt is paid after 40 years, in service.

. . . . . .

ATTENTION: While working on this column, I received three calls from the "Grandparent Scammers" who try to mimic your grandson and convince you to send money! Caution, they are clever. Just hang up.

Technical Luncheons

Human Capital in a World of Analytics and Big Data in Exploration Workflows

Register for Tech Lunch Westside

Register for Tech Lunch Downtown

Register for Tech Lunch North

Speaker(s): Katya Casey, Actus Veritas Managing Director and 2018 GSH Honorary Membership Awardee, katya.casey@actusveritas.com

Katya Casey

Westside

Tuesday, Sept. 18, 2018
11:00 a.m. – 1:00 p.m.

Location: Norris Conference Center (City Centre)
816 Town & Country Blvd.
Houston, TX 77024
(Free parking garage)

Downtown

Wednesday, Sept. 19, 2018
11:00 a.m. – 1:00 p.m.

Location: Petroleum Club of Houston
1201 Louisiana St, Floor 35
Houston, TX 77002
(Valet parking onsite)

Northside

Thursday, Sept. 20, 2018
11:00 a.m. – 1:00 p.m.

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

Abstract:

What is the value of experienced human capital in an automated environment?

In this session, we will discuss the use of big data, analytics, machine learning and other recently popular digital initiatives in upstream oil and gas projects. Optimization of repetitive processes is an obvious candidate for the established assets, but what can be done in exploration where each basin presents a new set of issues and challenges? We will cover aspects such as:

- What is repetitive and what is not in Exploration Workflows
- Machine learning versus human capital development in the E&P organization
- Spatial data as a foundation in E&P workflows
- Data transformation requirements from exploration into production
- Big Data in Exploration

Several case studies and examples will be available for discussion. Through these talking points, we will engage the audience in a lively and productive discussion.

Biography:

Katya Casey holds a Master of Science degree in Geophysics from the University of Houston. Katya started her career with the Russian Academy of Sciences in Moscow and continued it in the United States where she worked for Amoco Petroleum, Vastar Resources, BHP Billiton, Apache and Murphy Oil companies. Currently she is one of three managing directors at Actus Veritas Geoscience, LLC. She developed and applied a new method of iterative interpretation of geophysical and regional sub-surface data with plate tectonics reconstructions and integrating results into petroleum systems analysis. Katya is known in the petroleum industry for designing and implementing multiple geoscience technologies and innovations including an early adoption of ArcGIS into oil and gas exploration workflows. She is adept at project definition and optimization of team dynamics. She provides mentorship and develops early career geoscientists and colleagues through publications, training, teaching, and industry forum presentations. Katya is also a respected technical speaker. She has coauthored papers and presented at multiple industry conferences and workshops. In 2008 she received an award in "Leadership in Technology" from the Association of Women in Computing.

Technical Breakfasts

Discriminating Between Commercial and Residual Hydrocarbon Saturation Integrating Pre-stack Seismic and CSEM Data

Register for Tech Breakfast North

Register for Tech Breakfast West

Speaker(s): Pedro Alvarez,
Rock Solid Images
Pedro.Alvarez@rocksolidimages.com

Pedro Alvarez

North

Tuesday, Sept. 4, 2018
7:00 – 8:30 a.m.

Sponsored by Anadarko Petroleum and Lumina Reservoir Inc.

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

West

Wednesday, Sept. 5, 2018
7:00 – 8:30 a.m.

Sponsored by Schlumberger and WesternGeco

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

Abstract:

We present an example from the Hoop area of the Barents Sea showing a sequential quantitative integration approach for seismic and CSEM attributes using a rock physics framework, which allows us to discriminate between commercial and non-commercial (residual) hydrocarbon saturations. A dataset consisting of 2D GeoStreamer® seismic and towed streamer electromagnetic data that were acquired concurrently in 2015 by PGS provide the surface geophysical measurements used in this study. Two wells in the area: Wisting Central (7324/8-1) and Wisting Alternative (7324/7-1S) provide calibration for the rock physics modelling and the quantitative integrated analysis. In the first stage of the analysis, we invert pre-stack seismic and CSEM data separately for impedance and anisotropic resistivity respectively. We then apply the multi-attribute rotation scheme (MARS) to estimate rock properties from seismic data. This analysis verified that the seismic data alone cannot distinguish between commercial and non-commercial hydrocarbon saturations. Therefore, in the final stage of the analysis we invert the seismic and CSEM derived properties within a rock physics framework. The inclusion of the CSEM-derived resistivity information within the inversion approach allows for the separation of these two possible scenarios. Result show excellent correlation with known well outcomes.

Biography:

Pedro Alvarez received a B.Sc. (2002) in geophysical engineering from the Universidad Central de Venezuela, and an M.Sc. (2007) in petroleum geophysics from a joint program between the Centro Superior de Formacion (Madrid) and the Heriot-Watt University (Edinburgh). He is a lead geoscientist at Rock Solid Images with more than 12 years of experience integrating and interpreting multiple geophysical and geological data in hydrocarbon reservoir characterization and exploration projects. His main area of expertise is the creation and application of different workflows for the qualitative and quantitative interpretation and integration of poststack, AVO, seismic inversion, and CSEM attributes. He has worked on projects in Venezuela, Colombia, Mexico, Alaska, Gulf of Mexico, Texas, Pennsylvania, Australia, West Africa, the Falkland Islands, West Africa, the Middle East, and Norway focused in different geological settings (clastic, carbonate and unconventional reservoirs). He is an author and coauthor of more than 20 papers presented in international conference and peer-review journals. Appointed by SEG as a 2016 Latin America Honorary Lecturer.

Data Processing & Acquisition SIG

Diffraction Imaging as a Migration Velocity Analysis Tool

Register for Data Processing

Dmitrii Merzlikin

Speaker(s): Dmitrii Merzlikin,
TCCS consortium, UT Austin

Co-authors: Zhan Fu, Brad Wray and Hao Shen, CGG

Sponsored by Schlumberger

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

Tuesday, Sept. 4, 2018
4:30 p.m. Sign-in, Snacks, Social Time
5:00 p.m. Start of presentation

Abstract:

Diffraction imaging is a set of methods aiming to boost direct responses of subsurface discontinuities to a seismic wavefield. Subsurface discontinuities include faults, channel edges, fracture swarms and etc. These direct responses have a shape of diffractions and are often weaker than reflections associated with laterally continuous boundaries. Conventional seismic data processing is targeted to enhance the latter events, and, therefore, might decrease diffraction amplitudes with respect to reflections even more. Proper processing of diffracted energy is crucial for highlighting subsurface discontinuities. Diffractions along with reflections carry information about wave-propagation velocity in the subsurface and are the only source of velocity information for single-offset and other narrow-offset distribution acquisition geometries, where conventional normal-moveout velocity analysis is not a viable option.

I will illustrate diffraction imaging capabilities by field data examples; discuss methods for efficient reflection and diffraction separation to highlight diffracted events. I will present a method for diffraction-based migration velocity analysis and provide its velocity-model independent formulation based on the double-path summation framework. I will demonstrate the ability of the proposed approach to automatically estimate migration velocity from diffractions by synthetic and field data examples.

Biography:

Dmitrii Merzlikin is a fourth-year PhD student in Texas Consortium for Computational Seismology (TCCS) at The University of Texas at Austin supervised by Dr. Fomel. He holds MSc and BSc degrees in Geophysics from Lomonosov Moscow State University. His research interests include: Seismic Imaging, Signal Processing, Diffraction Imaging, Path-Summation Imaging and Inverse Theory.

Both talks given by Dmitrii at the 2017 SEG Houston Annual Meeting were ranked in the "top 39".

Employers Matching and Gifting Programs

Please consider supporting the GSH through your Company Matching or Gifting Program. Volunteer hours are often rewarded with an Outreach Grant / Gift to the organization. Check with your employer now.

The Geophysical Society of Houston is a 501(c)3.

Rock Physics SIG

Dependence of Shale Velocity on Clay-mineral Content and Temperature

Register for Rock Physics

Keith Katahara

Speaker(s) Keith Katahara

Location: CGG
10300 Town Park Dr.
Houston, TX 77072

Wednesday, Sept. 5, 2018
5:15 p.m. Refreshments
5:30 p.m. Presentation Begins
6:30 p.m. Adjourn

Sponsored by NER, CGG and Ikon Science

Abstract:

Well-log sonic velocities in shales from several basins are independent of clay-mineral content at low temperatures. As temperature increases, shale velocities start to decrease with increasing clay. The clay-velocity slope becomes increasingly more negative as temperature increases.

The strong variation of velocity with clay content at high temperature is not due to varying porosity as indicated by the dependence of density on clay content. The pattern of clay-velocity variation is consistent with increasing clay-mineral orientation with increasing clay diagenesis.

One practical implication is that pore-pressure estimates based on shale velocity may need to consider clay effects if clay content varies significantly from layer to layer. Given that clay content is often poorly known, I suggest using the shale velocity at the threshold between grain-support and clay-mineral-support for pressure analysis.

Biography:

After earning a Ph.D. in geophysics from the University of Hawaii, Keith Katahara spent several years in academia measuring ultrasonic and acoustic properties of various materials at high pressure and at high and low temperature. He then spent 35 years in industry including stints at ARCO-Vastar-BP, at Spinnaker-Hydro-Statoil, at Devon and Hess. He is now an independent consultant and is on the adjunct faculty at the University of Houston. His industry experience includes designing and operating well-logging tools, well-log interpretation, rock mechanics, pore-pressure analysis, rock physics and quantitative seismic analysis.

Microseismic SIG

Case History of Monitoring a Hydraulic Stimulation in the Midland Basin Using Microseismic, DAS, Time-lapse 3D VSP, Tiltmeters, Pressure Gauges, and Proppant Tracers

Register for Microseismic

Robert A. Meek

Speaker(s): Robert Meek,
Pioneer Natural Resources

Co-Author(s): R. A. Meek, R.A. Hull, H Bello

Thursday, Sept. 6, 2018
11:30 a.m. - 1:00 p.m.

Sponsored by MicroSeismic

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

Abstract:

The development of unconventional reservoirs is dependent on horizontal and vertical well spacing, completion strategy, and timing among other factors. By combining a number of different tools a more accurate estimate of the SRV can be determined.

Data were acquired with a vertical observation well that was instrumented externally with dual and single mode fiber optics for strain, acoustics (DAS), temperature (DTS), and external pressure gauges as well as internally instrumented with conventional tiltmeters and geophones. We used this instrumented well multiple times to record a number of nearby offset horizontal hydraulic stimulations as well as for a 3D 4D vertical seismic profile (VSP).

In summary, by employing multiple sensors, including a fiber based DAS system, we are able to better characterize the stimulation as well as relate and understand key physical processes occurring within the hydraulic stimulation.

Biography:

Robert A. Meek is a Technical Specialist in the Geophysical Technology group at Pioneer Natural Resources in Irving, Texas. His focus is on rock property estimation using prestack inversion, microseismic and surface seismic analysis, neural networks, DAS, and time lapse vertical seismic profiling. He began his career in 1987 as a geophysicist at Mobil Oil developing coherent noise removal algorithms, subsalt imaging and forward modeling. He then joined Conoco in Ponca City, Oklahoma and transferred to Stavanger, Norway where he performed AVO analysis and modeling, prestack depth migration velocity model building and processing QC. He has authored several patents, papers and technical presentations. Robert holds a B.S. in geology from the University of North Dakota and an M.S. in geophysics from Southern Methodist University.

GSH OUTREACH is looking for volunteers for:
***Science Fair Judges**
***Career Days**
***Earth Science Celebration**
***Young Women Energized**
Contact Lisa Buckner at: outreach@gshtx.org
To support OUTREACH:
https://my.reason2race.com/cause/gsh

Potential Fields SIG

Crustal Structure of the Guyana Basin Based on High-Resolution Seismic and 2D Gravity Modeling

Register for Potential Fields

Mark Longacre

Speaker(s): Mark Longacre, MBL, Inc.

Thursday, Sept. 20, 2018
5:30 p.m. - 8:00 p.m.

Sponsored by CGG

NEW LOCATION:

Location: The Black Lab Pub
4100 Montrose
Houston, TX 77006

Abstract:

This study, based on the integration of high-resolution long offset seismic and 2D gravity modeling, has determined the crustal structure and depth to Moho for the Guyana Basin offshore Guyana. Three (3) gravity models have been generated showing the different crustal types associated with the two tectonic phases, Jurassic and Cretaceous, for opening of the basin. Previous interpretations suggested the NW-SE Central Atlantic opening generated Jurassic aged oceanic crust and resulted in a transform margin in relation to the Guyana Craton continental crust. However, this study shows there was an initial period of extension on the margin before translational movement. That Jurassic aged crust transitions from a typical oceanic crust near the border with Venezuela to a "transitional" crust near the border with Suriname. A second transform margin exists between the Jurassic oceanic crust and the Cretaceous oceanic crust that formed during the opening of the Equatorial Atlantic. Mapping the crustal thickness, crustal type, crustal boundaries, and depth to Moho is extremely important to understanding the tectonic evolution of the basin and its impact on hydrocarbon generation.

Biography:

Mark Longacre has been a professional geophysicist for the past 37 years working exclusively as a gravity and magnetic specialist for the oil and gas exploration industry.

Mark graduated from the University of Wisconsin – Milwaukee in 1978 with a Bachelor of Science degree in geology. He then attended Purdue and graduated with a Master of Science degree in Geophysicist in 1981. His thesis advisor was Professor William Hinze, now a Professor Emeritus in the EAPS department.

Mark started his career in San Francisco with Sohio Petroleum in 1981 as a potential field geophysicist in the Special Projects Group. In 1982 Mark was transferred to Dallas, where he earned an MBA degree in Technical Management from the University of Dallas, and then to Denver. In 1985 Mark joined Aqua Terra International, a gravity and magnetic consulting firm, as Manager of US Operations in Denver.

Then in 1991, Mark started MBL, Inc., a gravity and magnetics consulting company in Denver. MBL, Inc. specializes in the acquisition, processing, and integrated interpretation of gravity and magnetic data for the oil and gas exploration industry. In 1999, Mark opened a second office in London, England.

