

June 2020



*The Epicenter of  
Geophysical Excellence*

# GSH Journal

GEOPHYSICAL SOCIETY OF HOUSTON  
Volume 10 • Number 10

## **Dick Baile,**

*a champion in the geophysical  
business and longtime  
supporter of the GSH and SEG.*

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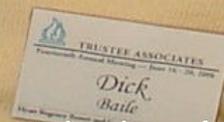
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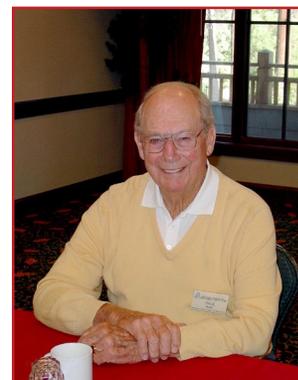
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## EDITOR'S NOTE

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

### GSH JOURNAL DEADLINES

Sept 2020..... July 13  
 Oct 2020..... Aug 17  
 Nov 2020..... Sept 14

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# Letter From The President

By Craig J. Beasley, GSH President



As we finish the last edition of the GSH Journal until Fall, 2020, the GSH finds itself in a very difficult position. This is not too surprising as most of the world is in the same situation. It is hard to fix on a certain date this started in earnest as the world has slowed in stages,

but GSH announced its COVID-19 policy of shut down in mid-March. It has been evident for some time, but it seems to be sinking in now, that this will not be over quickly. Indeed, it is now clear that the only real stopping of the contagion will come from a vaccine or effective treatment, neither of which is on the immediate horizon. We can only slow the spread through quarantine and limited exposure, which we are doing now. But it is not stopped and probably won't be stopped even with such strict measures. In the meantime, the world's economy has been severely damaged. This aspect may not be appreciated completely at this time.

We must have an economy to survive. For the moment, we are coasting on what was before. The government has created subsidies to keep citizens and companies going through this rough period, but we must realize that the government has nothing to give that we don't supply it through economic activity. It can print money, but the value of money is ultimately based on the value of the economy, or the perceived future value. There's the rub. I expect that we will have to relent on quarantine before we would like to, and that the contagion then will be revived to some extent. We will probably find a balance that allows us to survive economically with "acceptable" pressure on the health systems. This will be tricky to say the least, but as I write, governmental officials are beginning to restart the county. Another likely possibility: we may accept the risks of rushing the normal vaccine process if that risk seems better than the alternatives. Indeed, one of the vaccines under

development has already skipped the animal testing phase, going directly to human trials and "operation warp speed" has been started to jump start the process. We need a vaccine quickly as this virus is just too, well, virulent.

Organizations such as the GSH are in a particularly difficult position as a large part of income is based on social and technical gatherings, the very things we must avoid. We are working to provide more virtual, online content and events for members, but the fact is that these will not come close to generating the income from events GSH has had. There are many knock-on effects of the contagion, but for us, the blow to the oil and gas sector is monumental, both in terms of the effects on our members and the generous support we have enjoyed in the past. Companies can't sponsor events or pay for advertising when their own existence is in question. Again, as I write, substantial production cuts have been implemented, but it seems without economic revival, it may not be enough. In person events in May were canceled and we are offering many of the technical presentations virtually. Major events such as the Annual Meeting and Honors and Awards event, the Spring Symposium and the golf tournament were rescheduled for June, but now, none will occur as planned. H&A and AM will be done virtually, and the others are likely rescheduled. Please watch for the weekly GSH newsletter and check [gshtx.org](http://gshtx.org) for the latest information.

If this is not enough, I am saddened to inform you of the loss of a long-time leader of our community. We recently learned that Richard (Dick) Baile passed away at the age of 99. Dick was a lifelong supporter of geophysics and of the GSH, the SEG and the SEG Foundation. I knew him mainly through working with him in these organizations. Dick was an early supporter of Geoscientists Without Borders and I was particularly touched that his family asked that people donate to GWB in lieu of flowers or other remembrances. Lee Lawyer, Dick's longtime friend and colleague, leads

*Letter From the President continued on page 5.*

the GSH tribute from his unique perspective and recollections in his monthly column, From the Other Side. Bill Gafford pays tribute to Dick's support of our heritage in his piece on the GSH Geoscience Center, another of Dick's favorite causes. I encourage you to pause for a moment and read about this unique geophysicist as a tribute.

My message seems bleak, but there are some good things to consider. First, GSH will not cease to exist as we have a rainy-day cushion that can sustain us for some time. We don't ever want to use it, but now is the time – it's raining! And second, the American system will work. It is designed to be malleable to cope with difficult, unthinkable challenges. There will be a lot noise and fury, it will not be instantaneous, and it will not necessarily be pretty, but we will come through this. Send us your thoughts – we are listening. □



Dear GSH Journal readers,

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

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



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# A Word from the Board

By Alvaro Chaveste, Editor



With this issue, we close another editorial year. I joined the board in June 2019 with the expectation that I would be giving to the GSH, but in the end, I received more than I gave (cliché but true). It has been an amazing experience to work with accomplished professionals who volunteer their time

to provide a service to the geophysical community. The board and other volunteers bring in different expertise and personalities that contribute to the journal in different ways. It has been interesting to observe how the personalities of volunteers match their writing. During meetings, for example, it is expected to have Lee Layer's comments and approach to issues to be **From the Other Side**, whereas the observations made by Scott Singleton, GSH's Technical Article Coordinator, will be as sober and meticulous as his monthly revisions to the **Technical Article** and **The Doodlebugger Diary**. The ingenuity and analytic approach that Craig Beasley, GSH President, has brought to GSH is showcased in his May's article **Geophysics in the Time of Coronavirus**.

This Industry has seen many changes, and these seem to accelerate as time goes by. Many of us remember the digital revolution which gave way to improved recording, processing, and interpretation of ever-growing volumes of seismic data. Advances in digital and hardware technology have supported the development and production of many types of reservoirs, including those labeled 'non-conventional' (which are now the norm and hence conventional). The challenges addressed through time have prompted the continued emergence of algorithms that translate physical principles and measurements into interpretable data. Areas like imaging have had continued development; whereas others, like fracture/stress characterization, appear to have had a period of quick development and then progresses at slower pace. In many cases, algorithms make use of new or re-branded tools to optimize processing and interpretation; the latest being Artificial Intelligence (A.I.) and Machine Learning (M.L.).

As the industry breaks new ground, boundaries between O&G related disciplines are blurred or removed. Geophysicists' roles are no longer limited to exploration

and field development, and geophysical methods go beyond surface seismic. Take, for example, shallow hazard prediction, or drilling and completion operations for which we are often tasked with characterizing or monitoring stress or fractures. Methods to accomplish the latter cover a spectrum of seismic sources (including fractures themselves) and receivers in either the well or the surface.

The GSH evolves continuously to accommodate industry changes and the way we live in these challenging times. During the 2019-2020 editorial period, several new activities were initiated, including the Fall Forum and two Special Interest Groups (SIGs). The Fall Forum explored how geophysics is used in unconventional plays. The two SIGs: The Data Science and Machine Learning SIG & NextGen, were initiated by young professionals. The Data Science and Machine Learning SIG has the mission of giving geoscientists clear insights into the application of these technologies in our industry; whereas NextGen is a group of early career and young professionals focused on developing the "Next Generation" of geoscientists. In addition to these activities, a new feature has been added to the journal, GSH Movie Time, in which an informational or educational video is presented each month. The vintage videos, created by GSI in the late-'70s and mid-'80s, are courtesy of Schlumberger.

The many educational opportunities provided by webinars, Spring Symposium, Fall Forum, and regular technical meetings are complemented in the GSH journal. The Tutorial Nuggets, by the self-appointed 'Guru', are written in a unique style that highlights Mike Graul's ability to explain complex subjects with a penchant for humor. In contrast to the Nuggets, the GSI educational videos present, in a solemn tone, courses of instruction of seismic data processing.

While providing information on state-of-the-art and leading-edge technology (I have particularly liked the information on digital acoustic sensors in May's Technical Article), the journal reminisces on how technology has evolved. The GSI's informational videos and the Doodlebugger Diary give a glimpse of how field operations were carried out in the past.

We are looking forward to another year of publishing the GSH journal. The GSH will continue to evolve to meet the readership and industry needs, particularly in these challenging and uncertain times. □

# From the Other Side

By Lee Lawyer



## **Dick Baile as I Knew Him.**

There is a country road in North Texas. I may have meant a "county road", Texas has a lot of them. The timing is in the early fifties and a car belonging to a newly formed seismic company (Empire Geophysical) was making violent swings from one side of the road to the other as if the

driver had completely lost control. The car slowed down and came to a complete stop and a large young man exited from the left side of the car, obviously irritated. He looked up and down the road but saw no service stations. The only human in view was a farmer in the next field on a tractor. He approached the tractor and explained his problem to the farmer, he had run out of gas. To make a long story shorter, the farmer loaned him a few gallons of fuel.

A few months later he was driving down the same road and ran out of gas in the same location. Amazingly, the same farmer was there to offer him additional fuel, maybe from the same container.

I do not know who the farmer was, but the Driver was Richard (Dick) Baile. He was the Party Chief on one of two seismic crews, which was the start-up of Empire. The other crew was run by his partner, Howard Itten. Together they had started Empire Geophysical. Oh yes, why the wild gyrations and crazy driving? Dick knew that the gas tank on the car was fitted with a standpipe that extended a little above the bottom. He felt there was a little gas that he could splash up into the standpipe. Of course, he was wrong, twice.

Dick Baile is no longer with us, he left us on Thursday, March 19. I knew him well. This is his story. Nine years ago, I interviewed him for an item in the GSH Journal. I am sure the author (me) will not mind me using some of that interview to tell the story of a farm boy from central Missouri.

He grew up doing chores on his family farm. Cattle, hogs, corn, and hay were the major crops. Most of the corn went to the hogs. The hay went to the cattle. Asked about



his early days, he says it was a hard way to make a living. He graduated from Central Missouri State with a BS in mathematics. His spending money was made during the summer by driving a soft drink truck selling Grapette. In the summer of 1942 Dick and some fraternity brothers signed up on a soap sample crew for Procter and Gamble giving away samples of Duz (a laundry soap—Duz does it!) along with a sales spiel.

In the middle of his senior year, an incident occurred on December 7, 1941 that would affect his life for the next 3 1/2 years. Because he had a private pilot's license, it was natural for him to volunteer for the Army Air Corps. He was unable to get into flight training because of mild color blindness but finally got flying status as a flight engineer on a B-29 in the last year of the war. He was flying out of Tinian for raids on Tokyo. Dick recalls a B-29 parked far away from the flight lines. It caused a lot of speculation, but they saw many armed guards around the plane, which discouraged further investigation but in retrospect that was the plane that dropped the atom bomb on Japan. When asked about the high points of his flying days, he speaks of transporting General "Jimmy" Doolittle back from the Far East to Washington D.C. in 1945.

Upon leaving the Air Force in January 1946, Dick sought employment and was hired by Stanolind. His first assignment was on Stanolind, party 22 in Texas. As junior computer, he picked the uphole times and marked the timing lines on the records. As he became more experienced, he would work up the surveyor's notes and plot the shot points to the shot point base map. With more experience, he would compute the weathering corrections and plot the sections for interpretation. As a party chief he would make the key exploration maps.

*From the Other Side continued on page 8.*

In July 1946, he married his college girlfriend, Frances Fricke. There was nothing easy about family life on a nomadic seismic crew. Dick says, "What a trooper Fran was. She moved some 32 times, put up with me for many years. The crew moved to where the work was. It could be every few months or even sooner if key permits were not received from landowners. The families had to be ready to move on short notice. Children had to be pulled out of school and re-enrolled at the new location. Unless they were fortunate enough to have a mobile home, furnished apartments had to be found and occupied. This may not sound too difficult, but the crews were not working near large cities. Try renting a furnished apartment in a town with a population of 1200! 'Franie' preceeded his death by several years. (???)

