March 2019

GSH Journal

GEOPHYSICAL SOCIETY OF HOUSTON
Volume 9 • Number 7

The Epicenter of Geophysical Excellence

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On The Cover...

Seismic data acquisition in Bolivia.

Picture courtesy of Wireless Seismic.

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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

May 2019.....**Mar 8**
June 2019.....**Apr 12**
Sept 2019.....**July 12**

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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

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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	Alvaro Chaveste	713-393-4941	832-707-6505	alvarochaveste@hotmail.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
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	Maitri Erwin	713-380-4800	281-785-5814	maitri.erwin@gmail.com
	Haynie Stringer	281-491-2045	832-606-3993	hayniestringer47@yahoo.com
	Dennis Yanchak	713-296-6109		Dennis.Yanchak@apachecorp.com
	Craig Beasley		713-689-6818	cbeasley@slb.com
SEG ALTERNATE REPS	Bill Gafford	281-370-3264		geogaf@hal-pc.org
	Mike Graul	713-465-3181	713-248-3562	mgraul@texseis.com
GEOSCIENCE CENTER	Bill Gafford	281-370-3264		geogaf@hal-pc.org
SPG-NA Rep.	TBD			
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

Politics, Technology, People

By Dmitry Kulakov, Editor

The industry entered 2019 with a very cautiously optimistic mood. We have all the signs of growth associated with increasing investments in the exploration cycle; however, every player in the market is now very careful to make any forecast. The current downturn proved to us that modern industry realities are dramatically different from anything we've faced before. Every single little notice from some official social network account these days can drop a bomb on the market, and that impacts everybody in the field dramatically. What's frustrating is that some of these statements could be fake and end up being denied, but its impact is still felt.

Coming down from a political level of industry impacts to a technical level, it's very interesting how we start to adopt new approaches naturally, without creating a big "fuss" around it. Last year, in my Word from the Board article I talked a lot about our industry being very slow to adapt and how other technological fields are skipping the stages of exploration and appraisal to go straight into production and application of most modern techniques. Well, a year later, I can sure say that the mindset in our community has changed towards that agile and "do it" approach. I clearly see that the amount of talks like "How we could utilize big data analysis methodology in geophysics" has greatly decreased. Instead, we have new conferences and sections of case studies showing how it works! Now, I see that we are more integrated in a sense of trying new approaches in our day to day business. It takes only the will of learning something new to improve our activities and find solutions. After one individual identifies real room for improvement, it's only a matter of browsing on how similar things are implemented in different fields and solving the problem. For the past year, I've seen multiple examples of how easy it is to improve in anything, if you can re-think your problem from a different perspective. Motivation to change something for the better is a real kick-starter here, so that's what we should seek rather than waiting for market conditions to improve.

And, finally, coming to the most important level of industry impact: society. Being an Editor of the Geophysical Society of Houston's Journal is one of the best things that happened in my professional life. Now, when my second year of service is almost over, it's obvious to me that all the time I've put towards the society in general and journal in particular was a great investment. It's impossible to estimate the value of networking and meeting new people from your field that share a passion for this profession. By the nature of my assignment, I've been exposed to the great variety of materials that have been coming from all the different fields of GSH activities: I have been amazed to know how many outstanding technical events our society holds yearly and, what's more important, how broadly it covers all the aspects of modern and future geophysics; I've learned about and attended great social events that the GSH hosts like Icebreakers, Sporting Clays Tournaments, and multiple others; I've been shocked to see how much community work is done by the Outreach Committee on educating the younger generations on what Geoscience is; and, of course, my personal favorite is learning about geo-people life experiences from interviews, FTOS and Doodlebugger articles.

I feel like saying "Thank you" to the whole Society for all the things I've learned during my term. The opportunity to serve and impact on our local, but huge, community is priceless, and the only way to pay it back is to keep contributing towards ongoing and future activities that are greatly appreciated by all Geoscientists from Houston. □

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

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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.

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Contact Nicola Maitland to learn more about this excellent networking opportunity:

nmaitland@resolvegeo.com - 713-972-6209

From the Other Side

By Lee Lawyer

Integration vs teamwork? Specialist or a generalist? Somewhere in my past, it became 'de rerigueur' to organize employees in teams. The basic idea was (is) to create synergism. Synergism is defined as the simultaneous activity of separate individuals who create a greater total effect than the sum of each working separately. Classes were developed to further this notion and to teach 'teamwork'. Individuals are evaluated by superiors based on their ability to work as a team member and being classed as a poor team player is fatal.

Does each member of the team have the same impact on the result? That would seem to negate the idea of synergism. Would you like to become a member of a team? Are you on multiple teams? Is a team like a committee where one person does 90% of the work but only gets the credit divided by the number of members on the team? There have been tons of literature about teamwork and its value. To me the question is whether teamwork is the best utilization of manpower.

Is it better to have a geophysicist and a geologist work as a team or have one person well versed in geology and a working knowledge of geophysics? (I fall in this category.) Do we need a geologist to determine the parameters needed to process seismic data? Must we have a drilling engineer to locate a well? We are confusing integration with teamwork.

Or am I going off the deep end? (Don't answer.) I can see the need for ven diagrams to keep track of where an individual is assigned. We will color code them, the geophysical ven is red, geological ven is blue, engineer is green. These colors generally demonstrate value whereas red is used for expenditures, blue describes the wild--blue nature of geology without geophysics, and green indicates the actual 'return on investment'. Any are assigned to several teams, but this sort of sounds like forcing integration. Integrating all available data is a must but does that require a team effort? I don't think so. I think we dampen enthusiasm with organization and we have replaced leadership with process. We should spend our time and money giving employees a broad background, so they will know what and where the data is and how to utilize it to end up with a fully integrated result, that's what I think.

Have you heard of the '*Seismic Sound Off*' episodes in TLE? They are delivered via Podcasts. The first episode was back in August 2016 as part of SEG Knowledge Management Department activities. I knew about Sound Off from some comments during the SEG Board meetings. I thought it would be an item like "letters to the Editor" but I was wrong. My lack of knowledge is inexcusable. The Podcasts are organized and edited by Andrew Geary, Publications Outreach and EVOLVE Program Manager of the SEG. Usually there is a synopsis of the Episode in the TLE. Now and then an interview is recorded and made available as a 'podcast'.

I was "made aware" of them recently by a friend who was featured in one of the episodes. He conveniently sent me a link to the interview, so I dutifully logged on to my friend's podcast. I only got the first few minutes when other matters intervened, but I recently listened to the whole episode. I didn't time it, but it was about 30 minutes or less, and well worth the time invested. The friend was Don Paul who retired from Chevron as VP and Chief Technology Officer and he is well qualified to discuss industry issues particularly if they involve the technical aspects and trends. The episode is in the December TLE and it is hidden way in the back but I strongly recommend you listen to it. Good stuff.

The GSH has a problem with attendance at our Technical Luncheons. It is tough to understand the issue. Maybe they cost too much. Maybe the talk is not exactly what we are working on. Maybe, maybe, maybe. I usually attend all of the tech lunches and a SIG now and then in spite of the subject. The January Tech Lunch and January G&M SIG were in the same week and I attended both.

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From the Other Side continued from page 6.

One discussed broadening the spectrum of seismic data to get better definition of the horizons. The other was a review of magnetic stripes on either side of the mid-Atlantic ridge. The stripes were called Chrons. I am not sure about this terminology but they are time correlations or something like that. Where were you? You missed two good presentations. These technical talks are provided by the GSH (with good volunteers). Unless we improve attendance, the GSH will have to cut back. The downtown Tech luncheon is at risk. The G&M SIG moved from Hess to the Black Lab to save money. It was a successful move.

Sometimes I comment about the passing of a friend, colleague, geophysicist and someone you may have known or met here or there over the last 60 years or so. Neal Cramer was one of the senior managers of Western Geophysical company and I knew him well. Another friend who passed away a few weeks ago was Dave Agarwal, Dave was active in the GSH. I am getting tired of out-living my good friends. On the other hand..... □

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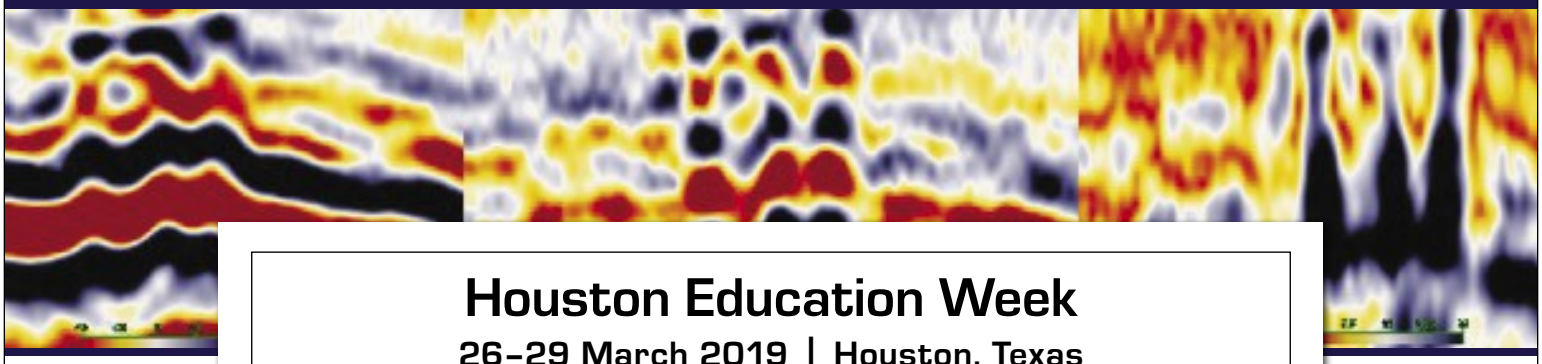

Houston Education Week
26–29 March 2019 | Houston, Texas

Don't miss these cutting-edge courses at the Norris Conference Center/Westchase, including:

26-27 March: Machine Learning Techniques for Engineering and Characterization (New)
by Sid Misra

26-27 March: Reservoir Geophysics: Applications
by Bill Abriel

28-29 March: Seismic Diffactions - Modeling, Imaging and Applications
by Tijmen Jan Moser

Image courtesy Tijmen Jan Moser

SEG

seg.org/education/courses

Technical Luncheons

Geomechanical Models for 4D Seismic Feasibility

Register for Tech Lunch Westside

Register for Tech Lunch Downtown

Register for Tech Lunch North

Speaker(s): Shauna Oppert
Chevron Energy Technology Company, Integrated Geomechanics

Co-author(s): Shauna Oppert and Jose Adachi
Chevron Energy Technology Company, Integrated Geomechanics

Shauna Oppert

Westside

Tuesday, Mar. 19, 2019
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, Mar. 20, 2019
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, Mar. 21, 2019
11:00 a.m. – 1:00 p.m.

NEW LOCATION

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

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

Abstract:

Time lapse seismic feasibility studies have been employed for understanding the value of information 4D seismic could bring to production monitoring, as well as for aiding interpretation of the 4D seismic results. The work typically relies on a relationship between stress and the elastic parameters to model the time-lapse changes to the reservoir due to production. It is not surprising that time-lapse feasibility results would yield a poor match to field data based on reservoir models that are not properly calibrated with produced volumes and pressures. However, it is possible that even with a calibrated reservoir model, the 4D seismic feasibility response may still not match the measurements. In such cases, geomechanical effects can be invoked as the likely candidates for explaining these divergences, although there is a relatively small amount of published work that demonstrates the significant impact that these geomechanical effects can have on the 4D seismic response. In this presentation, we explore the learnings from combining a coupled geomechanical/flow simulation with 4D seismic modeling and discuss the key components that led to impactful divergences from conventional flow simulation approaches.

The results from this work show that for a Deepwater Gulf of Mexico field, 4D seismic models that use coupled geomechanical/flow simulations predict larger time-lapse effects due to production. For example, depletion from deeper reservoir sands, which

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Technical Luncheons continued from page 8.

were modeled to be undetectable with a flow simulation only approach, show stronger 4D seismic amplitude differences. This result was mainly due to relating velocity to mean effective stress, instead of the conventional " effective overburden" stress, for both sands and shales in the 4D seismic model. The results also show a false 4D softening response in one sand and suggest that relatively thinner compacting sands sandwiched between dilating shales may be prone to exhibit this "false" elastic response. The inclusion of both sands and shales in the geomechanical model allowed the estimation of 4D seismic time shifts using R-factors derived from laboratory tests. The results demonstrate the importance of geomechanical effects on the 4D seismic signal in thick sands that experience significant depletion and provide motivation for utilizing coupled geomechanical/flow modeling to explore how time lapse seismic data can enhance our understanding of strain-related changes due to production.

Biography:

Shauna Oppert is a geophysicist working on integrating geophysical surveillance data in geomechanical applications at Chevron Energy Technology Company in Houston, Texas. She holds a MSc. in Geophysics from the University of Calgary, and a BSc. in Geology and Geophysics from the University of Missouri-Rolla. Shauna has 17 years of experience working as a geophysicist for Chevron and ExxonMobil. In 2002, she joined ExxonMobil and dedicated ten years to specializing in AVO, Seismic Lithofacies Inversion, Deep-water Stratigraphy and Time Lapse Interpretation. Since joining Chevron in 2012, she has worked in production, exploration and research areas, focusing much of her work on surveillance interpretation and geomechanics. Shauna serves as the Life of Field SEAM Technical Committee Chair for SEG, was an invited plenary panelist for the SPE IOR 2018 conference, and recently was an associate editor for THE LEADING EDGE special January edition on Reservoir Characterization. □

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Technical Breakfasts

Automated Scanning of Fine-Scale Geological, Petrophysical and Geomechanical Rock Properties and its Application in Reservoir Characterization

Register for Tech Breakfast North

Register for Tech Breakfast West

Ramil Ahmadov

Speaker(s): Ramil Ahmadov,
New England Research

North

Tuesday, Mar. 5, 2019
7:00 – 8:30 a.m.