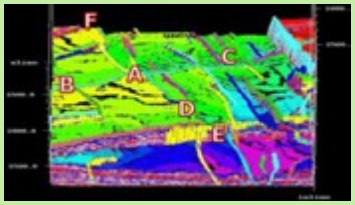
Over the past 27 years with MBL, Inc. Mark has traveled to over 60 countries doing a variety of specialized gravity and magnetic projects for the oil and gas exploration industry.

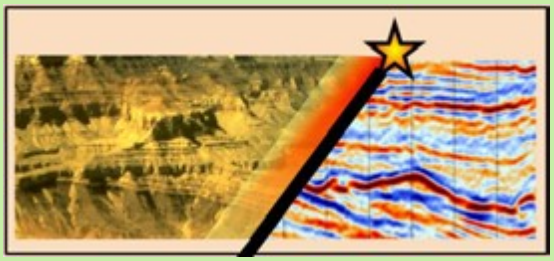
A Live Webinar

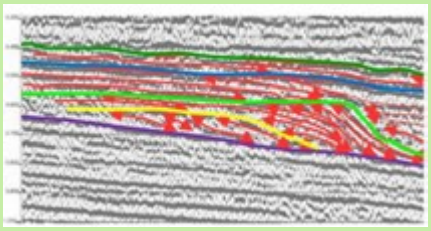
Sponsored Jointly by the SEG and GSH

Extracting Geology from Seismic Data

Part 2 in a series on Seismic Interpretation
Following up on the webinar by Herron & Wegner, May 2018







Four Half-days (10 AM – 2 PM)
Sept 25-28, 2018

Presented by
Fred W Schroeder

This webinar expands on the seismic interpretation webinar of May, 2018. Session 1 is a quick review of the geophysical theory behind seismic interpretation. Session 2 covers well-seismic ties and extracting structural information from seismic data. Session 3 focuses on extracting depositional sequences and system tracts. In session 4 we will discuss how we extract depositional environments and infer lithofacies. We will also look at some interpretation methods for the exploitation stage. Short lectures will prepare you to do hands-on exercises. The instructor will walk you through the various analysis techniques. Come prepared to work.

Session 1
- Seismic reflections
- Convolution
- 3D survey area
- Displays & vertical exaggeration
- Basic interpretation methods

Session 2
- Well-Seismic Ties
- Extracting structural info
- Interpreting fault cuts
- Interpreting fault traces

Session 3
- Extracting stratigraphic info
- Sequences and system tracts
- Selecting wildcat locations

Session 4
- Extracting depo environments
- Using seismic attributes
- Exploitation stage interpretation
- Tying development wells

Fred Schroeder holds a BS in Engineering Physics from Lehigh University and a Ph.D. in Marine Geology from Columbia University. For most of his career he worked as a seismic stratigrapher developing and applying new interpretation methods. For two years of semi-retirement, he was an contract trainer within industry and at Texas A&M. Serving as a volunteer, Fred has given seminars and short courses to over 2500 students.

This **16 hour course** can be taken in the comfort of **your office** or even **your own home**. It works on PC's, iPads, or iPhones. No travel costs. The **Course Fee: $390**, with major discounts for Groups and Students. 1.6 CEU's are awarded.

What if I have to miss a session?

Worry Not, All sessions are recorded and available to registrants.

Visit gshtx.org, Events Tab to register and see expanded Course and Presenter Information

Delaware Basin: Characterizing the Lower Abo Horizontal Oil Play Using Seismic

Johannes Douma, Meera Ramoutar, William Sirgo, Michael Swain, and Lee Catalano, Cimarex Energy Co.*

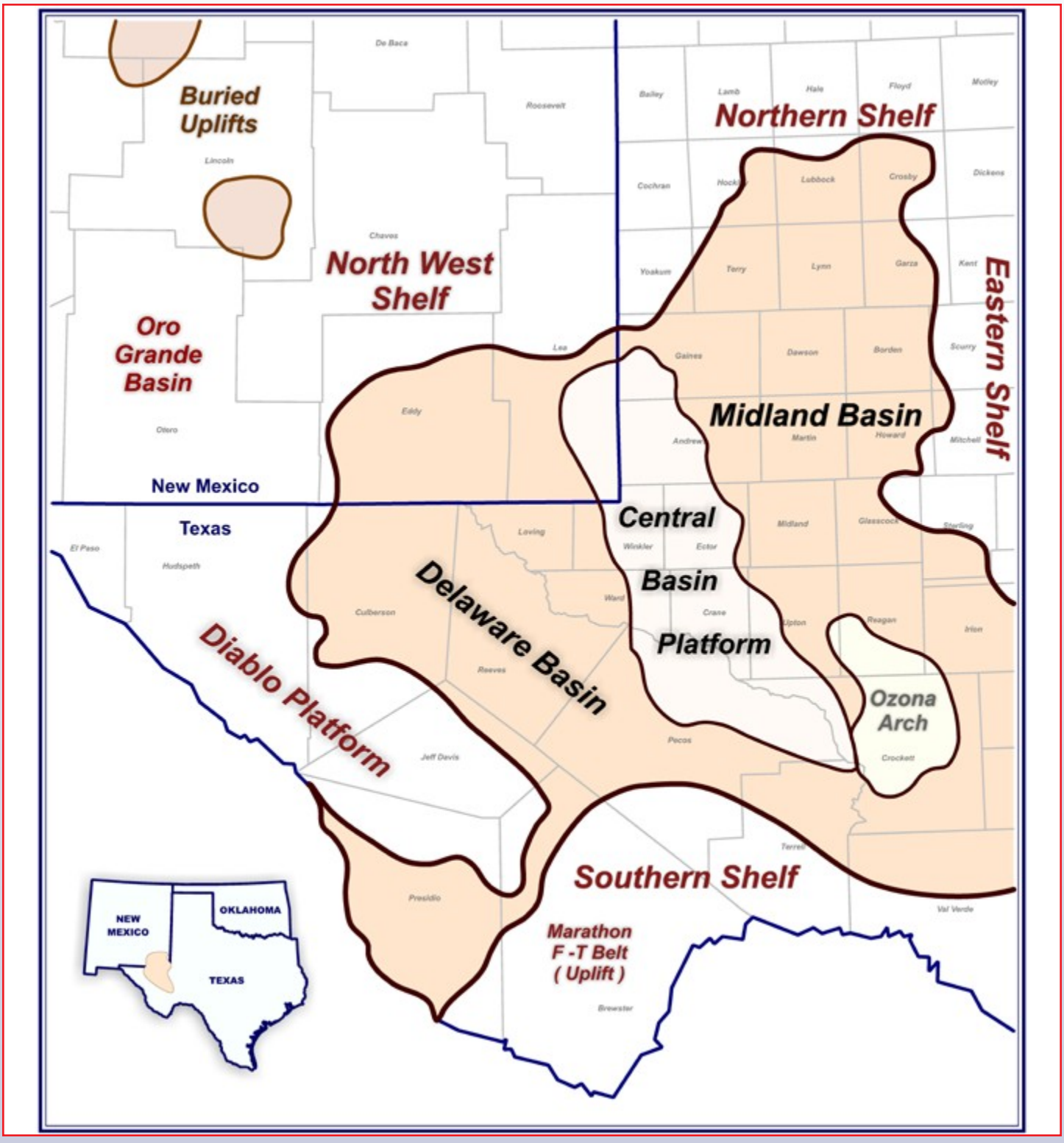


Figure 1: Permian Basin with its individual sub-basins shown.

Technical Article continued on page 16.

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

Technical Article continued from page 15

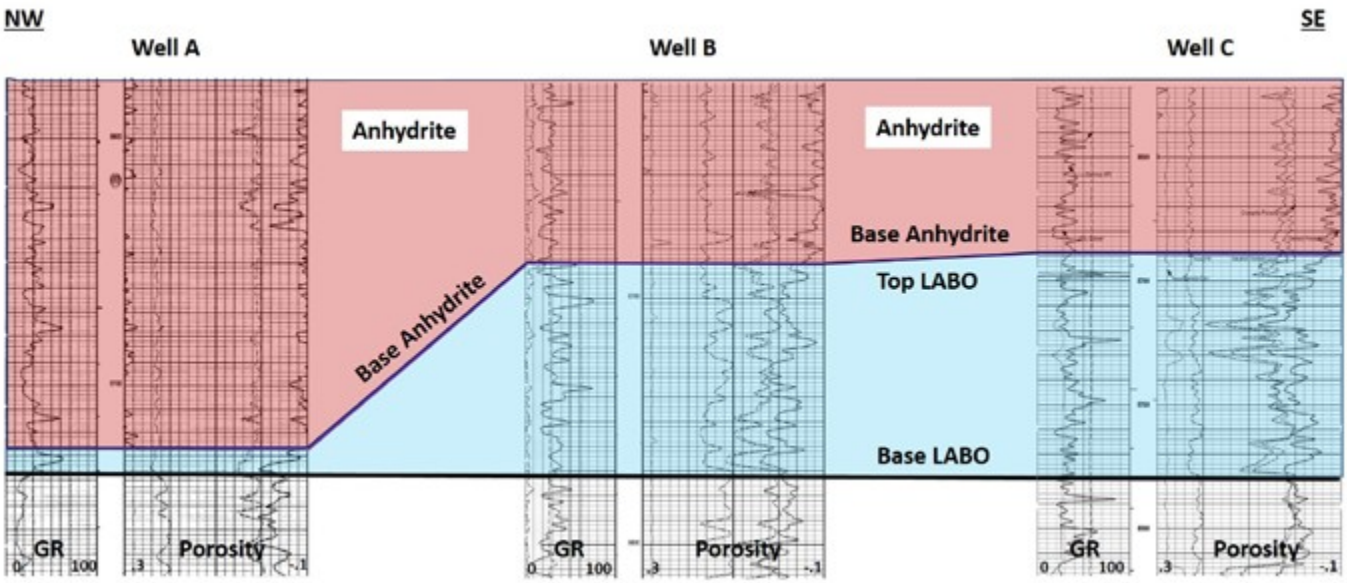


Figure 2: Shows a northwest to southeast cross-section through three vertical wells with their porosity logs shown. Pink color indicates the overlying regional anhydrite. Blue indicates the LABO interval.

Summary

The Lower Abo (LABO) formation is located along the Northern Shelf of the Delaware Basin. The porosity within the LABO occurs within dolomitized mudstone units. Three critical elements characterize the best performing wells within the LABO: rock quality, proximity to the facies change from dolomitized mudstones to anhydrite, and structure. An acoustic impedance volume derived from a post-stack inversion allows one to solve for all three parameters and provide better lateral resolution compared to vertical well control.

Introduction

The Delaware Basin is the westernmost sub-basin of the Permian Basin. It covers an area of approximately 13,000 mi^2 (33,500 km^2) across South Eastern New Mexico and West Texas (Hills, 1984). The Lower Abo (LABO) formation was deposited within shallow shelf, intertidal, lagoonal, and sabkha environments along the northern shelf edge. (Gawloski, 2011) The reservoir facies consists of dolomitized mudstones with associated secondary porosity. Individual dolomitized mudstone units are thin (three to six feet) and discontinuous. Horizontal drilling and fracture stimulation allow access to these discontinuous porosity lenses more efficiently than a vertical wellbore. The trapping mechanism for the play is caused by dolomitic mudstones pinching out into an updip and laterally equivalent regional anhydrite. Therefore, it is crucial to map the dolomitic mudstone facies pinchout in addition to understanding how the porosity varies.

Chopra *et al.* (2007) demonstrated several different seismic attributes that could be used to describe carbonate depositional environments. Post-stack seismic inversions allow one to characterize the subsurface by solving for acoustic impedance. It has been shown that acoustic impedance ties to porosity development associated with lithologic changes. (Dolberg *et al,* 2000 and Sarg *et al,* 2003) Although we were limited to only having a stacked amplitude volume without gathers, we were still able to characterize our reservoir using a post-stack inversion derived acoustic impedance volume.

Method

The seismic survey shown in this study was acquired in 2010 and processed by FairfieldNodal. The inversion workflow begins by first extracting a statistical wavelet from the seismic volume. The Low Frequency Model (LFM) is then generated by applying a bandpass filter to the logs with corner frequencies of 0-0-8-16Hz. The frequency filtered logs are used to build the LFM using either horizon based or image-guided interpolation (Douma *et al,* 2014). The post-stack acoustic impedance inversion volume is then generated using Hampson-Russel software.

Technical Article continued on page 17.

Technical Article continued from page 16.

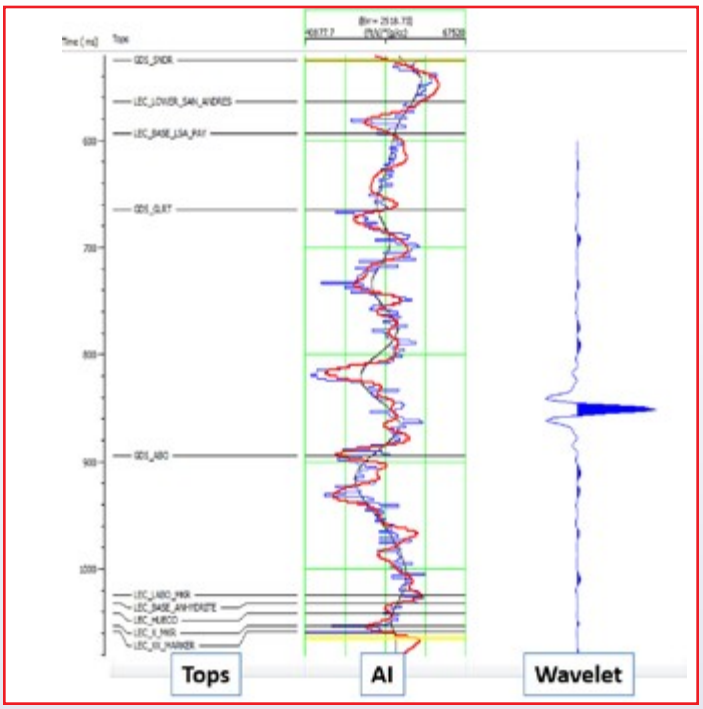


Figure 3: Post-stack inversion analysis. Curves shown are Acoustic Impedance (AI) where black curve is the low frequency model, blue curve is the true log, and red curve is the inversion result. The wavelet shown is the statistical wavelet extracted from the seismic and used in the inversion process.