In 1952, he and Howard Itten (a fellow Party Chief in Stanolind) started Empire Geophysical. "We were at the very peak of seismic activity. Everything was downhill from then on. But, the same year, almost the same month, Lorenz Shock formed Midland Geophysical, and Decker Dawson started Dawson Geophysical." In 1963, Independent Exploration Company (IX) acquired Empire Geophysical. Howard Itten wanted out, and Dick wanted to stay in. IX brought Dick to Houston and made him president. In 1966, Teledyne acquired both IX and National Geophysical. Dick served as president of the newly formed subsidiary, Teledyne Exploration Company until 1969, when he founded Challenge Pacific, Inc. In 1970, Challenge Pacific was acquired by Challenge Oil and Gas Company (Houston) where he served as president until 1979. He claims that Challenge was worth a fortune at one time. "We were sitting on top of the largest structure I ever saw in my life. But we could not get through the Nugget. We finally made a small oil well in the Niobara and then sold out, merging with Berry Industries where Dick served as Chairman of the Board until his retirement in 1984.

I first met Dick during a meeting of the SEG Foundation Board in 1987. At that time, the Foundation Board was automatically made up of the last five Presidents of the SEG, of which I was one. Baile and Neal Cramer, James Fresher, Fred Olander and Elwin Peacock asked for a meeting with us. They proposed to initiate a group within the Foundation called the Trustee Associates. The Trustee Associates would be responsible for fund raising. Since the Board had had little success in raising money, we quickly agreed. Thus, the Trustee Associates was formed with five TAs as charter members with Dick Baile as Chair. Under Dick's leadership the TA's met once a year at some scenic location and sponsored a luncheon at the SEG Annual Meetings. To become a member of the Trustee Associates, one needed to donate \$5,000, which could be spread over five years. That has increased to \$10,000

today. Dick was appointed to the Board of Directors of the Foundation in 1994 and later was elected chairman. Early on, most of the revenue came from the Trustee Associates. I am not sure but at one time, it totaled well over \$2 million.

To illustrate the force with which Dick handled the Foundation Board, I clearly recall a meeting (2005) during which Dick, moved that we initiate a fund-raising campaign with a target of \$20 million. His board was speechless and totally unaware of the magnitude of the target. A lively discussion followed. As I recall, Bill Barkhouse was selected to organize the effort. We did not quite make the target, but the fund drive collected \$17 million. We were thinking big, all as a result of Dick Baile's leadership.

Dick had a vision for the SEG and the AAPG. He was a member of both as am I. I quote from the interview, "This is a controversial issue. A greater effort needs to be made to merge those professional societies where common interests and goals exist. AAPG and SEG are a case in point. The blurring of distinctions between modern geologists and geophysicists plus the absolute need for total cooperation and understanding between them clearly suggests a new oil finder classification."

For several years, Dick tried to convince the Executive Boards that we should merge the SEG and the AAPG. He was listened to but not heeded. He tried to make the case that there was a financial reason for the merger. That did not work either. He said, "There is no question that any moves toward merging will be difficult. There will be much opposition in both societies. Many will raise issues that continue to separate us. But it is clear that if we wish to move forward into the future with innovative ideas and programs, we need to consolidate our efforts." From my perspective, he was trying to convince the Executive and Staff levels. Wrong, he should have focused on the membership. They are the ones to benefit from a strong professional Earth Science organization.

Dick is preceded in death by his parents, Arthur Hamilton Baile and Vida Lunn Baile; his sister, Catherine Baile Nichols (Raymond); his wife, Frances Fricke Baile; his son, John Christopher Baile; and his daughter, Ann Baile Hamric. Dick is survived by his brother, Charles Clifton Baile (Virginia); his children, Carolyn Chandler Loudon (Ed), Betsy Baile (Andy Taylor), James Baile (Lisa); his daughter-in-law, Kiley Baile; ten grandchildren and five great-grandsons.

I will personally miss Dick Baile. The SEG Foundation will miss him more. The Professional Societies need to listen to him. He thinks 'big'. □

# Online Tech Events through the 2020 Summer

*Topics & Speakers to be announced*

The GSH will continue to bring current Technical presentations throughout the summer in a Virtual format. We expect to continue with Wednesdays at 11 a.m.. Watch the website at [www.gshtx.org](http://www.gshtx.org) and weekly e-newsletters for updates.

Please mark your calendars for:

- **June 17<sup>th</sup>**
- **July 1<sup>st</sup>**
- **July 8<sup>th</sup>**
- **July 22<sup>nd</sup>**
- **Aug 5<sup>th</sup>**
- **Aug 19<sup>th</sup>**



Speaker suggestions and abstracts are welcome. Contact Matt Blyth at [MBlyth@slb.com](mailto:MBlyth@slb.com)

## Data Science & Machine Learning SIG in the 2020 Summer

Please mark your calendars for: **July 15<sup>th</sup> & August 12<sup>th</sup>**

# Data Science and Machine Learning SIG

*Applications of AI/ML to Geophysical Data;  
Seismic, Well-logs and Core*

Register  
for Data  
Science

**Speaker:** Ben Lasscock, Technical Lead  
Energy Solutions Group

**Wednesday, June 10, 2020**

11:00 a.m. - 12:00 p.m

**Sponsored by Quantico**

**Location:** **Online only event**  
You must pre-register  
to receive access  
information



**Ben Lasscock**

### Abstract:

We provide an overview of new tools applying Artificial Intelligence (AI) and Machine Learning (ML) methods for automating interpretation of geophysical data, including examples from seismic, well-logs and core. Software examples will be published for classifying textures in seismic data, with application to open data sets.

### Biography:

Ben holds a Ph.D. and a B.Sc. in physics and theoretical physics from the University of Adelaide. Before coming to geoscience, Ben worked as a portfolio manager at a large hedge fund in Australia. He has publications in the areas of high energy physics, Bayesian time series analysis and geophysics. Currently, Ben is working on developing ideas for physics based Artificial Intelligence. □

# Online Tech Event

## *Full TI Characterization - Using Borehole Sonic Logs for Seismic Applications*

Register  
for Online  
Tech Event

**Speakers:** Irina Mikhaltseva  
Acoustic team leader  
Schlumberger

**Wednesday, June 17, 2020**

11:00 a.m. – 12:00 p.m.

**Location: Online Presentation**



**Irina  
Mikhaltseva**

### **Abstract:**

Acoustic anisotropy caused by layering has many well documented effects on seismic processing and interpretation, including errors in time to depth conversion, poor seismic tie and creating false-positive AVO responses. Acknowledging this effect, operators often seek expensive methods to obtain the required Thomsen parameters, often neglecting readily available and often already recorded data from continuous borehole acoustic measurements.

The individual methods for obtaining Thomsen parameters from sonic logs from wells of multiple deviations have already been well described in the literature. This presentation will summarize the different techniques used to derive Thomsen parameters from sonic logs, discussing their applicability and limitations. The necessary input data for various inversion techniques used to invert recorded velocities at variable angles will be reviewed along with an overview of modern borehole sonic measurement capabilities showing what is, and is not, possible to record in a single well. Interesting evidence and examples from both US land and US offshore where such inversions were used is presented along with proposed validation procedures. Case studies shown include an example where a well drilled through folded formations provided enough data to

characterize the TI properties of the formation due to the acquisition of sonic measurements at different angles within the same wellbore. The minimum suggested logging suite, to limit the assumptions made as much as possible, is discussed and the reasons for selecting one sonic tool over another are reviewed. We will show why it is worth obtaining dipole shear measurements even if you are only interested in Thomsen's epsilon and delta as the split shear ( $S_h$  and  $q_{Sv}$ ) measured at intermediate relative dips will help to better constrain the estimate of delta.

### **Biography:**

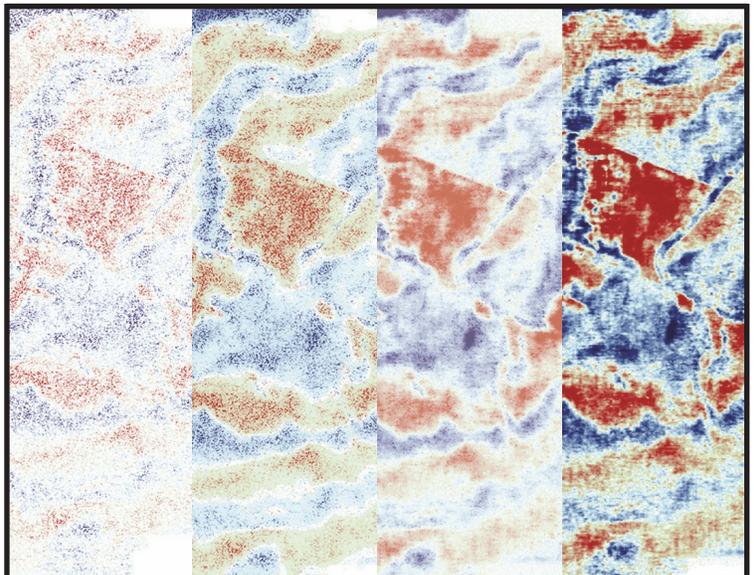
Irina Mikhaltseva is the acoustic team leader for the Schlumberger US Data Services team. She joined Schlumberger as a petrophysicist in 1996 after graduating from the Moscow state academy of oil and gas named after Gubkin. She started her international career in Venezuela as a petrophysicist, later working with integrated teams both in exploration and development in Mexico, Colombia, Russia, and the US. She has been working in acoustic processing since 2005 and she is an expert in processing the full range of sonic tools and associated answer products from both wireline and LWD. She is also actively involved in acoustics software testing and development. □

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# GSH Annual Meeting and Honors & Awards 2020

In normal times, the GSH Journal would be publishing great pictures of the event that marks the end of our year. The Annual Meeting and Honors and Awards event has been a glittering affair with a cocktail reception followed by a plated dinner, silent auction, presentation of awards, recognition of outgoing officers and announcement of the slate of incoming officers. These are anything but normal times. Technically GSH could have held the event in person, but the board decided it just wouldn't be the same under the current distancing restrictions and moreover, it seemed a little premature. So, like all of our recent events, we held the celebration virtually. Several members, including yours truly were seen to be celebrating and toasting in front of their screens. The event served its purpose and even had some great moments, but it is fair to say that we all are looking forward to next year when we may be able once again to meet in person. It has been a challenging year but it is gratifying to look back at how your board stepped up and dealt with some difficult situations. I am proud to have served with them and thank everyone for their help – officers, staff, and our members who have continued to volunteer, donate and stick with us. We geophysicists are a pretty good lot, that's for sure. ~ **Craig Beasley, soon to be past president of GSH.**



## 2020 Honorary Membership Awardee Andrew J Feustel, PhD

Drew Feustel grew up in Lake Orion, Michigan and attended Purdue University, where he received both a BS in Solid Earth Sciences (1989) and a MS in Geophysics (1991). He received his PhD in Geological Sciences in 1995 at Queen's University in Ontario, Canada.

For three years he worked as a Geophysicist for the Engineering Seismology Group, Kingston, Ontario, Canada, installing and operating microseismic monitoring equipment in underground mines throughout Eastern Canada and the United States. In 1997, Feustel began working for the Exxon Exploration Company (now ExxonMobil Exploration Company), Houston, Texas, as an Exploration Geophysicist designing and providing operational oversight of land, marine, and borehole seismic programs worldwide.

After working in industry for five years, Feustel was selected as astronaut candidate by NASA in July 2000.

In August 2002, he began NASA's two-year training program, training as a mission specialist. He is currently assigned to the Astronaut Office Space Shuttle and Space Station Branches, where he has been serving in technical support assignments.

Feustel's first mission was STS-125, which was successfully launched to repair the Hubble Space Telescope on May 11, 2009. On this mission, Feustel was a Mission Specialist, and performed three spacewalks to help repair the telescope itself. During the mission, Feustel accumulated a total EVA time of twenty hours and thirty-eight minutes. Feustel was a Mission Specialist on the STS-134 mission, during which he performed three more spacewalks.

In 2018, he joined Expedition 55/56 as Commander, riding with Russian Cosmonauts on a Soyuz spacecraft to the spacestation. He logged 197 days in space on this journey and is second among all US spacewalkers. He has received numerous awards in academia and industry and 2 NASA Distinguished Service Medals. □



## 2020 Honorary Membership Awardee Dr. Sergey Fomel

Sergey Fomel is the Wallace E. Pratt Professor of Geophysics at The University of Texas at Austin and the director of the Texas Consortium for Computational Seismology (TCCS). At UT Austin, he is affiliated with the Bureau of Economic Geology, the Department of Geological Sciences, and the Oden Institute

for Computational Engineering and Sciences. Sergey received a PhD in Geophysics from Stanford University in 2001. For his contributions to exploration geophysics, he has been recognized with a number of professional awards, including SEG's J. Clarence Karcher Award in 2001 and the EAGE Conrad Schlumberger Award in 2011. Sergey devotes part of his time to developing "Madagascar," an open-source software project for geophysical data analysis. □

*Honors and Awards continued on page 13.*

# GSH Annual Meeting and Honors & Awards 2020

## A Look to the Future “The future ain’t what it used to be.” Yogi Berra

Well that is certainly true today for your GSH. In the last 3 months many of our individual members have been furloughed or laid off, including yours truly. Many of our corporate members are on life support or worse. If we could hold live events, we probably would have a hard time finding an audience willing to attend, let alone pay. Paid attendance at events is one of the key sources of revenue for GSH. More than half our revenue comes from attendance at either technical or social events.