Sponsored by Anadarko Petroleum and Quantico Energy Solutions

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

West

Wednesday, Mar. 13, 2019
7:00 – 8:30 a.m.

Sponsored by Schlumberger and WesternGeco

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

Abstract:

The integration of plug and log scale characterization is key to generating representative geological, petrophysical and geomechanical models at all stages from exploration and development to production. The importance of whole core and plug measurements is especially vital in finely laminated rocks where well-log scale measurements miss mechanical heterogeneities that are required for realistic mechanical models. The presence of mechanical heterogeneity and anisotropy under the well log resolution is commonplace in unconventional plays and can deeply impact geomechanical assessments ranging from wellbore integrity to horizontal stress estimates. Yet, in order to fully realize the value of lab-based geological, petrophysical and geomechanical characterization, it appears critical that laboratory workflows be optimized in terms of both outputs and turnaround times. In this talk, we present an in-house fully automated core scanner for fast and non-destructive physical property measurements (not just scanning) of elastic, transport and compositional properties of rocks at a very fine scale (down to mm) as well as a set of workflows to incorporate aforementioned properties in conventional and unconventional reservoir characterization with examples from Permian Basin, Vaca Muerta Formation in Argentina and deepwater GOM.

Biography:

Ramil Ahmadov is a Principal Geoscientist at New England Research. Prior to joining NER, Ramil has held various roles at BP and Ikon Science. He has over 10 years of experience in conducting pure and applied research in the area of rock physics, quantitative interpretation and petrophysics. Ramil has considerable experience integrating laboratory, well log, seismic and production data within integrated multidisciplinary teams at all stages from exploration and development to production. Ramil holds MS Geology and PhD Geophysics degrees both from Stanford University. □

Rock Physics SIG

Rock Physics-based Interpretation Framework: Key to De-risking Amplitude-Supported Exploration Plays & Prospects, Offshore Mexico

Register for Rock Physics

Mario A. Gutierrez

Speaker(s): Mario A. Gutierrez,
Shell International Exploration and Production Inc.

Sponsored by NER, CGG and Ikon Science

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

Wednesday, Mar. 6, 2019
5:15 p.m. Refreshments
5:30 p.m. Presentation Begins
6:30 p.m. Adjourn

Abstract:

Mexico's Energy Ministry had successfully implemented tender processes for exploration blocks and farm-out opportunities in the southern Gulf of Mexico (GoM). Significant discoveries have been announced by foreign companies in the shallow waters of the Campeche area, following the award of many deepwater blocks and the selection of Pemex's partner for the development of the Trion oil discovery.

A key challenge faced by explorers in the southern GoM is to establish and validate the economic potential of the exploration opportunities using seismic amplitudes. This validation required the development and implementation of an interpretation framework for calibrating rock properties to seismic amplitudes. Empirical observations and rigorous theoretical modeling indicate that both Neogene and Paleogene exploration plays are amplitude-supported.

We built a robust and comprehensive Rock Physics (RP) model and associated interpretation framework that leverages an uniquely comprehensive local calibration data base with over 50 wells. The new predictive framework for Neogene and Paleogene exploration plays, fully integrated with petrology, pore pressure prediction, and basin modeling has been used for a confident screening and interpretation of the seismic amplitudes in terms of lithology, porosity, and fluids.

These integrated Quantitative Interpretation (QI) workflows have been effectively applied at regional and prospect scales to reduce reservoir and pore-fluid uncertainties. This regional work is an important component of Shell's approach to block and prospect ranking, and has been part of the selection process for top leads. Additional field-scale QI work is also helping with a better understanding and evaluation of farm-out opportunities.

Biographies:

Mario A. Gutierrez is currently a Principal QI Geophysicist at Shell, working primarily on the application of seismic- and rock physics-based methods, evaluating and risking the presence of reservoir rocks and hydrocarbons, to support business decisions and recommendations on exploration oil & gas projects worldwide. He has worked long periods of his career with three oil & gas operators including a NOC, a super major, and the biggest resource company in the world. Mario has been involved in numerous large scale E&P projects in multiple basins geographically and geologically diverse with several different exploration play types that vary from fluvial to deepwater deposits: Mexico Offshore, Nova Scotia, Alaska Chukchi Sea, Alaskan & Canadian Beaufort Sea, NPRA-Alaska, Labrador Shelf, offshore and onshore Colombia, offshore Nigeria, Cameroon, offshore North Africa, Angola ultra deepwater, offshore Sabah and Borneo, Brazilian offshore, North Sea, Gulf of Mexico and onshore U.S., and East Falkland Islands. He is member of SEG, GSH, and AAPG. Mario holds a B.S. in Geology from Universidad Nacional de Colombia, followed by a M.S. and Ph.D. in Geophysics from Stanford University. □

Microseismic SIG

Fiber-Optic Microseismic Monitoring

Register for Microseismic

Julian Drew

Speaker(s): Julian Drew,
Director of Microseismic Technology
Sigma Cubed Microseismic

Thursday, Mar 7, 2019
11:30 a.m. - 1:00 p.m.

Sponsored by MicroSeismic, Inc.

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

Abstract:

Microseismic Monitoring is one of the principal methods in monitoring and assessing the geometry of an unconventional completion. Fiber optics (F/O) in the form of distributed temperature sensing (DTS) and distributed acoustic sensing (DAS) has seen a rapid growth in its applications in recent years including long-term permanent monitoring of unconventional completions. Techniques are also evolving for the temporary deployment of fiber in a well including wireline and fiber optic encased in a carbon rod allowing for deployment akin to coil tubing.

While the use of DAS for seismic acquisition is not entirely new the sensitivity has been a limitation in its application to Microseismic Monitoring. Here the technology continues to evolve where the sensitivity of DAS will continue to improve.

A second challenge in the application of DAS for microseismic is in the processing and analysis of the data. One of the limitations is in that DAS is a single axis measurement as either strain or strain rate. In the case of a horizontal deployment we tend to predominantly observe a shear horizontal (SH) polarized arrival along with some component of the P-wavefield. As the measurement moves to the vertical this changes to the P-SV wavefield. In not having a full three component measurement we also cannot determine the direction of arrival beyond what can be resolved from the apparent velocity.

Another issue is in understanding the physics of the measurement in relation to the shear-arrival. To fully characterize the seismic source, we would need to recover the amplitudes and seismic spectra.

We will look at some recently acquired data including data recorded on multiple fiber array in combination with downhole three component geophone array. We will look briefly at signal processing addressing noise and signal detection in addition to some of the limitations of DAS for microseismic applications.

Biographies:

Julian Drew is the Director of Microseismic Technology at Sigma Cubed Microseismic. He formerly worked at Schlumberger including Wireline Borehole Seismic, Engineering and in Research. He has been involved for more than ten years in Microseismic developing some of the key algorithms and software technology in use today at Schlumberger and at Sigmacubed. Julian received a dual B.Sc. (Physics) and B.Eng. (Mech) from the University of Western Australia, and a PhD (Geophysics) from the University of Cambridge. □

Data Processing & Acquisition SIG

Distributed Acoustic Sensing VSP Data Acquisition in Diverse Fiber-Deployment Environments

Register for Data Processing

Mark E. Willis

Speaker(s): Mark E. Willis, Chief Scientific Advisor – Borehole Seismic, Halliburton

Co-author(s): Mark E. Willis, Glenn Wilson, Andreas Ellmauthaler, Xiang Wu, William Palacios, Dan Quinn, Halliburton

Tuesday, Mar. 12, 2019
4:30 p.m. Sign-in, Snacks, Social Time
5:00 p.m. Start of presentation

Sponsored by Schlumberger

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

Abstract:

Distributed acoustic sensing (DAS) is a rapidly evolving conveyance-agnostic fiber-optic technology for cement, perforation, stimulation, and production monitoring and more recently, seismic acquisition such as vertical seismic profiling (VSP). Fiber-optic cables can be deployed permanently behind casing, on tubing, or via pumped-down installations or temporarily via coiled tubing, wireline, or slickline. The breadth of fiber-conveyance options significantly expands the opportunities for VSP acquisition compared to wireline-conveyed geophones. This talk will introduce a DAS VSP system where remote radio control of the seismic source is combined with multiple fiber-stretcher modules to enable the direct capture of GPS and seismic source information (e.g., zero break time, sweep) into the DAS measurements. Subsequent interrogation and processing enables stacking, correlation, and common mode noise rejection to deliver VSP data in SEGY format in real time. Comparisons are shown of DAS and geophone data sets using both compressional-wave (P-wave) and shear-wave (S-wave) seismic data, and their corresponding geophysical answer products. DAS seismic data is validated by examining the extracted slowness values, incident angle responses, angles, corridor stacks, and common-depth-point transforms. While there are tradeoffs in seismic data quality depending on the manner of fiber deployment, it is shown that conveyance-agnostic DAS can significantly expand the VSP operating envelope.

Biography:

Mark E. Willis is a Chief Scientific Advisor in the Borehole Seismic group at Halliburton. In his career he has performed research and development in Distributed Acoustic Sensing VSP technology, fracture identification using seismic data (time lapse VSP, microseismics and surface seismic scattering), interferometric imaging, Kirchhoff and reverse time depth migration, velocity model building, and borehole sonic waveform processing. Previous to joining Halliburton in 2011, he worked in various research technology, supervisory and management positions at Mobil Oil (17 years), ConocoPhillips (3 years), Cambridge GeoSciences (6 years), and Massachusetts Institute of Technology (7 years). He holds a B.S. in applied math and physics from the University of Wisconsin – Milwaukee and a PhD in geophysics from MIT. □

Potential Fields SIG

Energy Flow in Terrestrial Controlled-source Electromagnetic Responses in the Presence of Steel Infrastructure

Register for Potential Fields

Mark Everett

Speaker(s): Mark Everett,
Howard Karren Endowed Professor,
Associate Department Head for
Graduate Affairs, Department of
Geology and Geophysics,
Texas A&M

Sponsored by CGG

NEW LOCATION:

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

Thursday, Mar. 21, 2019
5:30 p.m. - 8:00 p.m.

Abstract:

Visualizations of the flow of electromagnetic energy based on the time-averaged Poynting vector have yielded important and sometimes counter-intuitive physical insights in the case of electric circuits containing resistors and inductors. Less well-understood is the flow of electromagnetic energy in spatially contiguous media excited by grounded sources. It is important for geophysical interpreters to recognize how buried geological structures and steel infrastructure shape controlled-source electromagnetic responses measured at the surface. It is demonstrated herein using energy flow visualizations how a resistive layer impeding vertical electric current flow will produce a larger anomalous response to grounded-source excitation at Earth's surface than an equivalent conductive layer. Some effects of steel infrastructure on energy flow will be examined, with implications for quantitative interpretation of measured CSEM responses by explorationists and engineers at unconventional oilfields and construction sites.

Biography:

Dr Mark E. Everett is Howard Karren Endowed Professor and Associate Department Head for Graduate Affairs in the Department of Geology and Geophysics at Texas A&M. He specializes in near-surface applied geophysics, in particular electrical, magnetic, and electromagnetic methods including EM induction (EMI) and ground-penetrating radar (GPR). He has been a faculty member at Texas A&M since 1995 and has supervised (chaired) the dissertation research of 10 PhD students and the thesis research of more than 25 MS students. He has authored the textbook *Near-Surface Applied Geophysics* published in 2013 by Cambridge University Press, and is currently a co-Editor-in-Chief of *Journal of Applied Geophysics*. He received his PhD in 1991 from the University of Toronto under Prof. Nigel Edwards in the area of marine controlled-source electromagnetics at the mid-ocean ridge. He did post-doctoral studies at Scripps Institution of Oceanography and University of Cambridge and has been a visiting professor at ETH Zurich and Khon Kaen University in Thailand. Dr. Everett is a licensed professional geoscientist, with geophysics specialty, holding State of Texas Licence No. 5141. □

Ryan Marshall ‣ (713) 962-9414 ryan.marshall@dawson3d.com

GSH Office ‣ (281) 741-1624 karen@gshtx.com

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Characterization of Mass Transport Deposit Using Seismic Attributes: Upper Leonard Formation, Midland Basin, West Texas

Paritosh Bhatnagar, Matthew Scipione, Sumit Verma, University of Texas Permian Basin;
Ron Bianco, Fasken Oil and Ranch

Summary

The Leonardian Series of the structurally complex Permian basin had shelf to open marine depositional environment with many sedimentary features. Previous studies show the sediments were deposited as a large basin-floor submarine fan system and are commonly interpreted as deposits of turbidity currents. A different mechanism was observed on 3D seismic that is representative of a mass transport deposit. We interpreted the source of sediments coming in from the North and prograding into the basin. The feature mapped in the study area is 5 miles wide and extends 14 miles basinward. Seismic attributes such as a coherence and structural curvature are used to map the discontinuous mass transport deposit along with the lateral extent of the feature.

Introduction

In the early Pennsylvannian, uplift of the matador arch as well as aeolian processes provided the source of sediments for the Spraberry (Henry, 1988). During the Leonardian Series (280 Ma years ago), these sediments were deposited from the North into the Midland Basin. Previous studies, using well logs and core analysis, show the sediments were deposited as a large basin-floor submarine fan system which are commonly interpreted as deposits of turbidity currents and debris flow (Handford, 1981).

Mass transport deposits (MTDs) are characterized as remobilization of sediments as a result of slope failure. The sediments are transported downslope by gravitational processes leading to partial internal deformation of sediments as opposed to turbidite flows. Slope failure can either be caused by loose soil composition, steepness of slope or tectonic movement. Slope failures can also have an impact on hydrocarbon production as they trigger seal integrity and lead to vertical migration of hydrocarbons (Haflidason et al., 2002).