Discussion

The LABO reservoir facies is primarily dolomitized mudstones. In our case study, the LABO reservoir facies pinches out against an updip regional anhydrite. *Figure 2* illustrates a northwest to southeast cross-section through three vertical wells with their porosity raster log shown on a limestone matrix. The logs are stratigraphically hung on the base LABO pick which is at a depth of approximately 8800ft TVD. The gross thickness of LABO ranges from 89ft in well C to 11ft in well A where it pinches out into the regional anhydrite. The overlying anhydrite is tight and acts as a regional seal and thus creates an updip trap. The structure of the LABO is crucial because downdip wells are further from the regional pinchout causing those wells to encounter higher water cuts. Therefore, the optimal drilling location is situated updip structurally against the regional pinchout within a well-development dolomitized mudstone interval. Seismic inversion for acoustic impedance can help solve for all three parameters (rock quality, structure, dolomitic mudstone pinchout) and provide better lateral resolution compared to vertical well control.

We first generate our post-stack inversion to determine how well the inverted acoustic impedance matches the sonic log. *Figure 3* shows the inversion analysis for well C. The red curve represents the inversion result, the blue curve is the acoustic impedance log calculated using the sonic log data, and the black curve is the LFM. There is a good correlation between the inversion result (red curve) and the log calculated acoustic impedance (blue curve). The overlying anhydrite is high acoustic impedance compared to the LABO interval. This provides a reasonable confidence level in the inversion volume and its ability to indicate lithological changes.

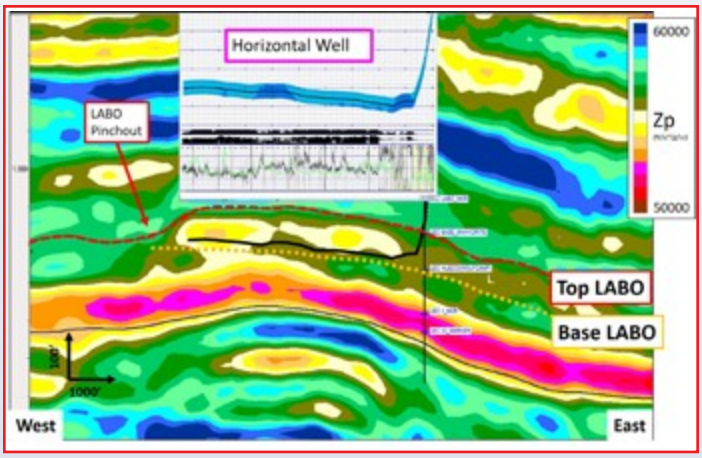


Figure 4: East-west profile through the acoustic impedance inversion volume where pink is low acoustic impedance and blue is high acoustic impedance. The bold black line shows the final deviation survey for the horizontal well with its corresponding mudlog shown on top. Light blue represents dolomite and dark blue represents limestone on the mudlog. The top and base of the LABO are illustrated with the dashed red and dotted orange line, respectively.

The acoustic impedance inversion volume is then used to improve the characterization of the LABO reservoir. Rafavich *et al* (1984) demonstrated an inverse relationship between acoustic impedance and porosity in carbonate rocks. Dolomite is different from limestone in terms of acoustic impedance because diagenesis increases the porosity which will decrease the acoustic impedance. *Figure 4* illustrated an east-west profile through the acoustic impedance volume with a horizontal well shown. The acoustic impedance decreases within the LABO moving updip towards the regional pinchout on the west. A horizontal well was drilled in this updip, low acoustic impedance lobe with the final deviation survey shown by the bold black line. The mudlog for the horizontal well corroborates the inversion indicating

Technical Article continued on page 18.

Technical Article continued from page 17

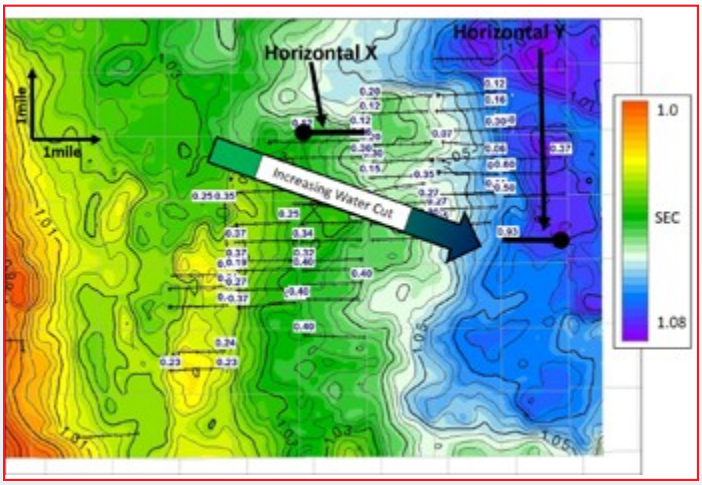


Figure 5: Top of Abo reservoir (base of anhydrite) time horizon. Blue colors indicate structurally deeper and red indicates structurally shallower. Watercut values posted for corresponding horizontal wells.

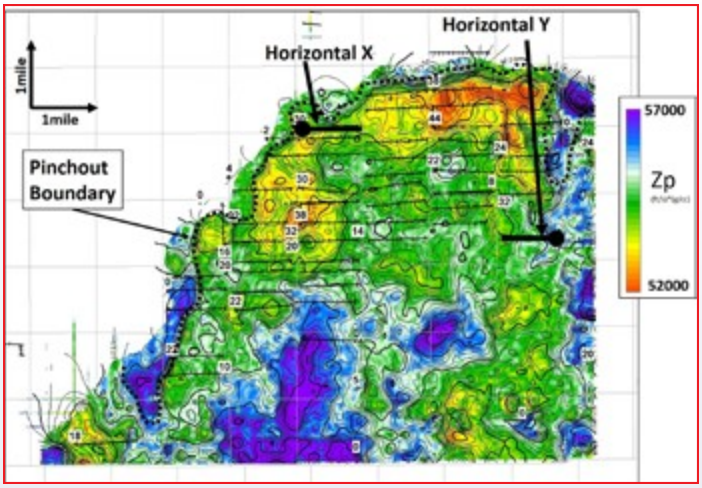


Figure 6: RMS average acoustic impedance extracted between the top and base LABO horizons. Red colors indicate low impedance, and blue indicates high acoustic impedance. The dotted black line delineates the interpreted dolomite pinchout. Values posted represent net porosity defined as net feet >4% porosity on dolomite matrix within gross LABO interval.

lithological changes along the lateral where the lateral landed in high acoustic impedance which was the tight limestone, and then drilled into low acoustic impedance rock which was the dolomite. Halfway through the lateral, the wellbore encountered another high acoustic impedance section where the mudlogger observed limestone. Once the wellbore cut back into low acoustic impedance lobe, the mudlogger only reported dolomite for the rest of the lateral. Therefore, the inversion is able to discern lithological changes within the LABO reservoir, aid in defining the top and base of LABO, and highlight where the regional pinchout or facies change occurs.

The first critical element that must be understood is water cut which varies significantly throughout the LABO reservoir. Water cut ranges from 6% to 93% within the area of interest. The inversion volume is used to pick the top and base of the LABO reservoir. The resultant pick of the top of LABO is shown in *Figure 5*. Note that structure is updip towards the W-NW direction. Water cut shows a general trend of increasing towards the southeast moving downdip. Therefore, the ideal well location would be towards the west updip against the regional anhydrite trap where the expectation is to observe lower water cut.

The next two critical elements for the play are rock quality and pinchout. The horizons corresponding to the top and base of the LABO reservoir are used to extract the RMS average acoustic impedance for the LABO interval. The resultant map is shown in *Figure 6*. The numbers posted on the map represent the net porosity for the LABO reservoir. Net porosity is defined as net feet >4% porosity on dolomite matrix within the gross LABO interval. The RMS acoustic impedance map clearly delineates the pinchout of the dolomitic mudstone towards the north and west as denoted with the dotted black line. Additionally, the map shows lower acoustic impedance towards the pinchout which corresponds to greater net porosity due to dolomite development. Towards the south, the LABO interval consists of tight limestone which is why the acoustic impedance increases and there is zero feet of net porosity. In order to better illustrate the relationship between net porosity and acoustic impedance, the acoustic impedance value was extracted at each well location and cross-plotted with net porosity in *Figure 7*. Net porosity is inversely proportional to acoustic impedance with an R squared of 71.7%.

Two horizontal wells illustrate the importance of structure *(Figure 5)* and impedance *(Figure 6)*. Horizontal well X, highlighted on *Figure 5 and 6* is a one mile lateral located against the pinchout in a low impedance lens. The mud logger observed dolomitic mudstone for the entire length of the lateral consistent with the impedance mapping. Additionally, the pilot log for horizontal well X encountered 30ft of net porosity. Since the well started producing, horizontal well X has produced at a 12% water cut and has an estimated

Technical Article continued on page 19.

Technical Article continued from page 18.

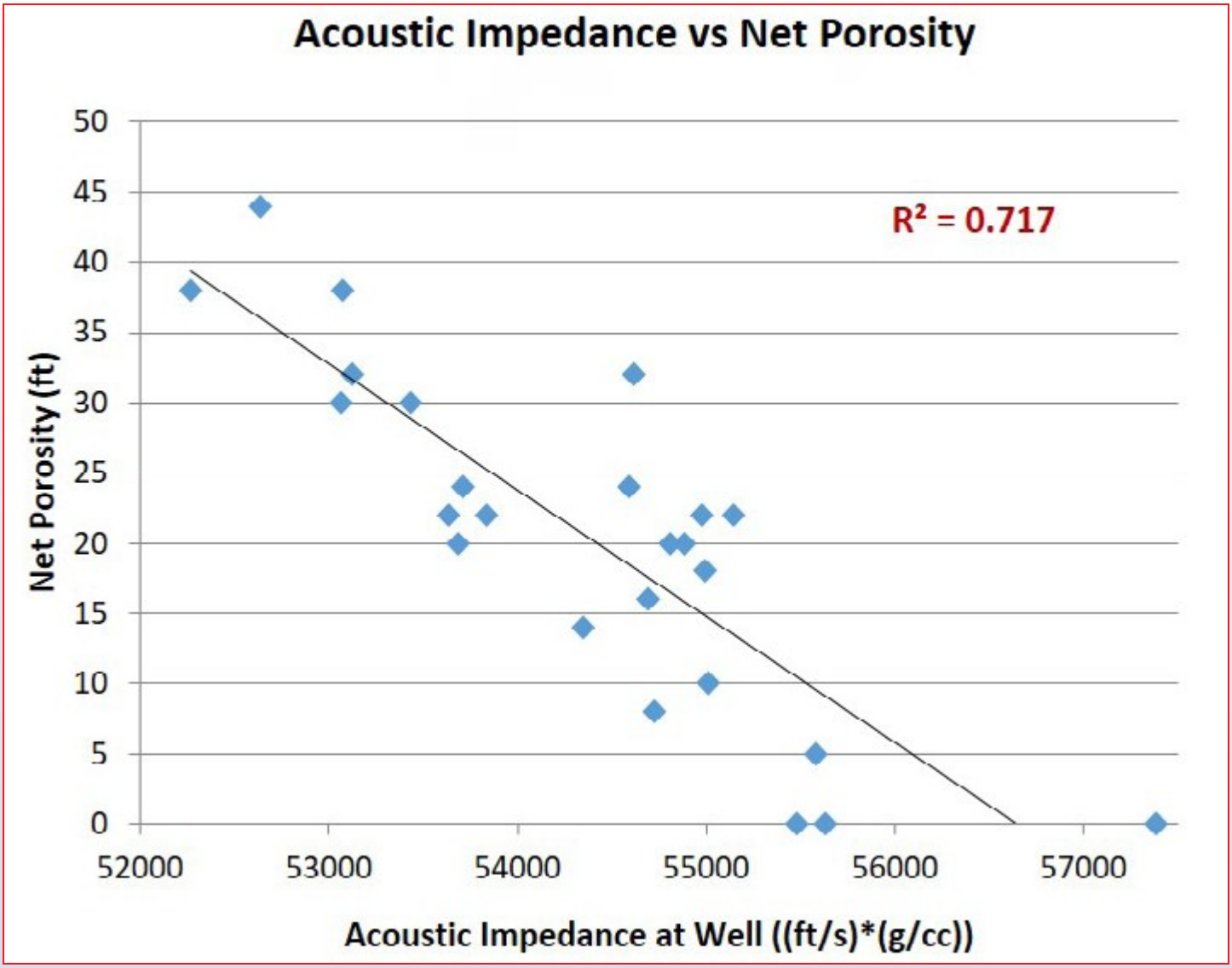


Figure 7: cross-plot with acoustic impedance extracted at the vertical well surface location on the X-axis and the net porosity (net feet >4% porosity on dolomite matrix within gross LABO interval) on the Y-axis.

ultimate recovery of 572 MBO. In comparison, horizontal well Y produces at a water cut of 93%. Based on the seismically generated maps, horizontal well Y is located several miles from the pinchout in a downdip location. The water cut encountered by this well is consistent with its low structural position.

Conclusions

The LABO reservoir within our case study is characterized as a dolomitized mudstone that exhibits a facies change in an updip position into a regional anhydrite. The overlying lateral anhydrite facies acts as the trapping mechanism for the porous dolomitic mudstone facies of the LABO. Additionally, the anhydrite creates an impedance contrast with the porous mudstone. Seismic inversion for acoustic impedance allows one to solve for the three critical parameters that impact well performance: porosity, structure, and proximity to the dolomitic mudstone pinchout. Two horizontal well locations illustrate production performance differences relative to three critical elements resolvable via the use of seismic inversion for acoustic impedance. Horizontal well X, drilled in a low acoustic impedance zone in an updip position showed good porosity development consistent with the mapped low impedance. Well performance of horizontal well X (572 MBO estimated ultimate recovery and 12% water cut) is consistent with the optimal location predicted using seismic inversion for acoustic impedance.