This year is going to be a real challenge. Fortunately, we have a small rainy-day fund to give us some runway. Just as fortunately, we have a great incoming Board to face these challenges. Our task will be to reinvent the value proposition and business model of GSH. We are all aware of how online events and virtual meetings are changing the way we live and learn. GSH is diving into this brave new world. Isn’t it always the case that it takes a crisis to knock you out of your old ways? But geophysics is not going away. The petroleum industry is not going away, and, moreover, geophysics is important to all sort of endeavors that will be part of our future. Our community is resourceful and resilient. Our science is one of exploration and discovery and discover new ways to thrive we will, both as individuals and as a community with a common passion. How do I know this? One – I have seen this wheel go around a few times. Two – its already starting with our NextGen group who got together on their own and are quickly schooling we older folks on the ways of the future. All we have to do is listen. ~Peter M. Duncan – President-Elect



### 2020 Life Membership Awardee Dennis Yanchak

Dennis Yanchak was born and raised in Canonsburg, PA. He went to school at Allegheny College with majors in Mathematics and Physics graduating in 1977. He then joined Gulf Oil in their R&D lab in Pittsburgh, PA and completed his MS in Physics at Carnegie-Mellon

University while working full time. Dennis also has an MBA in technology management.

Dennis moved to Houston in 1984 with Gulf Oil but joined Amoco in 1985 following the merger with Chevron working in their International Technology Group.

With Amoco and later BP he worked around the world with roles in exploration, development and production while working with seismic data interpretation, processing and acquisition. His experiences cover assignments in Denver, Cairo Egypt, and Moscow Russia.

Dennis Yanchak retired at the beginning of 2020 after 43 years in the industry, the last 10 years working on processing and acquisition projects world-wide with Apache Corporation. He is a member of the GSH, SEG and EAGE and is currently serving as Past President of the GSH. He and his wife, Claudia, are looking forward to traveling and enjoying retirement once the coronavirus issues subside. □

### 50 Year GSH Honorees

Michael Bennett

Rosemary Mullin

Michael Schoenberger

### 25 Year GSH Honorees

Stephen Carroll  
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Jerry Harmon  
Ben Hooper

G. Howard, IV  
William Marshall

Linda Sternbach  
W. David Willig

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## Announcing the GSH 2020 - 2021 New Officers



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**Klaas Koster**



1st VP Elect  
**Marianne Rauch**



2nd VP Elect  
**Katja Akentieva**



Treasurer  
**Chris Egger**



Secretary  
**Laurie Geiger**



Editor  
**Alvaro Chaveste**

**Congratulations to our newly elected officers!**

## President's Award Winners

**NextGen Committee** for Exceptional Leadership in Establishing **NextGen**  
and Engaging Young Professionals in the GSH



(left to right in photo)

**Oscar Vasquez, Drew Jones, Whitney Blanchard, Jennifer Graf, Peter Lanzarone & Matthew Romane**

Please register online at  
[www.gshtx.org](http://www.gshtx.org)

GSH Annual Golf  
Tournament 2020

~~MONDAY~~

**RESCHEDULED**  
**JUNE 15**  
**for NOV 9th**

**8:30 AM\***  
**SHOTGUN START**

*The Woodlands Country Club Palmer Course*

Space is limited to 216 players • Sponsorships are still available

\* Please note the new date and earlier start time

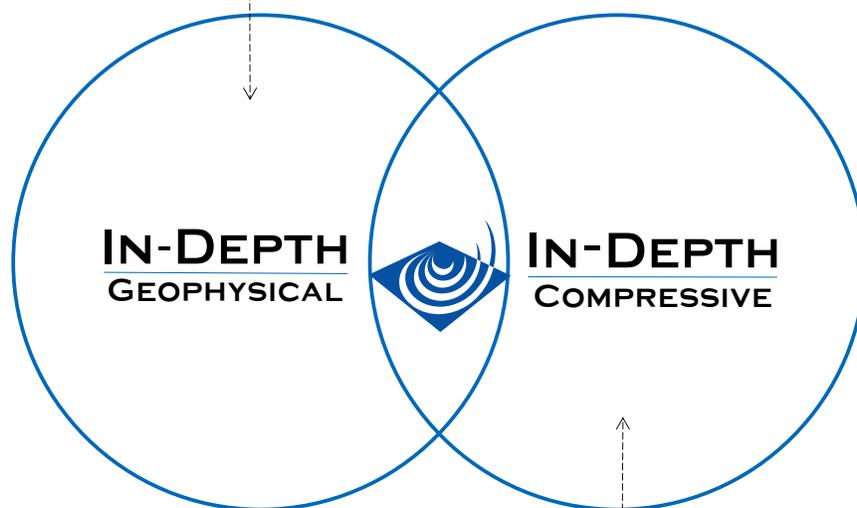
**\$200**  
GOLFER **OR** **\$800 PER**  
**TEAM**

For more information contact Wesley Tyrrell

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# 2020 GSH-SEG Spring Symposium and Expo



## HOW GEOPHYSICIST-MACHINE COLLABORATION IS CHANGING OUR INDUSTRY

**POSTPONED**

JUNE 16-17, 2020

NORRIS CONFERENCE CENTER, HOUSTON TX

### Actual case studies that highlight the applications of new technologies to solve Geophysical and E&P problems

- Tom Smith, GEOPHYSICAL INSIGHTS, **Multi-attribute machine learning improves thin bed resolution**
- Mike Li, CHEVRON, **Using Meta Learning to Build Adaptive AI Model for Oil and Gas Exploration**
- Wenyi Hu, AGT & UH, **Progressive transfer learning for low frequency prediction in FWI**
- Long Jin, SHELL, **Scalable seismic attributes computation framework in the age of deep learning and big data**
- Satinder Chopra, TGS, **Some machine learning applications for seismic facies classification**
- Hugo Garcia, GEOTERIC, **Automated Fault Detection from 3D Seismic Using Artificial Intelligence**
- Aria Abubakar, SCHLUMBERGER, **Machine Learning for Geoscience Applications**
- Elive Menyoli, EMERSON, **Wavefield separation via principle component analysis and deep learning in the local angle domain**
- Christopher P. Ross, CROSS QI, **Predicting production metrics for unconventional shale reservoirs**
- Chengbo Li, CONOCOPHILLIPS, **Hybrid learning-based framework for seismic denoising**
- Wen Hu, FORLAND, **Seismic Denoising using Structure-Aware Stacked Denoising Autoencoder Networks**
- Philip Neri, ENERGISTICS, **Standards for Knowledge Metadata are Crucial to Upstream Digital Transformation**
- Tammy Weir, WEIR CONSULTING, **Can I move my data to the Cloud?**
- Keith Gray, BP, **High Performance Computing at BP**

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Tuesday evening - Reception

Wednesday - Banquet roasting and toasting Mike Graul



2020 Honoree Mike Graul

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# Professional Society Response to Coronavirus Pandemic, June Update

By Scott Singleton

This is an update to the article I published in the May Journal describing how the different professional oil and gas societies have responded to lock-downs as a result of the coronavirus pandemic. By this point, all societies have adjusted to the new reality of shelter-in-place followed by the requisite social distancing behavior as we start to open up once again. Another reality that societies are trying to come to grips with is massive loss of revenue because of the cancellation of almost an entire spring season's worth of classes, meetings, conferences, social events, field trips, etc. This has caused turmoil across the spectrum and the fallout is only now starting to become evident. In this aspect, professional societies are much like the oil companies, service companies and academics which make up their ranks, all of which are facing great hardship. The steady drip of bankruptcies are not likely to end soon, nor will the unpleasant drumbeat of furloughs, lay-offs, and early retirement packages. The Houston Chronicle on May 26 reported that the oil and gas industry in Texas shed 26,300 jobs in April, 22,300 of which were in the service sector. Then on May 28 during its annual stockholders meeting, Chevron said it would cut 15% of its global workforce of 45,000. It's uncertain how many of Houston's 7,000 employees will be affected.

## SEG

SEG's success in moving the HL and DL lectures online in a virtual format in April continued into May. There were 3 lecturers (Johan Robertsson; Xinming Wu; Sergey Fomel) who gave 6 virtual lectures (2 for Robertsson; 3 English/1 Mandarin for Wu; 1 for Fomel). For these lectures, 2977 people registered and 1602 attended (having a large drop-off is a common occurrence). Nonetheless, these are impressive numbers, in fact are higher than

the previous year when all lectures were in person. Since the beginning of the year (most of which was virtual) there were 5 lecturers (Lisa Gavin; Johan Robertsson; Xinming Wu; Sergey Fomel; Estella Atekwana) who gave 11 lectures. There were 8648 who registered and 4503 attendees from 79 countries. There were an average of 409 participants per lecture (max 1070, min 52). These are such impressive results that SEG is evaluating whether it should move the HL and DL programs permanently to a virtual format.

SEG Live continues its aggressive schedule of online webinars and presentations (<https://seg.org/Events/SEG-Live/>). Nine presentations are scheduled to take place in June, two of which are Energy in Data Webinars (Tariq Alkhalifah on June 9 and Sunil Garg on June 25). There typically has been one EID webinar per month and the webinar for May was held on the 28th with Dr. Siddharth Misra as the presenter. There were 980 registered with 422 attendees. Again, impressive results.

Preparations for the SEG Annual Meeting (Houston, Oct 11-16) are continuing as normal with the expectation that we will be able to hold this event in the fall. However, simultaneously preparations are underway to enable virtual capability, which is a common theme among all the major conferences during this time of uncertainty. The Annual Meeting organizing committee is monitoring the preparations for a hybrid URTeC conference (discussed below) in the anticipation that it will need to incorporate the learnings from that conference.

And finally, as might be expected, SEG is not immune to the forces befalling our industry. Faced with a dramatic loss of revenue in the spring combined with warnings that there

*Professional Societies Responses continued on page 18.*

might be a resurgence in the coronavirus in the fall, thus adversely affecting members' ability to attend the SEG Annual Meeting in person, revenue projections have been poor for this fiscal year. As a result, a reduction in force has occurred in the Tulsa office resulting in the loss of some talented and experienced people and a reorganization of some of the portfolios among the staff.

## URTeC

Preparations for this year's URTeC conference (Austin, July 20-22) are continuing in light of the lifting of the stay-at-home orders and the progressive opening up of the economy. The URTeC management committee was notified by the Austin Convention Center that there would be no statutes in place at the time of our conference that would prevent the conference from happening (translated that means they will not let us out of our contract for the event).

In light of this and in anticipation that the general population will still be reticent about congregating in person throughout the summer, in early May it was decided to go to a completely hybrid event. What this means is that there will be an in-person showroom floor and technical sessions but authors presenting papers will be given the option of presenting in person while being filmed for online viewing or preparing an audio track to go along with their PowerPoint which can be submitted and counted as a presentation. The result of this will be that all presentations will be recorded in one way or another and be available for online viewing. Those wishing to register for only the online component can do so at a much reduced price. This might appeal to those who are prevented by either national boundary or company policy from attending in person. As an added attraction several of the sessions will be chosen to be fully interactive, meaning the filming will be broadcast online in real time and it might be possible for the presenter to take questions from the online audience (although

the technical details of that are still being worked out).