MTDs have the potential to alter original lithological composition of reservoir intervals thereby affecting porosity and permeability of sediments (Martinez, 2010). Spraberry rocks (siltstones and fine grained sandstones) have porosities averaging 8-10% and permeabilities of less than 1 mD (Elkins and Skov, 1963).

In this paper, we characterize the mass transport deposit observed within the Upper Leonard formation and understand its internal architecture with the help of coherence and structural curvature attribute. Such attributes are a great tool in understanding the extent of the discontinuous MTD and the direction of sediment influx by studying the chaotic seismic reflectors.

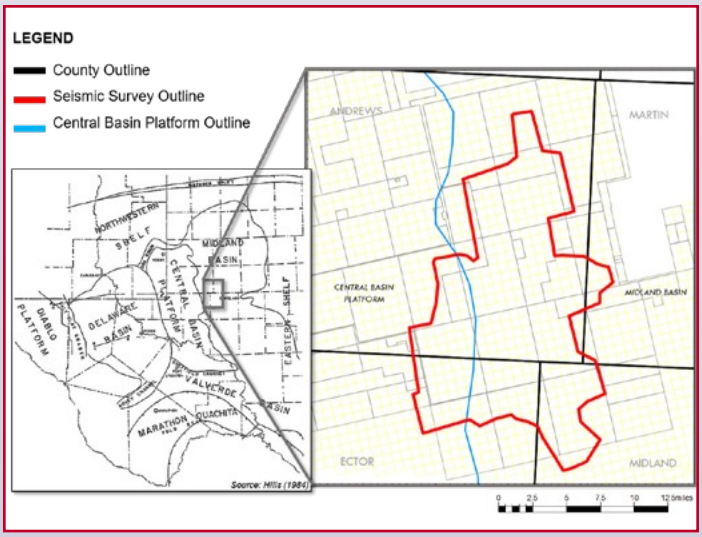

Figure 1. Paleogeography of Permian Basin region in Early Permian (modified after Hills, 1983). Right: Location of the study area. County sections and blocks are represented by yellow and grey respectively.

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

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Geology of the Study Area

The Permian Basin is a structurally complex sedimentary basin that began forming as many as 1.3 billion years ago as tectonic shift started molding the basin as we know of it today. Throughout its history of structural deformation, the Permian Basin was divided into 2 main basins: the Delaware Basin and the Midland Basin along with the Central Basin Platform as an uplifted basement block. Our study area spans across Andrews, Ector, Midland and Martin counties in the Midland Basin *(Figure 1)*. The study area is within the Spraberry trend which is currently being studied by the Bureau of Economic Geologist (BEG) and accounts for one of the largest plays in the world both conventionally and unconventionally. The Upper Leonard is considered to be equivalent to the Glorieta on the platform (Handford, 1981; *Figure 2*).

STRATIGRAPHIC CHART

System	Series	Central Basin Platform	Midland Basin
PERMIAN	OCHOA	DEWEY LAKE	DEWEY LAKE
		RUSTLER	RUSTLER
		SALADO	SALADO
	GUADALUPIAN	TANSILL	TANSILL
		YATES	YATES
		7 RIVERS	7 RIVERS
		QUEEN	QUEEN
		GRAYBURG	GRAYBURG
		SAN ANDRES	SAN ANDRES
	LEONARDIAN	GLORIETA	U. LEONARD
		U. CLEARFORK	U. SPRABERRY
			L. SPRABERRY
		TUBB	DEAN
		L. CLEARFORK	L. CLEARFORK
	WOLFCAMP	WOLFCAMP	WOLFCAMP

Figure 2. A simplified stratigraphic chart correlating shelf to basin facies (modified from Handford, 1981).

Figure 2. A simplified stratigraphic chart correlating shelf to basin facies (modified from Handford, 1981).

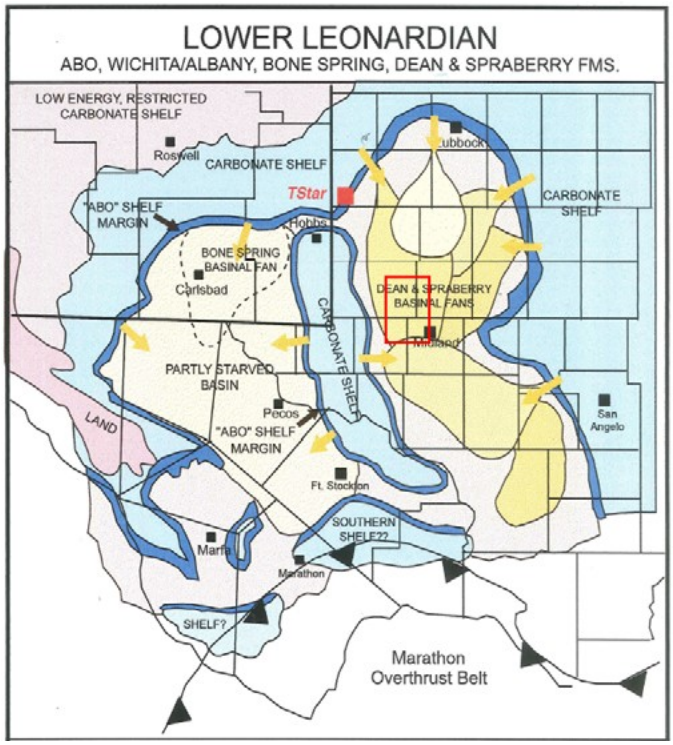

Figure 3. The influx of sediments coming from North and the Central Basin Platform during Spraberry time. Red box is the study area (Gibbs, 1996).

During the time of deposition (Upper Leonardian), the sediments are believed to be coming in from the North and pro-grading into the Midland basin *(Figure 3)*. The Spraberry can be delineated by three sand bodies in the upper Spraberry and four in the lower Spraberry. The upper and lower Spraberry sands can be separated by 250 feet of limestone. This cyclic repetition of terrigenous clastics and carbonates and shales identifies primarily carbonate or clasticly dominated shelf. Central Basin Platform also contributed to the sediment influx from the west, although this was relatively flat and consistent. *Figure 4* illustrates a cross sections running W-E showing the distribution of sediments during Spraberry time. *Figure 5* shows a regional N-S cross section indicating sediment influx from the northern slope and the distribution of different lithologies.

Stratigraphy

The midland basin is characteristic of shallow marine shelf to shelf margin carbonates but shelf

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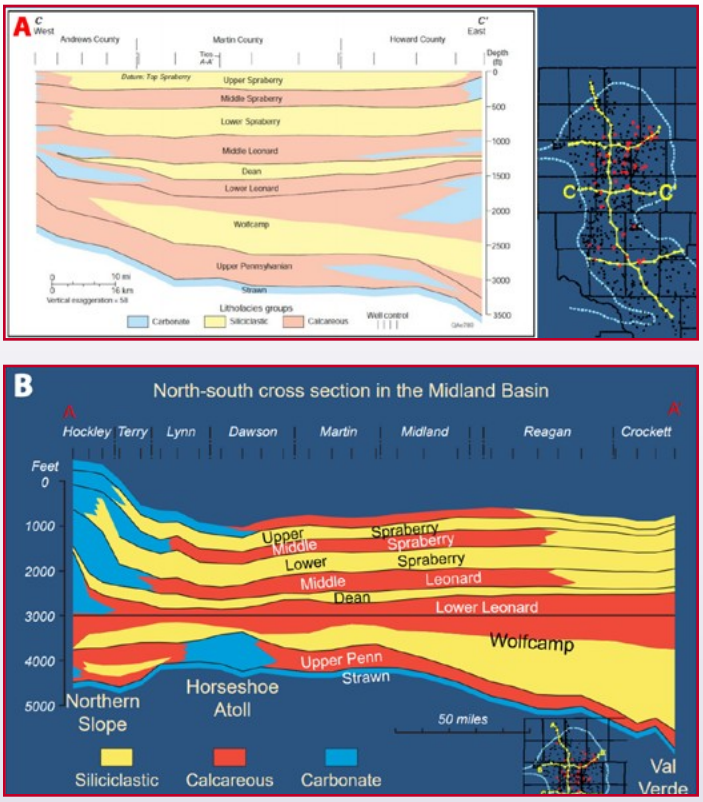

Figure 4. (a) Map showing Regional W-E cross section CC′ showing Lower Permian stratigraphy and lithology in central part of Midland Basin. (b) Regional N-S cross section AA′ showing sediment influx from the northern slope and lithology distribution (Hamlin, 2013).

to basin correlation is difficult because of abrupt changes in facies type, high relief topography, and inadequate well control. The Spraberry is considered to be equivalent to the Glorieta and/or Upper Clearfork on the platform (Handford, 1981; *Figure 2*).

The Spraberry formation strata consist of interbedded organic rich shales, and low-permeability, naturally fractured siltstone and sandstones. The Spraberry silty sandstone can be characterized by containing quartz (35-65%) with minor feldspars (10-15%) and clays (10-13%). These individual sandstone beds can 3 inches to 9 feet thick. The lower sections of the sandstone beds contain fluid escape structures and become more laminated going up section (Murphy 2015). The sandstone beds are well cemented by either calcite, dolomite, or quartz. Within the terrigenous clastics, two primary vertical sequences can be identified. First is discrete fining-upward interval characterized by turbidity flow. Second is a coursing upward sequence (Fisher 1988). Most sedimentologic evidence suggest that these terrigenous clastics were deposited by density current deposits as opposed to turbidity currents.

Seismic attribute analysis

Seismic and Well log data

The mega merge 3D survey consists of more than five different 3D surveys acquired over last two

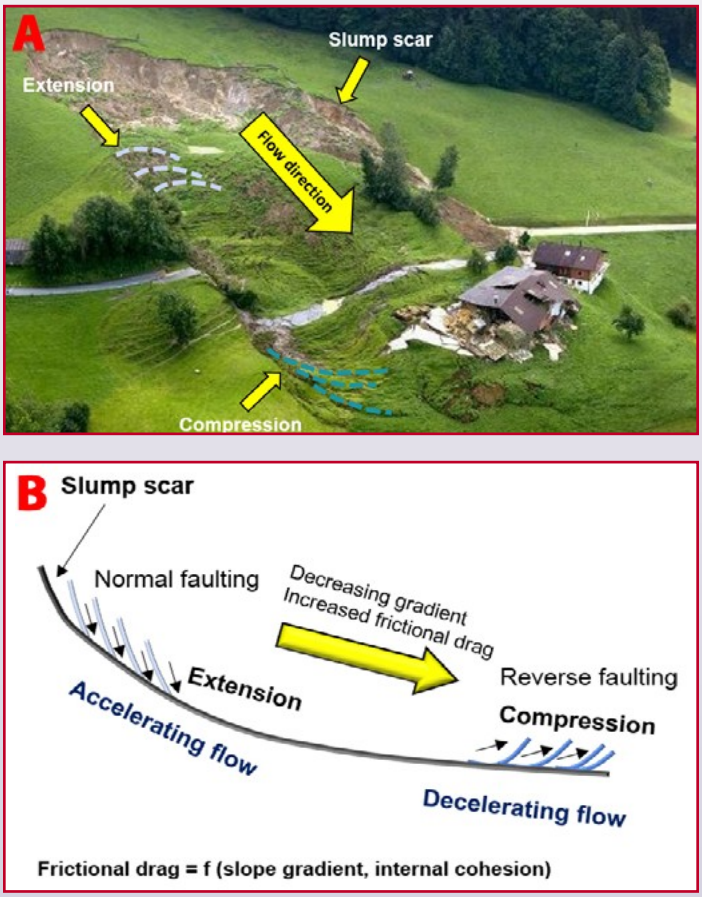

Figure 5. a) A small mass transport deposit observed in Bernese Oberland region, Switzerland; b) Compression and extension associated with mass transport deposit; c) Cross section showing sediment deformation within the complex MTD. Modified after Posamentier (2017).

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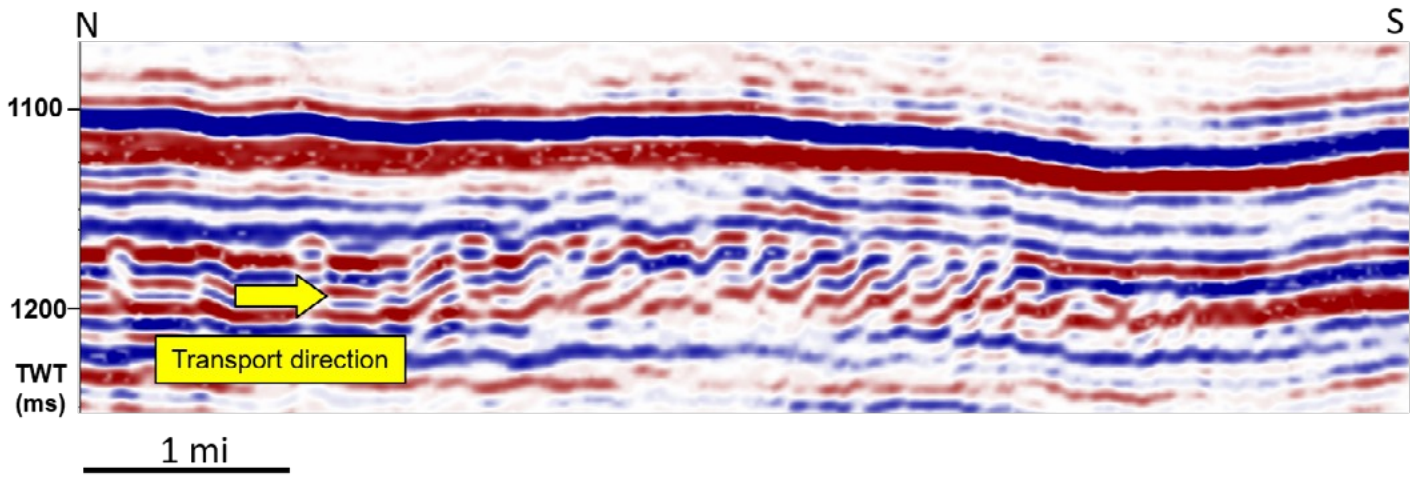

Figure 6. Seismic N-S cross section running across the MTD. The chaotic seismic reflectors indicate the partial internal deformation of sediments within the complex MTD. Notice the similarity between the model proposed by Posamentier and the pattern observed in the dataset

decades. The mega merge was processed after combining all the data together with a sample rate of 2ms and processed with a bin size of 110ft x110ft. The survey area is approximately 400 mi^2 covering parts of Andrews, Ector, Midland and Martin counties *(Figure 1)*. The dataset came with over 100 wells, out of which 30 wells had sonic and density log and 3 wells with core data. Although well analysis is not included in this study, we expect to use logs and core data to understand the depositional cycles and correlate it with seismic attribute interpretation, and include it in our final presentation.