Technical Article continued on page 20.

Technical Article continued from page 19.

Acknowledgments

The authors would like to thank the Cimarex Permian Exploration region for their support and the management of Cimarex Energy Inc. for permission to publish this work.

References

Chopra, S., and K. J. Marfurt, 2007, Seismic attributes for prospect identification and reservoir characterization: Society of Exploration Geophysicists.

Dolberg, D., J. Helgesen, T. H. Hanssen, I. Magnus, G. Saigal, and B. K. Pedersen, 2000, Porosity prediction from seismic inversion, Lavrans Field, Halten Terrace, Norway: The Leading Edge,19(4), 392-339.

Douma, J. and E. Naeini, 2014, Application of image-guided interpolation to build low frequency background model prior to inversion: 76th Conference and Exhibition, EAGE, Extended Abstracts.

Gawloski, 2011, The lower Abo horizontal oil play of southeast New Mexico: Presented at West Texas Geological Society 2011 Fall Symposium.

Hills, J.M., 1984, Sedimentation, tectonism, and hydrocarbon generation in Delaware Basin, West Texas and Southeastern New Mexico, AAPG Bulletin, v.68, p.250-267.

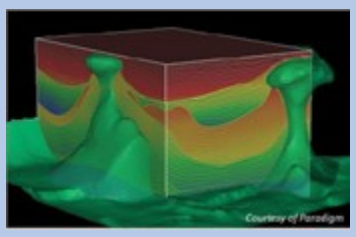
Rafavich, F., C. H. St. C. Kendall, and T. P. Todd, 1984, The relationship between acoustic properties and the petrographic character of carbonate rocks: Geophysics, 49, p1622-1636

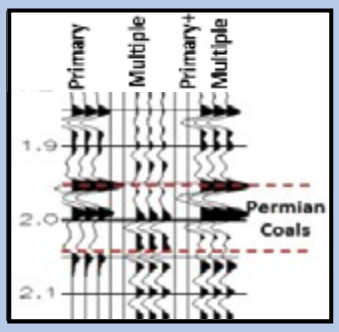
Sarg, J. F., and J. S. Schuelke, 2003, Integrated seismic analysis of carbonate reservoirs: From the framework to the volume attributes: The Leading Edge, 22, 640-645.

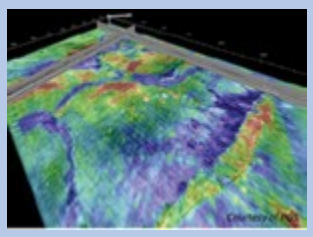
Permalink: https://doi.org/10.1190/segam2017-17643367.1

The GSH - SEG Webinar Series is Online

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







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

View more details & access the recordings by visiting
seg.org/Education/SEG-on-Demand
then click on GSH/SEG Webinar Recordings on the right

SOCIETY OF EXPLORATION GEOPHYSICISTS

GSH Outreach

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

All current volunteers and those interested in volunteering – Please send your name, preferred email address and mobile phone number to outreach@gshtx.org in order to receive notifications of upcoming volunteer opportunities. I lost access to my contacts, email and documents when I left my employer.






On a rainy Saturday, April 21, 2018 the **Reach for the Stars! STEM Festival** returned to Rice University with a new major sponsor: Gathering of Eagles. The GSH participated in the outdoor Street Fair under a covered building sidewalk with our exhibit booth until 2 pm and I conducted two student workshops from 2-4 pm. We demonstrated P and S waves using a large colorful slinky and the girls enjoyed playing the Drilling for Oil game. The Houston Geological Society booth was next to us and we used a seismic section on one of their posters to explain interpretation. Mac brought his rock specimens which gained a lot of attention from the students and their teachers and parents. At 2 pm we broke down the booth and I started the first of two "Exploring for Oil using Geophysics" student workshops. The girls worked in small teams to build a geologic model using sand, gravel and a water balloon "oil field" in a shoe box. They traded their model with another team and then conducted a seismic survey by tapping on the box lid and listening to the reflected waves to determine where to drill. They used a bamboo skewer to drill for the "oil" and almost all of the found it. Approximately 900 middle school girls (grades 5-8) were registered for the event. We gave away approximately 300 GSH logo plastic coiled toy springs.
A huge "Thank You" to our tireless volunteers that manned the booth.

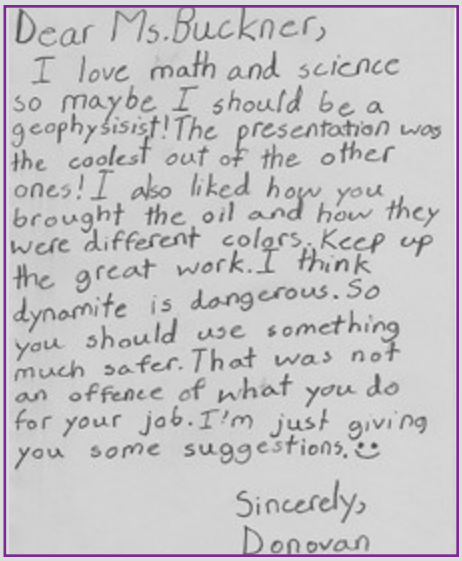


Outreach continued on page 23.

Outreach continued from page 22.

The First Annual Roberts Road Elementary School Family Science Night was held the evening of Thursday, April 26, 2018. The Waller ISD School is located in Hockley. Ilena Krupala, a HGS Teacher of the Year award winner, teaches science at this school and helped them organize the event which is similar to the Bellville Family Science Night that she organized previously and at which she still volunteers. GSH outreach volunteers, Ken Green and Fred Schroeder, hosted the GSH exhibit table. They had three activities: animated shot diagram, "Drilling for Oil" game and Fred's drilling game. Their table was very popular and they gave away 150 GSH coiled toy springs.

On Friday, May 4, 2018 I volunteered for the first time at the **Moore Elementary School Career Day** in Pasadena ISD. I gave three classroom presentations to one 2nd grade class and two 4th


Dear Ms.Buckner,
I love math and science so maybe I should be a geophysisist! The presentation was the coolest out of the other ones! I also liked how you brought the oil and how they were different colors. Keep up the great work. I think dynamite is dangerous. So you should use something much safer. That was not an offence of what you do for your job. I'm just giving you some suggestions. ☺

Sincerely,
Donovan


Dear Ms. Buckner

Thank you for teaching us about oil. that how it works and you inspired me to do it thank you for everything that you did.

from: Anthony
to: Ms. Buckner

thank you

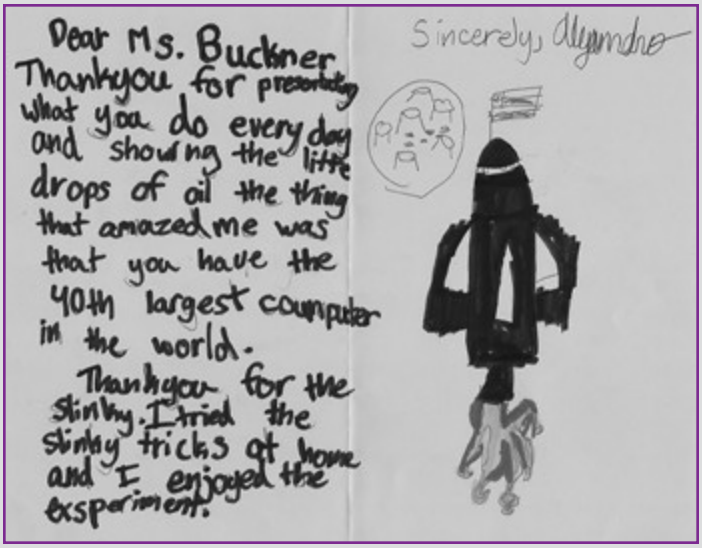

Buckner

Mrs. Buckner I loved your presentation and I loved everything. Thank you so much for the sticky. You are a really nice person. You are the best. You help me to learn more. I wish you the best like.

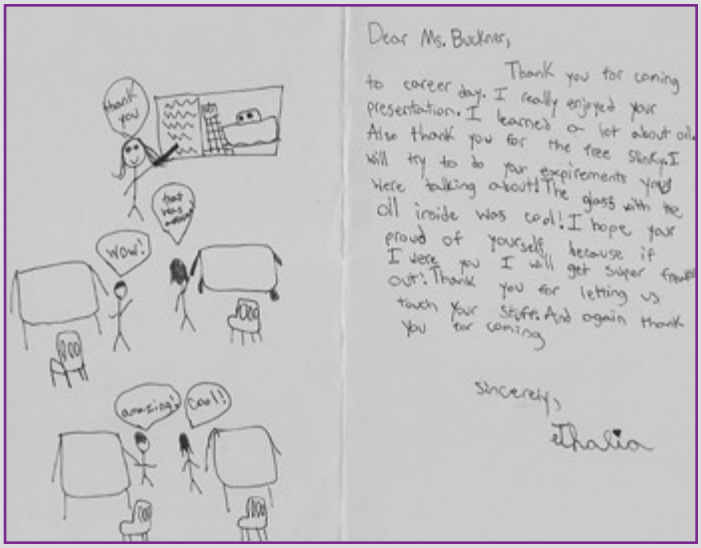
from: Beau
To: Buckner

BOOM

Thank you!!!


Dear Ms. Buckner
Thankyou for presenting what you do every day and showing the little drops of oil the thing that amazed me was that you have the 40th largest computer in the world.
Thankyou for the stinky. I tried the stinky tricks at home and I enjoyed the exsperiment.

Sincerely, Alyandra


Dear Ms. Buckner,

Thank you for coming to career day. I really enjoyed your presentation. I learned a lot about oil. Also thank you for the free Stinky. I will try to do your experiments you were talking about! The glass with the oil inside was cool! I hope your proud of yourself because if I were you I will get super proud of it. Thank you for letting us touch your stuff. And again thank you for coming

Sincerely,
Thalia

grade classes. The school counselor sent "Thank You" notes written by each student and said three student expressed interest in becoming geophysicists. I gave away a total of 60 GSH logo coiled toy springs.

Do you know of a school that has a career day seeking speakers, career fair or science night at which GSH might be able to host an exhibit booth? If so, please contact Lisa Buckner at outreach@gshtx.org and we can work together to bring awareness to the students of the many careers in the geosciences.

Outreach continued on page 24.

Outreach continued from page 23.

Upcoming outreach events on Saturdays where you can volunteer (contact Lisa Buckner at outreach@gshtx.org) or bring the children in your life to have fun while learning!

K-12 Outreach Volunteers Needed

Saturday, September 22, 2018 9:00 AM – 1:00 PM

STEM/Nova Day at Houston Museum of Natural Science

Earth Science Week 2018 Theme: "Earth as Inspiration"

Please help GSH educate children & families about geophysics and geology through fun and easy hands-on activities at our exhibit booths. Easy instructions will be provided for all volunteers.

Saturday, October 13, 2018 11:00 AM – 3:00 PM

Earth Science Celebration at Houston Museum of Natural Science

http://www.hmns.org or http://www.hgs.org

Lunch will be provided for all volunteers by the event coordinators.

Saturday, October 20, 2018 11:00 AM – 4:00 PM

Energy Day Festival at Sam Houston Park (downtown)

http://energydayfestival.org/houston

Contact Lisa Buckner at **outreach@gshtx.org** to volunteer at any event.

Come play with us!

GEOPHYSICAL SOCIETY OF HOUSTON, SEG EMERGING PROFESSIONALS INTERNATIONAL COMMITTEE AND SEG WOMEN'S NETWORK INVITE YOU TO

BUILD YOUR PROFESSIONAL BRAND

OVER A FINE GLASS OF WINE

- *Learn how to create your most professional self with introspection and conversation facilitated by experts from Lincoln Leadership Advisors.*
- *Network with colleagues and friends while tasting wine crafted by one of Houston's newest winemakers*
- *Two glasses of wine and hors d'oeuvres with entry*
- *Exciting sponsorship opportunities available, including your corporate logo on commemorative bottles of wine!*

Tuesday, 11 September 2018 | 4:30-8 PM
Sable Gate Winery | 2600 Travis St, Houston
Registration fees apply | Free parking
Registration and enquiries at **gshtx.org**

SAINT ARNOLD

PATRON SAINT OF BREWERS

+

GEOPHYSICAL SOCIETY HOUSTON

=2018-2019 GSH BREWERY ICEBREAKER

6-8pm Thursday, 27 September 2018

St Arnold Brewery, 2000 Lyons Ave, Houston, 77020

Register at www.gshtx.org

SHEARWATER

RPS

GEOPHYSICAL INSIGHTS

FROM INSIGHT TO FORESIGHT

seisware

INDUSTRIAL-STRENGTH SOFTWARE

Fracture ID

Members $10 and Non-Members $25

For More Info or Sponsorship contact Tony LaPierre tony.lapierre@rpsgroup.com or 281-733-5281

2018 OIL & GAS
MACHINE LEARNING SYMPOSIUM

27 SEPTEMBER 2018, HOUSTON, TX

Join us for a one-day symposium where Big Tech meets Oil & Gas

HEAR about rapid advances in machine learning, data analytics, and cloud computing.
ENGAGE with thought leaders in technology and oil & gas.
LEARN how others in the industry are leveraging these technologies.