## AAPG

As anticipated, AAPG pulled the plug on their Annual Convention and Exhibition (ACE) which was scheduled to occur June 7-10 in Houston. This swas relayed to all members via email on April 30. The convention page on their website (<https://ace.aapg.org/2020>) says the following:

*We'll be working with our committee members and suppliers over the next few weeks to develop alternative plans for ACE 2020. Right now, we're evaluating several possibilities, including new event dates, co-locating ACE with other scheduled conferences, and/or delivering the event virtually.*

My understanding is that they have already informed all vendors that if they wish their booth fees will be transferred to their 2021 convention which will be in Denver on May 23-26, 2021. This is a smart move because if, as indicated in their statement, they are able to co-locate with another conference (read: SEG Annual Meeting in October) then most of their vendors will also have paid booth fees to be in the SEG conference. However, simply saying that it would make the most sense for the two societies to share conferences doesn't make it any easier to actually do. There are a huge number of logistical hurdles, such as aligning registration fee amounts, allocating session room space for accepted papers from the two conferences, splitting booth fee revenue from the showroom floor, allocating meeting room space for all the normal functions of both societies, etc. Fortunately the GRB is a huge place and there are two first-class hotels just outside, so many of these hurdles could be solved if the two societies choose to do so. But whether that happens is anybody's guess. At the time of this writing, discussions were still going on between management of the societies and within the Boards of both societies. □



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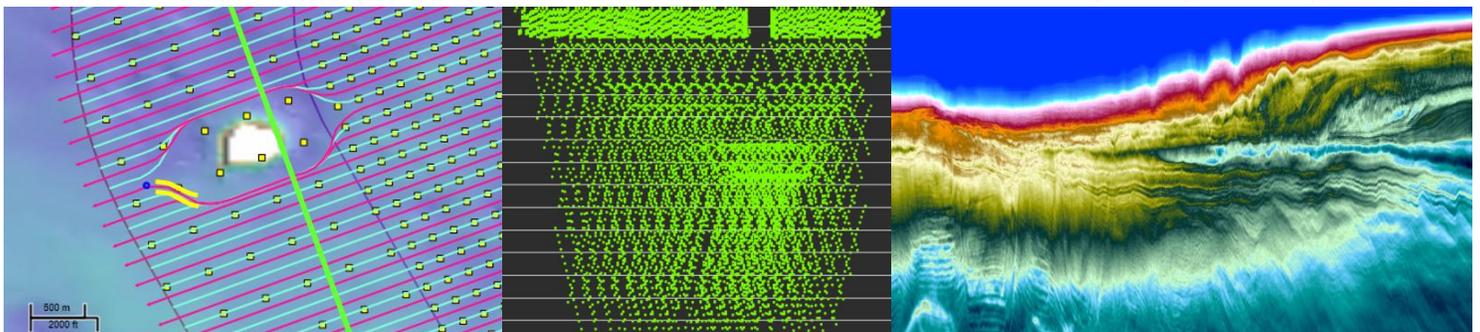


Speakers include global thought leaders such as Joe Dellinger (BP), Martin Widmaier (PGS), Gary Hampson (DUG Technology), Joachim Blanch (BHP), Jiawei Mei (CGG) and John Young (DHI Water and Environment).

This informal and interactive event will also feature presentations by co-chairpersons Dave Monk (Past President of SEG) and Malcolm Lansley (Consulting Geophysicist)

Visit [gshtx.org](http://gshtx.org), Events Tab to register and see full presenter information (when available)

### Event sponsors



Images (Clockwise from top left) courtesy of AGS, CGG, DUG Technology, Polarcus and ACTeQ

# Spectral Extrapolation and Acoustic Inversion for the Characterization of an Ultra-Thin Reservoir

Gorka Garcia Leiceaga, Multi-Physics Technologies, Charles Puryear, Geophysical Consultant, and Shantanu Kumar Singh, CatSeis Consulting

## Summary

In this paper, we present an ultra-thin gas reservoir seismic inversion study onshore Louisiana that includes seismic conditioning, spectral extrapolation and rock property inversion for acoustic impedance. The study was carried out using prestack seismic gathers and one well with sonic and density logs. The objective was to image the vertical and lateral extent of the gas-charged sand package with a thickness of nine meters (27 feet) at the well. The acoustic impedance inversion result using the spectrally extrapolated seismic data shows an improved match with the measured log in comparison to the conventional seismic data, allowing a more accurate delineation of the ultra-thin reservoir sand.

## Introduction

A comprehensive workflow (Figure 1) was carried out on a prospect located in Gulf Coast onshore

Louisiana. The prospect is part of a downthrown, three-way closure at a depth of nearly 5,000 meters (16,404 feet). The geology at the reservoir level is highly faulted and complex, making seismic imaging and drilling wells a challenge. The reservoir is a gas-charged sand package with a thickness of nine meters (27 feet) at the well location, overlain by a series of shale layers.

The data available includes 3D seismic offset gathers, processing velocities and one well with sonic and density logs. With a dominant frequency of approximately 15 Hz at the reservoir, the seismic data were insufficient for determining the lateral distribution of the reservoir. To overcome this obstacle, a spectral extrapolation algorithm based on spectral inversion was developed and applied to the data following a rigorous gather conditioning process. The spectrally extrapolated seismic data were then inverted for acoustic impedance and compared to the acoustic impedance inversion of the input seismic

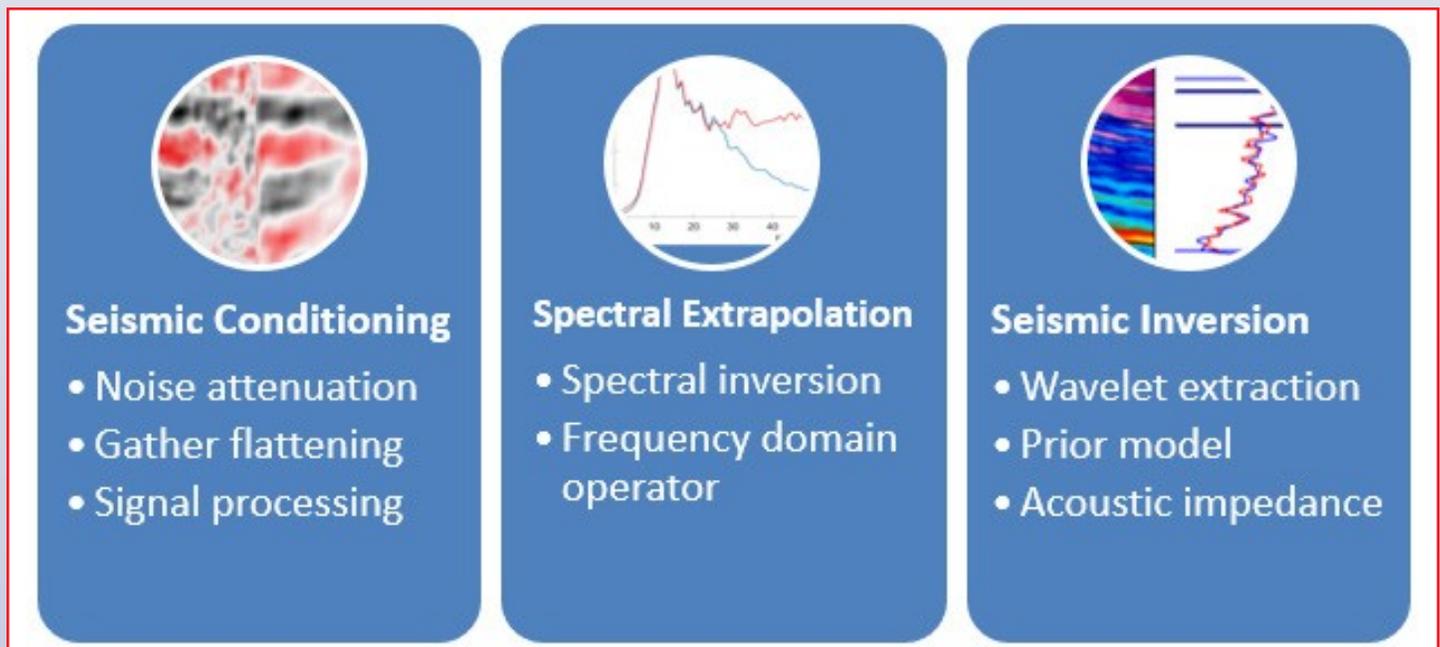


Figure 1: Three main parts of the processes used in the reservoir characterization.

Technical Article continued on page 22.

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

data. The result shows a high correlation with the well data and is considered fit-for-purpose for post inversion processes and an estimation of hydrocarbons-in-place.

### Seismic data conditioning

Seismic data conditioning is central to inversion for rock properties, although it does not fully compensate for the lack of high-quality data acquisition and processing work. The main challenges we faced in our attempt to prepare the data for spectral extrapolation and acoustic inversion included improving the S/N ratio, attenuating small move-out multiples, aligning the gathers and eliminating spatially aliased energy.

To address these challenges, we applied a seismic data conditioning workflow (Figure 2) that began with a high-resolution radon transform to reduce incoherent noise and remove internal multiples. Next, residual moveout correction was applied to better align the events prior to stacking.

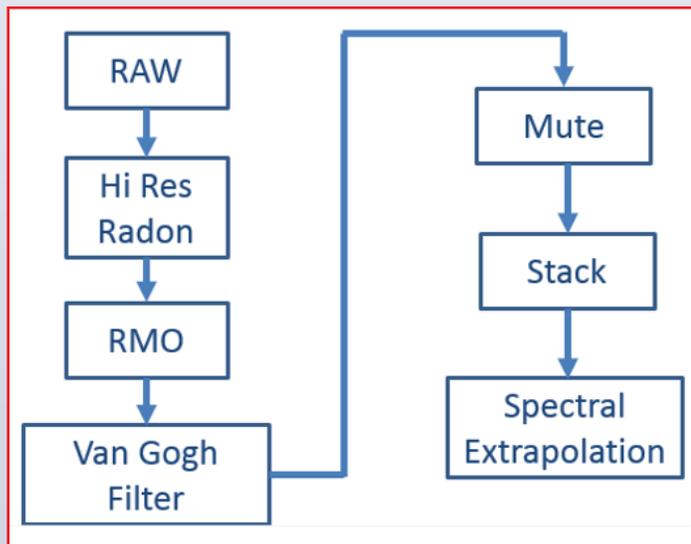


Figure 2: Conditioning workflow applied to the offset gathers prior to spectral extrapolation.

To improve the S/N ratio without sacrificing amplitudes, a non-linear, anisotropic diffusion (Van Gogh) filter with edge preservation (Fehmers and Hocker, 2003) was used to increase the coherency as well as enhance the discontinuities in the data. The last step in our workflow was to suppress the

longest offsets with a mute function and stack the near and mid offsets.

In Figure 3, we show a comparison of three offset gathers at the well including the raw (a) and the data after seismic conditioning (b). The result of our conditioning attenuated the noise and multiples that contaminated the seismic data, thereby preparing it for spectral extrapolation and acoustic inversion.

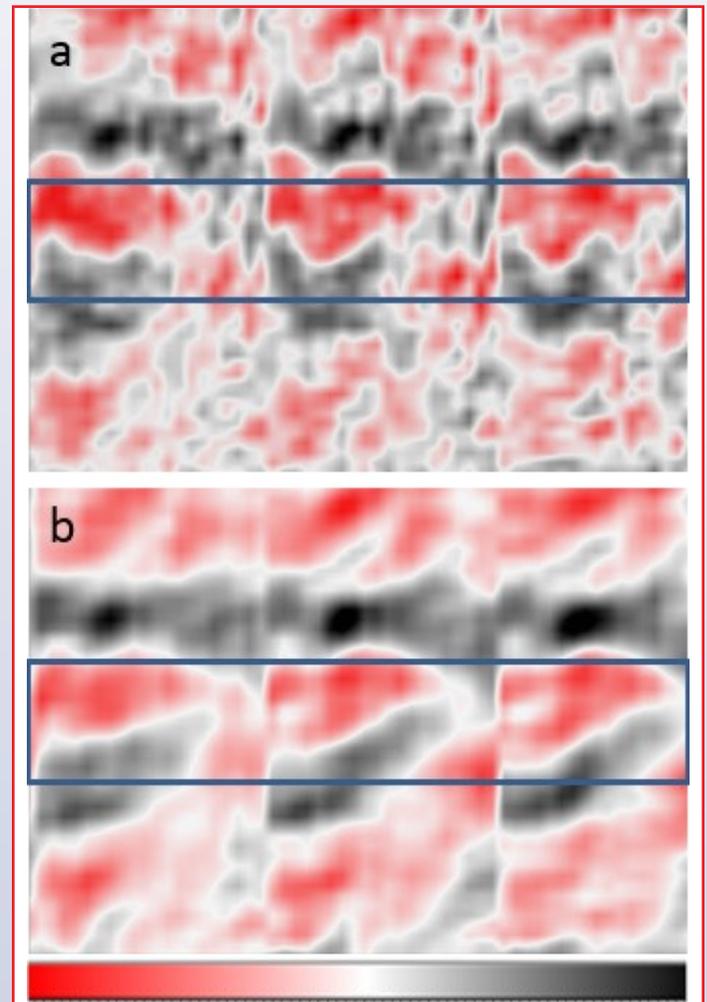


Figure 3: Comparison of three offset gathers at Well A including (a) the raw data and (b) after seismic conditioning.