Mass Transport Deposit (MTD) architecture

Figure 5 shows the architecture of the extension and compression associated with a mass transport sliding. Posamentier (2017) proposed a model of how a debris flow looks like in a slope setting *(Figure 5b)*. The sediment blocks breaks due to slope failure leaving behind a slump scar and causes the sediments to flow down the slope by extensional structures (e.g., normal and listric faults). As the sediments approach the lower slope, frictional drag takes over and decelerates the sediment flow (Posamentier, 2003). As a result, the sediments pile up on top of each other that represents a series of low angle thrust faults *(Figure 5c)*.

A small scale mass transport analog was observed in the Austrian Alps *(Figure 5a)*, where sediments were remobilized towards the toe of the slope due to slope failure. Notice the slump scar and the extensional and compressional faulting associated within the MTD *(Figure 5a)*.

Similar architecture can been seen on the cross section N-S in our study area. We believe the sediments were transported from the North and as frictional drag force took over, sediments started buckling on top of each other, leaving a compressional feature with low angle thrust faults *(Figure 6)*. One can deduce the transport direction by studying the thrust faults orientation.

Structural curvature and coherence

Seismic attributes such as coherence and structural curvature were used to map the MTD seen in the dataset. MTDs are discontinuous in nature and are easily detected by these geometric and structural attributes. Coherence attribute is an edge detection tool that detects the break in reflector configuration or lateral changes in waveform (Qi et al., 2017). It provides enhanced image of the small scale geologic feature and helps in understanding the internal complexity of the MTDs.

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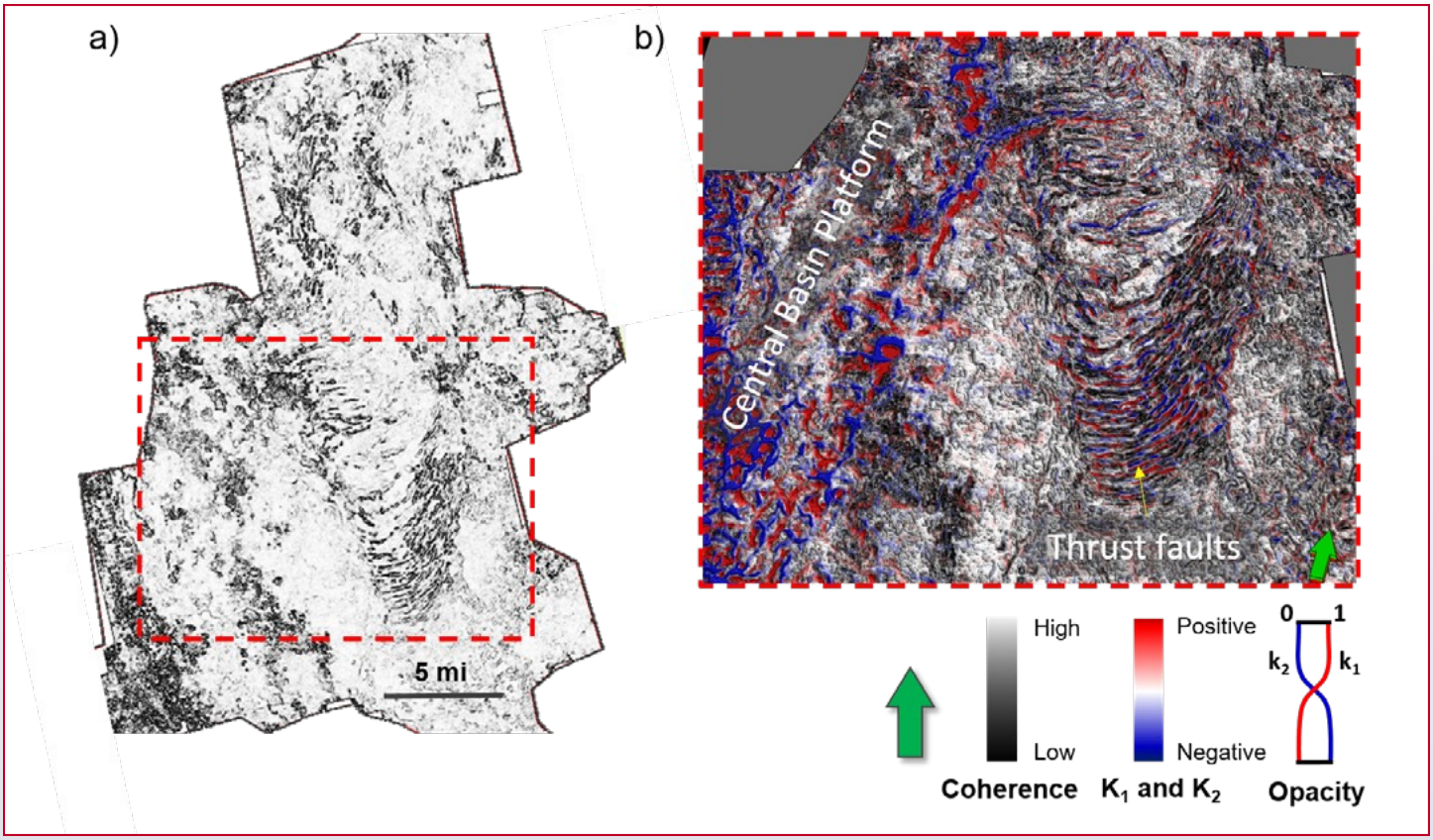

Figure 7. Stratal slice showing the MTD within the Spraberry formation. a) Coherence attribute computed on the stratal slice. Thrust faults are indicated by low coherence values. b) Coherence co-rendered with structural curvature attribute k1 and k2 computed on the stratal slice.

These discontinuities were computed on a flattened horizon that are represented by low coherence values indicated by black shown in *Figure 7a*. The discontinuous pattern that is seen in the figure are thrust faults caused by compressional forces as discussed by Posamentier (2017). We also computed structural curvature to understand the geometry of this feature. Blue colors indicate bowl shaped or valley like feature and red color represents dome shaped or ridge like feature (Al-Dossary and Marfurt, 2006; *Figure 7b*). After studying the pattern of these thrust faults, it is believed the sediments must have come from the northern slope, hence leaving an impression like the one observed in the dataset.

Discussion and conclusion

The proposed MTD model agrees with the feature seen on the dataset. After analyzing the extent of the MTD, it is hypothesized that the slope had a higher gradient effect, thereby increasing flow velocity and making the sediments travel farther. This would have created a high turbulence resulting in better sorting. With the help of seismic attributes, we were able to map the extent of the MTD and understand the internal partial deformation of sediments within the complex MTD. Further work needs to be done to evaluate seal integrity for exploration purposes. The presence of such a geologic anomaly can help interpreters better understand MTDs and its role as a potential hydrocarbon trap.

Acknowledgements

We would like to thank Fasken Oil and Ranch for providing us the 3D seismic survey. We used Attribute Assisted Seismic Processing and Interpretation Consortium's AASPI software to compute seismic attributes. We would also like to thank Schlumberger for providing Petrel licenses. □

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References

Al-Dossary, S., and K. J. Marfurt, 2006, 3D volumetric multispectral estimates of reflector curvature and rotation: Geophysics, 71, no. 5, P41–P51, https://doi.org/10.1190/1.2242449.

Elkins, L. F., and A. R. Skov, 1963, Cyclic water flooding the Spraberry utilized end effects to increase oil production rate: Journal of Petroleum Technology, 15, 877–881.

Haflidason, H., H. P. Sejrup, A. Nygard, J. Mienert, P. Bryn, R. Lien, C. F. Forsberg, K. Berg, and D. Masson, 2004, The Storegga Slide: Architecture, geometry and slide development: Marine Geology, 213, 201–234.

Hamlin, H. S., 2013,Wolfberry deep water depositional systems in the midland basin: Stratigraphy, lithofacies, reservoirs, and source rocks: Bureau of Economic Geology.

Handford, C. R., 1981, Sedimentology and genetic stratigraphy of Dean and Spraberry Formations (Permian), Midland basin, Texas: AAPG bulletin, 65.

Hills, J. M., 1983, Sedimentation, tectonism, and hydrocarbon generation in Delaware Basin, West Texas and Southeastern New Mexico: AAPG bulletin, 68, 250–267.

Martinez, F. J., 2010, 3D seismic interpretation of mass transort deposits: implications for basin analysis and geohazard evaluation, in D. C. Mosher, R. C. Shipp, L. Moscardelli, J. D. Chaytor, C. D. P. Baxter, H. J. Lee, and R. Urgeles, eds., Submarine mass movements and their consequences, Advances in Natural and Technological Hazards Research: Springer, 553–568

Murphy, R. J., 2015, Depositional systems interpretation of early permian mixed siliciclastics and carbonates, Midland Baisn, Texas: Master's thesis, Indiana University.

Posamentier, H. W., and V. Kolla, 2003, Seismic geomorphology and stratigraphy of depositional elements in deep-water settings: Journal of Sedimentary Research, 73, 367–388.

Posamentier, H. W. 2017, Seismic Stratigraphy and Geomorphology–The Next Frontier 21st Century Reservoir Characterization: AAPG South West Section (SWS) Bill Hailey short course.

Qi, J., F. Li, and K. Marfurt, 2017, Multiazimuth coherence: Geophysics, 82, no. 6, O83–O89, https://doi.org/10.1190/geo2017-0196.1.

Permalink: https://doi.org/10.1190/segam2018-2998610.1

MEET THE CANDIDATES

A Note From the President

Dear Fellow GSH Members,

Each year the GSH President is tasked with the selection of candidates for the election to the GSH Board of Directors. This process started in December, working with the Nominations Committee to identify appropriate individuals with the skills and interest to serve the GSH in achieving our strategic goals while maintaining a business focus. It is my pleasure to introduce the candidates for the 2019-2020 term. Each candidate offers a unique set of backgrounds, experiences and skills. Take a few minutes to read their biographies. Watch for announcements about the upcoming election.

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

Dennis Yanchak

James DiSiena

(Chevron Energy Technology Company)

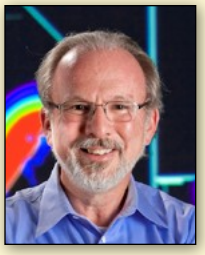
GSH Candidate for

President-Elect

2019-2020

I served in 2005-06 as 1st VP for GSH, in 1990-91 as VP for SEG and in 1989-90 as Dallas Geophysical Society President. I'm currently with Chevron Energy Technology Company, in Earth Science Strategic Research as a Consulting Geophysicist. I have held management, operations, and technical positions since joining Unocal in 1998. With GSH my most rewarding accomplishments were chairing the Spring

James DiSiena Biography continued on page 24.



Peter M. Duncan

(MicroSeismic, Inc.)

GSH Candidate for

President-Elect

2019-2020

Peter M. Duncan is President and CEO of MicroSeismic, Inc. a Houston based oil field service company specializing in hydraulic fracture stimulation, surveillance and evaluation. He holds a Ph.D. in Geophysics from the University of Toronto. His early career as an exploration geophysicist was with Shell Canada and then Digicon Geophysical, first in Calgary then in Houston. In 1992 he was one of 3 founders of 3DX Technologies

Peter M. Dunccan Biography continued on page 24.

Matt Blyth

(Schlumberger)

GSH Candidate for

1st VP-Elect

2019-2020

Matt Blyth is a technical advisor for Schlumberger with 21 years in the company, all in the field of Logging While Drilling (LWD). He is currently the LWD Geophysics, Acoustics and Geomechanics Domain Head for Schlumberger Drilling & Measurements in Houston. Matt graduated from Cambridge University in the UK in 1992 with a Bachelors and Masters in Engineering. He has worked for Schlumberger in wide variety of

Matt Blyth Biography continued on page 24.

Dr. Vladimir Grechka

(Marathon Oil)

GSH Candidate for

1st VP-Elect

2019-2020

Vladimir Grechka received a Ph.D. degree in geophysics from the Institute of Geophysics, Novosibirsk, Russia. He worked in the same institute from 1984 to 1994 as a research scientist. In 1995, he joined the Department of Geophysics at Colorado School of Mines, where he was an associate research professor and a co-leader of the Center for Wave Phenomena. From 2001 to 2012, Vladimir was a senior

Dr. Vladimir Grechka Biography continued on page 26.

Alvaro Chaveste

(Emerson)

GSH Candidate for

Editor

2019-2020

Alvaro Chaveste is currently a Senior Reservoir Characterization specialist at Emerson based in Houston. He holds a BSc. Degree in Geophysical Engineering from Montana Tech and has attended graduate courses in Geophysics at the University of Houston.

He has been involved in training and services for the oil industry in reflection seismology, high resolution 2D/3D seismic data

Alvaro Chaveste Biography continued on page 27.

MEET THE CANDIDATES

Tony LaPierre

(RPS Group, Inc.)