John Adamick
SVP Data & Analytics
TGS

Sumit Gupta
VP AI, Machine Learning & HPC
IBM

Ruben Rodriguez Torrado
Artificial Intelligence Advisor
Repsol

Satyen Yadav
GM, Edge Comp., Machine Learning
Amazon Web Services

Fabian Rada
Technical Advisor to PEMEX
Petroleum Oil and Gas Services

Tom Smith
President & CEO
Geophysical Insights

For more information and to register, visit **UpstreamML.com**

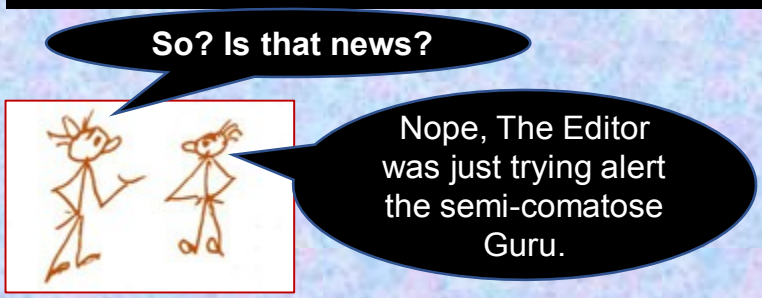
HOSTING SPONSOR

GEOPHYSICAL INSIGHTS
FROM INSIGHT TO FORESIGHT

PARTNER SPONSORS

SEG
SOCIETY OF EXPLORATION GEOPHYSICISTS

GSH Announces Tutorial Nuggets to be Published Monthly



The Guru deeply resents the snarky cartoon and innuendoes of the clumsy and disrespectful headline. While this month's offering is admittedly some 6 weeks late, your ever-diligent Guru has been seeking **Seismic Truth** no matter how deeply buried or distasteful it may be.

Loose Ends in Inversion

Motivational Note: please keep in mind that all the Occult Arithmetic and profound ponderings you are going through to get at Impedance is justifiable when considering the plums (and later, prunes) this information provides. For example, porosity has a deep and personal relationship with impedance through their mutual friendship with velocity and density.
Throw in Elastic Impedance, **ρVs**, and there's a world of largely untapped information about the rocks that can tell us not only the potential for finding grease, but the risk in trying. People with money, who willingly fork it over to wild-eyed Geo-Types appreciate knowing such things.

A Recap of Spring developments:

We have been working with a simple **model** of Impedance (**Z** = **ρV**) whose contrast give rise to reflectivity **R.**

The **R** is computed using a very close approximation: as

$$R_{n+1} = 0.5\ln(Z_{n+1}) - 0.5\ln(Z_n)$$

We are alarmed to discover that six **Z** values yield only 5 **R**. This means that in the inversion process, where we know **R** and seek **Z**, there are more Unknowns (**Z**) than equations for **R**. We balance the board by using an extra equation which is a constraint strongly suggesting that the average of the **Z** unknowns is equal to a value which is reasonable and is probably derived from well log information (sonic and density). In the Matrix, **G**, above the first 5 rows compute the **R** of the **d** matrix, and the last one shows the average **.5ln(Zn) = 4.931**.

Model **m**			**R**eflectivity
$\rho_0 = 2.24$	$V_0 = 9000$	$Z_0 = 20160$	$R_0 = 0.066$
$\rho_1 = 2.30$	$V_1 = 10000$	$Z_1 = 23000$	$R_1 = -0.032$
$\rho_2 = 2.271$	$V_2 = 9500$	$Z_2 = 21570$	$R_2 = -0.107$
$\rho_3 = 2.175$	$V_3 = 8000$	$Z_3 = 17400$	$R_3 = -0.066$
$\rho_4 = 2.119$	$V_4 = 7200$	$Z_4 = 15250$	$R_4 = 0.103$
$\rho_5 = 2.208$	$V_5 = 8500$	$Z_5 = 17770$	

$$\mathbf{G} \cdot \mathbf{m} = \mathbf{d}$$

$$\begin{pmatrix} -1 & 1 & 0 & 0 & 0 & 0 \\ 0 & -1 & 1 & 0 & 0 & 0 \\ 0 & 0 & -1 & 1 & 0 & 0 \\ 0 & 0 & 0 & -1 & 1 & 0 \\ 0 & 0 & 0 & 0 & -1 & 1 \\ 0.167 & 0.167 & 0.167 & 0.167 & 0.167 & 0.167 \end{pmatrix} \cdot \begin{pmatrix} 0.5\cdot\ln(Z_0) \\ 0.5\cdot\ln(Z_1) \\ 0.5\cdot\ln(Z_2) \\ 0.5\cdot\ln(Z_3) \\ 0.5\cdot\ln(Z_4) \\ 0.5\cdot\ln(Z_5) \end{pmatrix} = \begin{pmatrix} 0.066 \\ -0.032 \\ -0.107 \\ -0.066 \\ 0.104 \\ 4.931 \end{pmatrix}$$

Tutorial Nuggets continued on page 28.

Tutorial Nuggets continued from page 27.

If 0.5 ln(Zave) = 4.931, then **Zave = 19187** (g/CC)(ft/s). The augmented matrix, **G**, is now invertible, and could be used to compute a direct solution for **Z**, but in practice, for perhaps hundreds of **Z** values, the inverse matrix is troublesomely **slow** and subject to numerical immorality unwarranted by the problem. A better solution is obtained by **iterative methods** in which we creep up on the best solution (**LSE**) in a predictable number of steps to convergence, in this case, equal to the number of unknown impedances.

$$X_0 = \begin{pmatrix} 4.935 \\ 4.935 \\ 4.935 \\ 4.935 \\ 4.935 \\ 4.935 \end{pmatrix}$$

Initial Guess

One of the more venerable iterative methods is the **Conjugate Gradient** approach in which we start with an initial guess of the set of **Z** values and step toward the nearest better answer (smaller error in matching the data vector, **d,** the set of reflectivities and constraints). The "Conjugate" refers to each new estimate taking a step perpendicular (in the multidimensional sense) to the previous guess. The "Gradient" part means head down hill toward a smaller error ($\mathbf{G \cdot X_K - d}$). Steps are taken with a magnitude related to the size of the error art each iteration. Without going into the grisly and unwholesome details (better discussed with your Life Coach or Spiritual Advisor in privacy), let's look at the history of our initial guess, $\mathbf{X_0}$ for the set of 6 $\mathbf{Z_i}$. A reasonable first guess is the average $\mathbf{Z_i}$ expressed here as **0.5ln (Zi)**. Each iteration leads to convergence with near zero error at step 6. The error it will be the LSE closest to the average impedance. **Here, Not Bad**

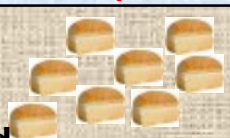
$$IMP_0 = \begin{pmatrix} 1.936 \times 10^4 \\ 1.936 \times 10^4 \\ 1.936 \times 10^4 \\ 1.936 \times 10^4 \\ 1.936 \times 10^4 \\ 1.936 \times 10^4 \end{pmatrix} \quad IMP_1 = \begin{pmatrix} 1.822 \times 10^4 \\ 2.119 \times 10^4 \\ 2.075 \times 10^4 \\ 1.863 \times 10^4 \\ 1.656 \times 10^4 \\ 2.13 \times 10^4 \end{pmatrix}$$

Initial Guess (Units of Impedance)

$$IMP_6 = \begin{pmatrix} 2.035 \times 10^4 \\ 2.321 \times 10^4 \\ 2.177 \times 10^4 \\ 1.756 \times 10^4 \\ 1.539 \times 10^4 \\ 1.894 \times 10^4 \end{pmatrix} \approx Z = \begin{pmatrix} 2.016 \times 10^4 \\ 2.3 \times 10^4 \\ 2.157 \times 10^4 \\ 1.74 \times 10^4 \\ 1.525 \times 10^4 \\ 1.877 \times 10^4 \end{pmatrix}$$

Iter 6 Model Impedances

[September Puzzle from June: Next Page]



The October Puzzle: 3 Guys Share 8 loaves of Bread.

Normally around the lunch table at the GSH International Headquarters, the Past Presidents get Free Lunch. This year, however, in an austerity move, every 3rd Thursday each month has been designated as a Buy-Your-Own-Lunch. Even the most recent PP's agree to the sacrifice. Tommie and Paul bring 5 and 3 loaves, respectively, of freshly baked bread. Glenn suggests they share the loaves for lunch and he will pay cash for his share.

They eat equal amounts and Glenn flops $8 on the table. The other two agree that's fair. Then the fun begins: How to split the money from Glenn. After much haranguing and expletive laden screaming, it was decided to bring in a judge to make the decision. There was *only* choice is Lee-The-Lawyer. How did he rule? You may assume that Lee is infinitely fair and most wise.

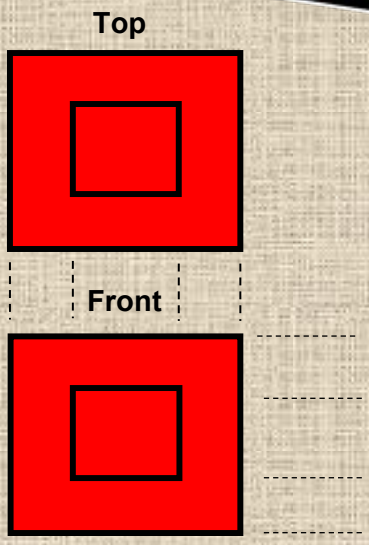
Tutorial Nuggets continued on page 29.

Tutorial Nuggets continued from page 28.

A New Season of Impossibly Probable and Probably Impossible Puzzles

The Summer Puzzle

3D Visualization

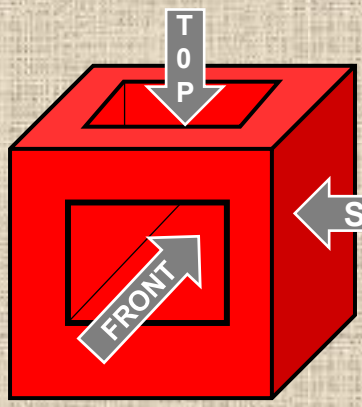


This brain teaser was used as a one question final exam for architectural students. The "Top" and "Front" views of a **solid object** are faithful to the rules of mechanical drawing, that is, an **edge** is shown as **a solid line,** and a **hidden edge** (internal or on the back surface) **is shown as a dashed line.**

Your assignment, due for the September GSH Journal, is to sketch the **side view** of this object.

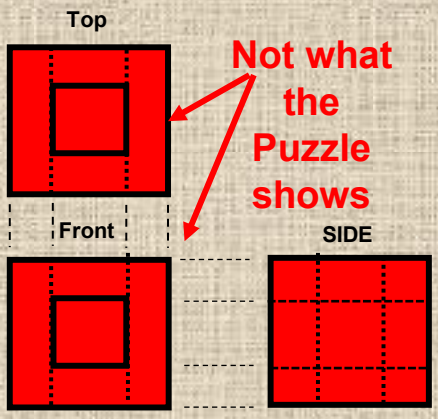
Is your answer unique?

Answer: First, before The Guru presents the Right Solutions (yes, more than one), let's look at a typical **wrong solution** (it will teach us a lot).

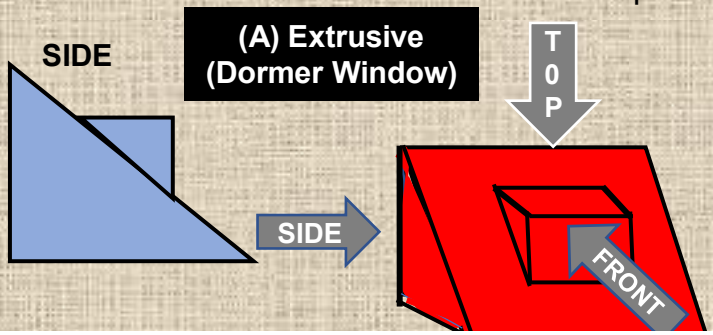


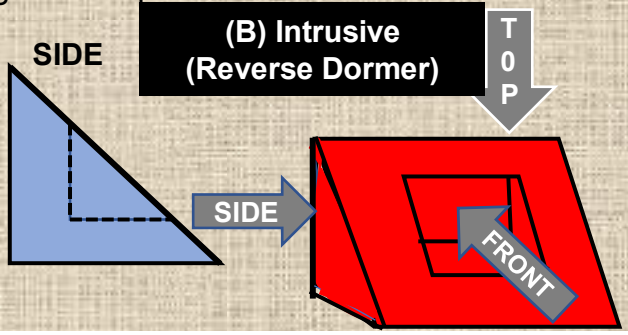
A brave but misled guess is that the cube is penetrated by square holes passing through the solid cube from both the top and front faces.

If that were true, the top, front and side views would appear as shown on the right. But they do not look like this, as shown in the puzzle.



The **correct** answers for the side view corresponding to the top and front views below





A Conversation With...

Robert Stewart, Ph.D.

By Azie Sophia Aziz

The SEG's incoming President, Rob Stewart, deprecatingly calls himself a "least-squares fit to an excess of interests." After a high school program centered on music, he studied math and physics at the University of Toronto. Being an avid nature lover, Rob spent a winter trekking in Nepal and exploring Thailand and India. He returned to Canada and worked at the Princess Margaret Cancer Hospital developing ultrasonic imaging systems for cancer detection. After a successful stint at the hospital, Rob went to M.I.T. for his Ph.D. in geophysics. Rob has held positions with Chevron, Veritas, and the University of Calgary. Currently Rob holds the Cullen Chair in Exploration Geophysics at the University of Houston and is Director of the Allied Geophysical Laboratories.

In this interview, with his former graduate student, Rob speaks about his background and beliefs, upcoming scientific adventures, commitment to diversity, passion for developing settlements on the Moon, and the challenges to tackle in geophysics and the world in general.

1. When you were little, what did you want to be when you grow up? And what skills and principles from those aspirations apply to what you do now?

As a little guy, I actually wanted to be an American Indian, because in my books and pictures, they seemed physically fit, had cool buckskin clothes, and knew how to live off the land. As I got older, I aspired to help the world somehow and planned on being a physician. My mother was a nurse and her capabilities and compassion made the medical world seem so rewarding. Later in high school and while studying in a music program, I was keen to become a jazz musician. In university, I was trying to be all of those (chuckle). Along with studies in physics and math, I worked a memorable summer in northern Ontario with two superb geophysicists (Dr. Gordon West and the late Roger Young). I also had an internship with Chevron in Calgary. I took a year off school to travel to Asia. On return, I undertook medical research in Toronto. But, after further introspection, I decided that geophysics was the best fit for me. Geophysics seemed to be a combination of science, travel, outdoors, mingling with people, and a rewarding career. Plus, growing up in Canada - as a very resource-dominated country - geoscience was a reasonable pathway. I had a wonderful example in my father, who was involved in the political and business worlds. He's an excellent communicator and taught his kids to be responsible with the finances. This helped balance some academic and artistic inclinations.