### Spectral extrapolation using spectral inversion

Given the input seismic frequency content, the thickness of our reservoir is well below the seismic

tuning thickness. For this reason, a spectral extrapolation algorithm based on spectral inversion was applied (Puryear and Castagna, 2008). This process may be used for estimating amplitudes at frequencies near or below the noise threshold in the seismic data, taking advantage of the harmonic resonance phenomenon. Partyka et al., 1999 and Marfurt and Kirlin, 2001, show that the spacing between spectral peaks and notches is exactly the inverse of the layer thickness in the time domain. Knowing this, the repetition of reflectivity patterns in the bands of the spectrum allows one to predict bands outside the seismic spectrum, according to patterns linked to the reflectivity in the seismic band.

Figure 4 illustrates the ideal amplitude response versus frequency for three thin layer models with varying reflectivity ratios in the absence of a wavelet. The thickness of the modeled layer can be estimated from the spacing between spectral notches.

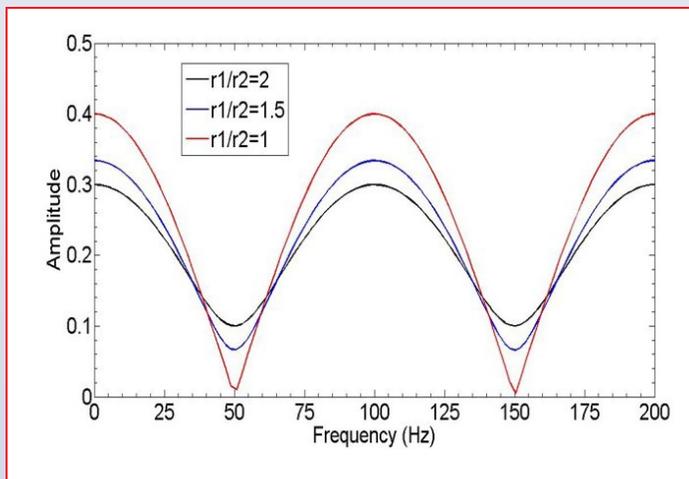


Figure 4: Amplitude response versus frequency for three thin layer models with varying reflectivity ratios. The acoustic impedance of each layer increases with depth.

For our dataset, a subset of the conditioned input seismic was spectrally inverted to derive a reflectivity series estimate in the target zone. Next, a frequency domain shaping operator was applied to modify the band of the reflectivity, preserving high frequencies while maintaining the shape of the original seismic band. In this example, the data were not extrapolated to the lower band since the

objective was acoustic impedance inversion, which already accounts for low frequencies from the prior model. The output from spectral extrapolation uses a modified version of the input seismic with increased resolution based on the noise level and processing limitations of the data.

Figure 5 shows the amplitude spectrum before and after spectral extrapolation. The frequency content of the spectrally enhanced seismic honors the input seismic and potentially extends the usable bandwidth out to ~ 65 Hz.

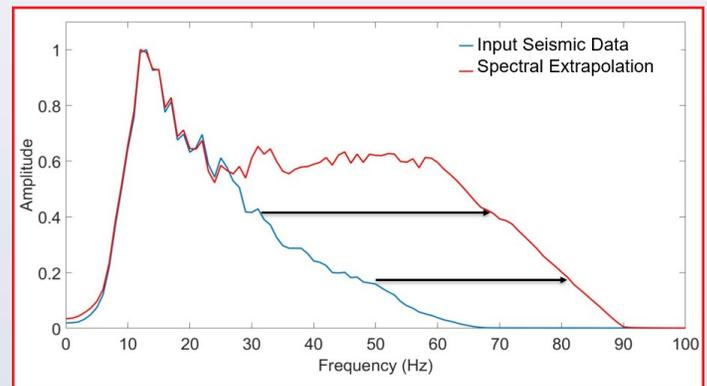


Figure 5: Amplitude spectra of the conditioned stack before and after spectral extrapolation. The spectrally extrapolated data spectrum closely matches that of the input seismic data up to approximately 25 Hz.

Figure 6 compares the conditioned seismic before (left) and after spectral extrapolation (right). As expected, the result reveals features not seen in the

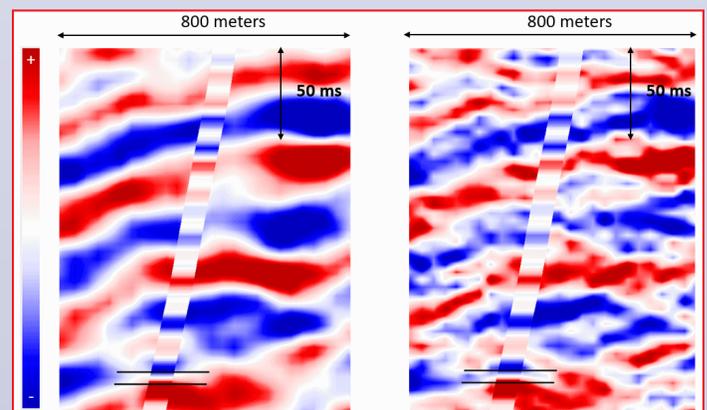


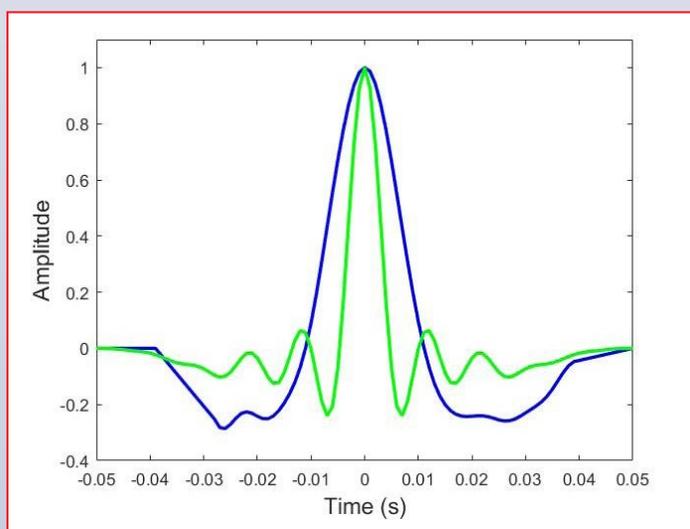
Figure 6: Seismic line with well trajectory before (left) and after spectral extrapolation (right). The reservoir top and base are indicated.

input seismic. To determine whether these features are geological and can be trusted, the data must be inverted for acoustic impedance (next section). An improved match between the high frequency inversion result and the measured log is key for determining whether the spectral extrapolation was able to enhance the frequency content without generating unwanted artifacts.

### Seismic inversion for acoustic impedance

The seismic inversion process begins with wavelet extraction. The objective is to determine a wavelet which best represents the wavelet used in seismic processing. A wavelet may be thought of as a transient superposition of many harmonic waves of different frequencies and amplitudes; a concept known as Fourier synthesis. In seismology, the wavelet is the convolutional operator that links seismic data and the reflectivity of the subsurface. In turn, the goal of seismic inversion is to remove the effect of the wavelet within the seismic bandwidth and recover physical rock properties. The process can also be performed on spectrally extrapolated data, which is analogous to seismic data containing higher frequencies.

The statistical wavelets extracted from each of the two datasets (conventional and bandwidth extended) are plotted in *Figure 7*. No well information was used in the wavelet extraction.



**Figure 7: Input wavelet (blue) versus spectrally extrapolated wavelet (green).**

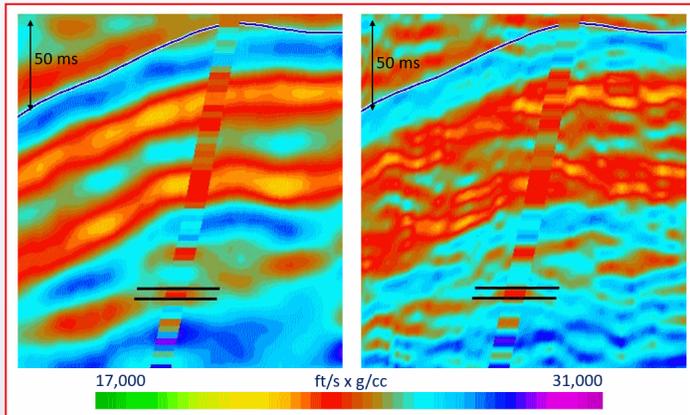
A low frequency model (LFM) was generated using the well acoustic impedance. The LFM or a priori model is the starting point of the inversion iteration process. The role played by the LFM is to fill in the lowest frequency gap left by most conventional seismic data acquisition methods (~0 to 10 Hz). Although the LFM contribution is a small part of a full bandwidth acoustic inversion, its role is crucial. Without an accurate background trend, accurate rock property values will not be obtained by the inversion no matter how precisely the mid-to-high frequency information is predicted. The main idea in the LFM process is to apply a low-pass filter to the well data, then interpolate and extrapolate the low frequencies at the well locations to fill the entire 3D seismic geometry. Such interpolation and extrapolation are constrained by the available interpreted horizons and faults, processing velocities and dip fields calculated from the seismic data.

An inverse problem is a mathematical process used for determining the physical properties of a system characterized by a set of model parameters (the model), given the observed response of the system (the data). In seismic inversion for rock properties, the observed response of the system refers to the seismic and well data; the model parameters refer to the subsurface acoustic and elastic properties. In a practical sense, the use of inversion methods allows for 1D borehole measurements to be parameterized into 3D space by analyzing the relationship between the well data and the seismic data. To some degree, the output simulates wireline measurements being recorded at each trace in a seismic survey without the need to drill expensive wells (Leiceaga et al., 2011).

The acoustic inversion algorithm uses a modified version of the Aki & Richards (1980) reflectivity approximation, converting seismic data from interface properties to layers of acoustic impedance. The inversion is based on a convolutional model, generating synthetic seismic data via an iterative process which seeks to minimize the error between observed and modeled seismic (Ma, 2002).

*Figure 8* shows the inversion result using the conditioned seismic (left – 4ms sample rate) versus the inversion using the seismic with spectral extrapolation (right – 1ms sample rate). The increased level of layer detail is validated

by the improved match at the well. Note that the acoustic impedance log was only used to fill in the low frequencies in the inversion process. The wavelets used were statistical, which helps validate



**Figure 8:** Inverted acoustic impedance section comparison at the well before (left – 4ms sample rate) and after (right – 1ms sample rate) spectral extrapolation. The reservoir top and base (8 milliseconds apart) are indicated along the trajectory. Note the improved match and higher frequency content in the spectrally extrapolated acoustic inversion.

the increase in resolution of the seismic and the high definition acoustic impedance.

## Conclusions

The results obtained show how advanced technologies such as spectral inversion can achieve success in resolving an ultra-thin reservoir that was previously thought to have a seismic character unsuitable to carry out a proper reservoir characterization. The seismic conditioning workflow applied to the data attenuated the multiples and random noise polluting the seismic. Next, a spectral extrapolation algorithm was applied, improving the frequency content of the data. The results from the spectral extrapolation were verified by the improved match between the well acoustic impedance and the bandwidth extended inversion volume. For data having a higher S/N and a wider initial band, greater extension of the bandwidth is possible.

## Acknowledgements

Our gratitude goes to Radiant Oil and Gas for the permission to publish the work carried out and to CGG GeoSoftware for the HampsonRussell software license provided to run the acoustic inversion. □

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Permalink: <https://doi.org/10.1190/segam2019-3209484.1>



## GSH Movie Time



### Now Showing Thunder Wagon of the Beauford Sea\* Film produced in late 1970s

#### Synopsis

In October 1975 regulatory agencies of Alaska informed the Oil and Gas industry that the use of explosives for offshore Beauford sea data collection would no longer be allowed.