GSH Candidate for
2nd VP-Elect
2019-2020

Tony LaPierre is the Technical Director of Seismic Operations and Site Investigations with RPS Group Inc. in Houston. Tony has degrees in Geology BSc (Hons) '86 and Engineering MASc'99 from Dalhousie University in Halifax, Nova Scotia. He has 32 years of geophysical industry experience including 20 years with RPS. Tony's responsibilities at RPS cover seismic and survey consultancy services worldwide. His core area

Tony LaPierre Biography continued on page 25.

Phil Schearer

(Shearwater GeoServices)

GSH Candidate for
2nd VP-Elect
2019-2020

Phil Schearer is an account manager at Shearwater GeoServices responsible for sales across the company's major product lines. After graduating from the University of Missouri with a bachelor's degree in mathematics, he began his career with Western Geophysical in the Land and Special Processing group. He was promoted to Group Leader, responsible for a team of 4-5 processors before transferring

Phil Schearer Biography continued on page 25.

Jennifer Graf

(BGeo)

GSH Candidate for
Secretary
2019-2020

Jennifer Graf began her geophysics career while studying at the University of Houston and earned a Bachelor of Science degree in Geophysics and a Mathematics minor. With professors like Robert Sheriffand Kurt Marfurt, she was destined to have a passion for geophysics. While studying at the University of Houston she was a Geoscience Assistant at Geoscience Earth and Marine Services (GEMS),

Jennifer Graf Biography continued on page 27.

Becky Olsen

(Tellurian Production Company)

GSH Candidate for
Secretary
2019-2020

Rebecca (Becky) is currently an independent geophysical consultant for Tellurian Production Company in Houston. Her focus in Geophysics began at Texas A&M University where she earned a BS in Geophysics and an MS in Geology. Seismic interpretation, oil and gas exploration and development have been her emphasis as she worked for small and large companies including Cities Service, ARCO, Seagull, UNOCAL, Black Pool

Becky Olsen Biography continued on page 25.

Marie Clavaud

(PGS)

GSH Candidate for
Treasurer
2019-2020

Marie Clavaud has 17 years of experience in the Oil and Gas industry as a geophysicist. She received a MS in Exploration Geophysics from IFP School (1998). Marie started her career in 1998 at Engie in Paris (France). She first worked in their Research division focusing on Time Lapse seismic studies for underground gas storages, then in the Exploration-Production division where her main area of interest was prospect

Marie Clavaud Biography continued on page 26.

Simon Voisey

(Apache Corporation)

GSH Candidate for
Treasurer
2019-2020

Simon Voisey is a staff geophysicist at Apache Corporation based in Houston. He has over 14 years of experience working in the oil and gas industry. His educational background includes a MSc in Petroleum Geosciences from the University of Aberdeen and a BSc in Geophysics from University College London. In 2003 to 2004 he was the President of the Geological Society at University College London.

Simon Voisey Biography continued on page 26.

Meet the GSH 2019 - 2020 Candidates continued from pages 22 & 23.

James DiSiena *Biography continued from page 22.*

Symposium and establishing the tradition of recognizing one of our outstanding Geophysical contributors at each annual symposium. My work as an SEG Continuing Education (CE) instructor led to working with Education Committees for SEG and AAPG. One of my proud moments came as SEG CE Chairman, assisting Peter Duncan in initiating the Distinguished Instructor Short-Course (DISC) program which raised the stature of the CE program while increasing the educational outreach to SEG members. By GSH hosting the Symposium and local DISC, we were able to offer non-members the opportunity to apply their fees towards a GSH membership, thus growing our overall membership. We also found local that university geophysics students benefitted from their participation and networking with members, at the cost of their helping in these programs operations. For both SEG and GSH, I've enjoyed judging and meeting the bright students participating in the International Science and Engineering Fair. I also served as an Assistant Editor for SEG, held various positions within the Dallas Geophysical Society and participated as a Trustee Associate for the SEG Foundation. I have presented at numerous conferences, received SEG Best Presentation and the AAPG Matson Award. Prior to my Chevron-Unocal years, I had the opportunity to work with remarkable folks at GDC after retiring from ARCO in 1994.I started my career with ARCO R&D in Plano, Texas after graduating with an MS in Exploration Geophysics from Stanford in 1979. Cleveland, Ohio is my home town and the location of John Carroll University where I received my BS in Physics. Since moving to Houston in 1990, it has become home with my wife as we enjoy gardening and cooking, along with rescuing and training dogs. I hope to use the podium as GSH President to better engage our membership to promote GSH relevance, such as growing the value of GSH especially to new members, and extending our local outreach in Earth Sciences as part of STEM. □

Peter M. Duncan *Biography continued from page 22.*

Inc., a publicly traded independent oil and gas exploration company. Duncan joined the GSH when he first moved to Houston in 1986 and served for 2 years as Continuing Education Chairman. He moved on to be Vice President of SEG in 1992-93 and then Continuing Ed Chair for SEG for many years during which time he started the popular DISC program for SEG. Duncan was 2003-04 President of SEG. Duncan was the Fall 2008 SEG/AAPG Distinguished Lecturer, speaking on the subject of Passive Seismic at 45 venues around the world. He is an Honorary Member of GSH, SEG, the Canadian Society of Exploration Geophysicists (CSEG), and the European Association of Geoscientists and Engineers (EAGE). He received the Enterprise Champion Award from the Houston Business Journal in 2010, the World Oil Innovative Thinker Award in 2011, and was the 2013 EY National Energy Entrepreneur of the Year. The GSH selected Peter as its honoree for their 2013 Spring Symposium. In 2014 he received the Virgil Kauffman Gold Medal from SEG. In his spare time Peter is passionate about being Quiz Master for the SEG Challenge Bowl contest, a regular feature of the annual GSH Spring Symposium. □

Matt Blyth *Biography continued from page 22.*

positions, starting as an LWD field engineer in the Gulf of Mexico and progressing through different sales and line management roles in both the US and Canada, before moving into the technical field. In his current role, he is responsible for the long term technical development of Schlumberger LWD seismic and borehole acoustics tools and products, while providing global support for operators running the services. His primary field is borehole acoustics, but he also has a strong interest and involvement in integrating surface seismic with borehole measurements to solve complex drilling problems. Matt is also involved with the SPWLA, having served as both the Vice President and President of the Houston SPWLA chapter. It was in this later role that he worked with the GSH to jointly organize the 2014 spring topical conference "Where Petrophysics Meets Geophysics: A Multidisciplinary Approach to Reservoir Challenges". He is also the current secretary of the SPWLA Acoustics SIG, and Matt has gained solid experience in the organization and running of technical societies. In both 2014 and 2017, he delivered a GSH webinar series entitled "An Introduction to Borehole Acoustics". When not working, Matt balances his time between raising 4 boys and suffering from a deep addiction to fly fishing. □

Phil Schearer Biography continued from page 23.

to Buenos Aires to become a processing center manager. Upon returning to the US he relocated to New Orleans as the center manager there after Western purchased HGS. In late 1994 he moved into the multiclient group with responsibilities for licensing the Western GoM library data to E&P companies in New Orleans, Lafayette and surrounding areas. Shortly after the Western Geophyscial & Geco-Prakla merger in 2001, he moved to Gatwick, UK (just outside of London) and assumed a sales role for the WesternGeco North Sea data library. He later transferred to Aberdeen as the manager of the North Sea data library. Returning to the US in 2006, he left WesternGeco and joined the PGS multiclient group in a sales and business development role focused on the US GoM and the beginnings of WAZ surveys. In 2008 he moved to Geokinetics in a sales role for data processing and upon Geokinetics' purchase of the PGS onshore group, as manager of onshore multiclient library sales. Two years later he joined Global Geophysical in their multi-client/business development group until its demise. He moved to ION in a sales position for processing and imaging until he was invited to join Dolphin Geophysical in 2016, in a similar role. In late 2017, Dolphin emerged from bankruptcy as Shearwater.

While living in New Orleans, Phil was the Arrangements Chair for the 1998 SEG and held the 2nd VP position in the Southeastern Geophysical Society (SGS). He was also a member of the Southwest Louisiana Geophysical Society (SWLGS) in Lafayette. In the UK he was a member of the EAGE and PESGB. Current memberships include the SEG, GSH and GSP. □

Tony LaPierre Biography continued from page 23.

of expertise is providing teams of technical experts to projects to manage and supervise geophysical and geotechnical projects and he manages teams tha work on some of the world's largest and most complex exploration seismic and geotechnical projects. Tony has a record of accomplishments in technical and business endeavors. Tony is a member of EAGE, GSH, SEG, and SPE and has presented papers at geophysical and geological conferences in Cairo, Copenhagen, Dublin, Halifax, Houston, and Moscow. Tony's ability to understand what is required in the field is founded in time spent offshore on marine seismic and seabed studies which started as an onboard geophysicist in the Arctic in 1986. Tony's business experience comes from starting and growing a geophysical operation consultancy business to a scale which was acquired by RPS. Tony moved to Houston in 2011 and joined the GSH at an Icebreaker event in 2013. He took on the role of Icebreaker Chair in 2014. With the support of RPS he has continued to contribute to the GSH as a Icebreaker Chair including heading up the St Arnold Brewery Icebreaker events in 2017 and 2018. He welcomes the opportunty to contribute further to the sucess of the GSH. □

Becky Olsen Biography continued from page 23.

and Southwestern Energy. Her early years of this exciting career focused on Alaska and largely Gulf of Mexico offshore and some onshore, working exploration and development. In 2010, Rebecca transitioned from conventional to unconventional plays, starting with the Fayetteville, next the Marcellus, and recently the Haynesville shale. Rebecca has been involved with the drilling of many wells and has been described as an oil finder. She mentored rotational geophysicists for several years and is a long term member of GSH, SEG, HGS and AAPG. Rebecca has published and presented field studies papers at AAPG, GCAGS, and other sister societies.

Rebecca derives many benefits from GSH volunteering which provides even more exposure to a large variety of geophysical subjects, current and past ideas and technologies, and the pleasure of getting to know other members, volunteers and the great GSH staff. Over the years, Rebecca has volunteered for the Cub Scouts, band booster clubs, and other typical parent organizations. She has 2 sons, 2 daughters-in-law and 2 grandchildren. She is enjoying her empty nest time with husband, Dana, and consulting business BecTech Geophysical Consulting, LLC. □

Simon Voisey Biography continued from page 23.

After completing his MSc in 2004 Simon started his career in oil and gas working as a technical assistant at Scott Pickford based in Croydon South London. The following year he started working for Hampson-Russell software's London office managing the technical support desk for EAME where he honed his problem solving and communication skills. Later he would provide onsite training to a number of companies in the UK and aboard, including a trip to Turkmenistan. These trainings would include individual and group lectures and they strengthened his public speaking abilities. He wrote numerous "how-to" documents and was a key contributor to the Hampson-Russell knowledgebase. In 2009 Simon transferred to Hampson-Russell's Houston office where he worked on seismic inversion, AVO and multi-attribute analysis projects for major oil companies based in North America. He was promoted to project leader and managed high profile, multi discipline projects. CGGVeritas honored his achievements with a CGGVeritex award in 2011. He moved to Apache Corporation in 2014 and continued to focus on seismic attribute analysis. He provided support for Apache's business units in Houston, Egypt, North Sea and Canada. He has written and presented technical training sessions on seismic inversion and well tie analysis. He has continued to produce "how-to" and information documents to share knowledge on seismic attribute techniques. In his current role as staff geophysicist he focuses on Egypt and works with an integrated team of geophysicists, geologists, petrophysicists and engineers where he provides seismic attribute support to help each project reach its main goals and objectives.

Simon is a member of the SEG and GSH. He has presented at the SEG annual conference and has reviewed SEG expanded abstracts for the last three years. He is also on the DISC board for the SEG. For the GSH is currently on the technical committee for the 2019 GSH spring symposium. He has lived in Houston for nearly 10 years and is part of the geophysical community. In his free time he enjoys hiking in the national parks and recently visited Arcadia and Joshua Tree. He supports Houston sport teams and is a season ticket holder for the Houston Dynamo and Houston Saber Cats. □

Dr. V. Grechka Biography continued from page 22.

geophysicist at Shell. Since 2012, he has been a senior technical consultant at Marathon Oil, focusing on the characterization of unconventional reservoirs with seismic, microseismic, and borehole data.

Vladimir has been an active SEG member for 25 years. He was a member of numerous SEG committees, chaired the committees on Publications and Nominations, and served on the SEG Board of Directors twice, from 2009 to 2011, as the Editor, and from 2015 to 2018, as a Director at Large. Vladimir received J. Clarence Karcher and the Best Paper in TLE awards from SEG. He teaches continuing-education courses on seismic anisotropy for SEG and EAGE. □

Marie Clavaud Biography continued from page 23.

maturation in the Southern Gas Basin (UK) and northern Africa. She moved to the US in 2001 and entered a 5-year career break. She moved to Houston in 2004, and in 2007 joined Ion-GX Technology as a depth imager in the MultiClient Span Group, building velocity models and interpreting salt for large 2D regional lines across the Congo basin, Brazil Santos and Campos basins and the US Gulf of Mexico. In 2009 she joined ConocoPhillips as a velocity model builder in the Subsurface Technology group where she helped develop an integrated model workflow leveraging geophysical and geological data. She then moved back to her early interest of prospect maturation in the western Gulf of Mexico. In 2013 she returned to Geophysical Technology where she led the Deep Water Imaging team, working mainly on internal imaging projects in the Gulf of Mexico, Angola and Senegal. In 2015, her interest moved to quantitative interpretation of seismic for assets in the Alaskan North Slope. In August of 2016, she joined PGS where she manages proprietary and MultiClient projects as Imaging Manager. She is an active member of SEG, GSH and AAPG. In her spare time, she enjoys cycling, running, and hiking. □

Alvaro Chaveste Biography continued from page 22.

processing, AVO, inversion, rock physics and reservoir geophysics for over 30 years. Started in GSI as field QC for vibroseis crews in Mexico. When transferred to Halliburton Geophysical in Houston he worked in borehole geophysics and land & marine seismic data processing. In 1994 he joined "The Andrews Group International" (AGI) where his duties included preparing and teaching Geophysics courses for Mexico and South America. He was technically responsible for Houston's and Mexico's data processing operations. In 1999 AGI was acquired by Core Laboratories where Alvaro started and managed the Advanced Reservoir Geophysics group. From 2000 and until 2012 he managed groups specializing in well-seismic calibration and estimation of rock properties to help reduce risk in the estimation of reservoir and geomechanical properties. In this period, he worked at Core Laboratories, Paradigm Geophysical and Geokinetics.