2. Who is your role model? Have you ever met someone whose work you truly admired?

I especially admired Albert Schweitzer for his remarkable roles as a musician, physician, writer, adventurer, and philanthropist. The great historical explorers (Marco Polo, Magellan, Vasco da Gama, Hudson, Burton) were always alive in my mind. Meeting some of the more recent giants (Sir Edmund Hillary, Scott Carpenter, and John Glenn) made their visions and accomplishments more real. My parents are part of that "Great Generation". That remarkable, conscientious, hard-working, and generous generation has given so much to us. My parents continue to be a deep source of inspiration to me.

Interview continued on page 32.

Interview continued from page 31.

3. What's the most rewarding thing you've ever worked on, that you're most proud of?

The first thing that comes to mind would be my graduate students. Nothing is more rewarding to me than to see my students growing academically and professionally, making new discoveries, finishing their programs, and prosper. I'm fortunate to have been able to supervise some 80 graduate students through convocation so far.

My good friends and colleagues, Don Lawton and Jim Brown, and I founded the CREWES Project – one of the early university-industry geophysical research consortia. Through its reports, meetings, surveys, staff, and students, we were able to advance elastic-wave prospecting methods and have a lot of fun.

I've been able to set up a Geophysics Field Camp at UH and run it for the last 10 years. Because we're in the field and working together intensely for several weeks, there're real connections made. I believe strongly in the value of making measurements, undertaking surveys, and assessing the data. I believe that every geophysicist is made better by some field experience.

Technically speaking, having helped develop the fields of VSP, tomography, and multicomponent seismology has been very satisfying. Now working with 3D printing, drones, and fiber-optic sensing is exciting.

In the scientific world, publishing is a big part of our deliverable; its analog in the music realm is recording. I was fortunate to sing with a group, now called Revv 52, which has produced a number of recordings. I did a vocal track, a Motown classic "Just My Imagination" on one of the CDs, which I felt was one of the most satisfying things that I'd ever done. Also, along happy musical lines, a charming videographer, Andrea Arias, produced a video of a song that I'd written about Mt. Everest.

4. What makes Rob Stewart, Rob Stewart? What's your brand?

I feel very fortunate to have had the opportunity and some capability to explore a number of countries, cultures, activities, and ideas. Professionally, it's been a blessing to practice geophysics in class, lab, industry, and field – with many colleagues and students. I try to bring as much energy and enthusiasm as I have to everything that I do – although, I'm not that great in mornings!!! Nonetheless, I'm lucky to be healthy. I try to carve out time to exercise most days – with a view that while there are plenty of other demands, I wouldn't be as long-term useful if unhealthy. It's a bit tricky to see yourself as does the outside, but I hope that any brand or reputation that I have, has something to do with making a positive professional and joyful social impact, doing something original, and helping advance lives.

Interview continued on page 33.

Interview continued from page 32.

5. You ventured into drones, that was an indicator of embracing where the future is leading. What's next?

It's really fun to fly and photograph with drones. After years of development in defense, unmanned aircraft systems (UAVs or drones) are now in commercial and individual hands. Meanwhile, drone capabilities, application, and regulation are advancing rapidly. I think that the drone's contributions in geophysics will include two broad areas: Fast, detailed, and inexpensive surveying for surface character (for example, topography and cover) and subsurface potential fields. And second, moving stuff around. It's said that drones are well suited for dangerous, dirty and arduous tasks. Seismic deployments can sometimes fall into those categories. So, with some background as a private pilot, I mocked up a quadcopter with geophones as landing legs and we test flew it. To my surprise, the concept worked and, on landing, had pretty good recording fidelity. We continue to work on seismic drones and I'd envision them being a nice part of many resource and hazard surveys a few years down the road.

Another exciting technology is fiber-optic vibration sensing. The fact that a thin string of glass can make hundreds of motion measurements is little short of magical! There have been quite a few borehole seismic surveys done with fiber sensing systems and this is where a bunch of our work is located.

What's the next big thing in exploration geophysics? Undoubtedly, there are still huge prizes in energy and resources: Petroleum, Lithium, Uranium, heat, fresh water …then, urban geophysics, smart and resilient cities, natural hazard reduction. Last year Houston and suburbs were inundated by Hurricane Harvey which caused some $180 billion in damage. This financial loss is of similar size to the whole annual US oil industry. Additional Hurricanes Irma and Maria plus the West Coast fires brought total losses into the $300 billion range for the year – not to mention untold human suffering (along with many acts of heroism). How can geophysicists help with that? How can we apply our techniques? I see us doing much more geotechnical engineering and hazard mitigation work in the future. The beauty of geophysical exploration for hydrocarbons has been that you can make a discovery and profit handsomely. An investment dollar should be paid back in several years and generate a healthy income thereafter. In the hazard world, like insurance, you might spend $1 say, to possibly not lose $100. Very different economics. But, with vast increases in infrastructure and its vulnerability plus population growth, the equation is becoming more and more compelling.

6. What's one trait that will shape the future of geophysicists? What will successful leadership of the future look like?

Curiosity. We need to value and nurture curiosity. I believe that most invention and innovation, which the future certainly needs, start with a puzzle or idea or conundrum – Why? What if? We need the luxury of noticing a problem or pursuing a puzzle along with the persistence that will be required to solve it. If I can, the next trait is personal energy – the will, drive, chutzpah, oomph to make things happen.

7. As SEG President-Elect, what is your commitment to diversity and inclusion?

Perhaps, being a geoscientist makes the appreciation of diversity easier and the importance of inclusion becomes clearer. We have seen valuable contributions from a wide variety of people and places. Our science is global. Resources are distributed worldwide. Many of us grew up reading science fiction where a remarkable set of possible futures are explored. I feel particularly blessed to have grown up between two wonderful and

Interview continued on page 34.

Interview continued from page 33.

capable sisters along with a talented younger brother - I regularly experienced different viewpoints! It is so important that we strive to have everyone able to get and take a fair shot. Economies, social values, and personal roles are all evolving. In the SEG, we are trying to provide a friendly and motivating place for all. I would like to see support offices in numerous parts of the world, further programs for different experience levels and specific scientific interests, encouragement of under-represented groups, and additional connections with nascent technologies such as remote sensing, GIS, planetary exploration, and various new engineering disciplines.

SEG aims to develop the science and people of geophysics - to increase prosperity. I go back to the 4C directive: Create, Communicate, Conserve, and Commercialize geophysics. This takes all types and talents. We are a mix of student, young professional, mid-career, senior, and retired groups. SEG is now almost 90 years old and it was born because of a new target (petroleum) and new technologies (seismic, gravity, magnetics). These were the economic and technical drivers. There are a host of new drivers now – a variety of resources, infrastructure development and protection, different demographics, and vastly improved technologies. Our SEG members are exceptionally diverse by many measures and we're trying to keep up with them in some areas as well as advance them in others.

8. NASA is going back to the Moon. What is your view on that?

As we have more understanding and delight in our cosmic neighborhood and greater ability to travel to our sibling planets and moons, I'm a big believer

that we should go back to the Moon. It's fairly close, readily accessible with current technologies, and full of exciting possibilities. Several years ago at the Johnson Space Center, we trained the new crop of astronaut candidates in the methods of exploration geophysics. They were fast studies! The goal, at the time, was to get them experience in contact surveying with a view to their eventual landing on the Moon and maybe Mars. Unfortunately, this visionary Constellation program was canceled, but it looks like there's new support to have a permanent presence on the Moon. Because the Moon is much less expensive and less risky than going to Mars, many more organizations can have a role. For one group going to Mars, we could have a hundred going to the Moon. Establishing a permanent lunar presence will fire-up imaginations, motivate kids to study science and engineering, teach us how to live in another world, and give us a structure and demand for discovery of all kinds. Imagine going there for the weekend – now, that's a HoneyMoon (laughter). It's so exciting that private companies like Blue Origin, SpaceX, and Virgin Galactic have entered the space realm. At the University of Houston, we are working on sensors for rovers, the properties of meteorites, and re-analyzing Apollo seismic data. I hope that we get to make a lunar visit someday!

9. What will be a surprising development in science and technology in the near term, say the next 25 years? What would surprise you socially?

A stunning discovery would be if we found evidence of life or sentient beings in other planetary or galactic places - there must be somebody out there somewhere! In the meantime, I think that we'll be tinkering much more with life and genetic engineering. There will probably be male pregnancy. Of course sensors, machines, computers, and analytics will be much more advanced

Interview continued on page 35.

Interview continued from page 34.

and further integrated into our lives. With economic and demographic change, increasing lifespans, more human-like robots, further interconnectedness, there will undoubtedly be many types of interpersonal relationships and groupings that would seem quite strange to us now.

10. Jeff Bezos, Elon Musk or Bill Gates?

I grew up more with the Gates and Microsoft story (plus Jobs and Apple). And like many witnessed the remarkable change from slides to PowerPoint, film to digital photography, pay phones to Smartphones. Gates was in the first wave of computer geeks who really changed the world (and has now led the world in philanthropy). Nonetheless, I had the recent opportunity to hear Jeff Bezos (who spent part of his childhood in Houston) speak at the Explorer's Club in NYC. He attributed much of his success to his parents and discussed converting a substantial part of his Amazon fortune to space access and exploration via his company Blue Origin. Interesting that other technology titans, Elon Musk and Richard Branson also have the space bug.

11. What's your current read?

I must admit that I've got piles of partially read books and dog-eared magazines in every corner of my home and office. Most of my reading, outside of Dan Brown and the like, is non-fiction. Right now, I'm reading a biography of singer-songwriter, Gordon Lightfoot; an investigation into why there seem to be bursts of creativity at certain times and places, "Geography of genius" by Eric Weiner; a book on "Big Data" by Brian Clegg; Roel Snieder and Jen Schneider's wonderful monograph on "The Joy of Science"; as well as some more controversial books such as "Jews, Confucians, and Protestants: Cultural Capital and the End of Multiculturalism" by Lawrence E. Harrison; and "Inconvenient Facts" by Gregory Wrightstone, which provides an alternative interpretation of some climate data. For a little lighter fare, I've turned to Jorge Cham and Daniel Whiteson, who recently gave a fabulous presentation at UH, with their book "We Have No Idea: A Guide to the Unknown Universe" and Cham's comic strip, "PhD - Piled Higher and Deeper". They basically poke fun at professors and the academic world – which has many acres of fertile ground for satire!

12. What is the single most important piece of advice you would offer to a young person just starting out? How to be the next Rob Stewart?

Be enthusiastic (and involved). Whatever you do, try to do it well. Bring your energy to everything, then you can do almost anything. The key is to be keen. Make a contribution. It's also important to nurture one's enthusiasm by discovering and making time for what is enjoyable. In career terms, I think of a Venn diagram with three intersecting circles to help determine a life pathway: What are you good at? What do you like doing? What can make a living? The intersection area of these circles is quite possibly a good place to pursue.

Interview continued on page 36.

Interview continued from page 35.

Then do the Myers-Briggs personality indicator – it's really helpful to further understand yourself and in what professions people like you have been happy.

13. How did you find time to be a professor, researcher, business owner, musician, and leader in the community?

Hmmmm – well, we all get our 24 hours a day. So, what do we do with them? I'm pretty accomplishment oriented, so I try to structure my time accordingly. Some other people, who otherwise seem happy, don't suffer from this problem! I have several ways to manage time. I focus my efforts on what is most meaningful for me (family, friends, science, health, charity, and fun). Purpose propels and contributing compels. Nonetheless, like most people, I love empty calories in food and leisure– however, they have to be quite limited. Thus, there's a certain amount of discipline required. It's important to not be sloppy with work or relationships by being as present and conscientious as possible. On one of our hectic Houston streets a few weeks ago, a fellow in the car next to me (with his elbows on the steering wheel) was texting, talking, and eating while driving. You don't want to be that busy.

14. What's your life motto? Is there a quote or person that you keep in mind and aspire to in your career approach?

When I look back at influences, there have been a number of mottos that have distilled or crystallized important wisdoms. The motto of my high school, Barrie District Central Collegiate, was "Labor omnia vincit" – Work conquers all – and the school, to its credit and our development, really emphasized that. The University of Calgary's Scottish Gaelic motto is "Mo shuile togam suas" which is translated as "I will lift up my eyes". I find that inspirational especially when the small stuff becomes weighty and I need to rise above it. The Stewart clan's motto is "Virescit vulnere virtus" which is translated as "Courage becomes greater through a wound". My interpretation of this is that hardship makes you stronger and that virtue can be found through sacrifice. I was in a restaurant that had a number of beautiful old English inscriptions in Latin – a useful one was, "Vir prudens non contra ventum mingit". This one is going to be homework, but involves a wise person, Mother Nature, and a strong wind!! I'm going to coin my own motto right here, "Ad astra per ingenium – to the stars through creativity."

I was raised in the Anglican (Episcopalian) tradition and keep in mind many of its teachings. Like other practices, its history and geography are fascinating – the journey of beliefs beginning with Abraham in Iraq several thousand years ago, through Egypt, Israel, Rome, refined via Reformations in Western Europe and eventually transplanted in North America -a remarkable path. A life-long quest of mine is to try to understand other great wisdoms and apply their learnings. Ultimately, one set of equations seems to describe our physical universe. So, you'd think that we should be able to arrive at a universal set of beliefs too.

There are several quotations that inspire me: In high school, we performed the musical South Pacific. One of the songs says, "You've gotta have a dream, if you don't have dream, how're gonna have a dream come true?" Simple with impeccable logic. Another uplifting one is "Failure is not the falling down, it's the not getting back up" attributed to various people including Actress Mary Pickford. When teaching, I try to be mindful of Winston Churchill's statement, "I love learning, but hate being taught!"

15. If you could resolve one of the great challenges we are faced with now, which problem would you solve and what would the outcome of the solution look like?

My goodness, we have plenty of challenges, don't we? Population growth seems to be moderating as

Interview continued on page 37.