In order to overcome the constraints, GSI conceived, designed and constructed a unique system for collecting data through the ice. The system combined elements of marine and land data collection technology to solve a difficult land data collection problem. It included GeoFix (a land-oriented satellite positioning system), the thunder wagon (an airgun energy source), and a land drag cable.

After recording, data is sent to the processing center where a processing sequence is determined, and a common depth point stack is produced for interpretation.



\* GSI vintage videos courtesy of Schlumberger – WesternGeco

# Apache

## EXPLORING WHAT'S POSSIBLE



## Azimuthal AVA Inversion (Continued)

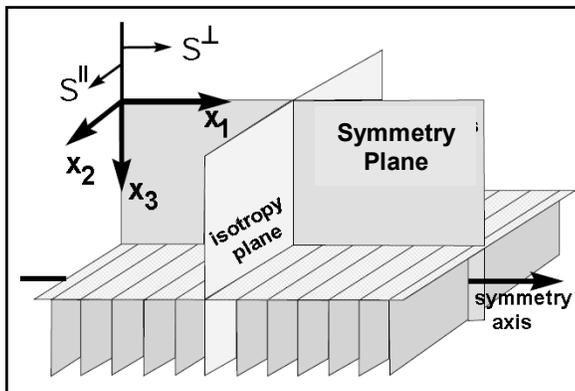
At our last encounter, we introduced the infrequent reader to the mandatory use of **azimuthal processing** of 3D data – especially if you're the type of geophysicist who would like to know your rocks better. Are they sandstone, limestone, oatmeal? Are they porous or tighter than the GSH purse string? Is there any grease? Inquiring minds want to know. And that is the job of the **Inverted Geophysicist**, the guy or gal who toils away in the home office trying to evaluate AVO or **AVA** data in a manner which goes beyond recovering contrasts at the boundary (e.g.,  $\Delta Vp$ ,  $\Delta Vs$ ,  $\Delta \rho$ ) and goes straight for the juggler, **Vp**, **Vs**,  $\rho$ .

With those parameters, you can get a profile of most rocks – if they are isotropic with no azimuthal dependence. But what about **AVA in Anisotopia**? A place where everything depends on how you look at it.

We will approach this question in the usual Guradic cautious and cryptic manner. We begin with a simple but poignant problem: determine the **fracturing orientation** in a target **reservoir**, be it sand, shale, or limestone.



**Inverted Geophysicist**



This little cartoon depicts the model of **vertical fracturing** by **Andreas Rüger**. The vertical cracks aren't usually this perfect and parallel, but they will do for descriptive purposes. The fractures occur in an otherwise homogeneous, isotropic layer, but with their presence, the rock will be **anisotropic** and cause all manner of mischief with our analysis of the **AVA** data. We will further assume that the rocks overlying this guy are homogeneous.

Let's get the introductions and definitions from a quick review of the **3D model**. The mutually perpendicular 3D axes,  $x_1$ ,  $x_2$ , and  $x_3$ , are related to the azimuthal orientation of the fracturing. The fractures are **parallel** ( $\parallel$ ) to the  $x_2$  axis and what is called the **Isotropy plane** since measurements of **Vp** and **Vs** made in this azimuth would be indistinguishable from the isotropic model (**no fractures**). So, if the source and receiver are lined up at this azimuth (**AZ**), the **P**- and **SV-waves** would sail along without a worry or impediment to their progress.

It's a different story, however, with the  $x_1$  axis which contains the "**Symmetry plane**" and is **perpendicular** ( $\perp$ ) to the **Isotropy plane and fractures**. Here, the waves travelling at velocities **Vp** and **Vs** encounter barriers to their progress as they impinge on the fracturing broad-side. Both **Vp** and **Vs** will be reduced, but the **S-Wave** typically loses the most fractionally.

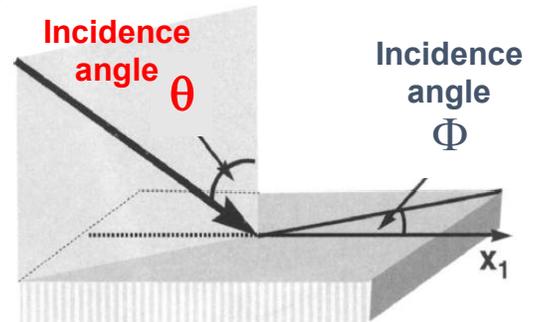
The root cause of all this fracturing is a differential **stress** field, itself anisotropic, with the maximum horizontal stress (**SHmax**) parallel to the fractures ( $x_2$ ) and minimum horizontal stress





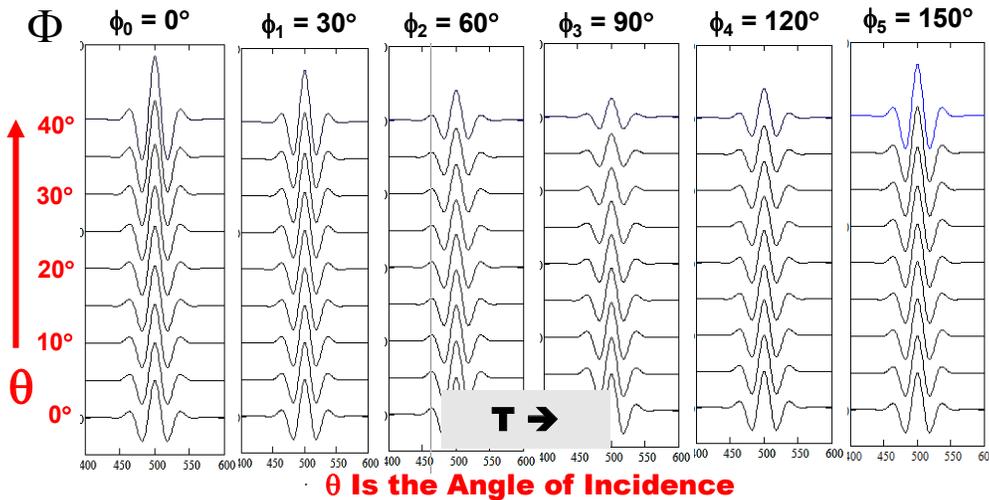
(SHmin) along the  $x_1$  axis,  $\perp$  to the fractures. Understanding the orientation of the stress field can be of significance to the wary interpreter.  $X_3$  is depth.

When a ray of Sv or P impinges on a fractured layer at an azimuth in neither  $x_1$  nor  $x_2$  vertical planes, as shown in the diagram, an interesting personality splitting disorder affects particularly the Sv wave with particle motion in the vertical plane along the  $AZ = \Phi$ . The wave splits into two polarized components, S1 and S2, the former traveling at  $VS_1$  ( $\parallel$  to  $x_2$ ), and the latter at  $VS_2$  ( $\parallel$  to  $x_1$ ). A.K.A. as  $S_{FAST}$  &  $S_{SLOW}$ .

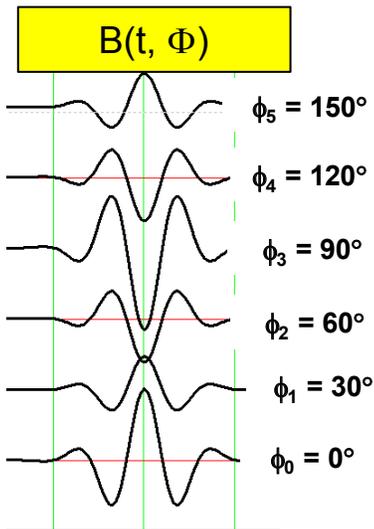


This phenomenon is a rich source of azimuthal misbehavior and another compelling reason to do your AVA analysis in azimuthally sectored gathers (see last month's discussion of this).

### AZ( $\Phi$ ) AVA( $\theta$ ) Gathers



This figure appeared in a recent issue illustrating the variation in AVA as a function of AZ ( $\Phi$ ). It is particularly obvious in the gradient (or slope) measuring the rate of amplitude ( $\sim$ reflectivity) change with increasing angle of incidence ( $\theta$ ). That information is carried by the AVA Gradient Trace – an AVA attribute,  $B(t, \Phi)$



The gradient traces more clearly depicts the serious variation in amplitude as a function of azimuth,  $\Phi$ . Here you see the maximum difference occur at  $\Phi = 0^\circ$  and  $\Phi = 90^\circ$ . These correspond to  $\Phi_{iso}$  and  $\Phi_{sym}$ , respectively. The peak of the first indicates a large positive gradient, while the second is a large trough indicating a big negative gradient. And yet the reflections are all coming from the same rock at the same location!

What would the B trace look like if we did the typical all azimuth AVA gathers? A clue is available to us if we think of stacking (summing) the AVA gathers (above) together. The now  $B(t)$  would be the average of  $B(t, \Phi)$ . In this case, that would be close to zero as the gradient traces cancel in pairs.





How did we get these **AVA** gathers with the alarming variation in **AVA attributes**? Once again from the modeling equations by **Rüger** which account for **anisotropy** and **azimuth**. Those equations and the model parameters will be revealed and discussed next **September** when, with a little luck and the crick don't rise, we will be post-pandemic and geophysically employed.

## The June Puzzle: Improbably Possible and Impossibly Probable

**Lee Lawyer** and 3 cronies are about to play golf and want to play as partners. **Crony Craig** suggests taking a ball (they all use different brands) from each and then randomly selecting **2** to be partners. **Haynie** says they only need **3** balls not all **4**, and randomly select **2** from that collection to achieve an equally probable outcome.

**Is Haynie right?** He does have a track record of bright solutions, but nobody's always right. Except for Haynie. Of course he's right with his efficient solution. Too obvious to discuss here

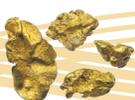
## Now for the Summer Puzzles To be solved for the September Issue

**(1) GSH Probable Justice.** **Craig Beasley**, a prisoner in the GSH Slammer, deep beneath the International HQ, is sentenced to death for Unspecified Crimes against the Society. The current **Emperor (Peter Duncan)** offers him a chance to live by playing a simple game. He gives him **50 black marbles, 50 white marbles and 2 empty bowls**. He says, "Divide these **100 marbles** into these **2 bowls**. You can divide them **as you like** if you use all the marbles. Then I will blindfold you and mix the bowls around. You then can choose one bowl and remove **ONE** marble. If the marble is **white, you will live**, but if the marble is **black, you will die**."

**How should Craig divide the marbles in the two bowls so that he'll have the greatest probability of choosing a white marble?**

**(2) Haynie** has been caught poaching SEG Short Course Instructors for use in the **GSH webinar program** and is brought before **Chief Justice & Executor Peter Duncan**. The Judge wants to show him some sympathy (Haynie is 2<sup>nd</sup> only to Lee Lawyer in running the **GSH Deep State**), but the GSH Bylaws clearly call for **two shots** to be taken at **Haynie** from close range. To make things a little better for **Haynie**, **C.J. & E Duncan** tells him he will place **two bullets into a six-chambered revolver in successive order**. He will **spin the chamber**, close it, and take one shot. If **Haynie** is still alive, The **C.J. & E.** will then either take another shot or spin the chamber again before shooting.

**Haynie** is a bit incredulous his ex drinking buddy and fellow Deep-Stater would carry out the punishment, and a bit sad that he was always such a **rule follower**. He steels himself as **Peter** loads the chambers, spins the revolver, and pulls the trigger. Whew! It was blank. Then **C.J & E. Peter** asks, "Do you want me to pull the trigger again, or should I spin the chamber a second time before pulling the trigger?" What choice should **Haynie** make?