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

Jennifer Graf Biography continued from page 23.

where she went to work after graduating. At GEMS she gained invaluable experience across the Gulf of Mexico and West Africa. After six years with GEMS, she left to pursue a Master of Science degree in Geology from Auburn University where she conducted petrographic analyses of shock features of Chesapeake Bay crater core samples in order to constrain the extent of high pressure, high temperature shock deformation.

She continued her graduate education at the University of Texas Institute for Geophysics where she studied moonquakes, induced seismicity, and Northern Carnarvon Basin Neogene deposition. During her time at the University of Texas she was a consultant for Berger Geosciences (BGeo) and Offshore Analysis and Research Solutions (OARS) where she worked offshore Greenland and the North Sea.

She then spent three years at Chevron as an Operations Geophysicist in the Gulf of Mexico and West Africa and has since re-joined BGeo as a contractor where she completes shallow hazards analyses in the Gulf of Mexico. Jennifer began volunteer and community service in Houston as a volunteer at Space Center Houston while at U of H. Her love of planetary sciences led her to volunteer on the USGS Chesapeake Bay Eyreville Drilling Project before starting graduate school at Auburn. Jennifer was fortunate enough to analyze many of the samples she helped characterize while logging core in Virginia.

Upon returning to Houston, she began volunteering at the Houston Area Women's Center and the Houston Food Bank. At Chevron, she was elected as the 2016 Volunteer Director on the Board of the Chevron Employee's Club of Houston and coordinated volunteer events within the company. Jennifer is currently an active GSH volunteer and serves as a 2019 volunteer editor for the GCAGS.

She also holds memberships with the SEG, HGS, and AAPG. She lives with her geophysicist husband Stephen in the Heights with their two beautiful girls, ages two and four, who themselves are becoming active little scientists. She would like to continue her dedication of service to the Houston community by working as the Secretary of the GSH and looks forward to supporting the GSH and helping the organization continue to grow. □

2019 GSH-SEG Spring Symposium and Exhibition

THE RESURGENCE OF SEISMIC INVERSION

APRIL 16-17, 2019
NORRIS CONFERENCE CENTER, HOUSTON, TX

SPEAKERS & TOPICS

John Castagna (Lumina) - Spectral decomposition inversion
Gabriela D'Aubeterre (Ikon) - Stochastic/facies/rock physics based inversion
David Johnston (Differential Seismic) - 4D inversion
Jon Downton (CGG) - Machine learning inversion
Klaas Koster (Oxy) - Conventional & unconventional reservoir characterization
Brian Russell (CGG) - History of inversion
Colin Sayers (Schlumberger) - Integration with engineering
Arcangelo Sena (ConocoPhillips) - Operator case study
Tad Smith (Consultant) - Rock physics for inversion
Rob Stewart (University of Houston) - PP PS inversion
... and short presentations by geophysics graduate students.

- SEG Student Challenge Bowl competition during lunch Tuesday
- Social gathering on Tuesday evening
- Banquet toasting and roasting the honorees during lunch Wednesday
- Great opportunities for knowledge sharing and networking
- Exhibit booths available

2019 Honorees
Dan Hampson and Brian Russell

For sponsorship and booth details, call the GSH at 281-741-1624 or visit **gshtx.org/symposium2019**

Gulf Coast CHALLENGE BOWL

The **Annual Spring Symposium** includes a Regional Competition of the SEG Challenge Bowl. The winning team has their expenses paid to attend the Finals at the SEG Annual Meeting. See more at our OUTREACH page, SEG CHALLENGE BOWL.

Winners from previous years represented:

Rice University

Texas A & M University

University of Houston

University of Texas

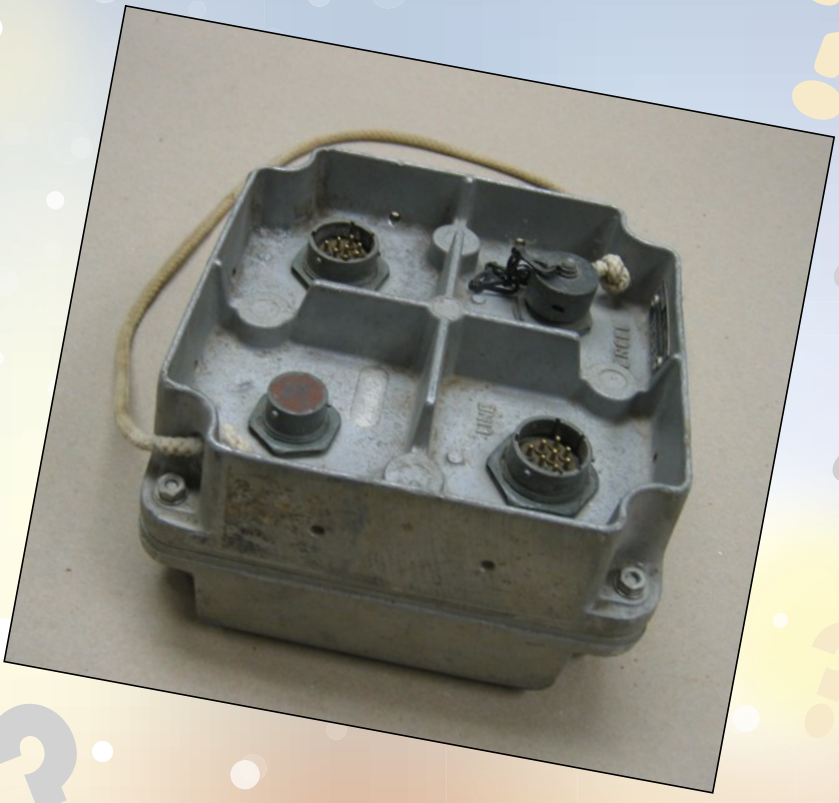
University of Tulsa

We encourage Individuals to support this event.
To donate to the 2019 Gulf Coast Challenge bowl hosted at the Spring Symposium, go to:
https://my.reason2race.com/PeterWang/GulfCoastChallengeBowl2019

Mystery Item

This is a geophysical item...

Do you know what it is?



This month's answer on page 32.

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

Honors and Awards Banquet

Thursday, May 9, 2019
New Location!
Norris Conference Center
Magnolia Room

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

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For information about Annual Sponsorship go to: gshtx.org

GSH Outreach

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

February was another busy month for the GSH Outreach volunteers with 3 events.

We hosted a Community Booth at the **Girls Exploring Math and Science (GEMS)** event for Girl Scouts on Saturday, February 16 at the Houston Museum of Natural Science. We told the Girl Scouts and museum visitors about geophysics & geology and gave them a GSH logo coiled toy spring. They also had fun playing our Drilling for Oil game.

The American Association of University Women (AAUW) West Harris County Branch sponsors the annual **Expanding Your Horizons in Science and Mathematics** event which provides career information and role models for Houston area middle school girls. It was held on Saturday, February 23 at Spring Forest Middle School SBISD. Professional women share their enthusiasm, education requirements and remuneration working in scientific, technical and financial careers with more than 400 girls, their parents and teachers. I presented two geophysics hands-on "Exploring for Petroleum" activity workshops along with Connie VanSchuyver and Marjosbet Uzcategui. Working in teams, they built a geologic model by filing a shoe box with layers of sand and gravel and burying a water balloon (oil reservoir). They traded their sealed box with another team. Then they conducted a seismic survey by tapping on the box lid and listening for any anomalous area. Finally, they "drilled" by inserting a bamboo skewer through the lid and into the box. Successful drillers found black food coloring from the water balloon on their skewer. The purpose of the event is to inspire young women to pursue STEM related courses in high school and college and ultimately STEM careers.

Project judging for the **Science and Engineering Fair of Houston** was also conducted on Saturday, February 23 at the George R. Brown Convention Center. GSH volunteers coordinated by Gokay Bozkurt selected four winners for GSH special awards. More GSH volunteers served as Place Award Judges to help select winners in the Earth Science, Physics and other categories. Top students will compete at the Texas State Science Fair and the Grand Place Award winners will go directly to the INTEL International Science Fair. The awards ceremony was held on March 2 at the UH Cullen Performance Hall where the GSH special awards were presented to the students in attendance.

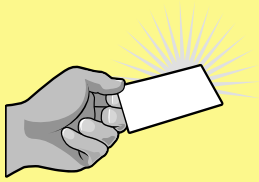
UPCOMING EVENTS – Volunteers Needed

Saturday, March 23, 2019 - HISD When I Grow Up Career Expo (Houston) – Career Exhibit Booth

Saturday, April 6, 2019 – Scout Fair (NRG Arena) - Science Exhibit Booth □

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

The Mystery Item
on page 30
a station unit for a Sercel SN 348 Telemetry
seismic recording system from the 1980's.



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ikon Science

Sue Pritchett
Business Development Manager

D +1 713 914 0300 - Ext 219 • C +1 281 451 6522
E spritchett@ikonscience.com • Sue Pritchett

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george@seisborg.com
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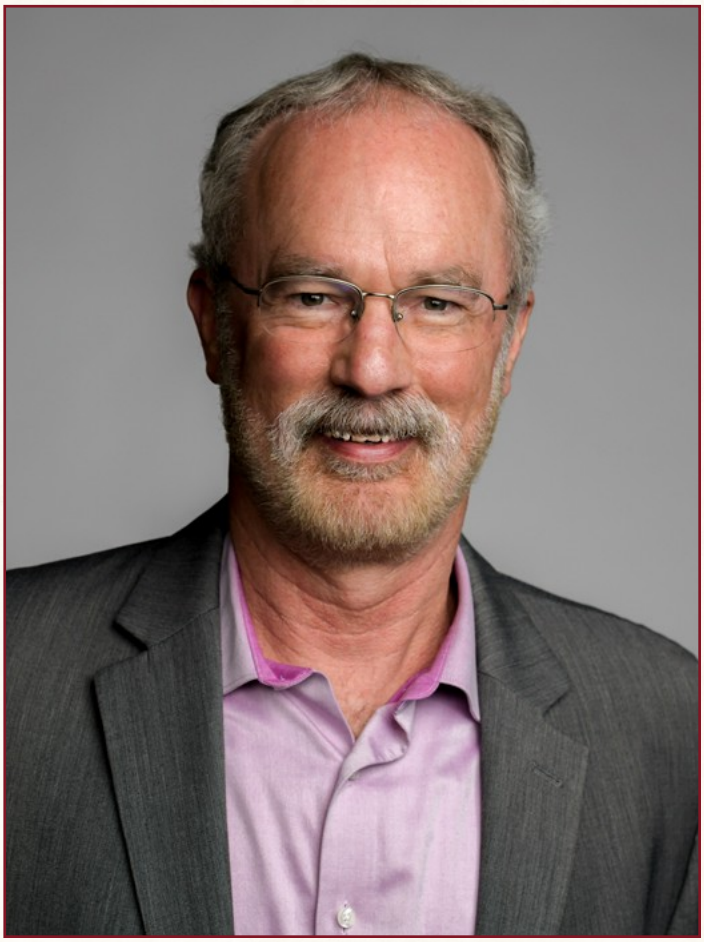
Recognizing Outstanding GSH Volunteers...

Scott Singleton

by Tommie Rape

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



Scott Singleton was born and raised in California, where his father was in the aerospace industry. After graduating from New Mexico Institute of Mining and Technology in 1979 with a BS in Geophysics, he spent the next five years as a doodlebugger in marine acquisition and processing for Western Geophysical, Seiscom Delta, and Digicom. Scott then attended Texas A&M University, where he received a MS in Geophysics in 1988. He then continued his doodlebugging activities in acquisition, processing, and interpretation with Fugro-McClelland Marine Geosciences. Scott has practiced and developed new processing techniques for several geophysical applications including relative amplitude techniques for AVO analysis, and processing for seismic inversion and rock property analysis. He has also developed techniques for lithology and fluid prediction. In 2008, Scott became Vice President of Global Processing and Interpretation for RSI where he was responsible for reservoir characterization project services throughout the company. With the same company in 2011, he became Seismic Technology Advisor, where he developed an integrated unconventional seismic workflow combining geology, geophysics, petrophysics, rock physics, and engineering techniques. Beginning in 2012, he worked for ION as their Technical Manager for their multicomponent unconventional program. Since 2015, he has worked for Independence Resources Management, managing the application of geophysical techniques in the Permian Basin.

Scott's wife, Eileen, currently works at Rice University as a Biochemistry Lab Manager, and his daughter attends Rice where she is studying language and international business.

Like some other GSH volunteers, Scott's initial volunteer efforts for the GSH occurred when he was asked to run as a candidate for a GSH office. Scott ran and was elected Treasurer in 2005. His involvement only grew from there. He was nominated for additional officer positions and was subsequently elected 1st Vice President in 2009 and President in 2012. During his years as an officer, the GSH benefited greatly from his presence, and he has left a lasting impact on the GSH from his efforts. Scott was President soon after the GSH separated its office and staff from the Houston Geological Society (HGS), and it was through his

Volunteers continued on page 34.