Interview continued from page 36.

people become more wealthy, educated, protected, and supported. Although, walking the streets of Shanghai, Mumbai, or New York will give a very different sense than driving the roadways of West Texas or the Canadian Prairies! Hopefully, prosperity can continue to outpace population. Perhaps, the follow-on challenge is psychological. With some 7.6 billion people on Earth, even a one-in-a-million problem has 7,600 cases! Different regions have come up with answers on how and why to live. Can we examine and filter them? Can we integrate science, spirituality, and psychology? Something like a testable and happy unified field theory of existence. It's essential that we continue to learn how to get along with each other – all the way from traffic courtesy to war avoidance.

On the environmental front, we're learning so much more about how our surroundings work, the roles of plants and animals, and how we interact with them. All life uses energy and creates waste. So, the question is how do we advance, enjoy our time here, and not create too much of a mess?

Unfortunately, I must also say, probably like many of us living in big cities, I see poverty and homelessness every day. So, how do we proceed? I believe that the answers lie in science, education, vibrant economies, and compassionate cultures.

Then how would the outcome look? Maybe something like Houston's Hermann Park on a sunny Memorial Day weekend! Lots of fountains, nearby museums, open green spaces close to medical and business centers, with a zoo, active restaurants, and a golf course – a place of vibrant diversity with good governance and developed people pursuing their happiness.

Mystery Item

This is a geophysical item...

Do you know what it is?

This month's answer on page 43.

Recognizing Outstanding GSH Volunteers...

Whitney Blanchard

by Tommie Rape

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

Whitney Blanchard was born in Michigan and moved west to Wyoming at the age of 16. Both of her parents were teachers at a community college. Growing up, Whitney developed keen interests, which she maintains today, in horses and music. She attended Montana Tech in Butte, where she obtained a BSc and a MSc in Geophysical Engineering. She later attended the University of Alabama, where she received a MSc in Geoscience. While in school, she worked at several internships in the US and UK. One of these internships, and the presence of her future husband, brought her to Houston where she went to work with Schlumberger in 2013. Whitney married Robert Blanchard, also a geophysicist, in 2015. Whitney and Robert were graced with a daughter, Charlotte, in 2017. And just to let you know, darling Charlotte was very active during the interview for this article.

Working at Schlumberger, Whitney performed commercial processing of microseismic data. She enjoyed the intense geophysical computer application and working with data. But the industry downturn caught up with her work group, and Whitney was amongst a significant group of people laid off from their jobs. With other work opportunities being extremely limited in the geophysical profession at that time, Whitney gravitated to a profession near and dear to her family - teaching. Whitney obtained a teaching certificate, and during the school year, she took a volunteer apprentice position in a middle school and began teaching physics and math in an after-school program. By this time the soul searching reached a crescendo, she did not want to leave geophysics behind. With the support of her geophysical husband, Robert, she began to look for volunteer opportunities in the geophysics realm. Having been a member of the GSH, Whitney knew that the GSH could provide connections that might find her another paid position in the geophysical industry. She approached Nicola Maitland, the volunteer coordinator for the GSH, and the GSH office to see what opportunities might exist for her to help. Whitney helped with the hosting and registration at several GSH technical events. This proved very useful in expanding her network within the geophysical community. Whitney became acquainted with many of the geophysicists in her areas of technical expertise. However, Whitney wanted to do more, so she offered to help in the GSH office part time. She helped Karen and Kathy with a variety of tasks, including utilizing her computer skills in the organization and preparation for many of the frequent technical events sponsored by the GSH. Her geophysical background also helped Kathy and Karen in the preparation of event notices and summaries. Her presence in the GSH office provided Whitney with the opportunity to meet many more geophysicists and further expand her geophysical network. But working in the GSH office provided Whitney another great opportunity, it helped to make her more aware of the many events

Volunteers continued on page 41.

Volunteers continued from page 40.

sponsored by the GSH, both technical and social, and the people that led them.

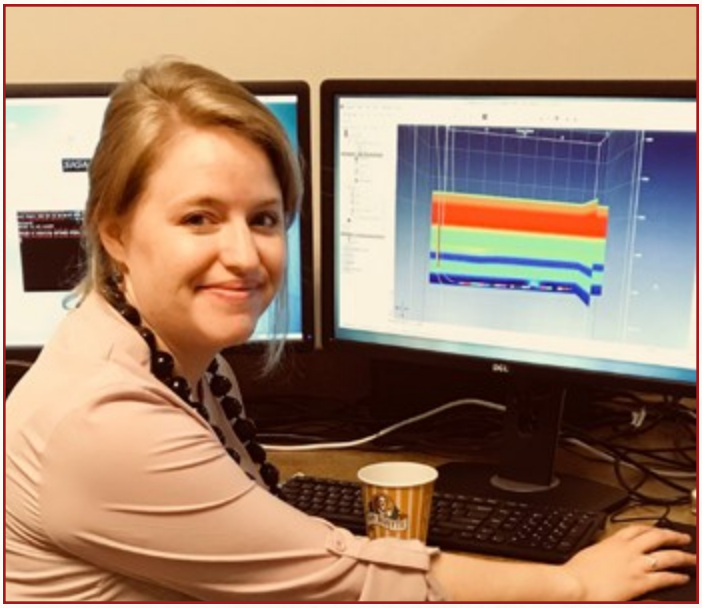
Since she was in the office, Whitney took the opportunity to attend some of the monthly GSH Board meetings. Her attendance at these meetings and her acquaintance with the GSH leadership greatly expanded her working knowledge of how the GSH operates. Whitney's willingness to help others should now be readily apparent. Later, she moved into her next volunteer position. Whitney became the Chair of the events for the Education and Career Development for Unemployed Professionals. Whitney organized speakers and networking events for the unemployed geophysicists in our area. She eventually had to pass this role along to someone else when she took time off to have her baby.

Whitney has proven to be a shining example from our younger generation of geophysicists. These younger geophysicists are often fully engaged in starting and raising families and trying to move forward in their professional career. They often find it very difficult to find the time to get more involved with the GSH. Whitney has shown, though, that expending that effort in volunteering for the GSH has benefited her in many ways. Through some of the people Whitney met, she did get interviews and job offers. She did get a job from her network, but from someone that she previously worked with. But this does show the importance of networking as we progress through our careers. Whitney is currently working for Sigma3 where she is continuing her passion for the processing of microseismic data. Whitney says that her role with the "Unemployment Forum" expanded her organization and leadership skills, which is a great asset for a young geophysicist looking to move ahead into supervisory positions at their company. She said that leading these events also helped her public speaking skills, and writing articles about the events gave her more confidence and improved her writing skills. But probably most importantly, her volunteer efforts with the GSH made her more confident that she should stay in geophysics and not go into teaching as a primary profession. Her volunteer work rekindled and reinforced her love for geophysics.

Whitney says that we must convince younger geophysicists that volunteering will help them and advance their careers. We must help these younger geophysicists understand that there is a bigger geophysical realm outside their company. We have all heard that "Who you know" is so important. In these difficult times when many jobs are on the line, knowing that critical person might make a small or big difference

in retaining your job. Whitney's husband, Robert, had a keen observation. He said that professional chapters in Houston are very large and not as closely knit as some smaller groups; then he said that once Whitney volunteered at the GSH, she became close to many other geophysicists.

The GSH appreciated Whitney's efforts and recognized her in 2017 with the President's Award for the GSH "Rookie of the Year". Thank you, Whitney, for all your efforts for the GSH and the geophysical community.



We appreciate our Corporate Members

Apache

ConocoPhillips

Fairfield Geotechnologies

In-Depth

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

AD FORMAT FOR ADVERTISERS

- Ads should be submitted as full color, print-ready, high-resolution pdf, tif, eps, Illustrator, or PhotoShop files.
- Do NOT submit ads as Word documents, PowerPoint, or Excel files.
- Avoid clip art and Internet images. All submissions should be to size and at least 300 dpi.
- Send a URL or email address for a hyperlink.
- All issues are permanently archived on the GSH website @ www.gshtx.org

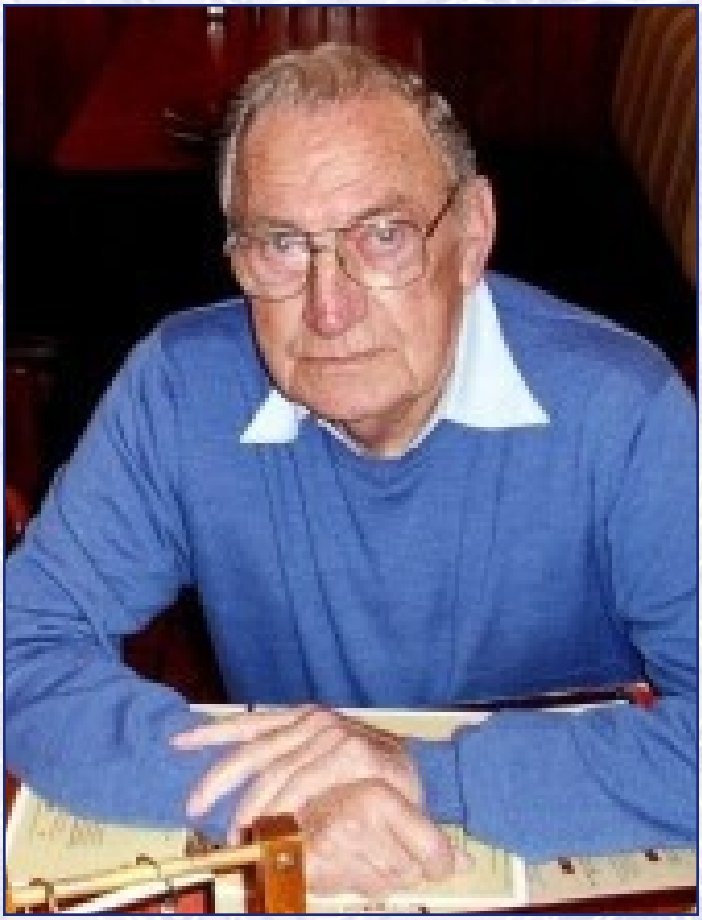
AD SIZE DIMENSIONS

Full Page	8" w x 10.25" h
Half Page - horizontal	8" w x 5" h
Half Page - vertical	3.875" w x 10.25" h
Quarter Page - vertical	3.875" w x 5" h
Quarter Page - horizontal	8" w x 2.375" h
Eighth Page	3.875" w x 2.375" h

In Memoriam

Donald William Townsend

February 11, 1928 - May 25, 2018



Donald William Townsend, 90, passed away on May 25, 2018 in Houston, Texas. Don was a pioneer in the industry, a friend to all who knew him, a gentleman, with a great sense of humor, and a scholar. He was an excellent writer, and his writings about his worldwide experiences as a "doodlebugger," especially in Libya, were very enjoyable and informative.

Don was born on February 11, 1928 in Harrow, England to William and Rose Townsend. He graduated from Acton College, London reading Geology and then trained in telemetry with the Royal Air Force. Working as a surveyor, seismic observer, and a seismologist, Don spent the 1950's and early 1960's working with exploration crews all over the Middle East. He married Elizabeth Hunn in 1961, and the couple moved to Tripoli, Libya, where their daughter, Deborah was born in 1964.

He and his colleagues pioneered the use of mainframe computers in oil exploration in the 1960's, working for Petty-Ray Geophysical, which later became Geosource, and still later, Halliburton Geophysical. In 1964, they installed the first mainframe (RayGeo system 360) in Tripoli, Libya, and subsequently developed the first generation of seismic software systems.

Don and his family moved to Houston in 1969, and thereafter, he continued to develop digital tools for the industry which were used by Ray Geo all over the world.In 1973, he became manager of worldwide system support for the Petty-Ray Division of Geosource Inc.

After retirement in 1993, Don divided his time between restoring a country cottage on the outskirts of Portland, Oregon; and establishing, organizing, and maintaining the Bob Sheriff library at the GSH Geoscience Center in Houston. In 2015, he was awarded a GSH President's Award for organizing the Sheriff library. He was also very helpful in identifying and explaining many of the older items in the Geoscience Center museum collection, and of course there were always the stories. A man of many talents, Don was also an enthusiastic wood-worker, and later, took up book-binding. Don is survived by his wife, Elizabeth and daughter, Deborah. He will be sorely missed by his family and many friends.

Mystery Item

The Mystery Item
on page 39 is a
Micro Altimeter
that was used in field work in geologic studies.

Geoscience Center News

By Bill Gafford

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

We had a number of donations to our Museum Collection over the summer, including some microscopes, which will enable us to include more geologic items in our displays. We also have some rock samples, well cores, geologic field study reports, and geologic training manuals.

Our most recent Living Legends Doodlebugger social event was held on Thursday, August 9th.

We were glad to see a few new visitors, as well as, some familiar faces. These events are open to everyone but are partly designed for our senior doodlebuggers, who enjoy having a chance to visit with old friends and reminisce about times in the oil patch. We usually find out more information about some of our artifacts on display during these events. The next event will be on Thursday, November 8th.

We had a successful fundraising effort earlier in the year with our Geoscience Center Challenge, which was for individuals. We are now in need of corporate donations. If you think that your company might be willing to donate, please let me know the name and address of the appropriate person to contact, and I will provide additional information. Company donors are recognized on the donor Wall at the entrance and individual donors are recognized on a "Friends of the Geoscience Center" listing. We are still interested in finding display space for some of our geoscience artifacts so that the public can understand and appreciate the technology used in the early days of petroleum exploration. Please contact me if you have any suggestions about places that would host a display.

Visitors are welcome at the Geoscience Center on Wednesday mornings from 9:00 until noon or by appointment. Volunteers are also needed to help with some of our ongoing projects, so if you have a little time, come visit us. Please contact me at geogaf@hal-pc.org or at 281-370-3264 for more information.

IS THE INDUSTRY READY FOR THE RETURN OF

GSH HGS

Geoscience Day

The Life of an Oilfield

An Overview of Geophysical and Geological Practices for Individuals New to the Industry

A full day of PRESENTATIONS, EXHIBITS, DEMONSTRATIONS and NETWORKING

Geoscience Day has been held annually over the past decade, but was not held in 2016 & 2017 due to the lack of new hires to the industry.