# GSH Outreach

*Committee Activities* By Lisa Buckner, [outreach@gshtx.org](mailto:outreach@gshtx.org)

During the 2019-2020 fiscal year, **19 GSH Outreach Volunteers participated in 13 events** and **reached more than 700 students**, their families and educators before the novel coronavirus COVID-19 canceled the events after March 1st. These efforts were made possible due your membership dues and the generous tax-deductible donations to the GSH made by our annual sponsors. A huge **THANK YOU to Apache, ConocoPhillips, In-Depth Geophysical, Shearwater Reveal, Dawson Geophysical, ExxonMobil, Schlumberger and Emerson.**

Do you enjoy reading this monthly article and viewing the photos? Do you support our mission of educating the general public about geophysics and geology and inspiring the next generation of geoscientists? We need additional financial support or we will have to say NO to some of the school and public events. You can help with any size donation

- **\$5 => 1 can of black shoe polish "oil field" for the Drilling for Oil activity**
- **\$25 => 5 USGS Tapestry of Time and Terrain maps for school educators**
- **\$115 => 100 GSH logo coiled toy springs which demonstrate P&S wave motion**
- **\$150 => 4 Science and Engineering Fair of Houston (SEFH) special awards**
- **\$300 => Energy Day exhibit booth sponsorship**
- **\$1000 => Summer Research Assistant at HMNS for SEFH high school student**

Make a donation today at  
<https://my.reason2race.com/cause/gsh/GSHOutreachFund20202020>

## **UPCOMING OUTREACH EVENTS (if the COVID-19 pandemic does not cancel them)**

**Saturday, September 19, 2020 - STEM/NOVA Day @HMNS**

**Saturday, October 15, 2020 - Earth Science Week @HMNS**

**Saturday, October 17, 2020 - Energy Day @Sam Houston Park (downtown)**

Do you know of a school that has a career day seeking speakers or a career fair at which GSH might be able to host an exhibit booth? Or have you been invited to give a classroom presentation at your child's school?

If so, please contact me at [outreach@gshtx.org](mailto:outreach@gshtx.org), and we can work together to bring awareness to the students of the many high paying and fun careers in the geosciences. □

# Mystery Item

This is a geophysical item...

Do you know what it is?



This month's answer on page 35.



*“Cutting advertising to save money is like stopping a clock to save time.”*

*- Henry Ford*

GSH Media Kits

## Item Of Interest

The Geophysical Engineering Company was formed in 1920 with the backing of Dr. William P. Haseman, Frank Buttram, Dr. Irving Perrine, the Ramsey brothers and D. W. Ohern.

It was headquartered in Oklahoma City. J. Clarence Karcher etc...

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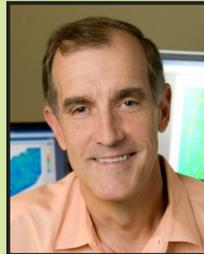
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Presented by  
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**Four Half-days  
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An interpreter-oriented approach to the theory, application, and interpretive aspects of depth imaging. The course covers an intuitive overview of migration theory and advances in tomography and full-waveform inversion for the near-surface model and velocity updating. A review of establishing seismic data polarity and phase is followed by a best practice for synthetic-seismogram ties; including the use of P-Impedance volumes and logs for greater accuracy. Advanced database-validation methods, such as cross plots between horizon interpretations and well tops, are then used to identify and remove inconsistencies before deriving anisotropic parameters and performing depth calibration.

Next, the course establishes intuitive QCs and provides spreadsheet analysis to plan and ensure stable depth solutions during the iterative depth-imaging process. A robust approach to well-top calibration of the depth volumes is demonstrated, as are statistical methods (freeware provided) for estimating depth uncertainty after calibration. Finally, the course reviews advanced attributes derived from depth imaging, including azimuthal inversion to yield lithologic and stress-field (fracture) properties, plus practical aspects of machine-learning classification and estimation.

**Intended Audience:** Seismic interpreters incorporating depth imaging into their evaluations, and depth-processing imagers looking to better interact with interpreters.

**Learning Goals:** Participants will gain an understanding of how to effectively design, guide, and quality control depth-imaging projects in a variety of geologic settings and be able to:

- Differentiate between time and depth migration
- Distinguish and select between commonly-used migration algorithms
- Evaluate the near-surface model: Using full-wave form inversion (below) and refraction solutions
- Issues and best practice for creating the initial velocity model (with attention to anisotropy!)
- Appraise methods for velocity updating (tomography/FWI) appropriate for the data and geology
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- Plan and review QCs for iterative velocity updates
- Perform well-top calibration of depth-imaging volumes
- Implement practical aspects of machine-learning classification and estimation

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# Geoscience Center

## *The History of Geophysics* By Bill Gafford

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



Dick Baile discussing some geophysical artifacts

The Geoscience Center lost one of our biggest supporters in March with the passing of Dick Baile. He was very encouraging when we started the project in 2012 and often voiced his appreciation for our efforts. Dick also suggested ways to involve the SEG and the SEG Foundation, both of which have been supporters. At one time, Dick had an office down the street from the Geoscience Center, and when he was considering closing his office, he donated a painting to us of a seismic field crew, which included vehicles from one of his CXC (Challenge Exploration Company) crews. The painting is still in our small conference room. When we started the quarterly Living Legends Doodlebugger social events at the suggestion of George Parker, Dick was a frequent attendee and

enjoyed visiting with many of the "legends" who attended. He is shown here in a picture from one of the events discussing some of the geophysical artifacts on the table, and he and George Parker also shared some of their airplane stories from their World War Two military service. Because of his involvement with a number of different seismic companies during his career, Dick had many stories to tell from the field operations to the management side of the industry. Dick had a long and interesting career in the petroleum industry and always thought that it was important to preserve the history of the various companies that developed the instruments and technology that allowed geophysics and geoscience to have such an impact on petroleum exploration. He also felt

*Geoscience Center continued on page 35.*

that the younger generations needed to know and appreciate the ingenuity of early explorationists, and he appreciated the fact that the GSH Outreach committee was able to use some of our artifacts in educating the youth about geophysics. Because of his many contacts, he was able to help us track down information about some of the older instruments in our collection and about some of the companies that no longer existed.

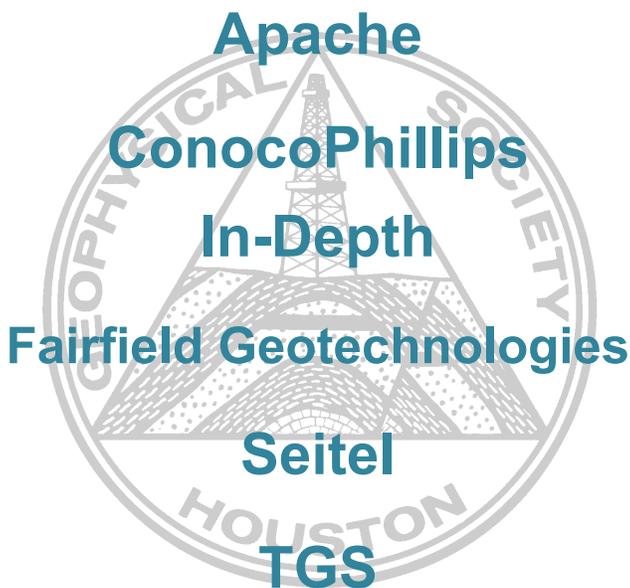
The financial health of the Geoscience Center was always a concern of Dick's, and he volunteered to donate in 2014 to start the Dick Baile Challenge to raise funds. That effort was successful and has been repeated in subsequent years, again initiated by donations from Dick, and others, including Scott Petty, Jr., Lee Lawyer, and Tom Smith. The most recent Challenge was successfully completed earlier

this year, raising a total of over \$25,000 from over 50 donors. Dick, all his tales of the oil patch, and support for the GSH Geoscience Center will certainly be missed.

The date of our next Living Legends Doodlebugger social event at the Geoscience Center will be sometime later this summer, and reminders will be sent. Everyone will be welcome, and the event is free. No registration is required. This will be a chance to visit with some of the legends of our industry and see some of the unique geoscience artifacts in our museum collection. We continue to receive donations of various items and instruments from the past, including books and periodicals, so there is always something new, even if you have visited the Geoscience Center before. □

The Geoscience Center is open on Wednesday mornings from 9:00 am to 12:00 pm or by appointment, and visitors are always welcome. Please contact me at: [geogaf@hal-pc.org](mailto:geogaf@hal-pc.org) or by phone at: 281-370-3264 for more information.

## We appreciate our Corporate Members



For more information about becoming a Corporate Member, go to [GSHTX.org](http://GSHTX.org)

The Mystery Item on [page 31](#) is a **Primacord or Broomstick charge, Model display.**

The graphic has a blue and yellow background with several question marks scattered around the text.



An exciting **Live Webinar** presented by  
the Geophysical Society of Houston



# Borehole geophysics: Using rock properties, well logs, and all kinds of seismic methods



*By Dr. Robert Stewart*

*Past President, Society of Exploration Geophysicists  
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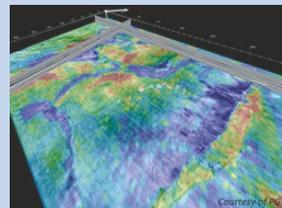
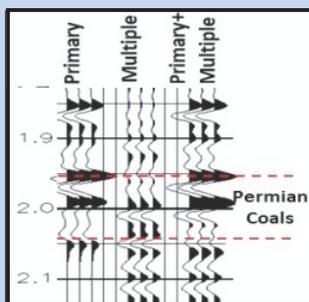
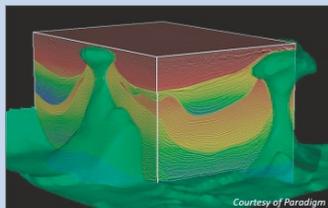
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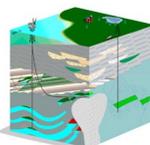
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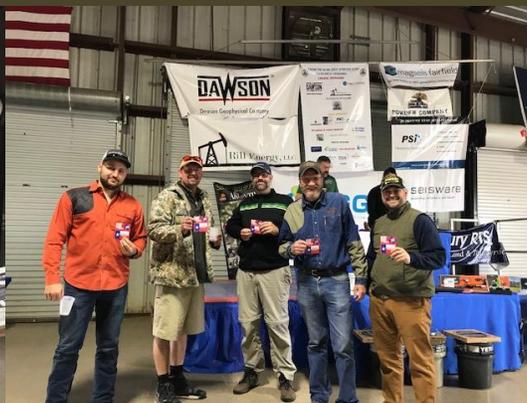
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Photos courtesy of Richard Hudgens



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# Doodlebugger Diary

## Party Pickings: Party 76 in the Gulf of Mexico

Paul Donner and Gerald Peterson, Reporters; Paul Donner, Photographer;  
Western Geophysical, 1978; originally published in the 1978

Winter Western Profile

Recounted by Scott Singleton

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

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

**Editor's Prolog:** I don't normally reprint items out of the 'Party Pickings' portion of the Western Profile because they're mostly short infomercials about what the various crews are doing, liberally listing the names of the crews so they get their names in print. However, this crew is different. My own start in the world of doodlebugging was on this very crew in May, 1979 (Figure 1). As a fresh-faced college graduate, Western Geophysical was more than happy to give me a crash course in offshore doodlebugging in hopes that in return I could pass on some of the things



Figure 1: Bow of the M/V Western Gulf sat the Galveston dock. (Photo from Scott Singleton, 1979)



Figure 2: Junior Observer Scott Singleton removing chains from the steamer as it was recovered. These chains were what held the steamer in close proximity to the seasonor for a type of shooting called "back down and drag", which was how data was acquired in shallow water. In the background is Observer Peter Van Borssum making sure the bridge kept the steamer directly behind us as the vessel went in reverse to pick it up. (Photo from Scott Singleton, 1979)

Doodlebugger continued on page 48.

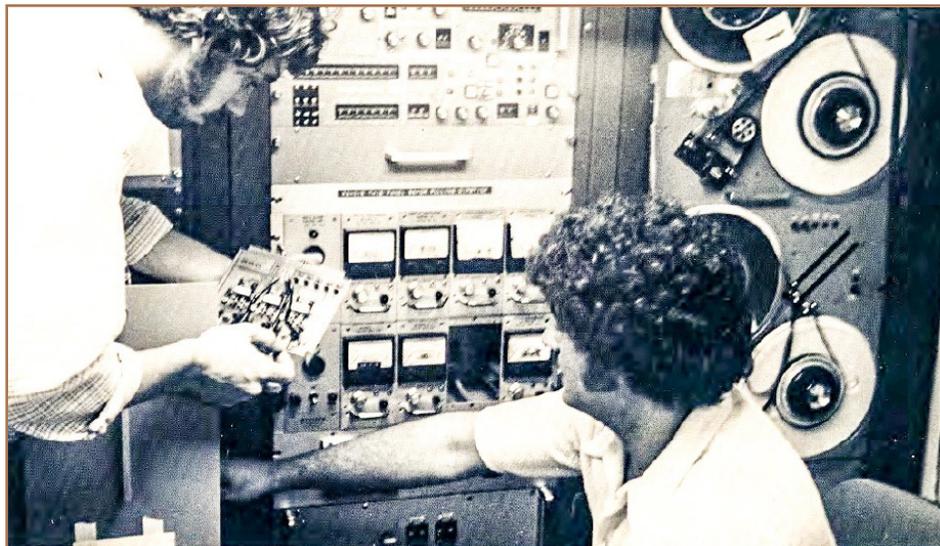
If you would like to add stories to the Doodlebugger Diary, send them to: Scott Singleton at [scott.singleton@comcast.net](mailto:scott.singleton@comcast.net)  
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I had learned in school about geophysics, and in particular seismic data. Thus, most of the people listed in this article I knew at one point in time. Peter Van Borssum and Richard Wise (both pictured herein) were both observers and shift leaders by the time I joined the crew (Figure 2). In fact, Peter became my best friend and was the best man at my wedding in 1991. You'll also note that Bill Regone is referred to. He also was a senior seismic crew member when I came onboard but he moved on to bigger and better things. As my career progressed, I always thought this person was Carl Regone, who had a successful career as a geophysicist with Amoco and BP, won the SEG Virgil Kauffman Gold Medal Award for wide-azimuth acquisition and imaging techniques for subsalt, and was an SEG DL a few years back, but unfortunately it turns out these are two different people.