Volunteers continued from page 33.

extensive efforts, and the efforts of our new staff, that our organization became organized and fully functional as an independently-officed professional organization. Through his leadership, various GSH committees became more active and helped grow the GSH into the outstanding professional organization that we have today. For instance, during his presidency, he led the Finance Committee in its development, and it's becoming much more active in the role of stewardship of the GSH finances. Scott continued to serve on the Finance Committee for several years.

It was after his role as President that Scott's volunteer nature became even more evident. He continued to offer excellent suggestions for improving various aspects of the GSH. He went beyond the idea generation mode, and where he thought improvement was needed, he jumped into the middle of the action and helped bring that improvement to fruition. Scott encourages all our geophysicists to come forward with their ideas on how the GSH can better support our geophysical profession, and then, Scott inspires them to jump in and help deliver the product. Soon after the GSH Journal was established in 2010, he volunteered and continues to this day as the Technical Article Coordinator, where he solicits and organizes the technical articles for the Journal. If you have an idea for a good technical article, contact Scott. Scott currently serves on the GSH Editorial Board that assists the Editor in planning and reviewing the content of Journal issues. He has been prominent in developing advertising techniques that are increasing the readership of the now-electronic Journal. Scott has also taken over writing the "Doodlebugger Diary" series in the Journal; check out this series that he took over in February of 2018, and be entertained by the many doodlebugger experiences that he has lived around the world. Scott also had a keen technical interest in the Microseismic SIG. And as Scott is prone to do, he did not just attend the SIG technical meetings, he volunteered to help the Microseismic SIG Committee. Within a year a new chairperson was needed for the Committee, and Scott took over the role. The newest very exciting GSH SIG is the Unconventional SIG. Scott saw the need for the GSH to be more involved in this technical area in our industry, so he led the effort in creating this new SIG and assumed the leadership role to help ensure its success.

Naturally, Scott's hard work and volunteering extends beyond his GSH efforts. He is currently an Associate Editor of SEG's The Leading Edge and is in charge of the Unconventional Special Section that is scheduled for the February edition. Scott was also on SEG's Organizing Committee in 2017 for the International Convention in Houston and was in charge of the Opening Ceremonies. Scott contributed heavily to the success of the convention, whose occurrence was in doubt following soon after Hurricane Harvey.

Scott also took an interest in the URTEC Conference and became a reviewer of the submitted papers. Soon, he became a Geophysics Session Chair and then the Geophysics Theme Chair. Now, Scott is in the first year of a three-year term as the SEG co-chair of the URTEC conference. Scott is also heavily involved in the Houston Gem and Mineral Society. His involvement in this area is because it is his hobby, and he has a serious technical interest in paleobotany. Scott has published professionally in paleobotany, in addition to geophysics. He has held many of its officer positions and currently runs the organization's website. For many years, he has

Volunteers continued on page 35.

Interview continued from page 34.

been Chair of their annual show. And in yet another effort, Scott is an Elder in the Presbyterian Church, and he coordinates the Men's Retreat for his church.

Once Scott was involved in the GSH, he said that he saw more clearly how much the GSH did to help him professionally. There was the obvious technical learning that he gained from the many technical events of the GSH, but he also recognized how valuable the networking was. Networking was key in his obtaining a new job when he was laid off during the most recent industry downturn. Scott says that the relationship between one's professional career and one's volunteer efforts is a two-way street. His professional work has helped his volunteer efforts, but his volunteer efforts have also helped his professional acumen. Scott's employment has helped him be aware of the key issues that have helped our SIG's focus on what is important and helpful to other professionals. His professional marketing skills have also helped the GSH better relate to Houston's geophysical professionals. But an important contribution to his professional skills came from working with the GSH and other organization's committees; he said that one of the most important things he learned was in how to deal with people and get them to do things when they do not work directly for you. This can be very important when working in a large company (or professional organization) and having to deal with people from other parts of the organization.

Scott is quick to give credit to others that help his efforts. But it is evident to many in the GSH that Scott is a "workhorse". Scott says he is driven by the desire to give back to the organization that has helped him. He is also driven by the premise that self preservation is critical, and he says that we all have to work as hard as we can to help ourselves and others. When Scott has one of his brilliant ideas in how to improve something, he says he has to jump into the middle of implementing it and may have to take ownership to help ensure that the product improvement is accomplished. Scott says that self fulfillment is very important. Scott will not have any problems looking back on what he has done for the GSH and being very proud of those accomplishments. When you see Scott, tell him how you are also proud of all that he has done for the GSH. □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Dave Ridyard
Founder & Advisor
e: dave.ridyard@ACTeQ.net
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Bill Thomas
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SHEARWATER
JESSICA WARDEN
Business Development Manager, OpenCPS
O: 713.224.6225
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C: 832.235.6437
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www.shearwatergeo.com
1080 Eldridge Parkway, Suite 1100 | Houston, TX 77077


TGS
Nathan Lenz
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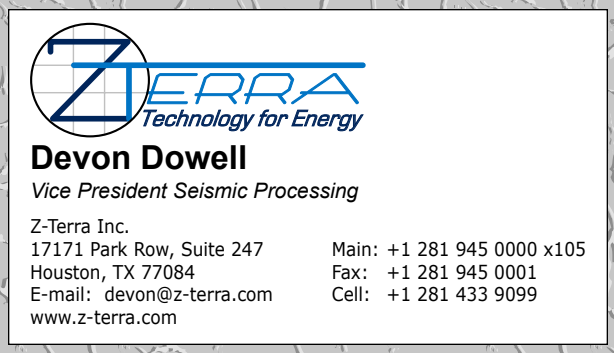
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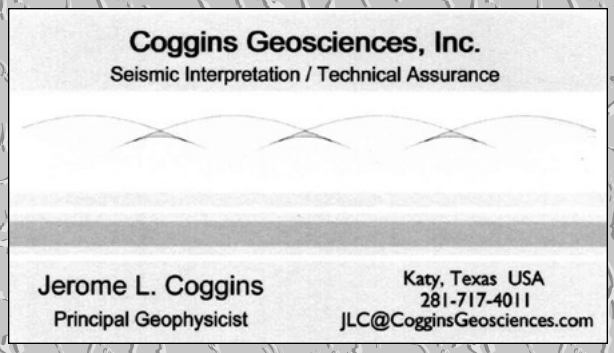
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Jerome L. Coggins
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Katy, Texas USA
281-717-4011
JLC@CogginsGeosciences.com

U of H Wavelets

SEG Wavelets Photo Contest *By Matthew Sexton*

Prismatic Springs at Yellowstone National Park

On December 3rd, 2018, SEG Wavelets in conjunction with AAPG Wildcatters and GeoSociety, hosted an annual holiday party at the Nouveau Antique Art Bar in Midtown, Houston. Aside from the plentiful drinks and Mediterranean buffet, this year's holiday party included festive games such as an ugly sweater/photo contest as well as a photo booth and raffle.

The SEG Wavelets enjoyed hosting the photo contest that included making a submission with either of the following themes: field work or lab research. From the photos submitted, 3 were chosen and voted upon at the party with the winning photo awarded to Monica Guerrero for her capture of the Prismatic Springs at Yellowstone National Park. □

Geoscience Center

The History of Geophysics *By Bill Gafford*

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

Entrance to the exhibit

We hosted another successful Living Legends Doodlebugger social event on February 14. There were some of our regular attendees as well as a few new visitors. Some of our more interesting artifacts were displayed on tables for discussion as well as some historical documents and early exploration reports from gravity, refraction seismic and reflection seismic projects. We had some of our recently donated artifacts as well as some of our Mystery Items available for viewing also. **Our next event will be on May 9**. Mark it on your calendar and come join us. Everyone is welcome.

Early geophones and survey instruments

Last month I described our display of geoscience artifacts at the UT Bureau of

Geoscience Center continued on page 39.

Geoscience Center continued from page 38.

Economic Geology Houston Research Center located in northwest Houston. This month I would like to tell about another display of our museum items. It is located at **Lone Star College-North Harris, which is located near Bush Intercontinental Airport**.

This display was arranged in 1994 and was the first public display of items from the GSH Museum Collection. In earlier years there had been a few of our items included in an energy exhibit at the Houston Museum of Natural Science, but these had been returned when the exhibit was updated. The North Harris exhibit is located on the 2nd floor of one of the classroom buildings in a short hallway and is the largest display of items other than at the Geoscience Center. The display, which includes seven cabinets of items, originally included items from our Petty Collection until many of those were relocated to the University of Texas Jackson School of Geosciences in 2007.

As with our other displays, each item has an identification card which includes the original donor's name and a brief description of the item. This display includes three different varieties of torsion balances, a seismic recording system from 1943, gravity meters, a magnetometer, and various early geophones, amplifiers, cameras, and other items from the 1930's through the 1980's. Some of these items can be seen in the pictures below.

We continue to receive a variety of donated items including various instruments, books, documents, and periodicals. We have a bookcase full of duplicate books and seminar manuals that are available for free to students or other interested visitors.

All are welcome at the Geoscience Center on Wednesday mornings from 9:00 until noon or by appointment. Please contact me at geogaf@hal-pc.org or at 281-370-3264 for more information. □

Early seismic amplifiers and detectors

Three varieties of torsion balances

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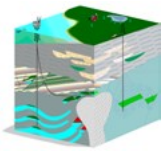

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KMS Technologies - KJT Enterprises Inc.
11999 Katy Freeway, Suite 160
Houston, Texas 77079, USA

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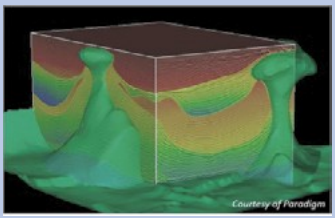

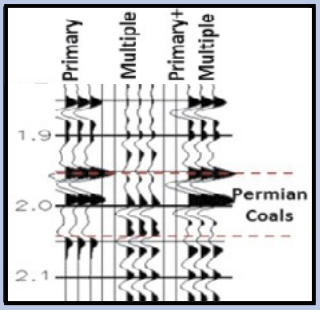

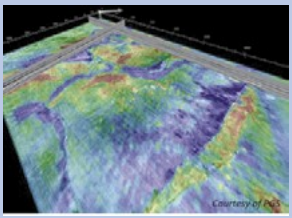

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Doodlebugger Diary

Peru – Land of the Inca Gods

Part 3: The 1997-98 El Niño Event *By Scott Singleton*

This month's Doodlebugger Diary is a continuation of the series Scott Singleton started in February 2018 with his 5-part series on being shipwrecked in the South China Seas in 1992 while surveying a pipeline route from Hainan Island to Hong Kong. He then wrote about his experiences in Eritrea in 1997 after the end of their civil war and in Vietnam in 1997 after that country opened up to Westerners once again. His new series is about his work in Peru in 1998.

The Doodlebugger Diary recounts 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, etc. I published a story about working in a data processing center. Please consider contributing a story about your past professional experiences. Contact me at Llawyer@prodigy.net *or our Editor at* editor@gshtx.org.

Figure 1: An oasis along the Peruvian coast. The lack of rain in this area is readily apparent. One wonders where these expensive hotels are getting their water from.

Doodlebugger continued on page 45.

If you would like to add stories to the Doodlebugger Diary, send them to: Lee Lawyer at llawyer@prodigy.net
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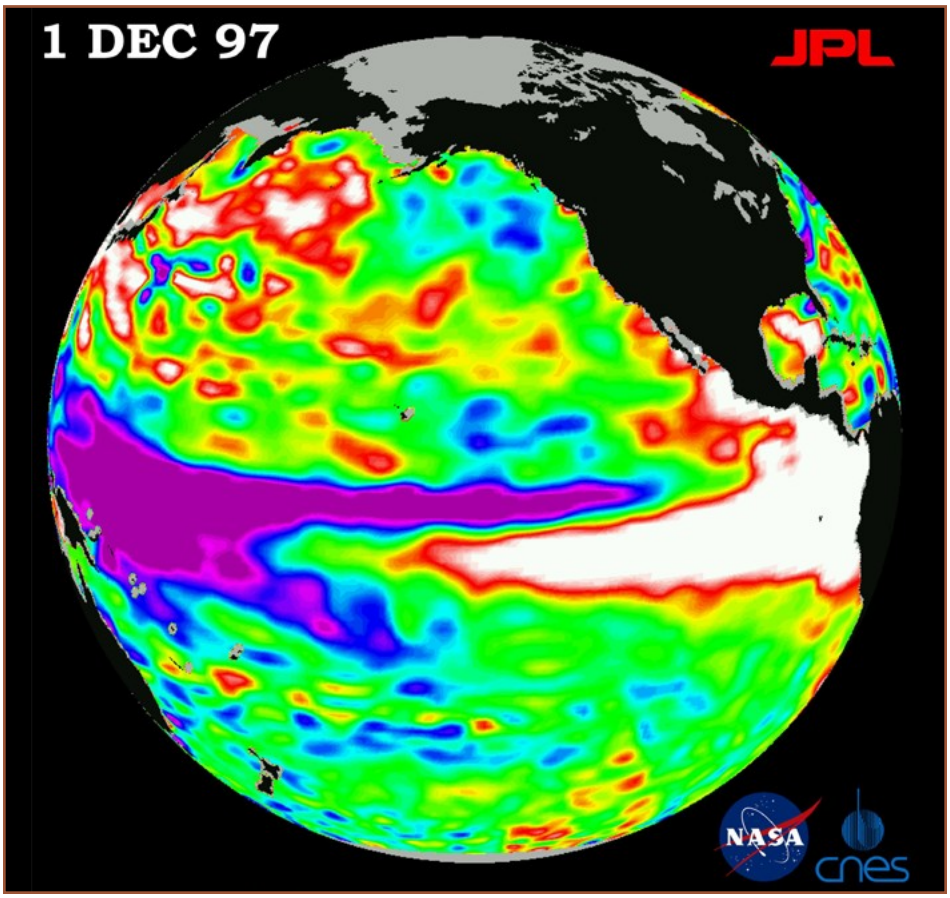


Figure 2: The 1997 El Niño observed by TOPEX/Poseidon satellite. The white areas off the tropical coasts of South and North America indicate the pool of warm water (courtesy of NASA).