ACTION REQUIRED!

We will hold the event in the late fall of 2018 if sufficient interest and support from companies and individuals exist. Please let us know if you would support/sponsor or attend the event by replying to office@gshtx.org or calling 281-741-1624.

GSH / HGS 18th ANNUAL SALTWATER TOURNAMENT

- Friday, October 12, 2018 -

TopWater Grill Marina, 815 Avenue O, San Leon, TX

Galveston Bay Complex and Offshore

We are looking forward to a big event this fall and we encourage full family participation!

Galveston Bay Complex Division

Trophies will be awarded for the heaviest individual Redfish (Non-Tagged), Speckled Trout, and Flounder. Trophies will also be awarded for the heaviest individual Stringer - 1 Redfish, 3 Speckled Trout, and 1 Flounder.

Galveston Offshore Division

Trophies will be awarded for the heaviest individual Ling, King Mackerel, and Mahi-mahi

REGISTRATION OPTIONS

Registration …… $75 ea
Includes Launch Fee, Refreshments, Seafood Dinner, Trophies, and Door Prizes.

Registration plus a spot on a Guided Boat for a Half Day …… $300 ea
Includes 4 hours in the morning or mid-day, bait & tackle. Just bring your tip and empty ice chest to take your filleted catch home. Check with the GSH Office for availability.

Registration plus a spot on a Guided Boat for a Full Day …… $400 ea
Includes a full day, bait & tackle. Bring tip & ice chest. Check for availability.

Non-fishing Registration …… $20 ea
Includes a Seafood Dinner and non-alcoholic drinks.

For more information, please contact:

Bobby Perez Cell: 281-787-2106
Home: 281-495-8695
E-mail: rdphtx@gmail.com

Nathan Lenz Cell: 281-468-5459
Office: 713 576 3371
E-mail: nathaniel.lenz@tgs.com

SEIMAX TECHNOLOGIES

Sara Davis
Director of Marketing & Business Development

4805 Westway Park Blvd., Houston, TX 77041
p: 832.554.4301 d: 832.554.4314 c: 713.256.8737
sdavis@seimaxtech.com

Spectrum
spectrumgeo.com

Eddie Pharr
Vice President Business Development, North America
eddie.pharr@spectrumgeo.com

Spectrum Geo Inc.
11750 Katy Freeway,
Suite 900, Houston,
Texas 77079, USA

tel: +1 281 647 0602
direct: +1 281 698 8864
fax: +1 281 589 8111
mob: +1 713 906 0743

SHEARWATER

PHIL SCHEARER
Account Manager – Processing & Imaging (US)

O: 281.921.8000
D: 281.921.8047
C: 281.948.9312
E: phil.schearer@shearwatergeo.com

www.shearwatergeo.com
1080 Eldridge Parkway, Suite 1100 | Houston, TX 77077

INT
Interactive Network Technologies, Inc.

Paul Schatz
VP Sales

Tel: 713-975-7434 • Cell: 713-829-5254
2901 Wilcrest, Suite 300 • Houston, TX 77042
paul.schatz@int.com http://www.int.com

Bill Thomas
BUSINESS DEVELOPMENT MANAGER
M +1 281 804 9435
E billt@dug.com

dug
DownUnderGeoSolutions

DOWNUNDER GEOSOLUTIONS
16200 Park Row Drive, Suite 100
Houston, TX 77084
United States of America
T +1 832 582 3221
www.dug.com

SHEARWATER

JESSICA WARDEN
Business Development Manager, OpenCPS

O: 713.224.6225
D: 281.921.8041
C: 832.235.6437
E: jessica.warden@shearwatergeo.com

www.shearwatergeo.com
1080 Eldridge Parkway, Suite 1100 | Houston, TX 77077

Boone Exploration, Inc.

Lynn D. Boone
President

J.C. Carlisle
Vice President

21 Wire Road
P.O. Box 8660
Huntsville, TX 77340

Phone: 936-295-4066
Fax: 936-295-4042
Email: jcc9551@aol.com

www.booneexploration.com

Z-TERRA
Technology for Energy

John Asma
Business Development Executive

Z-Terra Inc.
17171 Park Row, Suite 247
Houston, TX 77084
E-mail: johna@z-terra.com
www.z-terra.com

Main: +1 281 945 0000
Fax: +1 281 945 0001
Cell: +1 713 857 7842

PARAGON
GEOPHYSICAL SERVICES, INC.

AARON BATEMAN
President
Cell: (316) 640-0423 • abateman@paragongeo.com

(316) 636-5552 • Fax (316) 636-5572
3500 N. Rock Rd., Bldg. 800 • Wichita, KS 67226

Coggins Geosciences, Inc.
Seismic Interpretation / Technical Assurance

Jerome L. Coggins
Principal Geophysicist

Katy, Texas USA
281-717-4011
JLC@CogginsGeosciences.com

Doodlebugger Diary

Eritrea – What Happened To Thee?

By Scott Singleton

Doodlebugger Diary are the experiences of geophysicists during their working lives. Usually these are not recent events, but more recent ones are just as welcome. Think back to an earlier time when you were on a seismic crew, operating a magnetometer survey, gravity stations, or whatever. I included one that involved a data processing center. Seriously consider contributing a story or two. Scott Singleton recalls a few interesting stories. We are going to run them over several issues of the Journal. Scott is a past President of the GSH and still very active in professional affairs. I know you will enjoy his adventures as a truly certified doodlebugger. ~Lee Lawyer

If you have an item for the Doodlebugger Diary, send it to llawyer@prodigy.net or to editor@gshtx.org.

Recently the world was pleasantly shocked when Ethiopia's new Prime Minister, Abiye Ahmed, who was sworn in only in April 2018, reached out to Eritrea by fully embracing the peace accord that ended a border war in 1998-2000, but which has been smoldering since, because in 2002 Ethiopia got cold feet about implementing it and continued occupying border regions within Eritrea. There is hope that relations can be normalized, allowing landlocked Ethiopia to have port access as an outlet for its growing economy.

Figure 1: Map of Eritrea showing juxtaposition between Ethiopia and the Red Sea. Sudan (or rather now South Sudan) lies to the west and the war-torn country of Yemen is directly across the sea from Eritrea.

Doodlebugger continued on page 49.

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

Doodlebugger continued from page 48.

There is also hope that the normalization of relations will result in an opening up of Eritrea, currently considered one of the most closed and repressive regimes in the world. This has been a tragic outcome to such a beautiful area that at one time contained an educated and developed society. This was the result of it being a long-time Italian colony, and as such was provided with the resources and architecture befitting of its Italian overseers. However, this all ended in WWII with the British taking over and then handing it to Ethiopia in 1950 under Emperor Haile Selassie who was trying to rebuild the Ethiopian empire. When Selassie reneged on his promise to provide independence for Eritrea after 10 years of Ethiopian rule, Eritreans took up arms and waged a war for 30 years finally re-capturing the county in 1991. They held a referendum on independence in 1993 which was almost unanimous and in 1994 officially became a country *(Figure 1).*

Oil, of course, was one of the resources they hoped to develop in order to rebuild their devastated country. Anadarko picked up leases in their offshore Red Sea territory and was looking for a place to spud an exploratory well. There had not been much exploration prior to this point in time, despite its location near the prolific Arabian platform. A few several decade old wells had been drilled offshore, one of which resulted in a natural gas blowout that burned down the drilling rig. But natural gas had very little value in the latter half of the 20th century so these wells were all abandoned. Anadarko's intent was to take another look at this area. This is where we entered the story.

The first step in assessing potential offshore drilling locations was to determine the location and severity of shallow hazards. Thus in 1997 Anadarko contracted out a supply vessel that was rigged up for hi-res acquisition *(Figure 2)*, including geochemical sampling, piston coring, fathometer, 3.5 kHz sub-bottom profiling, and sparker. I was working for the client-rep company Energy Innovations (EI) and was one of their hi-res experts (which is what led EI to

Figure 2: The converted supply ship that was to serve as our seismic and coring vessel.

Doodlebugger continued on page 50.

Doodlebugger continued from page 49.

Figure 3: The terrain on the outskirts of Asmara. This is the view immediately upon leaving the city and heading along the highway to Massawa.

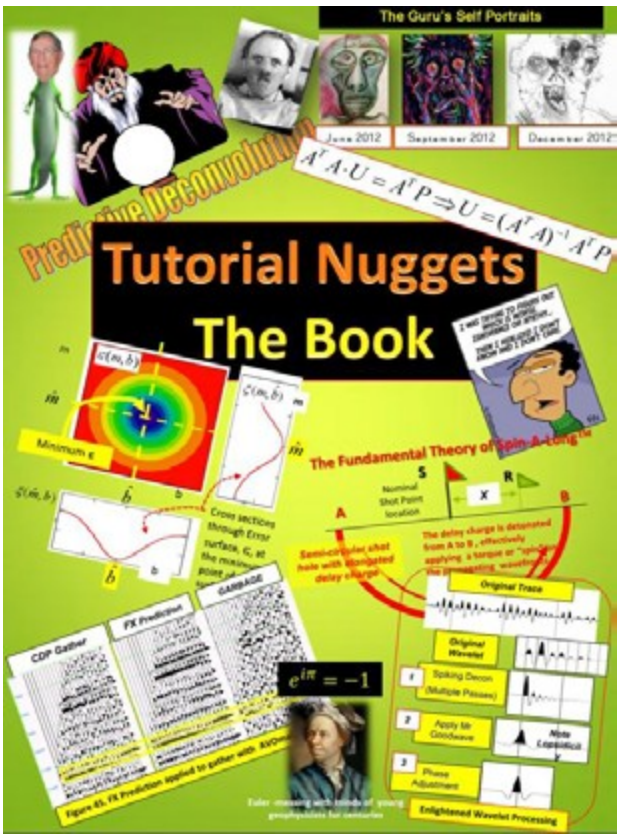
send me to the South China Sea for the infamous Hong Kong to Hainan Island gas condensate pipeline survey in 1992 that I wrote about previously in the Doodlebugger Diary). I was charged with surveying and sampling a number of pre-defined sites in the Massawa Channel between the mainland and the Dahlak Archipelago *(Figure 1)*. In this capacity I had wide latitude to search potential areas of interest during our surveying mission and thus had to do onboard interpretation of the hi-res data. This project definition was right up my alley and was one I was excited to be a part of.

So in the fall of 1997 we were ready to roll. The ship was to dock in the port city of Massawa *(Figure 1)* and ready to meet the scientific crew. We flew into Addis Ababa, the capital of Ethiopia, and then to Asmara, the capital of Eritrea, on Ethiopian Airlines. We could do this because in 1997 this was supposedly the new era of friendship and cross-cultural trade between the two countries. In fact, the local oil company representatives were actually Ethiopian that had been transferred to work with the Eritrean national oil company. Everyone was happy to see the cross-cultural ties because these countries shared the same language and customs.

Asmara is a city of 800,000 situated in the mountains at 7600' elevation. It has a cool and temperate climate *(Figure 3)* and appeared to us to be a thriving city. Its Italian roots were very evident in the architecture. About the only sign we saw of the recently ended war was a rather old, destroyed Soviet MIG on the outskirts of town. It was explained to us that Ethiopia was in the Soviet sphere of influence in the war and Soviet MIGs took off from Asmara, which was held by Ethiopia, to go on bombing runs at the front lines. They were proud of the fact this MIG was destroyed by partisans during the war.

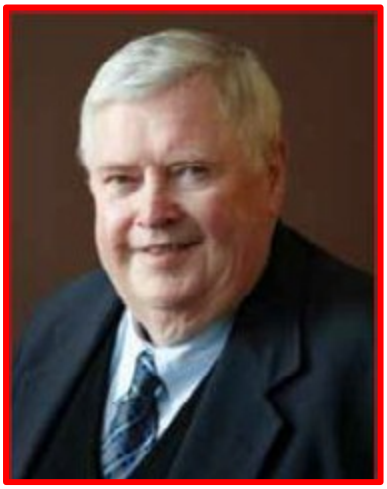
We should have taken that to be an omen of what was to come but I think we were all just thrilled to be in this very interesting and historic culture, and to be running into very friendly people wherever we went.

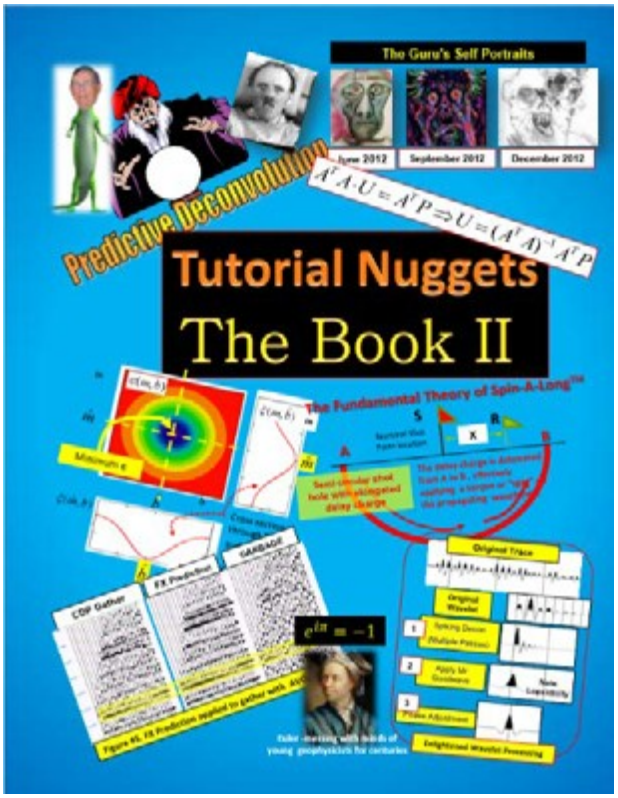
Next month: Part 2 – Massawa



Tutorial Nuggets The Book

Over 200 pages of information, formulas and humor!





Tutorial Nuggets The Book II

ORDER at
www.gshtx.org
Proceeds will be used to further scholarships, student memberships, educational outreach, and other activities of the Society.

The GSH is a 501(c)3 organization.

MEMBER PRICE $75