So, since I've introduced the topic with this Party Pickings segment, when the Journal starts its fall issues in September I'll introduce a series of Doodlebugger Diaries recounting my early years on the Western Gulf. You can bet there will be some far-fetched tales in those stories....

### Party 76, Summer of 1978

*"Water, water, everywhere."* That poetic comment is certainly indicative of Party 76's everyday environment, for our operations during the past year have ranged far and wide throughout the Gulf of Mexico. We have been contracted to several prominent clients, who, we



*Figure 3: Party 76 Junior Observer Richard Wise (left) explains on instrument changeover aboard the Western Gulf to Helper C. M. (Mike) Long. The Western Gulf and Party 76 switched from streamer/ AQUAPULSE operations to high resolution work in the Gulf of Mexico in June.*

understand, were quite pleased with the production capabilities of the crew.

Since Party 76 really does not walk on water, we are proud to have what we consider to be one of the finer ships of the fleet, the M/V *Western Gulf*. She has taken us safely through Mother Nature's less amiable moments, from the great "northers" to the drizzly "southeasters." We take our Western hats off to the old girl; she is truly a home away from home.

A good ship certainly requires a well-trained and professional crew, and we think that we have the best. At the helm there are Captains JERRY DE HOOG and PETER CLARKE. Jerry resides in Santa Barbara, California, and Peter has joined us after several years' stay in the Far East.

"All ahead one third" is well understood by our experienced marine engineers, HAROLD ANDERSON and LONNIE PINKHAM. Our mates on the crew are Seamen RICHARD FRENTZ and FREDRICK STOW. Richard has been with Western for several years and was one of the better cooks in our fleet, but recently he made up his mind that he was going to work up to captain. In his current position as mate/seaman he is well on his way. We are all with you, Richard.

On a happy note, the crew suddenly learned that Seaman FRED STOW was married during this last crew break to the former KATHERINE (KATIE) LOUISE HORTON of San Antonio, Texas, on July 29 at the Botanical Gardens in Houston. Fred and Katie spent their honeymoon in Aransas Pass, Texas, managing

to be there at the same time tropical storm "Amelia" came roaring through. We do not imagine that Fred will ever forget an anniversary! They are residing in Houston.

From the seismic side of things, Party 76, for the majority of the year, has been doing streamer/AQUAPULSE® energy source-type operations in the Gulf of Mexico. During June, however, in response to industry demands, Party 76 switched over from streamer to high resolution work. We are using the gamut of "high res" equipment, such as Sparker, Mini-Streamer, Magnetometer, Uni-Boom, and Side Scan Sonar, all of which must be operating at peak efficiency and at the same time.

It is no accident that the Western Gulf, Party 76, was selected for high resolution operations specifically because our coordinator, GERALD PETERSON, has had a bit of experience in this area. Accordingly, excellent data are being acquired for our client, and we expect to be doing this type of work for another month.

Along with all of this, Gerald at the moment is somewhat on pins and needles because his wife, GALE, is expecting their first child very shortly. The blessed event is to take place in the middle of September. We shall bring out a Party 76 "extra" with all of the happy details.

Our seismic crew is probably one of the most adaptable and resilient around as evidenced by the recent shift to high resolution operations. The whole crew took the change in stride and has

adapted to the new demands of this type work. Gerald says that this is one of the best crews with which he has ever dealt.

Our shift supervisors on Party 76 are Junior Observers PETER VAN BORSSUM and RICHARD WISE, JR. Peter hails from Galveston, Texas, and is an industrial arts graduate. Richard comes from Houston, which is, of course, "God's Country." Adaptability is a trait of Assistant Gun Mechanic STEVE THORNE, as well as the rest of the crew. Since we are not using the big guns in "high res," Steve has been working quite hard in the recording room. The way it looks, we will need to come up with a new job description for him. How does high resolution sgunner sound?

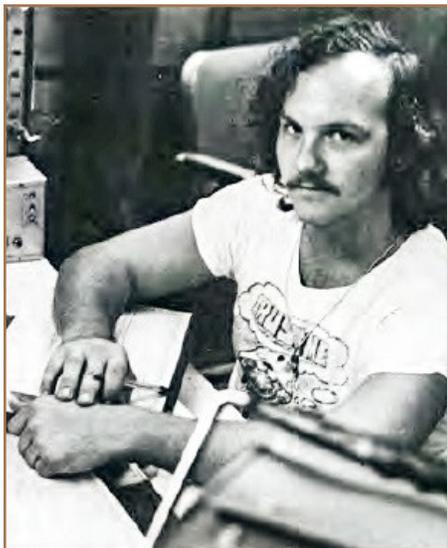
The latest arrival to the seismic crew is Helper MIKE LONG from Houston. Thanks to Mike, Party 76 can now claim to have its own private bartender. (No crew should be without one!) Before joining Western, Mike was bartending at one of Houston's plusher watering spots. We said that we had an adaptable crew. Martini, anyone?

Party 76 also has its own private security force all in one individual. That is Helper THOMAS WILKIE, who went through the Florida Police Academy before joining Western. Does a ship ever get a parking ticket?

Helper BILL REGONE joined us from New Orleans and has a



*Figure 4: Party 76 Assistant Gun Mechanic Steve Thorne (left) listens to Coordinator Gerald Peterson while he explains the ship's magnetometer console.*



*Figure 6: Helper Thomas D. Wilkie checks the camera and logs fix point data from the sparker mini-streamer aboard the Western Gulf.*

degree in forestry. He says that he is going to work like heck for a few years and then head for the hills. There surely are not many trees in the Gulf of Mexico! Helper EDMOND ST. AMANT, III, comes from Biloxi, Mississippi. It has been rumored that the party manager had to get an extra briefcase to take care of Ed's mail.

The crew, of course, does not eat hardtack and sea biscuits, thanks to our new cook, N. W. (BILL) BYRON. Bru, whose home is in Houston, is an experienced and excellent cook and baker. We will have to watch our waistlines now. We are all glad that Bill has joined us.

Helper GARY STEWARD recently left us to travel to Party 66. He will be working with "iron" air guns, diesels, and air compressors and is now going to a special school. We wish Gary all of the best.

During the past several months there have been some changes in the crew's party managers because of operational necessity. HARVEY HEARN went to Alaska for the summer season and was temporarily replaced by Field Supervisor MARK HUDSON. Mark has since gone to coordinate the mobilization and refitting of a new Western vessel (Party 66). PAUL DONNER has now taken over the reins where Mark has left off. Paul joined Western after working as party manager for several years with one of the "other" companies.

We really cannot do much in this offshore business unless we know exactly where we are. That difficult and sometimes frustrating job is very adequately handled by our Lorac satellite navigators, S. A. (RED) BLACK and EUGENE (CHRIS) CHRISTENSEN. All of us are glad to have them aboard and part of the crew.

Probably the best way to close out our little report is to relate a genuine "Doodlebug Streamer Cable War Story." Early last spring a Western vessel lost about 46 sections of its streamer cable, and the crew was frantically searching for in the vastness of the sea with little success. (The anguish and despair aboard the ship can be felt only by those who have experienced this first-hand.) Unfortunately, this is one of the more common hazards of towing 2 miles of streamer behind a boat. The Gulf is filled with shrimp boats, all with 'doors' on the end of long lines scraping the bottom, supply vessels zipping to and fro, large tankers going into the various ports, and worse of all, well heads and other drilling

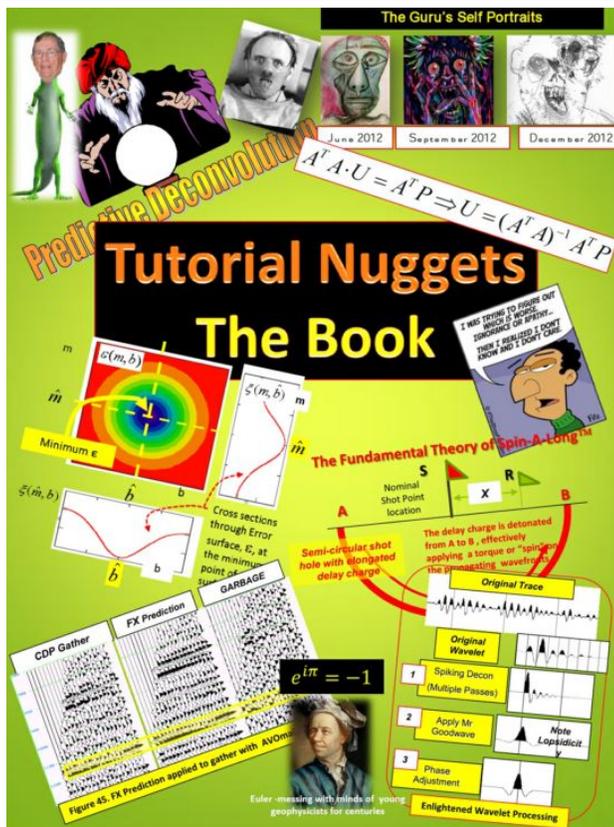


*Figure 5: Party 76 Helper William "Bill" Regone (left) and Junior Observer Peter Van Borssum prepare to launch a Uni-Boom sled and a transducer from the Western Gulf, which is working in the Gulf of Mexico.*

rig debris seemingly everywhere, all with their teeth out ready to snag a streamer and rip it to shreds.

Thus, a call went out to Party 76, the Western Gulf, to lend assistance in locating the elusive cable since we were the closest Western vessel in the area. The Western Gulf pulled up its gear and sailed for 60 nautical miles to the area where miraculously we found the cable after a short period of time. Needless to say, there was a very much relieved Western crew that day in the Gulf. Comadre was established between the two crews and promises were exchanged for free beers the next time we both hit the dock together. This is the bond that doodlebuggers share.

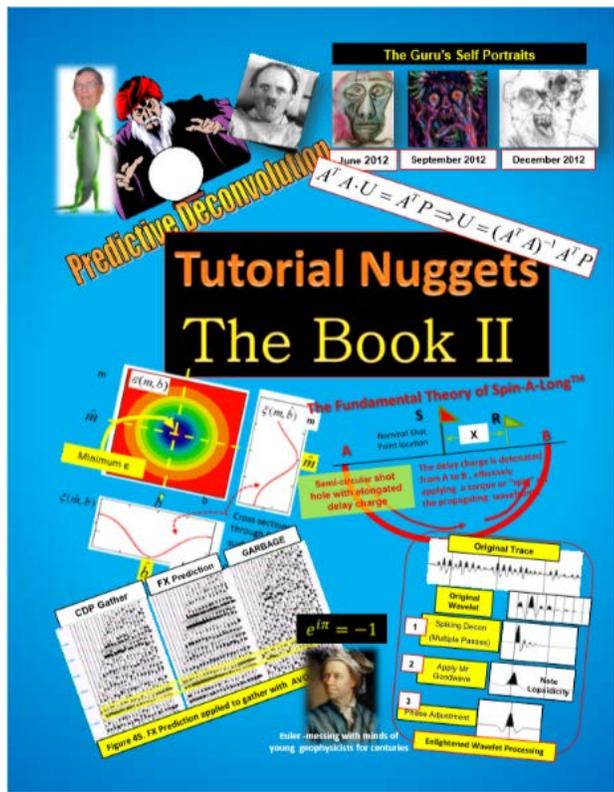
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