When I arrived in Talara in the spring of 1998 I had no idea of what these people had just been through in the previous 6 months. I had noted that the place was very dry. Lima was located on an elevated coastal plain that was dry scrubland. Between Lima (in the central part of the country) and Talara (in the extreme north), Talara was even drier with scattered oases apparently living on desalinated or well water *(Figure 1)*.

It wasn't until we had a shore break and walked around town (of course to find the best bars) that we saw the huge amount of damage caused by the rains. This of course made us want to find out what had just happened. We found out that the region had just experienced the worst El Niño event in recent memory. Allow me to elaborate:

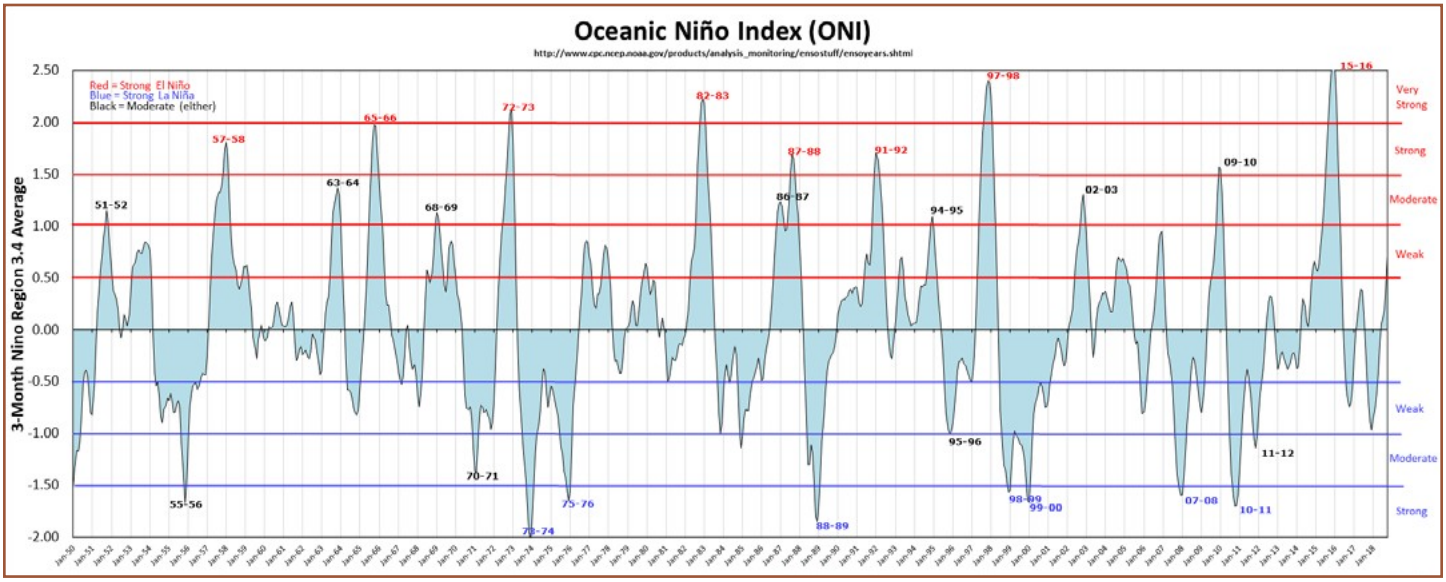
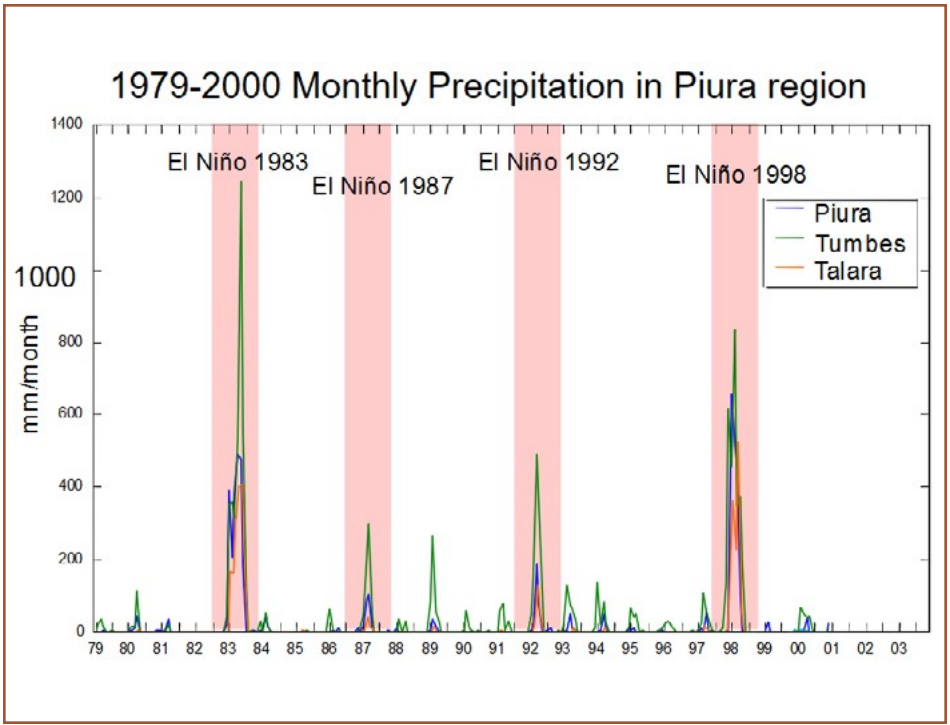


Figure 3: A graph of the Oceanic Niño Index from 1950 to present. The El Niño of 1997-1998 was the strongest in modern records until the 2015-2016 event. After that time these two events are used interchangeably when illustrating the disruptive power of this phenomenon. (Source: Golden Gate Weather Services, https://www.ggweather.com/enso/oni.htm. Used with permission).

Doodlebugger continued on page 46.

Doodlebugger continued from page 45.

Figure 4: Monthly precipitation in the Piura region, which encompasses the northwestern-most province in Peru. The cities of Talara and Piura are in this province. The city of Tumbes is in the Chira province which is on the northern border of the Piura province and borders Ecuador. (Source: Weather forecasting using MM5 in Peru and new perspective for climate modeling, PPT presentation by Yamina Silva of Centro de Prediccion Numerica del Tiempo y Clima Instituto Geofisico del Peru, https://slideplayer.com/slide/4819204/).



El Niño: This is the name given to "the warm phase of the El Niño Southern Oscillation (commonly called ENSO) and is associated with a band of warm ocean water that develops in the central and east-central equatorial Pacific (between approximately the International Date Line and 120°W), including off the Pacific coast of South America *(Figure 1)*. El Niño Southern Oscillation refers to the cycle of warm and cold temperatures, as measured by sea surface temperature (SST) of the tropical central and eastern

Figure 5: Floodwaters coursing through town. Photo credit: Perureports.

Doodlebugger continued on page 47.

Doodlebugger continued from page 46.

Pacific Ocean. El Niño is accompanied by high air pressure in the western Pacific and low air pressure in the eastern Pacific. The cool phase of ENSO is called "La Niña" with SST in the eastern Pacific below average and air pressures high in the eastern and low in western Pacific" (extracted from https://en.wikipedia.org/wiki/El_Ni%C3%B1o, embedded links are from the original Wikipedia entry).

1997-1998 El Niño event: "The 1997–98 El Niño was regarded as one of the most powerful ENSO events in recorded history *(Figure 2)*, resulting in widespread droughts, flooding and other natural disasters across the globe. It caused an estimated 16% of the world's reef systems to die, and temporarily warmed air temperature by 1.5 °C, compared to the usual increase of 0.25 °C associated with El Niño events (https://en.wikipedia.org/wiki/1997%E2%80%9398_El_Ni%C3%B1o_event).

Not all El Niño's have the same affects globally but one place that is always adversely affected is Peru (where the term 'El Niño' was first used). The warming of the Eastern Pacific during an El Niño event always contributes to higher than normal rainfall in Peru, sometimes, as was the case in 1997-1998, catastrophically so. One location, Tumbes, in northwestern Peru, received 2,100 mm (82.7") of precipitation between December 1997 and May 1998, including 730 mm (28.7") in January alone *(Figure 3)*. The normal rainfall for Tumbes between December-May is just 200 mm (8"). Flooding and mudslides killed over 200 in Peru and over 250 in Ecuador. The Peruvian government said that damage to the nation's infrastructure cost US$2 billion (Weather Underground, https://www.wunderground.com/blog/weatherhistorian/the-el-nino-of-19971998.html).

Epilog: So what we found out was that mere months before we arrived, the town was inundated with rivers of water, mud and debris. In the words of a local emergency relief organization, "During El Niño 1997-98, practically all the coastal basins overflowed due to rains that caused an increase in

Figure 6: Damage to existing infrastructure as a result of the floodwaters. Photo credit: El Regional Piura

Doodlebugger continued on page 48.

Doodlebugger continued from page 47.

water flow, water erosion, activation of dry ravines, and formation of mud avalanches of different sizes that sent solid materials towards the lower parts of the valleys, causing sedimentation and clogging of riverbeds, thus contributing to overflowing and subsequent flooding" (U4x4A Peru, online blog, http://unidad4x4ayudaemergenciasperu.blogspot.com/2015/07/efectos-del-fenomeno-el-nino-1997-1998.html).

This was evident in deep ruts running down all the roads, making them completely impassible by vehicle. We all just looked at each other wondering what this town was going to do to get back on its feet again, given that the necessary resources like machinery and manpower were not visible anywhere we went. It was apparent the locals did what they could, which meant getting out and clearing away debris and sediment so that at least the place had some resemblance of what it looked like before the floods.

Each time we made our way back to the boat we hoped that the surveying we were doing would make a positive impact on exploration and production efforts which would in turn help the government dig its way out of a huge mess that was not of their own making.

Next month: Part 4: Processing in Lima □

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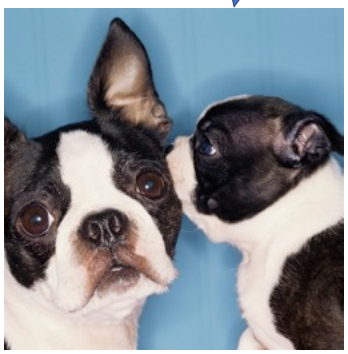

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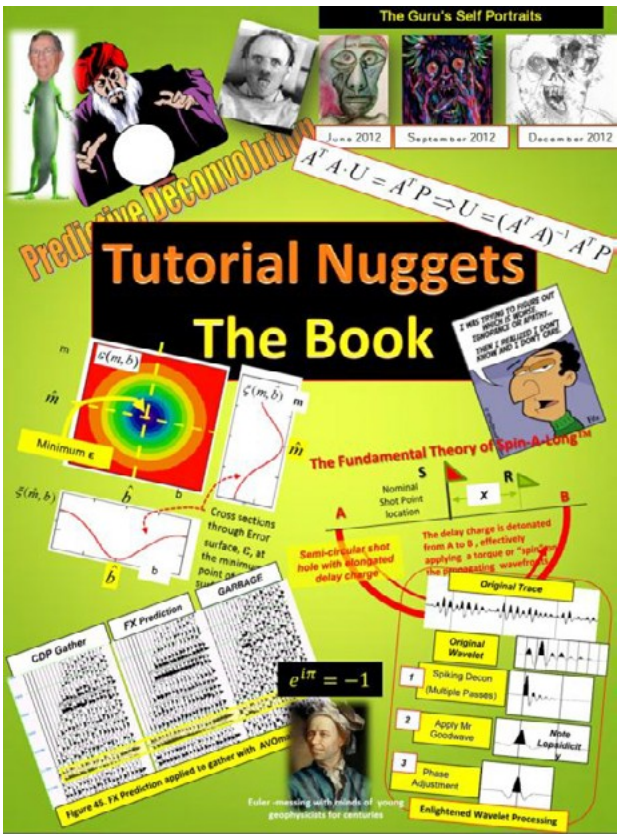

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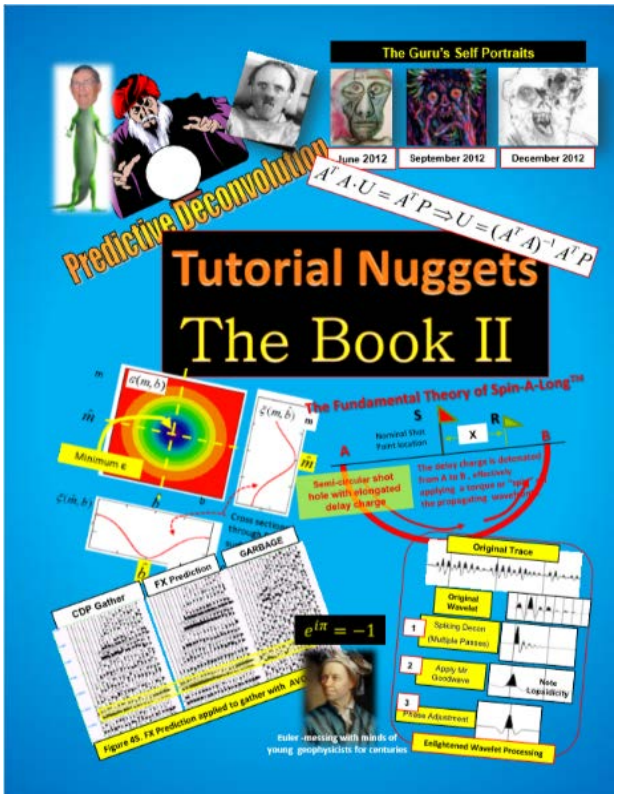

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